

Notice: This opinion is subject to formal revision before publication in the Atlantic and Maryland Reporters. Users are requested to notify the Clerk of the Court of any formal errors so that corrections may be made before the bound volumes go to press.

DISTRICT OF COLUMBIA COURT OF APPEALS

No. 10-CF-1001

ROBERT C. YOUNG, APPELLANT,

v.

UNITED STATES, APPELLEE.

Appeal from the Superior Court
of the District of Columbia
(CF1-20533-09)

(Hon. Herbert B. Dixon, Jr., Trial Judge)

(Argued September 25, 2012)

Decided April 4, 2013)

Jessica Brand, Public Defender Service, with whom *James Klein and Jaclyn Frankfurt*, Public Defender Service, were on the brief, for appellant.

Nicholas P. Coleman, Assistant United States Attorney, with whom *Ronald C. Machen Jr.*, United States Attorney, *Roy W. McLeese III*, Assistant United States Attorney at the time the brief was filed, and *David A. Last*, Assistant United States Attorney, were on the brief, for appellee.

Before GLICKMAN, BLACKBURNE-RIGSBY, and OBERLY, *Associate Judges*.

GLICKMAN, *Associate Judge*: After a jury trial, appellant Robert Young was convicted of kidnapping and rape based on an FBI examiner's testimony that his DNA profile matched the DNA profile of the rapist. On appeal, Young argues that the trial court committed reversible error under the Confrontation Clause of the

Sixth Amendment when it allowed the government to present this testimony without calling as witnesses the laboratory scientists who derived and identified the two DNA profiles and performed the calculations on which the testifying examiner based her conclusions. In addition, Young contends that the court abused its discretion in denying his motion to compel discovery of the frequency of profile matches and near-matches in the government's DNA database. We agree with Young's first claim but not his second.

I. Factual Background

A.

In the afternoon of October 11, 2006, Carmen Villatoro was assaulted in her apartment building in Northeast D.C. Her assailant, whom she did not know, dragged her down to the basement, forced her to perform oral sex, and attempted to penetrate her vaginally. After finding himself unable to penetrate her fully, he left.

Ms. Villatoro immediately went up to her apartment and spit the semen she had in her mouth into a tissue, which she tossed in a trash can. Her family called the police. Villatoro had avoided looking directly at her assailant's face, but she

was able to describe him to a detective as a six-foot-tall black man with big lips and thick eyebrows. She later added that he had a broken tooth. The police collected the contents of the trash can and other evidence from the scene of the crime. Villatoro was taken to a hospital, where a sexual assault nurse examined her and took swabs from her mouth and vagina. The swabs and the contents of the trash can were sent to an FBI laboratory in Quantico, Virginia, for DNA testing and analysis.

A team of scientists at the FBI lab reportedly derived a male DNA profile—the profile, presumably, of Villatoro’s attacker—from her vaginal swabs and entered it into the FBI’s database of offender DNA profiles. In November 2007, a CODIS¹ search resulted in a “cold hit,” i.e., a match between the derived DNA profile and one of the many DNA profiles stored in the database. That stored profile was Young’s, and this was how he was identified as a suspect in the Villatoro rape investigation.² Eventually, in 2009, D.C. police obtained a buccal

¹ CODIS is an acronym for the Combined DNA Index System, which is the software used to search and load profiles in the various offender DNA databases maintained on the national, state, and local levels.

² Young had been required to provide a DNA sample for inclusion in the database when he was convicted in 1985 of burglary.

tissue sample from Young and submitted it to the FBI lab for analysis.³ The lab reported that a DNA profile generated from the buccal sample matched the DNA profile created at the lab of Villatoro's assailant. An indictment was returned against Young a few months later.

Prior to the start of his trial, Young moved the court pursuant to Criminal Rule 16⁴ to direct the government to search the National DNA Index System ("NDIS") and determine the frequency of DNA profile matches between unrelated people in the database. Young wanted this data in the hope of being able to rebut the government's DNA evidence against him by showing that matches are more common, and hence less probative of identity, than is generally believed. The court denied the request on the primary ground that the information Young sought would not be material and, secondarily, because his request was untimely in any event.

³ A "buccal" sample is obtained by swabbing the cheek area inside of a person's mouth. See *United States v. Mitchell*, 652 F.3d 387, 406-07 (3d Cir. 2011).

⁴ Super. Ct. Crim. R. 16 (a).

B.

The government presented its DNA evidence at Young's trial through the testimony of a single witness: Rhonda Craig, the FBI examiner who had compared and matched the DNA profiles generated from the buccal sample and the crime scene evidence. Young objected that the admission of Craig's testimony would violate his Sixth Amendment right to be confronted with the witnesses against him because she herself had not done the testing or produced those results. After hearing Craig's testimony, the trial court overruled Young's objection.

Craig was qualified as an expert in forensic serology and DNA analysis. She testified that she supervises five FBI serologists and biologists who follow written testing procedures and National Quality Assurance Standards applicable to "all forensic DNA testing laboratories" in order to isolate DNA from evidentiary source materials and generate DNA profiles that she then compares and interprets.⁵

⁵ To create a DNA profile, the FBI extracts DNA from the sample under examination, amplifies the DNA found, and then examines the genetic code at thirteen specific places, or loci, on the DNA strand. A computer-generated electropherogram displays peaks of varying heights representing alleles at each of these thirteen loci. This "profile" is then compared to the electropherogram from another sample, which may lead to a "match." *See Roberts v. United States*, 916 A.2d 922, 926-28 (D.C. 2007) (describing analysis process).

Craig said the FBI lab personnel carefully record their handling of evidence on “chain of custody documentation” that follows the evidence “throughout the laboratory” from the moment the evidence is received. When a DNA profile of an unknown person derived from an evidentiary source is found to match the profile of a suspect, lab personnel use a specialized computer program known as “PopStats” to calculate the random match probability or “RMP.” This is the probability, Craig stated, that a randomly selected, unrelated person in a given population group would have the same DNA profile as the evidentiary sample (assuming that the unrelated person was not in fact the source of the DNA in the sample).⁶ Under FBI guidelines, a RMP of one in six trillion or lower allows the examiner to opine to a reasonable degree of scientific certainty that the suspect was the source of the evidentiary DNA.⁷

⁶ The PopStats program calculates the probability of a random match in several different populations.

⁷ For the sake of clarity, we pause to note that the RMP itself—the probability that a person picked at random would match the crime scene sample—should not be confused with other statistics such as the probability that the suspect was the source of the evidence (and it appears that Craig took care to avoid such confusion in her testimony). “Common erroneous perceptions include the belief that the RMP expresses: the probability that the defendant is the source (‘the chance that it’s from him’), the probability that someone other than the defendant is the source (‘the chance that it’s not from him’), the probability that the defendant is guilty or not guilty, or the probability that someone else would have the same profile.” David L. Faigman et al., 4 *Modern Scientific Evidence* § 31:24, at 184-85 (2012-2013 ed.) (footnotes omitted).

Craig described the evidentiary submissions that the FBI laboratory received and tested for DNA in order to identify Villatoro's assailant. These submissions included Villatoro's vaginal swabs and the tissue containing her attacker's semen that Villatoro deposited in her trash can, which the lab acquired in 2006, and the buccal swab taken from Young, which the lab received in 2009.⁸ Craig testified that she had compared a DNA profile of Young created by her staff from his buccal swab with a male DNA profile derived at the lab from Villatoro's vaginal swabs. Craig found that the two profiles matched at all thirteen loci. She next compared Young's profile with a male DNA profile that the lab developed in 2010 from the tissue recovered from Villatoro's trash.⁹ Again, Craig testified, there was a thirteen-loci match.¹⁰ A lab employee then ran the DNA profile on the PopStats

⁸ Craig identified this physical evidence based on the laboratory's tracking number, the initials of a biologist on her team, and her own examiner symbol, all of which were placed at some point on the packages containing the items. Based on notes prepared by personnel at the lab's evidence control unit, Craig testified that the packages were still sealed when the lab received them.

⁹ Although the contents of the trash can were submitted to the FBI laboratory in 2006, they were not inspected for some reason until 2010. At that time, lab personnel examined the contents and selected the tissue for DNA testing and typing.

¹⁰ The government did not rely at Young's trial on the earlier cold hit match between the vaginal swab profile and Young's profile in the government database.

program. The printouts, Craig testified, showed a random match probability in the African-American population of one in 2.8 quintillion and even lower probabilities of a match in other populations.¹¹ Because the probability of a random match was so low, Craig opined that, to a reasonable degree of scientific certainty, Young was the source of the male DNA in Villatoro's vaginal swabs and tissue.

