UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

UNITED STATES OF AMERICA	**:**	
	:	
v.		**Case No. 18-237 (TSC)**
	:	
LONNELL HART	**:**	

DEFENDANT'S OMNIBUS OPPOSITION TO THE GOVERNMENT'S MOTION TO INTRODUCE DNA EVIDENCE AND 404(b) EVIDENCE

I. THE PROPOSED DNA EVIDENCE SHOULD BE EXCLUDED

The government has filed a notice of expert testimony stating that it proposes to introduce the testimony of forensic scientists from the District of Columbia Department of Forensic Sciences Forensic Biology Unit ("FBU"). Presumably, those scientists would testify regarding reports that they prepared about their testing and analysis of DNA obtained from items seized subsequent to two of the four charged robberies (April 24, 2017 and October 25, 2017). Mr. Hart opposes the introduction into evidence of DNA reports and testimony regarding the reports, requests that such evidence be excluded and, in the alternative, requests a hearing pursuant to *Daubert v. Merrell-Dow Pharms. Inc.*, 509 U.S. 579 (1993).

The FBU reports contain a likelihood ratio ("LR") to convey the results of the DNA analysis. The LR, generated by a probabilistic genotyping software program called STRMix, is a statistical estimate regarding the possibility that some of the DNA material found on the items belonged to some individuals but not others. The LR created by STRMix in this case is unreliable because the program's code relies upon information that is subjective and can vary to

an impermissible degree depending on the individual analyst and laboratory. Furthermore, the evidence does not meet accepted standards for use of this program. Lastly, submission of these results to a jury would be unfairly prejudicial. Thus, this evidence is inadmissible under Federal Rules of Evidence 702, 703, and 403, and the principles outlined by the Supreme Court in *Daubert*.

The FBU determined the number of contributors who contributed to each DNA mixture, the percentage of the mixture that each contributor contributed, and, based on its use of STRMix, a likelihood ratio:

1) A skull cap seized from Jason White's car on October 25, 2017 is alleged to contain a mixture of DNA of four contributors, contributing 72%, 24%, 3% and 1% to the DNA mixture, and "the mixture DNA profile obtained from [the skull cap] is at least 482 septillion . . . times more likely if it originated from Lonnell Hart . . . and three unknown, unrelated individuals than if it originated from four unknown, unrelated individuals." (Attachment A, FBU Report dated February 1, 2018; Attachment B, STRMix Report).
2) A t-shirt seized on April 24, 2017 is alleged to contain a mixture of DNA of four contributors, contributing 78%, 15%, 4% and 2% to the DNA mixture, and "[t]he mixture DNA profile obtained from [the t-shirt] is at least 79.2 sextillion . . . times more likely if it originated from Andrea Denise Kabo [the t-shirt's owner] . . . and Lonnell Hart . . . and two unknown, unrelated individuals than if it originated from Andrea Denise Kabo . . . and three unknown, unrelated individuals." (Attachment C, FBU Report dated February 6, 2018; Attachment D, STRMix Report).
3) A leather-type jacket seized on October 25, 2017 is alleged to contain a mixture of

DNA of three contributors, contributing 88%, 7%, and 5% to the DNA mixture, and "[t]he mixture DNA profile obtained from [the leather-type jacket] is at least 6.56 octillion . . . times more likely if it originated from Denzel Moore . . . and two unknown, unrelated individual(s) than if it originated from three unknown, unrelated individuals." (Attachment E, FBU Report dated June 19, 2018; Attachment F, STRMix Report).

4) Earbuds seized on October 25, 2017 are alleged to contain a mixture of DNA of two contributors, contributing 92% and 8% to the DNA mixture, and "[t]he mixture DNA profile obtained from [the earbuds] is at least 1.76 octillion . . . times more likely if it originated from Denzel Moore . . . and one unknown, unrelated individual than if it originated from two unknown, unrelated individuals." (Attachment E, FBU Report dated June 19, 2018; Attachment G, STRMix Report).

5) A baseball cap seized on October 25, 2017 is alleged to contain a mixture of DNA of three contributors, contributing 75%, 21%, and 3%, and "[t]he mixture DNA profile obtained from [the baseball cap] is at least 6.21 octillion . . . times more likely if it originated from Denzel Moore . . . and two unknown, unrelated individual(s) than if it originated from three unknown, unrelated individuals." (Attachment E, FBU Report dated June 19, 2018; Attachment H, STRMix Report).

6) A skull cap seized on October 25, 2017 is alleged to contain a mixture of DNA of five contributors, contributing 67%, 16%, 10%, 6% and 1%, and "[t]he mixture DNA profile obtained from [the leather-type jacket] is at least 3.68 octillion . . . times more likely if it originated from Denzel Moore . . . and four unknown, unrelated individual(s) than if it originated from five unknown, unrelated individuals."

(Attachment E, FBU Report dated June 19, 2018; Attachment I, STRMix Report).

With the exception of the t-shirt owner's DNA, no information has been provided to the defense with respect to the identity of the other contributors of the DNA on the seized items.

A. The basics of DNA extraction and analysis

> DNA, an acronym for DeoxyriboNucleic Acid, is the chemical blueprint for life. Most human cells, other than reproductive cells, contain identical copies of a person's DNA. Although 99.9% does not vary from person to person, no two persons other than identical twins have the same DNA. *See* National Research Council, The Evaluation of Forensic DNA Evidence 63 (1996) ("NRC II"); *United States v. Shea*, 957 F.Supp. 331, 333 (D.N.H.1997), aff'd, 159 F.3d 37 (1998), cert. denied, 526 U.S. 1077, 119 S.Ct. 1480, 143 L.Ed.2d 563 (1999).
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> Human DNA is organized into 23 pairs of chromosomes and each chromosome contains a DNA molecule. DNA molecules have a classic double-stranded helical structure that can be envisioned as a spiral staircase. *See* National Research Council, DNA Technology in Forensic Science 2 (1992) ("NRC I"). Running between the two sugar-phosphate strands forming the handrails of the staircase are millions of steps comprised of two loosely bound nitrogen bases. Each step is referred to as a "base pair." There are four types of bases: adenine (A), thymine (T), guanine (G), and cytosine (C). A's ordinarily pair only with T's, and C's ordinarily pair only with G's. As such, if the sequence of bases on one side of the DNA molecule is known, the corresponding sequence of bases on the other side can be deduced. Importantly, the actual arrangement of base pairs in chromosomal DNA comprises the genetic code that differentiates humans from non-humans and makes every person unique. *See* Elaine J. Mange & Arthur P. Mange, Basic Human Genetics 19–20 (1994).
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> In total, the DNA molecules in the 23 pairs of human chromosomes contain roughly 3.3 billion base pairs. While most of these base pairs are arranged in the same sequence in all humans, every DNA molecule has regions known as "polymorphic sites" where variability is found in the human population. *See* NRC II, *supra*, at 62–63. Each possible arrangement of base pairs that occurs at a polymorphic site is referred to as an "allele." Alleles can result from a difference in a single base pair, differences in multiple base pairs, or differences in the number of base pairs that comprise a site.
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> Because there is no way to sequence and compare all 3.3 billion base pairs in a person/s DNA, forensic DNA analysts seek to identify individuals through meaningful variations in their base-pair sequences at particular polymorphic loci. The method of DNA typing employed by the [FBU] in the instant matter is commonly referred to as PCR/STR typing. PCR/STR typing begins with the PCR amplification process. PCR is not itself a method of DNA typing, but is instead a

