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ARTICLE

RISE OF THE MACHINES: MACHINE-GENERATED DATA AND THE CONFRONTATION CLAUSE[†]

Brian Sites[*]

Forensic machines and other such devices can create powerfully incriminating evidence, and some do so with little or no human aid. In a world where machines increasingly perform that task, what happens to the right to cross-examine the human witnesses who would have testified but for the machines? Through errors, bias, and even fabrication, machine operators, calibrators, and others involved in the forensic process still have the power to cause these tools to incriminate the wrong person. There is no shortage of evidence that this occurs. Many courts have concluded, however, that there is no right to cross-examine the operators of these machines. This Article analyzes that result.

The Article begins by discussing Confrontation Clause jurisprudence from across the nation, including machine-generated testimony cases and areas of Confrontation Clause jurisprudence that might be instructive in addressing machine-generated data, such as cases involving photographs, videos, interpreters, and dog handler testimony. The Article then considers the strengths

and weaknesses of several potential approaches to machine-generated testimony and concludes that multiple approaches are defensible, but the approach that best adheres to the purposes of the Confrontation Clause focuses on the degree and nature of the operator's control over the machine. Under that model, there is no right to cross-examine the operators of many modern machines. Though that result is troubling, there are alternative models that might extend the lifespan of the Confrontation Clause. However, as machines become increasingly automated, the right to cross-examine their human assistants and progenitors will approach extinction.

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I. INTRODUCTION

"[D]ata are not 'statements' in any useful sense. Nor is a machine a 'witness against' anyone. If the readings are 'statements' by a 'witness' against the defendant, then the machine must be the declarant. Yet how could one cross-examine a gas chromatograph?"[1]

"[T]he witnesses with whom the Confrontation Clause is concerned are human witnesses . . . ."[2]

Machines are vital tools for investigating crimes. In this digital age, they create powerfully incriminating evidence, and some do so with little or no human aid. Even for machines that require some human decision-making, most machines do the heavy-lifting in analysis and data generation. The machines of the future will do amazing things, but those in the present are already impressive: facial-recognition software;[3] 3D lasers and forensic drones that map crime scenes;[4] enhanced law enforcement tools;[5] and self-calibrating forensic tools are just the beginning.[6]

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1. United States v. Moon, 512 F.3d 359, 362 (7th Cir. 2008).

2. United States v. Lamons, 532 F.3d 1251, 1263 (11th Cir. 2008) (emphasis in original).

3. *See, e.g.*, David Kravets, *Facial Recognition Nabs 14-year Fugitive in Nepal, FBI says*, ARS TECHNICA (Aug. 13, 2014, 12:20 PM), http://arstechnica.com/tech-policy/2014/08/facial-recognition-nabs-14-year-fugitive-in-nepal-fbi-says/.

4. *See, e.g.*, *3D Forensic Mapping*, LEICA GEOSYSTEMS, http://www.leica-geosystems.us/forensic/3d_scanning.html (last visited Aug. 13, 2014) (describing its ScanStation model, which "allows the 3D data . . . to *automatically* be mapped onto the data producing a visually stunning 3D rendering of the scene"); Katie Collins, *Laser-mapping crime scenes officially a thing*, WIRED.CO.UK. (Feb. 13, 2014), http://www.wired.co.uk/news/archive/2014-02/13/3d-mapping-crime-scenes (discussing use of 3D mapping devices in Australia); *Domestic drones are already reshaping U.S. crime-fighting*, REUTERS.COM (Mar. 3, 2013, 10:06 AM), http://www.reuters.com/Article/2013/03/03/us-usa-drones-lawenforcement-idUSBRE92208W20130303 (including a comment from a Colorado sheriff's deputy, "[w]e can now bring the crime scene right into the jury box, and literally re-enact the crime for jurors").

5. *See* Victor Li, *Law enforcement's latest highway tech speeds up info-gathering, but critics say it violates privacy*, ABA JOURNAL (Oct. 1, 2014, 4:10 AM), http://www.abajournal.com/magazine/Article/data_driven_latest_highway_technology_speeds_up_info_gathering_but_critics/ (describing use of automated license-plate readers and Stingray, a tool that imitates a cell phone tower to gain information from mobile devices).

6. Among other technologies on the horizon are the FBI's new "Next Generation Identification" system and also an "autonomous" five-foot, 300 lb.