Craig acknowledged in the course of her testimony that she did not personally perform the DNA testing and computer analysis that generated the DNA profiles she compared and the RMP she reported. Nor did Craig claim that she personally observed the receipt and handling of the evidence and the performance of the lab work preparatory to the DNA testing. Thus, when she informed the jury that the DNA profiles she examined were derived from the vaginal swabs and tissue furnished by Villatoro and the reference sample supplied by Young, Craig was not testifying from personal knowledge of those facts. Rather, she was relaying information provided by her subordinates through their documentation and identification of their work product. Similarly, in testifying to the RMP, Craig relayed information provided to her by the lab employee who ran the PopStats program. And in testifying to the sealed condition of the physical evidence when it

¹¹ Although she did not run the PopStats program herself, Craig stated that she could tell from the printouts what data had been entered.

was received by the lab, she relayed information recorded by the evidence control unit. In other words, all Craig could say from personal knowledge was that she compared electropherograms and they matched; she could not say from personal knowledge whose electropherograms they were or how they were derived.¹²

C.

In a post-verdict motion for a new trial, Young renewed his claim that Craig's testimony was admitted in violation of the Confrontation Clause because it was

based on the work that other, non-testifying witnesses performed. Ms. Craig had no personal knowledge of the DNA extractions or analysis that occurred prior to her reviewing the computer generated data at the end of the process. Indeed, Ms. Craig had no personal knowledge of the random match probability calculation that formed

¹² The government has suggested on appeal that Craig's testimony left open the possibility that she might have observed the DNA testing even though others performed it. We will not indulge that supposition in the evidentiary vacuum before us. The government, as the proponent of Craig's testimony, had the burden of establishing the basis for its admissibility when appellant objected to it. *See, e.g., Patton v. United States*, 633 A.2d 800, 810 (D.C. 1993) (quoting *In re M.L.H.*, 399 A.2d 556, 558 (D.C. 1979)). Yet in responding to appellant's argument that Craig would be relating testimonial hearsay, the government did not claim that it was not hearsay because Craig personally had witnessed the DNA testing and seen how the results were obtained. Nothing in the record suggests she did.

the basis of her conclusion that Mr. Young was the source of the evidence sample DNA. Nevertheless, Ms. Craig repeatedly testified regarding work that others had done and conclusions that others had reached.

The court denied the motion in a written order, concluding that the Sixth Amendment “does not demand that a testifying expert perform the lab work herself[;] rather an expert may testify about laboratory reports prepared by a different lab technician so long as the testifying expert performs an independent analysis of the data and reaches her own conclusions.”

II. Confrontation

A.

In *Crawford v. Washington*, the Supreme Court held that the Confrontation Clause of the Sixth Amendment bars the prosecution from introducing “testimonial” hearsay of an absent witness against a defendant at trial unless the witness is unavailable to testify and the defendant had a prior opportunity to cross-examine him.¹³ Forensic evidence, including DNA analysis, is not exempt from *Crawford*'s holding; the Supreme Court has rejected arguments that the

¹³ *Crawford v. Washington*, 541 U.S. 36, 53-54 (2004).

requirement of confrontation should be relaxed for testimonial hearsay reporting the performance and outcome of supposedly “neutral scientific testing.”¹⁴ Permitting the defendant to cross-examine a surrogate expert who did not personally perform or observe the forensic analysis at issue is not a constitutionally permissible substitute for cross-examination of the scientist who actually did the testing.¹⁵

The critical question in Confrontation Clause jurisprudence is the meaning of the term “testimonial.” The Supreme Court has declared that for a hearsay statement to be deemed “testimonial,” it must be “[a] solemn declaration or

¹⁴ *Melendez-Diaz v. Massachusetts*, 557 U.S. 305, 317 (2009) (internal quotation marks omitted) (holding that the defendant was denied his right of confrontation by the admission at his trial of affidavits reporting drug test results obtained by analysts who did not testify at trial).

¹⁵ *Bullcoming v. New Mexico*, 564 U.S. ___, 131 S. Ct. 2705, 2715-16 (2011) (holding that the introduction of a forensic analyst’s determination of the defendant’s blood-alcohol level through the testimony of another analyst who was not involved in the “particular” testing did not comport with the requirements of the Confrontation Clause, even though the surrogate analyst worked at the same laboratory and was qualified to testify as an expert about the lab’s procedures and the process and equipment utilized); *Gardner v. United States*, 999 A.2d 55, 62 (D.C. 2010) (holding that the admission of DNA and serology test results through the testimony of expert witnesses who reviewed and relied on the results but who did not conduct the testing themselves was constitutional error).

affirmation made for the purpose of establishing or proving some fact”¹⁶ for use in the prosecution or investigation of a crime, or a statement made under “circumstances objectively indicat[ing] that” the declarant’s “primary purpose [was] to establish or prove past events potentially relevant to later criminal prosecution.”¹⁷ Thus, briefly put, to be testimonial, a statement must have been made, primarily, for an evidentiary purpose. A statement made primarily for a different purpose, such as enlisting police assistance to “meet an ongoing emergency,” is not testimonial.¹⁸ In determining the primary purpose of an extrajudicial statement, the inquiry is an objective one: “That is, the relevant inquiry is not the subjective or actual purpose of the individuals involved in a particular encounter, but rather the purpose that reasonable participants would have had, as ascertained from the individuals’ statements and actions and the circumstances in which the encounter occurred.”¹⁹

¹⁶ *Crawford*, 541 U.S. at 51 (internal quotation marks omitted).

¹⁷ *Davis v. Washington*, 547 U.S. 813, 822 (2006).

¹⁸ *Davis*, 547 U.S. at 822 (holding that statements made during 911 call were not testimonial); *see also Michigan v. Bryant*, 562 U.S. ___, 131 S. Ct. 1143, 1166-67 (2011) (holding that, under the circumstances, police interrogation of the shooting victim had the primary purpose of responding to the emergency of a roaming gunman and, thus, the elicited statements were not testimonial).

¹⁹ *Bryant*, 131 S. Ct. at 1156.

The Supreme Court is divided on whether, in addition to having a primarily evidentiary purpose, an out-of-court statement must meet any additional requirements in order to be deemed “testimonial.” The divisions, which date back to *Crawford* itself, were on display most recently in *Williams v. Illinois*,²⁰ where they culminated in a fractured decision for which no single rationale commanded a majority.

The facts before the Court in *Williams* were similar, but not identical, to those in the present case. A woman in Illinois was kidnapped and raped. Vaginal swabs taken from her were submitted to an independent, private laboratory—Cellmark. In response, Cellmark produced a report transmitting a DNA profile that its analysts had developed from the swabs. A state police DNA analyst then searched the state’s database and found a matching profile, that of Williams. At trial, over Williams’s Confrontation Clause objection, the police analyst was permitted to testify that the DNA profile of Williams on file in the state database matched a male DNA profile Cellmark had created from semen in the victim’s vaginal swabs. (Cellmark’s written report, on which the analyst relied to give this

²⁰ 132 S. Ct. 2221 (2012).

testimony, was not itself introduced in evidence.) No witness having personal knowledge of Cellmark's development of the putative offender's DNA profile testified at trial.²¹

On these facts, five Justices concluded that the Confrontation Clause was not violated by the state analyst's testimony because the information in Cellmark's report was not testimonial. The remaining Justices disagreed with that conclusion.

Four members of the Court, in a plurality opinion authored by Justice Alito, reasoned that the Cellmark report was not testimonial because it did not have "the primary purpose of accusing a targeted individual."²² That is, because no one had yet been identified as a suspect when the report was prepared, the primary purpose of Cellmark's DNA testing was not "to accuse petitioner or to create evidence for

²¹ *Id.* at 2229-31 (plurality opinion). There was live testimony at trial, however, from the state analyst who had developed the DNA profile of Williams that was in the database.

²² *Id.* at 2243. The plurality also concluded, in the alternative, that there was no Confrontation Clause problem because the Cellmark report was not offered for its truth, but solely for the non-hearsay purpose of explaining the assumptions underlying the testifying expert's opinion. This was a minority view, however. All of the other Justices disagreed with this alternative rationale, which we shall discuss later in this opinion. For now, we shall concentrate on the Justices' analyses of whether the Cellmark report was testimonial.

use at trial” but, rather, “to catch a dangerous rapist who was still at large.”²³ The plurality thus viewed Cellmark’s report as analogous to statements made “to enable police assistance to meet an ongoing emergency” or “to bring an end to an ongoing threat,” which the Court previously had held not to be testimonial.²⁴ Given their non-accusatory motivation, the Court reasoned, the Cellmark scientists had “no incentive to produce anything other than a scientifically sound and reliable profile.”²⁵

Justice Thomas provided the fifth vote in support of the *Williams* judgment. He rejected what he called the plurality’s “new primary purpose test,” under which even a statement with a primarily evidentiary purpose is testimonial only if it is meant to incriminate a particular known individual, as “lack[ing] any grounding in

²³ *Id.*

²⁴ *Id.* (quoting *Hammon v. Indiana*, 547 U.S. 813, 822 (2006), and *Michigan v. Bryant*, 562 U.S. ___, 131 S. Ct. 1143, 1155 (2011)). The Court observed in *Bryant* that “there may be *other* circumstances, aside from ongoing emergencies, when a statement is not procured with a primary purpose of creating an out-of-court substitute for trial testimony.” 131 S. Ct. at 1155.