> technique of sample preparation. PCR is a laboratory process for copying a short segment of DNA millions of times, thereby replicating the natural DNA duplication process. This process allows labs to produce a substantial number of specific, targeted segments of DNA which exhibit genetic variation that can then be typed and compared from an original sample that may have been of a sub-analytical quality.

United States v. Morrow, 374 F.Supp.2d 51, 56-58 (D.D.C. 2005); *see also People v. Blash*, 2018 WL 4062322 (Sup. Ct. VI, August 24, 2018) (explaining process of DNA extraction and analysis). The genetic material then is passed through a capillary electrophoresis instrument, which separates the DNA fragments by size for identification. "The DNA profile is comprised of the particular sequences that an individual has at each locus, each of which is called an 'allele.'" *United States v. Gissantaner*, 417 F.Supp.3d 857, 862 (W.D. Michigan 2019). In other words, the number of times that a particular sequence repeats at a particular site corresponds to an "allele." "By analyzing a sufficiently large number of loci, a unique DNA profile is determined, such that it is highly improbable that any two people who are not identical twins would have the exact same DNA profile. Each forensic lab determines the number of loci targeted for analysis." *Id.* At 862. Following electrophoresis, a graph called an electropherogram ("EPG") is generated, wherein the peaks are proportionate to the amount of DNA present. When "three or more identified peaks appear at a locus, the analyst knows that the profile usually contains a mixture of DNA. When the DNA profile is found to contain a mixture of more than one contributor, probabilistic genotyping software is used the further analyze the DNA sample." *Id.* at 864.

B. STRMix, a probabilistic genotyping software program

"Probabilistic genotyping refers to the use of software and computer algorithms to apply biological modeling, statistical theory, and probability distributions to infer the probability of the profile from a single source and mixed DNA typing results given different contributor genotypes." *Gissantaner*, 417 F.Supp.3d at 864. The software generates likelihood ratios (LRs)

such as the FBU posited in this case, e.g., "The mixture DNA profile obtained from the evidence item listed above is at least 6.56 octillion times more likely if it originated from Denzell More and two unknown, unrelated individual(s) than if it originated from three unknown, unrelated individuals." (Attachment E) (parentheticals omitted).

STRMix is one such software program. It generates statistical estimates—likelihood ratios—to communicate the laboratory's "assessment of how strongly forensic evidence can be tied to a suspect." (Attachment J, Article, National Institute of Standards and Technology, "NIST Experts Urge Caution in Use of Courtroom Evidence Presentation Method," October 12, 2017). The likelihood ratio "considers the probability of obtaining the evidence profile(s) given two competing propositions, usually aligned with the prosecution case and defence case." *Gissantaner*, 417 F.Supp.3d at 865 (quoting Jo-Anne Bright, Duncan Taylor, Catherine McGovern, Stuart Cooper, Laura Russell, Damien Abarno, John Buckleton, "*Developmental validation of STRMix, expert software for the interpretation of forensic DNA profiles*," Forensic Science International: Genetics 23 (2016) 226- 239 ("FSI 23"), p 226-239, Attachment K). To generate a likelihood ratio in a case, the individual laboratory chooses two hypotheses. The first hypothesis is characterized as a prosecution fact – in this case, for example, that the defendant's DNA and the DNA of three unknown individuals are present on the skull cap attributed to Mr. Hart. The second hypothesis is a defense hypothesis – that the material contains the DNA of four unrelated persons, not the defendant. "In essence, an LR represents the likelihood of whether a particular person's DNA is present in a mixture, as compared to a random person's DNA, based on standard reference databases." *Gissantaner*, 417 F.Supp.3d at 865. However, due to the statistical methodology used in STRMix, "[t]he results of no two analyses will be completely the same." (Attachment K, FSI 23, p 232.)

STRMix uses the information from the electropherogram "to calculate the probability of the profile given all possible genotype combinations." *Gissantaner,* 417 F.Supp.3d at 866. The program "assigns a relative weight to the probability of the [electropherogram] given each possible genotype combination at a locus, and the weights across all combinations at that locus are normalized so that they sum to one." *Id.* at 866-67. However, "several factors entered into the STRMix program are under the control of the operator/analyst or the individual laboratory, and thus are variable, and affect errors." *Id.* at 867. For instance, "although '[t]he true number of contributors to a profile is always unknown,' the individual analyst determines the number of contributors to a DNA profile for purposes of the STRmix analysis." *Id.* at 867. "[S]tudies indicate it is difficult to determine with certainty the actual number of donors to any given mixture, *especially as the number of donors increases*." *Id.* (emphasis supplied). The determination of the number of donors/contributors is an estimate, based on the overall quality of the electropherogram, the locus with the greatest number of interpretable alleles, the peak height of alleles within a locus and the presence of possible alleles below the analytical threshold.

In addition to the number of contributors, the STRMix program relies upon other terms set by the individual laboratory, such as analytical thresholds,[1] stutter ratios,[2] drop-in rates,[3] and saturation levels. *Gissantaner,* 417 F.Supp.3d at 867. Furthermore, the amount of DNA tested "can have a dramatic impact on the quantity and quality of the STR results obtained, and the significance of the likelihood ratios are negatively impacted as the input DNA amount decreases

[1] The analytical threshold is a limit selected by the laboratory to distinguish "baseline or noise" from a true allelic peak.