²⁵ *Williams*, 132 S. Ct. at 2244. In *Bryant*, the Court had reasoned similarly, stating that because the “prospect of fabrication” is lessened when a statement is made to deal with an ongoing emergency rather than to provide evidence, “the Confrontation Clause does not require such statements to be subject to the crucible of cross-examination.” 131 S. Ct. at 1157.

constitutional text, in history, or in logic.”²⁶ Among other things, Justice Thomas argued that the targeted-accusation requirement “makes little sense” because “[a] statement that is not facially inculpatory may turn out to be highly probative of a defendant’s guilt when considered with other evidence.”²⁷ Nonetheless, Justice Thomas concurred with the plurality’s conclusion that the Cellmark report was not testimonial. While he “agree[d] that, for a statement to be testimonial within the meaning of the Confrontation Clause, the declarant must primarily intend to establish some fact with the understanding that his statement may be used in a criminal prosecution,” Justice Thomas deemed that to be only a “necessary criterion,” not a “sufficient” one.²⁸ The Cellmark report failed, in Justice Thomas’s view, to satisfy the additional requirement that, to be testimonial, a statement must possess sufficient “indicia of solemnity.”²⁹ Only “formalized testimonial materials, such as depositions, affidavits, and prior testimony, or statements resulting from formalized dialogue, such as custodial interrogation,”

²⁶ *Id.* at 2262 (Thomas, J., concurring in the judgment).

²⁷ *Id.* at 2263.

²⁸ *Id.* at 2261.

²⁹ *Id.* at 2259.

satisfy that criterion.³⁰ But the Cellmark report, Justice Thomas noted, was “neither a sworn nor a certified declaration,” and “[a]lthough the report was produced at the request of law enforcement, it was not the product of any sort of formalized dialogue resembling custodial interrogation.”³¹

Justice Kagan, in an opinion joined by Justices Scalia, Ginsburg, and Sotomayor, dissented. Like Justice Thomas, the dissenters rejected the plurality’s “targeted accusation” test on multiple grounds. Among other things, they noted that for Confrontation Clause purposes “it makes not a whit of difference whether, at the time of the laboratory test, the police already have a suspect” because “the typical problem with laboratory analyses—and the typical focus of cross-examination—has to do with careless or incompetent work, rather than with personal vendettas” or a particular analyst’s dishonesty.³² The dissenters also

³⁰ *Id.* at 2260 (internal quotation marks omitted). This is subject to Justice Thomas’s caveat that, to curtail prosecutorial abuse, the Confrontation Clause reaches informal statements when they are used “in order to evade confrontation.” *Id.* at 2260 n.5 (internal quotation marks omitted). Justice Thomas saw no indication that the Cellmark report had been used for that purpose.

³¹ *Id.* at 2260.

³² *Id.* at 2274 (Kagan, J., dissenting). Justice Kagan also argued that the DNA analysis performed by Cellmark “to catch a dangerous rapist who was still at large” were not analogous to the statements held in *Bryant* and *Davis* to be non-
(continued...)

rejected Justice Thomas’s “formality” criterion, saying it “grants constitutional significance to minutia, in a way that can only undermine the Confrontation Clause’s protections”—for example, by enabling prosecutors to evade the requirement of confrontation “by using the right kind of forms with the right kind of language,” so as to ensure that no report of forensic analysis would be formal enough to be considered testimonial.³³

For the dissenters, “adher[ing] to the simple rule” established by the Court’s Confrontation Clause precedents made *Williams* “an open-and-shut case.”³⁴ Simply put, the report showing a DNA profile produced by a Cellmark analyst was testimonial because it was made to establish “‘some fact’ in a criminal proceeding” (namely, the identity of the victim’s attacker),³⁵ yet the prosecution at Williams’s trial introduced the results of Cellmark’s testing through an expert witness who had only hearsay knowledge of how they were generated. This violated Williams’s

(continued...)

testimonial. *Id.* (stating that the comparison “stretch[ed] both our ‘ongoing emergency’ test and the facts of this case beyond all recognition”).

³³ *Id.* at 2276 (“It would not take long to devise the magic words and rules—principally, never call anything a ‘certificate.’”).

³⁴ *Id.* at 2265.

³⁵ *Id.* at 2266 (quoting *Bullcoming*, 131 S. Ct. at 2716).

right of confrontation because, as the Court held in *Bullcoming* and *Melendez-Diaz*,

if a prosecutor wants to introduce the results of forensic testing into evidence, he must afford the defendant an opportunity to cross-examine an analyst responsible for the test. Forensic evidence is reliable only when properly produced, and the Confrontation Clause prescribes a particular method for determining whether that has happened.^[36]

The fractured decision in *Williams* may be a harbinger of changes to come in the Supreme Court’s Confrontation Clause jurisprudence, but for now its force as precedent is uncertain because no rationale for the decision—not one of the three proffered tests for determining whether an extrajudicial statement is testimonial— attracted the support of a majority of the Justices. When “a majority of the Court expressly disagree[s] with the rationale of the plurality,” a case is “of questionable precedential value.”³⁷ In *Marks v. United States*, the Court instructed that “[w]hen

³⁶ *Id.* at 2264.

³⁷ *Seminole Tribe of Fla. v. Florida*, 517 U.S. 44, 66 (1996); see also *Texas v. Brown*, 460 U.S. 730, 737 (1983) (a plurality view is “not a binding precedent”); *Pink v. United States*, 315 U.S. 203, 216 (1942) (“Nor was our affirmance of the judgment in that case by an equally divided court an authoritative precedent. While it was conclusive and binding upon the parties as respects that controversy, the lack of an agreement by a majority of the Court on the principles of law involved prevents it from being an authoritative determination for other cases.”) (internal citation omitted).

a fragmented Court decides a case and no single rationale explaining the result enjoys the assent of five Justices, ‘the holding of the Court may be viewed as that position taken by those Members who concurred in the judgments on the narrowest grounds. . . .’³⁸ However, this approach works only when the narrowest opinion actually does represent “a common denominator.”³⁹ If one opinion “does not fit entirely within a broader circle drawn by the others,” the *Marks* approach does not work, as it would “turn a single opinion” to which “eight of nine Justices do not subscribe” into law.⁴⁰

We do not get very far applying *Marks* here, for the two opinions of the Justices who concurred in the judgment in *Williams* lack the necessary common denominator. A statement could be made for the purpose of accusing a targeted individual and therefore be testimonial under Justice Alito’s test without being formal enough to satisfy Justice Thomas’s test. Conversely, a statement could be sufficiently formal to pass Justice Thomas’s test without being accusatory or

³⁸ *Marks v. United States*, 430 U.S. 188, 193 (1977) (quoting *Gregg v. Georgia*, 428 U.S. 153, 169 n.15 (1976) (opinion of Stewart, Powell, and Stevens, JJ.)).

³⁹ *King v. Palmer*, 950 F.2d 771, 781 (D.C. Cir. 1991).

⁴⁰ *Id.* at 782.

targeted at a particular person. Thus, the rationales of Justice Alito’s opinion and Justice Thomas’s opinion are incommensurable—neither rationale is subsumed within the other or narrower than the other in any meaningful sense that we discern.

Appellant therefore contends that *Williams* is not binding precedent and that this court should ignore it and continue to adhere to *Bullcoming*, *Melendez-Diaz*, and our own cases that have applied the Confrontation Clause to forensic testimony. The government disagrees and argues that even if *Williams* lacks a rationale to which a majority of the Court subscribes, the case still must be taken by lower courts to govern the outcome of cases with analogous facts.

There is an intermediate position. By analogy to *Marks*, it can be argued that while Justice Alito’s rationale and Justice Thomas’s rationale may not be includible *within each other*, the different tests they utilize to determine whether a statement is testimonial are subsumed within and narrower than *the dissenters’* test. That is so because Justice Alito and Justice Thomas each added an additional requirement to the basic “evidentiary purpose” test espoused by Justice Kagan. If the four-Justice plurality would deem a statement testimonial under the targeted accusation test, the four dissenting Justices surely would deem it testimonial under

the broader evidentiary purpose test. Similarly, if Justice Thomas would deem a statement testimonial employing his formality criterion along with the evidentiary purpose test, the four dissenting Justices necessarily would deem it testimonial using the evidentiary purpose test alone. It therefore is logically coherent and faithful to the Justices' expressed views to understand *Williams* as establishing—at a minimum—a sufficient, if not a necessary, criterion: a statement is testimonial at least when it passes the basic evidentiary purpose test plus *either* the plurality's targeted accusation requirement *or* Justice Thomas's formality criterion. Otherwise put, if *Williams* does have precedential value as the government contends, an out-of-court statement is testimonial under that precedent if its primary purpose is evidentiary and it is either a targeted accusation or sufficiently formal in character.

As we shall see, this is all we need to say about *Williams* (and its value as precedent) for purposes of deciding the present case.

B.

We now may turn to the dispositive question—whether the government's expert witness at trial, FBI examiner Rhonda Craig, relayed testimonial hearsay

concerning the DNA testing and analysis on which she based her opinion that appellant was Carmen Villatoro's presumptive assailant. This is a question of law, as to which our review is *de novo*.⁴¹ The question has two parts: (1) whether Craig transmitted hearsay and, (2) if so, whether that hearsay was testimonial. We shall address each part separately.

1. Hearsay

The government argues that Craig did not quote any particular hearsay statements, mention any out-of-court declarants, or introduce a report prepared by other technicians. Rather, she couched her account of the testing and analysis in generalities and purported to describe her “understanding” of what was done based, largely, on her familiarity with the FBI laboratory's standard practices. Therefore, the government argues, it introduced no hearsay through Craig, testimonial or otherwise.

⁴¹ *Thomas v. United States*, 978 A.2d 1211, 1225 (D.C. 2009).

We disagree. An out-of-court statement offered in evidence to prove the truth of the matter asserted is hearsay⁴² whether the statement is quoted verbatim or conveyed only in substance; whether it is relayed explicitly or merely implied; whether the declarant is identified or not. “[T]estimony need not be explicit to qualify as hearsay. . . . [L]awyers may not circumvent the Confrontation Clause by introducing the same substantive testimony in a different form.”⁴³ Thus, that a written forensic analysis report was not formally entered into evidence, or that Craig did not read verbatim from any such report, is not determinative. “[T]he appropriate question is whether the substance of the testimonial materials is shared

⁴² *Wilson v. United States*, 995 A.2d 174, 183 (D.C. 2010). For these purposes, a “statement” encompasses not only an oral or written assertion but also nonverbal conduct intended as an assertion. *Little v. United States*, 613 A.2d 880, 882 (D.C. 1992) (adopting the definition of “statement” in Federal Rule of Evidence 801 (a)). Implicit assertions are included in the definition as well. *See, e.g., Ginyard v. United States*, 816 A.2d 21, 40 (D.C. 2003).

⁴³ *Ryan v. Miller*, 303 F.3d 231, 248 (2d Cir. 2002) (condemning the introduction of a hearsay accusation through testimony stating only that a conversation had taken place and then describing what was done following that conversation); *see also United States v. Meises*, 645 F.3d 5, 22 (1st Cir. 2011) (“[A]ny other conclusion would permit the government to evade the limitations of the Sixth Amendment and the Rules of Evidence by weaving an unavailable declarant’s statements into another witness’s testimony by implication.”).

with the fact-finder to suggest its truth, without the report's author being available for cross-examination.”⁴⁴

We think it plain that Craig relayed hearsay. She admittedly relied throughout her testimony not just on her general understanding of FBI laboratory procedures, but on the documentation, testing, and analysis written or produced by other employees of the FBI laboratory in connection with this particular case. The prime example is Craig's testimony that she matched a DNA profile derived from appellant's buccal swab with male DNA profiles derived from Villatoro's vaginal swabs and her discarded tissue. Because Craig was not personally involved in the process that generated the profiles, she had no personal knowledge of how or from what sources the profiles were produced. She was relaying, for their truth, the substance of out-of-court assertions by absent lab technicians that, employing certain procedures, they derived the profiles from the evidence furnished by Villatoro or appellant. Those assertions were hearsay.⁴⁵ Without them, what

⁴⁴ David H. Kaye, David E. Bernstein, & Jennifer L. Mnookin, *The New Wigmore: Expert Evidence* § 4.10.2 at 200 (2d ed. 2011) [hereinafter *The New Wigmore*].

⁴⁵ *See Williams*, 132 S. Ct. at 2258 (Thomas, J., concurring) (“Lambatos opined that petitioner's DNA profile matched the male profile derived from L.J.'s vaginal swabs. In reaching that conclusion, Lambatos relied on Cellmark's out-of-court statements that the profile it reported was in fact derived from L.J.'s swabs,
(continued...)”)

would have been left of Craig's testimony—that she matched two DNA profiles she could not herself identify—would have been meaningless.⁴⁶

Appellant argues that Craig similarly incorporated hearsay in her testimony about the random match probability (on which she based her opinion that appellant was the source of the male DNA in Villatoro's vaginal swabs and tissue). What Craig reported was the calculation of the RMP as shown in a computer printout generated at her direction by applying the FBI's PopStats computer program to the DNA profile Craig had received and which she understood to have been obtained from Villatoro and appellant. Craig, however, did not run the program herself; rather, a subordinate allegedly entered the pertinent profile data into the computer, ran the program, and returned to Craig with the printout. The record indicates

(continued...)

rather than from some other source."); *id.* at 2270 (Kagan, J., dissenting) ("By testifying in that manner, Lambatos became just like the surrogate witness in *Bullcoming*—a person knowing nothing about 'the particular test and testing process,' but vouching for them regardless.") (quoting *Bullcoming*, 131 S. Ct. at 2715).

⁴⁶ We see no merit in the government's argument that appellant failed to object that Craig's testimony lacked a proper foundation in personal knowledge. On the contrary, that was exactly the point of appellant's objection that Craig was conveying testimonial hearsay. *Cf. Hill v. White*, 589 A.2d 918, 922-23 (D.C. 1991) (noting that testimony regarding the witness's birth must be hearsay because the witness necessarily lacked personal knowledge about it).

Craig did not observe her subordinate's performance of this assignment and therefore had no *personal* knowledge of what the subordinate did to obtain the printout, or even whether the document was authentic. Of necessity, appellant argues, Craig relied on and implicitly transmitted her employee's express or implied assertion that he had produced the printout by applying the PopStats program to the relevant DNA profile.

On the other hand, that may not be so. The subordinate's task may have been purely ministerial or mechanical insofar as his inputting of the data given him by Craig and returning a printout to her may not have involved skilled judgment or analysis or the like. If so, it is at least arguable that the Sixth Amendment did not require his testimony at trial because no assertive conduct on his part was involved. Moreover, it is possible that Craig could infer what procedures were followed from the output itself and the surrounding circumstances without relying on any out-of-court assertion by her employee. As the government argues, Craig testified that she could tell from the printout exactly what data was entered in PopStats to generate the RMP shown. And because she personally selected and ordered the input data and was available for cross-examination at trial, the mere existence of an intermediary person would not necessarily implicate appellant's Sixth Amendment right of confrontation.

The record thus leaves us somewhat uncertain as to whether Craig may have conveyed hearsay in reporting the results of the PopStats calculation, as we do not know exactly what the subordinate did. But in view of our conclusion that Craig relayed critical testimonial hearsay respecting the identity of the DNA profiles about which she testified, we need not resolve the issue with respect to her RMP testimony.

We emphasize, however, that it is too simplistic to say the DNA profiles and the RMP printout were not hearsay because they were “nothing more than raw data produced by a machine.”⁴⁷ “[D]ata that appears to be produced by a machine may depend on inputs that require judgment or permit subjectivity, and these inputs may well be appropriately characterized as testimonial [hearsay]. In that case, the machine output must be so designated as well.”⁴⁸ In the present case, the DNA profiles and, perhaps, the PopStats printout, do not stand on their own but, instead, have meaning because they amount to a communication by the scientists who produced them—the assertion, essentially, that the scientists generated these

⁴⁷ *United States v. Summers*, 666 F.3d 192, 202 (4th Cir. 2011).

⁴⁸ *The New Wigmore* § 4.12.5 (2013 Cum. Supp.).

specific results by properly performing certain tests and procedures on particular, uncorrupted evidence and correctly recording the outcomes.⁴⁹ As the Supreme Court recognized in *Bullcoming*, such “representations, relating to past events and human actions not revealed in raw, machine-produced data, are meet for cross-examination.”⁵⁰

This is not a case, moreover, in which out-of-court statements were admitted solely for the non-hearsay purpose of enabling the jury to understand the basis and “evaluat[e] the reasonableness and correctness” of an expert’s conclusions.⁵¹ The trial court did not instruct the jury, as would have been required, on the limited,

⁴⁹ It is axiomatic, for example, that if a human being does not enter correct information, the output from a computer means nothing. This principle is known in computer science as “garbage in, garbage out” and is traced back to Charles Babbage: “On two occasions I have been asked,—‘Pray Mr. Babbage, if you put into the machine wrong figures, will the right answers come out?’ . . . I am not able rightly to apprehend the kind of confusion of ideas that could provoke such a question.” Charles Babbage, *Passages from the Life of a Philosopher* 67 (1864).

⁵⁰ *Bullcoming*, 131 S. Ct. at 2714.