[2] Stutter is the phenomenon that is caused by miscopying in the PCR process.

[3] Drop-in is a non-reproducible, unexplained peak within a profile.

and the extent of allelic and locus drop-out increases." *Id.* Where a minor contributor contributed less than 20% to the DNA mixture, the STRMix analysis is less reliable. In other words, not all profiles are suitable for STRMix application.

C. The "likelihood ratio" should not be admitted as a tool to convey the results of DNA analysis in this case because it is subjective, unreliable, and highly prejudicial

i. The standard for admissibility of scientific evidence

The Federal Rules of Evidence ("FRE") require a trial judge to ensure that an expert's testimony is both reliable and relevant before it may be admitted. *Daubert.* (evaluating plaintiffs' expert's testimony that ingestion of morning sickness pills manufactured by the defendant pharmaceutical company caused limb defects in the plaintiffs). FRE 702 grants the district court the discretionary authority to determine reliability and relevancy, given the particular facts and circumstances. *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999). This "gatekeeping" duty of the district court applies to all specialized knowledge, including, but not limited to technical and scientific knowledge. *Id.*; *see also Daubert*, 509 U.S. at 589. The government must prove by a preponderance of the evidence that scientific evidence is admissible. *Daubert*, 509 U.S. at 592-93; *see also Bourjaily v. United States*, 483 U.S. 171, 174 (1987) (evidentiary admissibility determinations that hinge on preliminary factual questions must be established by the proponent of the evidence by a preponderance of the evidence).

To testify "in the form of an opinion or otherwise," an expert witness first must be qualified based on her "knowledge, skill, experience, training, or education." FRE 702. Once qualified, for the testimony to be admitted, the rule requires:

> (a) the expert's scientific, technical, or other specialized knowledge must help the trier of fact to understand the evidence or determine a fact in issue;

> (b) the testimony is based on sufficient facts or data;
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> (c) the testimony is the product of reliable principles and methods;
>
> (d) the expert must have reliably applied the principles and methods to the case.

FRE 702.

Expert opinion must be based on actual knowledge, not subjective belief or unsupported speculation. *Daubert,* 509 U.S. at 590. Although an expert may base an opinion on facts if "experts in the particular field would reasonably rely on those kinds of facts or data in forming an opinion," inadmissible facts or data may be disclosed to the jury "only if their probative value in helping the jury evaluate the opinion substantially outweighs their prejudicial effect." FRE 703.

Finally, even relevant evidence must be excluded "if its probative value is substantially outweighed" by the possibility of unfair prejudice, confusion of the issues, misleading of the jury, undue delay, wasting time, or needlessly presenting cumulative evidence. FRE 403.

The Supreme Court in *Daubert* set forth factors for a court to evaluate in determining the admissibility of scientific or expert testimony:

> (1) whether the expert's theory or technique can, or has been, tested;
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> (2) whether the theory or technique has been subjected to peer review and publication;
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> (3) the known or potential rate of error of the technique or theory for a particular scientific technique and the existence and maintenance of standards controlling the technique's operation; and
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> (4) whether the theory or technique is generally accepted in the relevant scientific community.

Daubert, 509 U.S. at 593-94. However, no single factor alone is necessarily dispositive, and other factors may be relevant. See *id*. at 593; *see also Kumho Tire,* 526 U.S. at 149. The Court

observed that subjection to scrutiny is a component of good science, in part because it increases the likelihood that substantive flaws in methodology will be detected. *Daubert*, 509 U.S. at 593-94.

"Widespread acceptance can be an important factor in ruling particular evidence admissible, and '[a] known technique that has been able to draw only minimal support within community may properly be viewed with skepticism.'" *Id.* at 594. Importantly, "[s]cientific conclusions are subject to perpetual revision," and "[t]he scientific project is advanced by broad and wide-ranging hypotheses, for those that are incorrect will eventually be shown to be so[.]" *Id.* at 597. "[N]othing in either *Daubert* or the [FRE] requires a district court to admit opinion evidence that is connected to existing data only by the *ipse dixit* of the expert. *General Electric Company v. Joiner*, 522 U.S. 136, 146 (1997). In *Joiner*, the respondent sought to admit the testimony of expert witnesses who testified that they believed his exposure to certain materials in the workplace were "causally linked to" or "contributed to in a significant way" his cancer. *Id*. at 143. However, the district court refused to admit the evidence, finding that the reports upon which Joiner's experts had relied involved "isolated studies of laboratory animals"–namely, infant mice–who had had massive doses of the chemicals injected directly into their bodies. *Id*. at 143. Further, the Court observed, the cancer in the mice and in Joiner were different. Id. at 144. Finally, the results of two of the four epidemiologic studies offered by the plaintiff were not "statistically significant," and the remaining two studies involved different chemicals than those at issue in the case. *Id.* at 145-46. The Supreme Court observed that while "[t]rained experts commonly extrapolate from existing data," in *Joiner*, the analytical gap between the data and the opinion proffered was simply too great. *Id*. at 147.

Finally, a district court has broad discretion to ensure that evidence is presented to the

jury in an effective and efficient manner. See FRE 611(a). A trial results in a "binding legal judgment—often of great consequence—about a particular set of events in the past." *Daubert*, supra, 509 U.S. at 597. The rules of evidence apply with equal force to questions of admissibility in criminal cases, where the consequence at stake is a wrongful conviction and attendant sentence. Although "[v]igorous cross-examination, presentation of contrary evidence, and careful instruction on the burden of proof are the traditional and appropriate means of attacking shaky but admissible evidence," *id*. at 596, sometimes, clear effective presentation to the jury will be impossible.

ii. The likelihood ratio (LR) generated by FBU's application of STRMix does not meet the standards for admission of scientific evidence set forth by the FRE because the underlying methodology is not scientifically valid

Modern forensic DNA analysis was an issue tackled in a September 2016 report to the President by his Council of Advisors on Science and Technology, or PCAST.[4] PCAST was tasked with determining whether additional steps should be taken, "beyond those already taken by the Administration in the aftermath of a highly critical 2009 National Research Council report on the state of the forensic sciences, that could help ensure the validity of forensic evidence used in the Nation's legal system."[5] The report offers recommendations to the National Institutes of Standards and Technology ("NIST"), the White House, the FBI, the Attorney General, and the

[4] Attachment L, President's Council of Advisors on Science and Technology, Report to the President, "Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods" ("PCAST Report"), located at https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/PCAST/pcast_forensic_science_report_final.pdf

[5] The White House Blog, "PCAST Releases Report on Forensic Science in Criminal Courts," located at https://obamawhitehouse.archives.gov/blog/2016/09/20/pcast-releases-report-forensic-science-criminal-courts.

judiciary on "actions that could be taken to strengthen forensic science and promote its rigorous use in the courtroom."[6]

The 2016 PCAST report acknowledged the well-settled proposition that "DNA analysis of a sample from *a single individual* is an objective method," observing that the laboratory protocols in single-source analysis are precisely defined and that the interpretation "involves little or no human judgment." (Attachment L, PCAST Report, pp 7, 70, 71 (emphasis added)). However, the Council observed, "[a]s DNA testing kits have become more sensitive, there has been growing interest in 'touch DNA' – for example, tiny quantities of DNA left by *multiple individuals* on the steering wheel of a car." (Attachment L, PCAST Report at p 75 (emphasis added)). The report explained that "the fundamental difference" between analysis of *complex mixtures*, versus single source and simple mixtures (the latter of which is defined as two contributors), lies *in the interpretation of the resulting DNA profile*. (Attachment L, PCAST Report, pp 7, 75 (emphasis added)).

The report states:

> Interpreting a mixed profile is different for multiple reasons: each individual may contribute two, one or zero alleles at each locus; the alleles may overlap with one another; the peak heights may differ considerably, owing to differences in the amount and state of preservation of the DNA from each source; and the "stutter peaks" that surround alleles (common artifacts of the DNA amplification process) can obscure alleles that are present or suggest alleles that are not present. *It is often impossible to tell with certainty which alleles are present in the mixture or how many separate individuals contributed to the mixture, let alone accurately to infer the DNA profile of each individual.*
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> * * *
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> Because many different DNA profiles may fit within some mixture profiles, the probability that a suspect "cannot be excluded" as a possible contributor to

[6] PCAST Report, located at https://obamawhitehouse.archives.gov/blog/2016/09/20/pcast-releases-report-forensic-science-criminal-courts.

> complex mixture may be much higher (in some cases, millions of times higher) than the probabilities encountered for matches to single-source DNA profiles. As a result, *proper* calculation of the statistical weight is critical for presenting accurate information in court.

(Attachment L, PCAST Report, pp 75-76) (emphasis added)).

The PCAST report then addressed probabilistic genotypic software programs like STRMix. (Attachment L, PCAST Report, pp 78-79.) The Council cautioned that while these programs are a "major improvement over purely subjective interpretation," they still require careful scrutiny regarding the validity of these scientific methods because "the programs employ different mathematical algorithms and can yield different results for the same mixed profile."[7] (Attachment L, PCAST Report, pp 8, 79.) The Council noted that the two most widely-used methods, STRMix and TrueAllele, are commercial competitors and appear reliable only within a certain range – that is, according to the companies' own studies, they appear to be reliable for three-person mixtures in which the DNA amount exceeds the minimum level required for the method and in which the minor contributor constitutes at least 20 percent of the intact DNA in the mixture. (Attachment L, PCAST Report, p 80.) The Council urged "appropriate evaluation" of the proposed methods by multiple groups that are "not associated with the software

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[7] In a study by the NIST, 108 labs across the country to determine whether a separate DNA sample was part of the mix. Seventy-three of the labs got it wrong, saying the suspect's DNA was part of the mix when, in fact, it was not. When dealing with a mix of DNA from various potential subjects, "too much is left to the analysts' discretion." As the NIST geneticist who set up the scenario observed, "it's the Wild West out there." (Douglas Starr, "Forensics gone wrong: When DNA snares the innocent," Science Magazine, Mar. 7, 2016, p 5.)

In the District of Columbia, prosecutors stopped sending DNA evidence to the city's lab in 2015 after they discovered errors in the way analysts determined whether a sample can be linked to a suspect or a victim. https://www.washingtonpost.com/local/crime/dc-prosecutors-criticize-city-crime-labs-handling-of-some-dna-cases/2015/03/05/b5244f88-bea4-11e4-b274-e5209a3bc9a9_story.html

developers." (Attachment L, PCAST Report, p 79).

After the PCAST report was issued, on October 12, 2017, the National Institute of Standards and Technology ("NIST"), a non-regulatory agency of the United States Department of Commerce, released a study concluding that using the likelihood ratio (LR) in courtrooms is not consistently supported by scientific reasoning. (Attachment J, NIST Article; Attachment M, Lund, et. al, "Likelihood Ratio as Weight of Forensic Evidence: A Closer Look," Journal of Research of National Institute of Standards and Technology, Vol. 122, Art. No. 27 (2017) ("NIST Study")).[8] The authors of the study, NIST statisticians Steve Lund and Hari Iyer, warned that the justification for using LR in courtrooms is flawed because it "risks allowing personal preference to creep into expert testimony and potentially distorts evidence for a jury." (Attachment J, NIST Article, p 2.)

Lund and Iyer explain that proponents of the LR approach appear to justify its use with Bayesian decision theory, "a reasoning approach that has long been used by the scientific community to create logic-based statements of probability." (Attachment M, NIST Study, p 2; Attachment J, NIST Article, p 2.) Bayesian reasoning is "a structured way of evaluating and reevaluating a situation as new evidence comes up." (Attachment J, NIST Article, p 2.) Essentially, under Bayes' rule, "individuals multiply their previous (or prior) odds by their respective likelihood ratios to obtain their updated (or posterior) odds, reflecting their revised degrees of belief regarding the claim in question." (Attachment M, NIST Study, p 1.) Applying this approach allows an expert to come up with a logic-based numerical LR that makes sense to the expert *as an individual*. (Attachment J, NIST Article, pp 2-3.)

[8] Located at https://doi.org/10.6028/jres.122.027.