⁵¹ *In re Melton*, 597 A.2d 892, 901 (D.C. 1991) (en banc) (internal quotation marks omitted) (upholding, *inter alia*, the admission in civil commitment proceedings of expert psychiatric testimony recounting information obtained by the expert from the patient’s family members and other out-of-court sources, because such information was of a type on which a psychiatrist reasonably would rely in formulating an opinion as to the patient’s future dangerousness); *see also* Fed. R. Evid. 703.

non-hearsay use it could make of the DNA test results mentioned by Craig (though the prosecutor suggested the court might consider such an instruction). Nor, as also would have been required, did the court balance the legitimate probative value of the hearsay testimony for that limited non-hearsay use against the danger that the jury would consider it as substantive evidence.⁵² Thus, it is clear that Craig’s testimony about the DNA test results came in for its truth and constituted hearsay.⁵³

⁵² See *In re Amey*, 40 A.3d 902, 912 (D.C. 2012) (“Under the common law of the District of Columbia . . . , the hearsay bases of an expert witness’s opinions may be presented to the jury on direct examination of the expert, subject to a proper limiting instruction, unless their legitimate probative value in assisting the jury’s assessment of the reasonableness of the opinions is substantially outweighed by their prejudicial effect, i.e. by the risk that, despite the limiting instruction, the jury will consider the hearsay as substantive evidence.”); see also *Gardner v. United States*, 999 A.2d 55, 60 (D.C. 2010) (explaining that *Melton* “stressed” the necessity of a limiting instruction when otherwise inadmissible hearsay is admitted for the non-hearsay purpose of enabling the jury to evaluate an expert witness’s conclusions).

⁵³ In any event, in *Williams*, five Justices rejected the argument that the Confrontation Clause allows the government to introduce testimonial hearsay for the supposedly “non-hearsay” purpose of explaining the basis of an expert’s opinion. See 132 S. Ct. at 2257-59 (Thomas, J., concurring); *id.* at 2268-72 (Kagan, J., dissenting). We agree with them that the non-hearsay rationale for admission does not work because “the purportedly ‘limited reason’ for such testimony—to aid the factfinder in evaluating the expert’s opinion—necessarily entails an evaluation of whether the basis is true.” *Id.* at 2257 n.1.

[W]hen a witness, expert or otherwise, repeats an out-of-court statement as the basis for a conclusion, . . . the statement’s utility is then dependent on its truth. If the

(continued...)

Furthermore, the validity of Craig's conclusion that appellant was the source of the male DNA found in Villatoro's vaginal swabs and tissue also depended on Craig's hearsay testimony stating that the profiles she compared were properly created. Only if the jury credited as true Craig's testimony that the DNA analysis results—and the associated match probabilities—were correctly generated could it accept her conclusion.

(continued...)

statement is true, then the conclusion based on it is probably true; if not, not. So to determine the validity of the witness's conclusion, the factfinder must assess the truth of the out-of-court statement on which it relies. That is why the principal modern treatise on evidence variously calls the idea that such "basis evidence" comes in not for its truth, but only to help the factfinder evaluate an expert's opinion "very weak," "factually implausible," "nonsense," and "sheer fiction." . . . Admission of the out-of-court statement in this context has no purpose separate from its truth; the factfinder can do nothing with it *except* assess its truth and so the credibility of the conclusion it serves to buttress.

Id. at 2268-69 (quoting *The New Wigmore* § 4.10.1).

2. Testimonial

The next question is whether the hearsay Craig relayed was testimonial. This court has said in past decisions that “the conclusions of FBI laboratory scientists” who conduct DNA profiling tests are testimonial in nature,⁵⁴ as are the data “produced by operation of a DNA-typing instrument.”⁵⁵ The government conceded as much in *Gardner*.⁵⁶ The DNA test results at issue in the present case are no different in principle from the forensic analyses we considered in those cases; the DNA profiles and RMP about which Craig testified were generated for the primary purpose of establishing or proving a past fact relevant to later criminal prosecution, namely the identity of Villatoro’s assailant. Under the basic “evidentiary purpose” test, that is enough to render the test results testimonial.

⁵⁴ *Roberts v. United States*, 916 A.2d 922, 938 (D.C. 2007).

⁵⁵ *Veney v. United States*, 936 A.2d 811, 831 (D.C. 2007).

⁵⁶ *Gardner v. United States*, 999 A.2d 55, 58-59 (D.C. 2010) (“The government concedes that the conclusions set forth in the DNA and serology reports were ‘testimonial’ . . . [and that] the admission of these results, either through the admission of the DNA report or the expert testimony, violated appellant’s rights under the Confrontation Clause of the Sixth Amendment because the scientists who actually conducted the testing were not available for cross-examination.”).

The DNA results obtained at the FBI lab after appellant was identified as a suspect by a cold hit also satisfied the “targeted accusation” criterion set forth in Justice Alito’s plurality opinion in *Williams*. These “post-targeting” test results included the DNA profile derived from appellant’s buccal sample, the male DNA profile derived from the tissue recovered from Villatoro’s trash can, and the RMP calculation (which, as previously discussed, may or may not have involved hearsay). Each of those results was obtained for “the primary purpose of accusing a targeted individual.”⁵⁷ Collectively, they were central to Craig’s trial testimony—she relied on them to conclude that appellant was the source of the DNA left by Villatoro’s assailant.⁵⁸

Thus, Craig conveyed testimonial hearsay under both the basic evidentiary purpose test and the supplemental targeted-accusation requirement. As we explained above, that is enough for purposes of this case to establish a violation of appellant’s Sixth Amendment right of confrontation. In holding otherwise, the trial court deemed it significant that Craig independently analyzed the data produced by

⁵⁷ *Williams*, 132 S. Ct. at 2243 (plurality opinion).

⁵⁸ The critical difference between this case and *Williams* lies in the fact that the prosecution in this case did not appreciably rely at trial on the cold hit match with a DNA profile in the government database to prove appellant’s guilt, whereas the prosecution in *Williams* relied exclusively on such a cold hit match.

the scientists under her supervision and reached her own conclusions. *Bullcoming* subsequently rejected such a rationale for the admission of testimonial hearsay,⁵⁹ which we ourselves had done in *Gardner*.⁶⁰ Much as we said of comparable DNA expert testimony in *Gardner*, it would “require an impossible feat of mental gymnastics” to “disaggregate” Craig’s own non-hearsay conclusions from the interwoven hearsay on which she relied, relaying the results of the DNA testing and analysis performed by other FBI lab employees.⁶¹ This “would be a different case if, for example, [it had involved] a supervisor who [had] observed an analyst conducting a test [and who then] testified about the results or a report about such results.”⁶² But without evidence that Craig performed or observed the generation of the DNA profiles (and, perhaps, the computer calculation of the RMP) herself, her supervisory role and independent evaluation of her subordinates’ work product

⁵⁹ *Bullcoming v. New Mexico*, 564 U.S. ___, 131 S. Ct. 2705, 2715-16 (2011) (“[T]he [Confrontation] Clause does not tolerate dispensing with confrontation simply because the court believes that questioning one witness about another’s testimonial statements provides a fair enough opportunity for cross-examination.”).

⁶⁰ *Gardner*, 999 A.2d at 61-62 (rejecting admission of DNA evidence based on the theory that the supervising expert had done an “independent analysis” from lab analyst).

⁶¹ *Id.* at 62.

⁶² *Bullcoming*, 131 S. Ct. at 2722 (Sotomayor, J., concurring).

are not enough to satisfy the Confrontation Clause because they do not alter the fact that she relayed testimonial hearsay.⁶³

We do not hold that every analyst and technician who performed any aspect of the multi-stage process used to isolate, amplify, identify, and analyze DNA evidence must testify at a defendant's trial absent a waiver. This is an issue of great practical importance that the Supreme Court left open in *Williams*.⁶⁴ It is not an easy issue under current Sixth Amendment doctrine. Perhaps, as has been proposed in one treatise, a practical compromise ultimately will be reached pursuant to which the Confrontation Clause will be deemed satisfied so long as the testifying expert was personally and significantly involved in all the critical stages of the DNA testing process, even if others "played a supporting role."⁶⁵ Perhaps, as also has been suggested, the prosecution may be allowed to call a substitute

⁶³ See *Gardner*, 999 A.2d at 61; see also *The New Wigmore* § 4.12.4 at 42 (2013 Cum. Supp.) ("Permitting a supervisor [to testify] is a superficially attractive approach, but it is not supported by careful scrutiny unless, as [Justice] Sotomayor puts forward in her hypothetical, the supervisor observed the analyst conducting the test. If not, the supervisor has no greater connection to *this specific test* than does any other qualified laboratory employee.").

⁶⁴ See *Williams*, 132 S. Ct. at 2244 (Breyer, J., concurring); *id.* at 2273 n.4 (Kagan, J., dissenting).

⁶⁵ *The New Wigmore* § 4.10.3 at 206.

expert to testify when the original expert who performed the testing is no longer available (through no fault of the government), retesting is not an option, and the original test was “documented with sufficient detail for another expert to understand, interpret, and evaluate the results.”⁶⁶

In this case, however, we need not address such possible solutions to the practical difficulties of implementing *Crawford* in connection with forensic evidence. The government has not argued that practical considerations made it necessary to present its DNA test results through Craig as opposed to witnesses with personal knowledge of the critical testing, and Craig clearly lacked personal and significant involvement in critical parts of the process.

C.