However, Lund and Iyer argue, Bayesian reasoning "breaks down in situations where information must be conveyed from one person to another such as in courtroom testimony." (Attachment J, NIST Article, p 2). The problem, they explain, is when jurors are told to incorporate the expert's likelihood ratio into their own decision-making, because an expert's judgment often involves complicated statistical techniques that can and do generate different likelihood ratios, depending on the expert. (Attachment J, NIST Article, p 3). Lund and Iyer observe that "[c]omputing an LR for anything but the simplest of problems will involve approximations[,]" (Attachment M, NIST Study, p 7), explaining that:

> . . . reporting a single LR value after an examination of available forensic evidence fails to correctly communicate to the [decision maker] the information actually contained in the data. Personal choices strongly permeate every model.

Attachment M, NIST Study, p 14 (emphasis added).

The authors warn that "Bayesian decision theory neither mandates nor proves appropriate the acceptance of a subjective interpretation of another, regardless of training, expertise, or common practice." (Attachment M, NIST Study, p 22). Furthermore, although validation can demonstrate that a particular interpretation may be reasonable, "this should not be misunderstood to mean the model is accurate or authoritatively appropriate." (Attachment M, NIST Study, p 22). While a decision maker "only needs to be personally satisfied regarding the suitability of using any given LR in Bayes' formula, guiding the probabilistic interpretation of others [such as jurors] requires greater care." (Attachment M, NIST Study, p 7). The authors argue that an extensive uncertainty analysis is critical for assessing when and how likelihood ratios should be used and recommend that a probability-based model LR is only warranted when evaluating high-quality sample of DNA from a single source. (Attachment J, NIST Article, p 2). Lund and Iyer maintain that for a technique to broadly apply, it must be based on measurements that can be

replicated. (Attachment M, NIST Article, p 2).

Here, the methodology underlying the likelihood ratio is not scientifically valid. The methodology fails, at a minimum, the second, third, and fourth prongs of *Daubert*.

First, with respect to an assessment of whether the theory or technique has been subjected to peer review and publication, the NIST report and the PCAST report both reveal that when subjected to scrutiny, the scientific community detected "substantive flaws in the methodology" of determining the LR. *Daubert*, 509 U.S. at 593-94. In particular, the LR method impermissibly risks allowing personal preference to creep into expert testimony, "potentially distort[ing] evidence for a jury." (Attachment J, NIST Article, p 2). As Lund and Iyer noted, "[p]ersonal choices strongly permeate every model" because using LR necessarily implicates an analyst's judgment about whether to include certain data in the analysis, including the individual laboratory's analytical thresholds, drop in/out, stutter, saturation, and an analyst's assessment of the number of contributors. (Attachment M, NIST Study, p 14). Thus, as the NIST experts point out, an expert's judgment, even when employing Bayesian reasoning correctly, can generate substantially different answers. (Attachment J, NIST Article, p 3.). The factors incorporated into the STRMix program involve subjective interpretation, but as the NIST study points out, the decision-maker in this case (the individual juror) does not know the information actually contained in the data. (Attachment M, NIST Study, p 14).

More generally, much of the actual DNA material in this case was not suitable for subjection to STRMix analysis. The PCAST report observed that according to their own studies, STRMix and TrueAllele appear to be reliable for three-person mixtures in which the minor contributor constitutes at least 20 percent of the intact DNA in the mixture and in which the DNA amount exceeds the minimum level required for the method. (Attachment L, PCAST, p

76). Here, however, three of the six items analyzed involved four or more contributors: the t-shirt and the two skull caps involved at least four contributors. And each of the six items involved minor contributors who contributed less than 20%. Two of the four contributors on the skull cap attributed to Mr. Hart contributed 3% and 1%. Four of the five contributors on the skull cap attributed to Denzel Moore contributed 16%, 10%, 6%, and 1%. Regarding the t-shirt, the owner of the t-shirt contributed 78% to the mixture which the other three contributors contributed only 16%, 4% and 2%. The two of the three contributors to the leather-type jacket contributed only 7% and 5%. The minor contributor to the earbuds contributed 8%. Two of the three contributors to the baseball cap contributed 21% and 3%. Thus, with each piece of evidence that was swabbed, the contribution of the minor donor(s) did not meet the 20% threshold specifically recommended by PCAST to the legal and scientific community to strengthen forensic science and "promote its rigorous use in the courtroom." (Attachment L, PCAST Report, p 76).

With respect to the third prong of *Daubert*, meaningful standards controlling the operation of the technique do not exist, chiefly because STRMix is a proprietary program. *Daubert*, 509 U.S. at 593-94. While FBU analysts are provided instructions on how to operate the commercial program available to them, they are not expert statisticians qualified to offer testimony regarding the proprietary software's internal calculus.[9] The defendant's inability to cross-examine a an FBU analyst or a qualified STRMix software expert about the impact and basis for the program's formulas, directions, and outcomes, would violate his Sixth Amendment right to confrontation. See Crawford v. Washington, 541 U.S. 36, 66-67 (2004). Furthermore, an

[9] See Kirchner, L., "Where traditional DNA testing fails, algorithms take over," published on ProPublica, Nov. 4, 2016, located at https://www.propublica.org/article/where-traditional-dna-testing-fails-algorithms-take-over (last accessed Dec. 12, 2017.)

FBU analyst's testimony that he or she personally knows of the program's uses in the field and has read papers where the programs were used is inadequate to establish that the application is reliable and cannot qualify him or her as an expert on STRMix software. While "[t]rained experts commonly extrapolate from existing data," in a case involving complex statistical algorithms protected by patent, "too great an analytical gap" exists between the data and the opinion proffered. *Joiner*, 522 U.S. at 147.

Finally, as to the fourth prong of *Daubert*, the LR methodology is not generally accepted in the scientific community. The PCAST report and the NIST study demonstrate that the scientific community does not accept the potential error rate inherent in this methodology. Experts in the field are openly questioning whether "the DNA results were based on scientifically valid principles and derived from scientifically valid procedures," *id*. at 564, and the "absence of consensus is not immaterial." *Id*. at 562. Programs like STRMix apply complex statistical algorithms to calculate the likelihood that a particular person, as opposed to a random person, is present in the mixture. But algorithmic analysis programs like STRMix are a new frontier of DNA science, and as the PCAST report concluded, the validity of this software has been established only in certain circumstances not present here, and additional, independent, research is critically needed. (Attachment L, PCAST, p 76). A known technique that has drawn only minimal support within community may properly be viewed with skepticism. *Daubert*, 509 U.S. at 594.

Because of the subjective principles upon which it relies, submission of the likelihood ratio here would only marginally help the trier of fact to understand the evidence, while creating an enormous possibility of unfair prejudice and confusion of the issues. FRE 403. According to the American Psychology Association, research has demonstrated that "people generally aren't

very good at interpreting probabilities, and they are easily swayed by the way statistics are presented."[10] Furthermore, "[j]urors often get too much information, and not enough instruction on how to analyze it."[11] For instance, as a 2007 article by the APA explains:

> Since everyone's DNA—except that of identical twins—is unique, the chance of a coincidental match is often around one in 10 billion, which sounds really impressive, given that the population of the earth is about 6.5 billion. But one in 10 billion is a statistical probability of coincidence-not proof that only one person on the earth could have this profile. What's more, that number does not factor in other potential problems, such as lab errors[.]
>
> In the courtroom, jurors tend to think that match statistics such as one in a billion cover all possibilities for error, but they only refer to one area, such as the chance of a coincidental match, and there are other mitigating factors such as the chances of a false match[.][12]

Here, the likelihood ratios incorporate astronomically high numbers—for example, 79.2 sextillion—that are likely to make a powerful impact on a juror's perception of the DNA evidence. Yet the underlying assumptions upon which this figure is based implicate proprietary and extraordinarily complex theories of statistical calculus to which even trained FBU analysts cannot expertly speak. FRE 703. Even "vigorous cross-examination and careful instruction on the burden of proof" would be insufficient to attack this evidence, because "clear and effective presentation to jury" is impossible. *Daubert*, 509 U.S. at 596. The danger that a jury will place too much stock in a likelihood ration of "79.2 sextillion times more likely" is great. This

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[10] Article, "The problem with DNA," American Psychological Association, June 2007 Monitor on Psychology, Vol. 38, No. 6, p. 52 (June 2007), located at http://www.apa.org/monitor/jun07/problem.aspx.

[11] Article, "The problem with DNA," American Psychological Association, June 2007 Monitor on Psychology, Vol. 38, No. 6, p. 52 (June 2007), located at http://www.apa.org/monitor/jun07/problem.aspx.

[12] Article, "The problem with DNA," American Psychological Association, June 2007 Monitor on Psychology, Vol. 38, No. 6, p. 52 (June 2007), located at http://www.apa.org/monitor/jun07/problem.aspx (last accessed Dec. 15, 2017).

evidence should not be disclosed to the jury because its probative value is substantially outweighed by the prejudicial effect. FRE 403.

II. THE PROPOSED FRE 404(b) EVIDENCE SHOULD BE EXCLUDED

The government has filed notice of its intention to seek permission to admit other crimes evidence pursuant to Federal Rule of Evidence 404(b). Specifically, the government proposes to introduce 1) evidence of Mr. Hart's 2007 conviction for armed robbery, and 2) evidence in support of its allegation that Mr. Hart participated in an uncharged robbery of a CVS store in Greenbelt, Maryland on April 15, 2017. Mr. Hart opposes the admission of 404(b) evidence, because "convictions are supposed to rest on evidence relevant to the crime charged, not on evidence of other, unrelated bad acts suggesting nothing more than a tendency or propensity to engage in criminality." *United States v. McGill*, 815 F.3d 846, 878 (D.C. Cir. 2016); FRE 401.

Rule 404(b) "bars the admission of 'evidence of a crime, wrong, or other act . . . to prove a person's character in order to show that on a particular occasion the person acted in accordance with the character." *McGill*, 815 F.3d at 879 (quoting FRE 404(b)1)). While such evidence may be admissible for the legitimate evidentiary purposes of proving motive, opportunity, intent, preparation, plan, knowledge, identity or absence of mistake or accident, before such evidence may be admitted a determination must be made that (1) the evidence is probative of a material issue other than character and (2) the probative value of the evidence for that purpose is not outweighed by its unfair prejudice to the defendant. Fed. R. Evid. 404(b). *See United States v. Sheffield*, 832 F.3d 296, 307 (D.C. Cir. 2016) (otherwise relevant evidence can be excluded if its probative value is substantially outweighed by a danger of unfair prejudice, confusing the issues, misleading the jury, undue delay, wasting time, or needlessly presenting cumulative evidence."

(quoting *McGill*, 815 F.3d at 880 (quoting Fed.R.Evid. 403)).

While it is true that Rule 404(b) directs the Court to potentially non-propensity purposes, it remains the case that the bad act is excluded if the bad act is in fact offered to prove propensity. To call Rule 404(b) a rule of inclusion (Government's Notice at 45) merely invites the Court accept evidence with a very weak link to any non-propensity purpose. The better view is that

> the term "inclusionary" merely reiterates the drafters' decision to not restrict the non-propensity uses of evidence. It does not suggest that prior offense evidence is presumptively admissible. On this point, let us be clear: Rule 404(b) is a rule of general exclusion, and carries with it "no presumption of admissibility." 1 Christopher B. Mueller & Laird C. Kirkpatrick, *Federal Evidence* § 4:28, at 731 (4th ed. 2013). The Rule reflects the revered and longstanding policy that, under our system of justice, an accused is tried for *what* he did, not *who* he is. And in recognition that prior offense evidence is generally more prejudicial than probative, Rule 404(b) directs that evidence of prior bad acts be excluded – *unless* the proponent can demonstrate that the evidence is admissible for a non-propensity purpose.

United States v. Caldwell, 760 F.3d 267, 275 (3d Cir. 2014).

However, even if a non-character purpose is articulated, the Court must assess whether the probative value is substantially outweighed by the risk that the jury will either impermissibly use the evidence for the character or propensity purpose or will convict the defendant just for being a bad person. In making this assessment, "the district court should not just ask whether the proposed other-act evidence is relevant to a non-propensity purpose but how exactly the evidence is relevant to that purpose – or more specifically, how the evidence is relevant without relying on a propensity inference." *United States v. Gomez*, 763 F.3d 845, 862-63 (7th Cir. 2014 (*en banc*) (prior possession of cocaine improperly admitted to prove identity because probative value for identity was dependent on inference that because the defendant sold drugs before, he sold them again); *United States v. Smith*, 725 F.3d 340, 342 (3d Cir. 2013) (proponent seeking to

admit evidence under Rule 404(b) must set forth "a chain of logical inferences, no link of which can be the inference that because the defendant committed . . . offenses before, he therefore is more likely to have committed this one.") (citations omitted). *See generally* Ranaldo, *Is Every Drug User a Dealer?: Federal Courts are Split in Applying Fed. R. Evid. 404(b),* 8 Fed. Cts. L. Rev. 147 (2014); Sonenshein, *The Misuse of Rule 404(b) on the Issue of Intent in the Federal Courts,* 45 Creighton L. Rev. 215, 218 (2011) ("What chain of reasoning can link the prior drug history to the charged crime other than none that infers that the defendant has a drug-related propensity . . .? The earlier drug use, which is behavioral evidence, can be relevant only if we assume that the defendant's behavior forms an unchanging pattern.").