Having found a violation of appellant’s Sixth Amendment right of confrontation, to which he made timely and appropriate objection at trial, we must reverse his conviction unless we can conclude the error was harmless beyond a

⁶⁶ *Id.* § 4.10.2 at 204-05.

reasonable doubt.⁶⁷ We cannot reach such a conclusion here. The DNA evidence implicating appellant as Villatoro's assailant "was the cornerstone of the government's case."⁶⁸ There was no other evidence directly incriminating appellant; Villatoro did not identify him, no fingerprint or other physical evidence connected him to the crime, and he made no admissions. Without Craig's testimony, the government would have been left with an argument that appellant fit Villatoro's comparatively vague description of her assailant and lived not far from where the attack took place. It may be doubted whether this would have been enough to allow the case to get to the jury. Therefore, reversal is required.

III. Denial of Discovery

A.

After appellant received the FBI laboratory's DNA case file in discovery, he requested the government to provide him a report listing all the DNA profiles in the National DNA Index System ("NDIS") that matched each other at nine or more

⁶⁷ *Gardner*, 999 A.2d at 58 (citing *Chapman v. California*, 386 U.S. 18, 24 (1967)).

⁶⁸ *Id.* at 62.

loci and identifying those that were known to belong to siblings. If the government was unwilling to conduct the “pairwise comparison” search required to create such a listing, appellant requested that his own expert be given access to the NDIS to perform the search.⁶⁹ The government refused appellant’s requests.

Thereafter, approximately one month before the scheduled trial date, appellant moved to compel the government to furnish the discovery he sought on DNA profile matches and near-matches in the NDIS database.⁷⁰ Appellant argued that he was entitled to this data because it constituted documentary and scientific information in the government’s possession that would be material to the preparation of his defense.⁷¹ Specifically, citing what he called the “astonishing” results of searches that had been performed in a few, comparatively small, state offender DNA databases, appellant predicted that an unexpectedly high number of nine-or-more-loci profile matches would be found in the large national offender

⁶⁹ A “pairwise comparison” involves comparing each profile in the database with every other profile in the database to determine whether they match in whole or in part.

⁷⁰ Appellant filed his discovery motion on March 31, 2010. His counsel had received the DNA case file on December 10, 2009, and asked the government for a report on DNA profile matches in NDIS on or about February 12, 2010. The government had denied that request on February 18, 2010.

⁷¹ *See* Super. Ct. Crim. R. 16 (a)(1)(C)-(D).

database as well—even, conceivably, matches at all thirteen of the loci tested. The frequency of such partial (or even full) matches, appellant claimed, would demonstrate that the formula used by the FBI to calculate the rarity of DNA profiles must be flawed, causing it to “erroneously overstate the rarity of a profile by a significant factor.”⁷² Appellant argued that such a demonstration, by showing that the true random match probability associated with his thirteen-loci DNA profile must be “far greater” than the minuscule probability the FBI had calculated, would enable his defense to impeach Rhonda Craig’s opinion that he was the source of the DNA left by Villatoro’s assailant.⁷³

The government opposed appellant’s discovery demand. Disputing the relevance of the requested discovery, the government contended that the partial

⁷² Appellant explained that the frequency of pairwise matches in the state databases has led some scientists to question the underlying assumptions of the rarity formula—in particular, the assumption that the alleles at the thirteen tested loci are inherited independently of each other, which (if true) permits all their individual probabilities to be multiplied together to determine rarity in accordance with the “product rule.” See *United States v. Jenkins*, 887 A.2d 1013, 1018 (D.C. 2005).

⁷³ A “far greater” RMP in appellant’s case would imply a higher (though still low) probability that the DNA profile of Villatoro’s assailant would be the same as Young’s profile if Young were not the source. See *The New Wigmore* § 14.1.2; David H. Kaye, *Trawling DNA Databases for Partial Matches: What is the FBI Afraid Of?*, 19 Cornell J.L. & Pub. Pol’y 145, 151 n.27 (2009) [hereinafter Kaye, *Trawling DNA Databases*].

profile matches found in the state offender databases are neither statistically surprising nor meaningful and that data on pairwise matches in NDIS similarly would cast no doubt on the FBI's formula for calculating rarity or, in particular, the FBI's thirteen-loci RMP calculation in this case. Indeed, the government claimed, because the likelihood of a coincidental match at all thirteen tested loci is so minute, scientists have yet to see such a match that did not turn out to involve identical twins. In addition, the government argued, it would take months, if not years, to conduct a full pairwise search of NDIS and obtain the data appellant requested, and appellant's motion to compel such an effort, filed on "the eve of trial," was untimely.

After hearing argument on the motion to compel, the trial court denied it for two reasons: lack of materiality and untimeliness. As to the first criterion, the court held that "there is hypothetical materiality with respect to the search that's being requested, but it's not true materiality in the real sense" because there is no "real basis" to question the correctness of the government's statistics or expect data on pairwise matches in NDIS to undermine the FBI's calculation of a RMP based

on a thirteen-loci match.⁷⁴ For that reason alone, the court emphasized, it would have denied appellant's discovery motion even if it had been made at the earliest possible time. Additionally, though, because appellant had waited to file his motion until trial was only about a month away, and in view of how long it would take to search NDIS according to the government's credible estimate, the court ruled that his request was untimely.

B.

Appellant argues that the trial court erred both in finding that the results of an NDIS search would not be material to his defense and in ruling that his motion to compel such a search was untimely. We disagree with appellant on both counts.⁷⁵

⁷⁴ The court was "struck by the uniqueness in this case of what the claim is; . . . that there's a 13-loci match that at least as far as anyone knows . . . no one has ever seen outside of the possibility of identical twins."

⁷⁵ Although we agree that the trial court properly denied appellant's motion as untimely, we deem it desirable to consider the materiality of appellant's discovery request, both because appellant otherwise could be expected to renew the request on remand before any retrial, and because the same discovery issue has arisen in other cases (including some now pending on appeal).

1. Materiality

We review a trial court's determination as to whether information sought by a defendant in discovery would be material to the preparation of his defense for abuse of discretion.⁷⁶ The burden of establishing such materiality is on the defendant. He "must demonstrate a relationship between the requested evidence and the issues in the case, and there must exist a reasonable indication that the requested evidence will either lead to other admissible evidence, assist the defendant in the preparation of witnesses or in corroborating testimony, or be useful as impeachment or rebuttal evidence."⁷⁷ While "[t]he threshold showing of materiality is not a high one . . . , '[n]either a general description of the information sought nor conclusory allegations of materiality suffice.'"⁷⁸ Thus, in the present case, where appellant requested discovery in order to impeach the FBI's statistical analysis of the rarity of his DNA profile, he needed to make "some preliminary

⁷⁶ *United States v. Curtis*, 755 A.2d 1011, 1014-15 (D.C. 2000) (citing *United States v. Lloyd*, 992 F.2d 348, 350-51 (D.C. Cir. 1993)).

⁷⁷ *Id.*

⁷⁸ *Id.* at 1015 (quoting *United States v. Mandel*, 914 F.2d 1215, 1219 (9th Cir. 1990)).

showing of a reason to doubt the [statistical] analysis provided by the government.”⁷⁹

As we have said earlier in this opinion, a RMP statistic calculated by the FBI measures the rarity of a given DNA profile in a particular population; it is a calculation of “the probability of finding a match by randomly selecting one profile from a population of unrelated people.”⁸⁰ Applying the “product rule,”⁸¹ the FBI

⁷⁹ *Id.*

⁸⁰ *United States v. Jenkins*, 887 A.2d 1013, 1018 (D.C. 2005). More precisely, “[t]he random-match probability is the probability that (A) the trace sample would have the identifying features possessed by the individual tested given that (B) the individual tested is not the source.” *The New Wigmore* § 14.1.2, at 618. It should be understood that the nearly infinitesimal probabilities computed, such as the probability of one in 2.8 quintillion in the present case, do not measure the actual frequency of observed profiles in any real-world population:

They apply to a hypothetical, infinite population. Obviously the frequency of any observed DNA type . . . in a real population on earth cannot be smaller than . . . one in seven billion or so. The large exponents in the powers of 10 [in more miniscule RMPs] mean that the features that constitute the full DNA profile . . . are extremely variable—there are so many possible, complex types that only a small fraction of them will be realized in an actual population.

Id. § 14.1, at 611.

⁸¹ “The product rule provides that ‘if two events are independent of each other, the probabilities of each occurring can be multiplied, and the resulting
(continued...)”

computes the RMP essentially by multiplying together the population-specific frequencies of the alleles found at thirteen designated loci on the DNA strand with a so-called “theta correction” to adjust mathematically for certain departures from allelic independence attributable to population substructure (the phenomenon of preferential mating patterns in subpopulations, which may result in correlations of alleles).⁸² This method of calculating the RMP follows the recommendations in a 1996 report of the National Research Council of the National Academy of Science (the “NRC II report”);⁸³ it has been tested empirically⁸⁴ and its scientific

(continued...)

product is the probability of both events occurring.” *Jenkins*, 887 A.2d at 1018 n.6 (quoting *State v. Link*, 25 S.W.3d 136, 144 (Mo. 2000)).

⁸² See *Jenkins*, 887 A.2d at 1018. At trial, Craig was asked about the theta (mistranscribed as “stata”) correction. She stated that it “is a measure of the amount of non-random mating that could exist in population groups. . . . It is sort of a correction for that amount. . . . It’s applied when there’s what we consider a [homozygotic] profile,” which is when someone has a matching set of alleles at a particular locus, because then parents could “happen to be related.” The value of the correction is .01. See also *United States v. Morrow*, 374 F. Supp. 2d 51, 58-60 & n.8 (D.D.C. 2005) (explaining calculation of allelic frequencies and use of the “theta inbreeding coefficient correction”).

⁸³ See *Jenkins*, 887 A.2d at 1018; *Morrow*, 374 F. Supp. 2d at 59-60.

⁸⁴ See, e.g., Bruce S. Weir, *Matching and Partially-Matching DNA Profiles*, 49 J. Forensic Sci. 1009 (2004) (finding that observed numbers of pairs of individuals with various numbers of matching or partially matching loci in CODIS data published by the FBI and in forensic database data reported by Australian authorities are in “good overall agreement” with numbers predicted by application
(continued...)

foundations and basic accuracy are generally accepted in the scientific community.⁸⁵

To make the required showing that significant flaws in the FBI's rarity statistics would be shown by searching NDIS for profile matches, appellant relied on the allegedly "astonishing" number of partial matches at nine or more loci found in certain state DNA databases. The primary example of such matches, because it is well-documented and has been studied by researchers, involved Arizona's offender DNA database. According to a report prepared by the Arizona Department of Public Safety (which appellant submitted to the trial court with his motion), a search of the Arizona database in 2005, when it contained 65,493 DNA profiles, turned up 144 partial matches: 122 pairs of people whose profiles matched at nine out of the thirteen tested loci and twenty pairs that matched at ten

(continued...)

of the product rule with the theta correction; "[s]etting $\theta = 0.01$ does produce a conservative result at nearly every locus in all three samples").

⁸⁵ See, e.g., Yun S. Song et al., *Average Probability That a "Cold Hit" in a DNA Database Search Results in an Erroneous Attribution*, 54 J. Forensic Sci. 22, 23 (2009) (noting that "there is a consensus about using the recommendation of NRC II for computing the RMP"); *id.* at 24 (recognizing "a consensus that the theta correction using the recommended values of theta provides a conservative basis for computing the per-locus match probabilities") [hereinafter Song, *Average Probability*].

of the thirteen loci.⁸⁶ Some similar results apparently were obtained in Maryland and Illinois, though the details in those cases remain preliminary and unexamined.⁸⁷

So many matches at nine and ten loci in a collection of only sixty-five thousand profiles may seem “astonishing” when the number is contrasted with microscopically small random match probabilities. For example, the RMP associated with the first nine-loci match found in Arizona’s database reportedly was “1 in 754 million in Caucasians, 1 in 561 billion in African Americans, and 1 in 113 trillion in Southwest Hispanics.”⁸⁸ In fact, though, such a simple contrast is misleading and does not warrant astonishment. As the government argued, several factors may explain why numbers such as those seen in Arizona are not inconsistent with the rarity statistics generated by the FBI. Appellant did not rebut

⁸⁶ One pair of profiles matched at eleven loci and one pair matched at twelve loci, but these matches were between confirmed siblings. The extent to which relatives were involved in the nine-loci and ten-loci matches was not determined.

⁸⁷ See *People v. Wright*, 971 N.E.2d 549, 561-62, 567 (Ill. App. Ct. 2012) (relating findings of 903 matches at nine or more loci in Illinois’ 220,000-profile database and 32 such matches in Maryland’s under-30,000-profile database).

⁸⁸ Erin Murphy, *The New Forensics: Criminal Justice, False Certainty, and the Second Generation of Scientific Evidence*, 95 Cal. L. Rev. 721, 782 (2007).

these factors or present the trial court with analyses showing any significant incompatibility or reason to believe that the FBI's RMP calculations materially understate the true probability of a random match. On the contrary, studies submitted to the court by both parties indicate that the profile matches seen in databases are consistent with the standard formula for calculating profile rarity.

The foremost explanatory factor is the basic mathematics of the inquiry. As the government pointed out, "when the number of pairwise comparisons in a particular felon database nears the discriminating power of the typing system (which is a function of the number of loci used), partial pairwise matches are expected." Simply put, a pairwise database search for coincidental matches between each and every DNA profile represented in the database can involve a huge number of comparisons—far more than a database search for a coincidental match with a single DNA profile—and the contrast becomes more and more dramatic as the size of the database increases. In a database containing n entries, the search for a coincidental match with a single DNA profile will require n comparisons; the number grows linearly with the size of the database. This means that a match is very unlikely if the RMP is tiny, as it typically is when nine or more loci are compared. But the pairwise search of the database for matches requires every profile in the database to be compared with every other, for a total of $n(n-$

$1/2$ comparisons. The number of comparisons thus increases as the square of the size of the database. As Professor Kaye says, “[t]his combinatorial explosion . . . creates a vastly greater number of opportunities for a match among profiles,” meaning “the database need not be so huge before one can expect many matches that have very small random-match probabilities.”⁸⁹

⁸⁹ Kaye, *Trawling DNA Databases*, at 156. To understand this point, it may be helpful to appreciate that the phenomenon

is analogous to the famous “birthday problem.” The problem is to determine the minimum number of people in a room such that the odds favor there being at least two of them who were born on the same day of the same month. In its simplest form, the birthday problem assumes that equal numbers of people are born every day of the year. Since the random-match probability for a specified birthday is about $1/365$, most people think that more than 180-some people must be in the room. Indeed, one might think that for a match to be likely, the number should be larger still. After all, the chance of a match between two randomly selected individuals having a given birthday (say, January 1) is a miniscule $1/365 \times 1/365 = 1/133,225$.

But a precise calculation shows that it takes only 23 people before it is more likely than not that at least two people in the room share a birthday. The actual number is this small because the matching birthday can be any one of the 365 days in the year and because the number of comparisons among birthdays scales as n^2 with an increasing number n of people in the room.

Id. at 156-57 (footnotes omitted). See also Bruce S. Weir, *The Rarity of DNA Profiles*, 1 *Annals Applied Stat.* 358 (2007).

To apply the math to appellant's prime example, in the Arizona offender DNA database, which held 65,493 profiles, there were over two billion distinct profile pairs: $65,493 \times 65,492/2 = 2,144,633,778$. And as Kaye explains, "that is not all":

For each pair, there is only one way to match all thirteen loci, but there are many more ways to get a nine-locus partial match. The profiles in the pair might match at the first nine loci and not match at the next four; they might not match at the first four but then match at the next nine; and so it goes for the $(13!)/(9!)(4!) = 715$ distinct combinations of nine items out of thirteen. With no particular set of nine loci that need to match, we perform $715 \times 2,144,633,778$ comparisons, which gives us more than 1.53×10^{12} opportunities to find some nine-locus matches.^[90]

In other words, over one-and-a-half trillion nine-loci *pairs* created from 65,493 *profiles* were compared in Arizona. Merely to illustrate the potential significance of that calculation, suppose the average RMP for a nine-locus profile in the Arizona database is one in ten billion and that none of the 65,493 profile

⁹⁰ Kaye, *Trawling DNA Databases*, at 157 (footnotes omitted). A similar calculation can be performed with respect to the number of 10-loci comparisons: there are $(13!)/(10!)(3!) = 286$ ways of obtaining a ten-loci match, resulting in $286 \times 2,144,633,778 = 6.13 \times 10^{11}$ (613 billion) different pairings.

contributors is related to each other. Then the expected number of nine-locus matches would be $(1.53 \times 10^{12}) \times (10^{-10}) = 153$ nine-loci matches.⁹¹

In addition to the sheer size of offender databases and the consequent explosion of combinatorial possibilities for pairwise comparison, the frequency of partial matches in such databases is affected by their makeup. Offender databases are not created from randomized collections of unrelated members of a single defined population; far from it. As the government pointed out, offender databases include DNA profiles of siblings, parents and children, and other close relatives; moreover, they are heterogeneous, meaning they include persons from different population groups in unknown proportions. Each of these factors can lead to more partial matches than one would predict on the basis of random match probabilities alone.

Because close relatives are much more likely than strangers to share the same genes, their DNA profiles have a much greater likelihood of matching than

⁹¹ *See id.* Although we do not know the average RMP that would be applicable to the Arizona database, it appears that a one-in-ten-billion RMP for a nine-loci profile is not atypical. *See* Guangyun Sun et al., *Global Genetic Variation at Nine Short Tandem Repeat Loci and Implications on Forensic Genetics*, 11 *Eur. J. Hum. Genetics* 39, 45 (2003).

do the profiles of unrelated individuals. At appellant's trial, Rhonda Craig supplied an example of this when she testified that, while the RMP for appellant's 13-loci profile is less than 1 in 2.8 quintillion, the probability that his full sibling would have that same profile is 1 in 747 thousand—roughly speaking, a ten trillion-fold increase. Furthermore, as Kaye notes, it appears “likely that close relatives comprise a substantial fraction of the offender databases,” perhaps on the order of “a third or more.”⁹² Consequently, the presence of siblings and other close relatives in an offender database may make a significant difference to the number of partial matches found there.⁹³ In Arizona, matches were found at eleven and twelve loci, but they involved confirmed siblings. While it was not determined how many of the 144 matches at nine and ten loci also involved siblings (or other

⁹² Kaye, *Trawling DNA Databases*, at 170 & n.143 (citing Allen Beck et al., Bureau Just. Stat., *Survey of State Prison Inmates* 9 (1991) (37% of inmates reported having a parent or sibling “who had served time”); Doris L. James, Bureau Just. Stat., *Profile of Jail Inmates* 9 (2002) (national survey of jail inmates found that 46% of the inmates had a sibling or parent who had been incarcerated)).