A. There is no legitimate purpose for which to introduce evidence of Mr. Hart's 2007 conviction.

The government seeks to introduce evidence that ten years before the charges in this indictment Mr. Hart and his brother robbed a hardware store at gunpoint.

At page 46 of its motion, the government argues that it should be permitted to introduce evidence of the ten-year old robbery in its case-in-chief in "anticipat[ion]" of Mr. Hart's "denial of intent and knowledge." Government's Notice Regarding Rule 404(b) Admissibility at 46 ("Government's Notice"). However, Mr. Hart will not defend himself on the ground that he committed the conduct alleged by the government in this case but did not intend to affect interstate commerce. Nor will he defend himself on the ground that he committed the conduct alleged by the government but did not intend to take property from another against that person's will by the use of actual or threatened force, violence or fear of injury. *See United States v. Jefferson,* 911 F.3d 1290, 1296 (10th Cir. 2018) ("In a Hobbs Act robbery, the government must prove: (1) 'the taking of property from another against that person's will'; (2) 'the use of actual

or threatened force, violence or fear of injury'; and (3) 'the conduct obstructed, delayed, interfered with or affected commerce.'" (quoting *United States v. Wiseman*, 172 F.3d 1196, 1215 (10th Cir. 1999)). Nor will Mr. Hart defend himself by claiming that he committed conduct alleged by the government, but did so unknowingly. Mr. Hart's defense that he was not one of the robbers does not implicate intent or knowledge. *See United States v. Oliver*, 379 F.Supp.2d 754, 760 (E.D.PA 2005) (where defendant's defense was that he was not one of the robbers, court's failure to instruct on specific intent to steal harmless error). Thus, this very prejudicial evidence is not probative of either intent or knowledge, and will merely serve to suggest that because Mr. Hart previously robbed a business establishment at gunpoint he did so here as well, which is classic character/propensity evidence.

At page 48 of its motion, the government argues that evidence of the 2007 robbery is admissible on more than half of the grounds permitted by FRE 404(b): preparation, plan, intent, modus operandi, skill, and knowledge. (Government's Notice at 48 (arguing every ground for admission except motive, opportunity, identity and absence of mistake or accident)).

The 2007 robbery sheds no light on Mr. Hart's "preparation" in regards to the current charges, and the government fails to elucidate.

The 2007 robbery sheds no light on Mr. Hart's "plan" in regards to the current charges, and the government fails to elucidate.

The 2007 robbery sheds no light on Mr. Hart's "modus operandi" and the government suggests only that it is "eerily similar" to the current charges. It is only "eerily similar," however, in the sense that all gunpoint robberies of cash from business establishments are similar unless they have some distinctive feature, which these did not. A Westlaw search of the terms "'hobbs act robbery' and firearm" in "All Federal" produces 2,797 cases. A Westlaw search of the terms

"robbery and mask" in "All States" produces 9,575 cases. A Westlaw search of the terms "robbery and safe" in "All States" produces 8,975 cases. Robbing a business with a gun is not uncommon, wearing a mask to conceal identity is not uncommon, and robbing money from a business's safe is not uncommon. *See United States v. Powers*, 978 F.2d 354, 361 (7th Cir. 1992) (ski mask is "common" apparel for robbers). The cases cited by the government illustrate that 404(b) evidence admitted for modus operandi is far more distinctive than in this case. *See* Government's Notice at 48, n7. For example, in *United States v. Danzey*, 594 F.2d 905 (2d Cir. 1979), the defendant himself explained his "signature": he stole two cars—one light and one dark—before each bank robbery to be used as the "getaway" and the "switch" cars, committed the robberies between 9 a.m. and 11 a.m., wore a ski mask and gloves, wore two sets of clothes, one of which he would remove after leaving the bank, ran into the banks in a crouched position, vaulted over the counter, stole the trays with the money, drove the getaway car a few blocks to the switch car, then abandoned the switch car. 594 F.2d at 911. Here, the 2007 robberies and charged robberies shared the following: robbery with a gun, taking money from a safe, wearing a mask. Those features are ubiquitous. Furthermore, the 2007 robbery was early in the morning (8:38 a.m.), unlike the charged robberies which ranged from late night to after midnight (3:22 a.m., 2:48 a.m., 1:30 a.m., 11:28 p.m.). In *United States v. Sappe*, 898 F.2d 878, 879-80 (2d Cir. 1990), the defendant's modus operandi was distinctive: he used a toy gun hidden inside a folder newspaper. In *United States v. Woods*, 613 F.2d 629 (6th Cir. 1980), the defendant's "signature" was the fact that before each robbery he stole a car to be used as the getaway car, and that he and his cohorts wore not just ski masks, but eye goggles and jumpsuits—an odd uniform—each time. In *United States v. Hudson*, 884 F.2d 1016 (7th Cir. 1989), at each of the bank robberies one man approached a teller asking for change then two other men vaulted the counter to steal the money.

In *United States v. Powers*, 978 F.2d 354, 361 (7th Cir. 1992), the robber in each of the robberies wore a distinctive Panama-style hat, a suit, and carried a briefcase, and the demand notes were typewritten.

The 2007 robbery also sheds no light on Mr. Hart's "skill" in regards to the current charges, and the government fails to elucidate, except to cite a case involving complicated hijacking trucks that had left their loading stations and were en route to their destinations, taking the trucks to pre-arranged locations to be unloaded, stealing the merchandise, and then selling the stolen goods on the black market. (Government's Notice at 48, citing *United States v. Latoore*, 922 F.2d 1, 8 (1st Cir. 1990)). In fact, no skill is required to don a mask, brandish a gun and demand money. Mr. Hart is not alleged to have cracked a safe, just to have demanded that employees open and safe and give him the money inside. No skills required.