⁹³ See, e.g., Bruce Budowle, F. Samuel Baechtel, & Ranajit Chakraborty, *Partial Matches in Heterogeneous Offender Databases Do Not Call into Question the Validity of Random Match Probability Calculations*, 123 Int'l J. Legal Med. 59, 60 (2009) (explaining that “the number of matched loci becomes highly distorted toward the direction of a larger number of matched loci in the presence of relatives in the database, and the deviation depends on the extent of the number of relatives as well”).

close relatives), it seems highly likely that some significant number of them did too.⁹⁴

The Arizona data may also indicate how heterogeneity can make a difference. As the government argued, “[i]f members of a Native American tribe in Arizona, who would be expected to share close kinship, commit felonies, their DNA profiles will be added to the state’s offender database,” leading to more partial matches than would otherwise be expected.⁹⁵

⁹⁴ In a 2008 study, Professor Laurence Mueller estimated the number of sibling profiles that needed to be present in the Arizona database to explain the observed partial match results at nine and ten loci under the standard assumption of allelic independence relied on to compute random match probabilities. Mueller concluded that there had to be roughly one to three thousand sibling pairs, meaning between 3.1% and 9.2% of the profiled offenders had to have siblings in the database. Mueller also concluded that “[m]ore remote relatives, even as close as parents and offspring, are unlikely to help much at explaining these observations.” See Laurence D. Mueller, *Can Simple Population Genetic Models Reconcile Partial Match Frequencies Observed in Large Forensic Databases?*, 87 *J. Genetics* 101, 107 (2008). The actual makeup of the Arizona database is not known, but if Kaye is correct about the likely prevalence of close relatives in offender databases, Mueller’s estimate appears plausible.

⁹⁵ Another factor to bear in mind is that duplicate DNA profiles appear in offender databases because offenders use aliases and because different jurisdictions collect and submit DNA profiles of the same offender. Undetected duplications artificially inflate the number of full matches in a database.

Researchers have studied the match frequencies found in offender databases, including the Arizona database, to determine whether they in fact imply that the foundations of the formula for calculating RMPs need to be reconsidered. Appellant and the government presented the trial court with some of their published results. The studies are not conclusive; questions remain. Reputable scientists and scholars have argued that it would be desirable as a matter of policy and scientific accuracy to investigate the frequency of matches in very large databases such as NDIS in order to determine whether the theorized amplification of slight deviations from allelic independence across multiple loci affects the accuracy of RMP calculations based on the product rule.⁹⁶ The FBI has resisted such a search of the national database, citing privacy concerns and law enforcement priorities.⁹⁷ Nonetheless, we see no reason to disagree with Professor

⁹⁶ See, e.g., Song, *Average Probability*, at 24 (“[F]ailure to reject the hypothesis of independence across loci is not equivalent to verifying that the RMP computed from the product rule is accurate. Only by carrying out more studies [of profile matches in databases] can we be sure that multiplying across loci produces accurate results”); Kaye, *Trawling DNA Databases*, at 170 (urging the government to make an “anonymized version of NDIS” available to researchers because, while “[s]tudies to date tend to support the accepted method for computing random-match probabilities, . . . these studies are limited by sample size and the lack of details on individual profiles and familial relationships of the individuals whose DNA profiles are in the databases”).

⁹⁷ See Kaye, *Trawling DNA Databases*, at 149. The DNA Identification Act of 1994, 42 U.S.C. §§ 14131-14136e (2006), also restricts access to the NDIS database.

Kaye who, reviewing the studies in 2009, concluded that, “[i]n sum, the research to date gives little reason to doubt the adequacy of the existing model for computing” random match probabilities.⁹⁸ Appellant did not present the trial court (and has not presented this court) with any database studies contradicting that conclusion.

Furthermore, even if we posit that data from a NDIS search might demonstrate that RMPs as currently calculated could be more accurate, that does not mean the difference would be material in this or any other case. We are not aware that the postulated inaccuracy or error range has been estimated or quantified, but we think it would have to be very substantial indeed to have a material effect on such an extremely low RMP as that calculated in this case (less than one in 2.8 quintillion). What difference could it really make to a jury, for example, if the RMP were increased even a thousand-fold, to one in 2.8 quadrillion? That still would be an extremely low random match probability; and under FBI guidelines, it still would have allowed Rhonda Craig to testify to a reasonable degree of scientific certainty that appellant was the source of the

⁹⁸ Kaye, *Trawling DNA Databases*, at 164; *see also id.* at 161-62 (“The studies of the few numbers reported in Arizona do not demonstrate that the theoretical computations [of RMPs] yield absurdly small estimates of the true probabilities of a match among unrelated individuals.”).

evidentiary DNA.⁹⁹ Like the trial court, we have been given no reason to believe that the impact on the calculation of a correction that might be warranted by NDIS data possibly could be great enough to be helpful to appellant.¹⁰⁰

For the foregoing reasons, we conclude that appellant did not meet his burden of showing reason to believe the discovery he sought from the NDIS would enable him to impeach the material accuracy of the FBI's statistical calculations or otherwise would be material to the preparation of his defense. The trial court did not abuse its discretion in so ruling.

2. Untimeliness

Although our decision with respect to materiality suffices by itself to dispose of appellant's challenge to the trial court's denial of his discovery motion, we think it appropriate to add that the court did not err by ruling, in the alternative, that the motion was untimely. Even where material is otherwise discoverable, the request

⁹⁹ We express no view on the appropriateness *vel non* of an expert opinion so framed.

¹⁰⁰ When the trial court asked defense counsel during the argument on his discovery motion whether there was "any projection from anyone" as to how the NDIS search results might affect the RMP, counsel admitted there was not.

for it must be reasonable and not unduly burdensome to the government or the court.¹⁰¹ Here appellant waited until a month before trial to file his motion. No reason appears why the motion could not have been filed much earlier. The government proffered that, according to information furnished by the Chief of the CODIS Unit and NDIS, the initial pairwise search of the database alone would take several months or more.¹⁰² Appellant disputed this estimate and argued that the search could be done much faster, as shown by the fact that the computerized search of the Arizona offender database (which also was searchable using the

¹⁰¹ See *United States v. Curtis*, 755 A.2d 1011, 1016 (D.C. 2000).

¹⁰² And that initial search, the government argued, would only be the beginning. The process of identifying duplicate and sibling profiles would itself be a “massive undertaking,” the government explained, because

[T]he FBI only has access to the personally identifiable information relating to federally convicted offenders at NDIS. The remainder of the convicted offender records do not contain personally identifiable information sufficient to ascertain duplicate or sibling profiles and it would not be possible to identify any such duplicate or sibling profiles at the National level. To ascertain such information would require extensive research by each and every state and local law enforcement agency which would, in turn, have to be checked against each and every state and local database because felons can be registered in any number of different local and state databases, along with the federal database. There is simply no way to estimate how many months/years it would take the states and local authorities to comply with such a request.

CODIS software) was performed in only about half an hour. The court acknowledged that it did not “know for certain” how long an NDIS search would take, but it found the government’s estimate more credible. On that basis, the court ruled that appellant’s motion was untimely.

Appellant faults the court for failing to resolve the factual dispute and determine how long the search actually would take. We are not persuaded by that complaint. Presumably, such a determination would have required an evidentiary hearing, which appellant did not request. In any event, we do not think such a hearing would have been required even if appellant had asked for one. The government’s estimate was plausible, and appellant’s counter-argument was weak. As we have explained, a pairwise search of a database requires comparing each profile in the database with every other profile in the database. This takes time. The search of the Arizona database may have taken only half an hour, but that database contained only 65,493 profiles, which meant approximately 2.14 billion pair comparisons. (As previously mentioned, the formula to determine the number of pairwise comparisons in a database containing n profiles is $n(n-1)/2$.) In contrast, the NDIS contained (at the time the motion for discovery was made in this case) approximately 7.8 million profiles. That translates to over 30.42 trillion pair comparisons—roughly *fourteen thousand times* the number in the Arizona

search.¹⁰³ We readily appreciate that the difference between the Arizona database and NDIS supports the government's projection.

IV. Conclusion

Although appellant's discovery claim ultimately fails, he is entitled to relief on his Confrontation Clause claim. Accordingly, we reverse appellant's convictions and remand the case for a new trial.

¹⁰³ A back-of-the-envelope estimate indicates that a NDIS pairwise comparison done at Arizona speeds therefore would take roughly 10 months (if the computer ran non-stop).