Moreover, the 2007 robbery is too old to shed light on the current charges. Evidence is not admissible pursuant to Rule 404(b) when "the unrelated bad act is 'tenuous and remote in time from the charges in the indictment.'" *United States v. Hernandez*, 975 F.2d 1035, 1039 (4th Cir. 1992) (quoting *United States v. Cole*, 491 F.2d 1276, 1279 (4th Cir. 1974)).

In short, the proposed evidence "is precisely the type of naked propensity [evidence] that Rule 404(b) forbids." *McGill*, 815 F.2d at 886 (contention that defendant was a cocaine supplier in 1995 because he had cocaine dealings [four years earlier] is precisely the type of naked propensity argument that Rule 404(b) forbids").

B. Evidence of Mr. Hart's prior conviction would be unfairly prejudicial, outweighing any legitimate probative value.

The unfair prejudicial effect of the evidence substantially outweighs its probative value. Obviously, evidence that Mr. Hart committed a prior armed robbery of a business establishment is extremely prejudicial to Mr. Hart. And unfairly so, given the fact that the evidence of the 2007 robbery is not probative of the purpose for which the government seeks its introduction. Accordingly, the government's proposed 404(b) evidence should be excluded under Federal Rule of Evidence 403.

Even if Mr. Hart's prior robbery of a business establishment is marginally probative, it also increases the risk that the evidence would be used for a prohibited reason. Such evidence will unfairly taint Mr. Hart's character and, based on this tainted character, the jury will believe that "if he did it before he probably did so this time." *Gordon v. United States*, 383 F.2d 936, 940 (D.C. Cir. 1967). If the 2007 robbery is so similar to the current charges, odds that the jury will misuse the evidence is that much more increased, as the D.C. Circuit recognized in *United States v. Manner*, 887 F.2d 317, 323 (D.C. Cir. 1989)**.** Thus, even if the Court were to find that evidence regarding the 2007 robbery passed the test of Rule 404(b), it should be excluded under Rule 403.

The D.C. Circuit has recognized the prejudicial impact of allowing a jury to learn of an accused's criminal record:

> T]he exclusion of bad acts evidence is founded not on a belief that the evidence is irrelevant, but rather on a fear that juries will tend to give it excessive weight, and on a fundamental sense that no one should be convicted of a crime based on his or her previous misdeeds. That juries treat prior convictions as highly probative has been confirmed by empirical investigations. Such reliance by the trier of fact offends the "long standing tradition that protects a criminal defendant from 'guilt

by reputation' and from 'unnecessary prejudice.'"

United States v. Daniels, 770 F.2d 1111, 1116 (D.C. Cir. 1985) (citations omitted).

Even with a limiting instruction, there exists a grave danger that jurors will lower the bar for conviction or scrutinize the facts less searchingly because they do not fear convicting an "innocent" man. They will also have a difficult time resisting the natural human impulse to make the impermissible inference that someone who has previously committed an armed robbery of a business is more likely to have done so in this instance. That inference is the very inference Rule 404(b) was intended to prevent. The value of a limiting instruction is overrated, as the D.C. Circuit noted in *United States v. Lipscomb*, 702 F. 2d 1049, 1062 (D.C. Cir. 1982) (limiting instructions of this type require the jury to perform "a mental gymnastic which is beyond, not only their powers, but anybody's else." In the words of Justice Jackson: "the naive assumption that prejudicial effects can be overcome by instructions to the jury, all practicing lawyers know to be unmitigated fiction.") (citations omitted). The inevitable prejudicial impact here substantially outweighs any probative value the evidence might have regarding the issue of Mr. Hart's guilt in the charged robberies.

Finally, the D.C. Circuit "has recognized that '[e]vidence of other crimes or acts having a legitimate nonpropensity purpose," and thus unaffected by Rule 404(b), may nevertheless "contain the seeds of a forbidden propensity inference," *McGill*, 815 F.3d at 880 (quoting *United States v. Bowie*, 232 F.3d 923, 931 (D.C. Cir. 2001), and "[a]s a result, Rule 403's balancing of prejudice and probativeness may still bar the introduction of evidence, even if Rule 404(b) by itself would not. *McGill*, 815 F.3d at 880 (citing *United States v. Mathis*, 216 F.3d 18 , 26 (D.C. Cir. 2000). For this reason too, the evidence of Mr. Hart's 2007 conviction should be excluded.

C. There is no legitimate purpose for which to introduce evidence suggesting Mr. Hart's involvement in an uncharged robbery.

The government seeks to introduce evidence that Mr. Hart participated in a Hobbs Act robbery of a CVS store in Prince George's County on April 15, 2017, a robbery that has not been charged in this case.

At page 50 of its notice seeking permission to introduce 404(b) evidence, the government argues that the uncharged robbery is probative of Mr. Hart's knowledge, plan and skill in committing the four robberies for which he is charged, his "common plan or scheme," his preparation for the robberies for which he is charged, and his "inten[tion] to seek access to the manager [in the Prince George's County robbery], so that [he] could then access the office and safe contained within the store."

The arguments made in Section II(a), *supra*, regarding the probity of the 2007 robbery to prove Mr. Hart's knowledge, plan and skill in committing the four robberies for which he is charged apply equally here.[13] Mr. Hart will not defend himself by claiming that he committed the conduct alleged by the government, but did so unknowingly. A robbery at one CVS store does not suggest a plan to rob another CVS store, even if both were committed by the same person. And, neither the Prince George's County robbery nor the other robberies required skill. Robbery of one store does not suggest "preparation" for a robbery of another store, and the robbery of the CVS store in Prince George's County—in which the robbers stole money from the

[13] Mr. Hart interprets the government's statement that "the robbery of the CVS in Prince George's County reflects a common plan or scheme that resonates throughout the multi-month crime spree carried out by Hart and his accomplices" (Government's Notice at 50) to be a reiteration of its argument that evidence of the Prince George's County robber is probative of his "plan."

cash register and a witness allegedly heard the robber ask for the manager—might suggest that the robbers "intended to seek access to the manager" in that store but does not suggest anything relevant to the charges for which Mr. Hart has been indicted.

D. Evidence of the Prince George's County robbery would be unfairly prejudicial, outweighing any legitimate probative value.

For all the reasons stated in Section II(b), *supra*, admitting evidence of the Prince George's County robbery would be unfairly prejudicial and would outweigh any legitimate probative value.

Respectfully submitted,

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