These are not negative developments. But, in a world where machines increasingly create evidence against defendants, what happens to the right to cross-examine the human witnesses who would have testified but for the machines? Through errors, bias, and even fabrication, machine operators, calibrators, and others involved in the forensic process still have the power to cause these persuasive tools to incriminate the wrong person. There is no shortage of evidence that this occurs.[7]

Many courts have concluded, however, that forensic machines speak with a voice of their own, and those statements—the raw data of a machine—invoke no Confrontation Clause right.[8] Although courts hold that the statements of lab analysts in lab reports are testimonial,[9] for machine-generated data, courts have widely held that it is not the analysts who make the statements: the declarants are the machines, and there is no right to cross-examine a machine.[10] Mass spectrometers, scales, breathalyzers, and gas chromatographs alike thus have a story of their own, and they tell

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K5 robot designed "to predict and prevent crime" through "predictive analytics" and "social engagement." *Next Generation Identification*, FEDERAL BUREAU OF INVESTIGATION, http://www.fbi.gov/about-us/cjis/fingerprints_biometrics/ngi (last visited Aug. 17, 2014) ("This program will further advance the FBI's biometric identification services, . . . offer[ing] state-of-the-art biometric identification services and . . . a flexible framework of core capabilities that will serve as a platform for multimodal functionality.").

7.   *See, e.g.*, Williams v. Illinois, 132 S. Ct. 2221, 2250 (2012) (Breyer, J., concurring) (stating that lab procedures have often been abused and listing sources in support of that observation); Pamela R. Metzger, *Cheating the Constitution*, 59 VAND. L. REV. 475 *passim* (2006) (same); *DNA Exonerations Nationwide,* THE INNOCENCE PROJECT, http://www.innocenceproject.org/ Content/DNA_Exonerations_Nationwide.php (last visited Aug. 17, 2014) (describing analysis of 316 post-conviction exonerations and attributing "unvalidated or improper forensic science" as "play[ing] a role in 49 percent of wrongful convictions later overturned by DNA testing"); Roma Khanna & Steve McVicker, *Probe finds crime lab faked results in 4 cases*, HOUSTON CHRONICLE (June 1, 2005), http://www.chron.com/news/houston-texas/Article/Probe-finds-crime-lab-faked-results-in-4-cases-1494739.php (noting, e.g., that one of the analysts continued to work at the lab years later). Machines can also make mistakes on their own. *See, e.g.*, David Kravets, *License plate reader error leads to traffic stop at gunpoint, court case*, ARS TECHNICA (May 12, 2014, 5:43 PM), http://arstechnica.com/tech-policy/2014/05/after-being-held-at-gunpoint-due-to-lpr-error-woman-gets-day-in-court/.

8.   *See infra* Part III.

9.   *See generally* Melendez-Diaz v. Massachusetts, 557 U.S. 305 (2009).

10.   *See, e.g.*, United States v. Washington, 498 F.3d 225, 229-30 (4th Cir. 2007).

it in a language immune to the Confrontation Clause.[11] The result is that some evidence once subject to the Confrontation Clause—because it came in the form of individuals testifying about what they saw or what they did—no longer triggers a confrontation right because machines now generate the evidence in place of humans.[12]

A right to cross-examine human agents will not catch or prevent all errors,[13] but it will prevent some.[14] Further, analysts are sometimes unavailable for important reasons as illustrated in recent cases: the analyst might have been indicted for making false statements under oath,[15] have a relevant mental illness,[16] or have been placed on "unpaid leave" for unspecified reasons.[17] Revealing that information to the jury, in the analyst's own words, may be important. However, that right will come at a price, and not just as a matter of efficiency.[18] In some cases, a right to confront the operator of the machine will lead to the exclusion of

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11.   *See, e.g.*, United States v. Moon, 512 F.3d 359, 362 (7th Cir. 2008) ("the instruments' readouts are not 'statements', so it does not matter whether they are 'testimonial'").

12.   *See* Bullcoming v. New Mexico, 131 S. Ct. 2705, 2712 n.3 (2011) ("The trial judge [in this case] noted that, when he started out in law practice, 'there were no breath tests or blood tests. They just brought in the cop, and the cop said, 'Yeah, he was drunk.'"). Notably, machines producing evidence in place of humans might do so through different methods. For example, while the officer might have testified that he believed based on his own observations that the defendant was drunk, a breathalyzer machine testifies to that conclusion based on an analysis of the defendant's breath.

13.   *See, e.g.*, Merritt Baer, *Who Is the Witness to an Internet Crime: The Confrontation Clause, Digital Forensics, and Child Pornography*, 30 SANTA CLARA COMPUTER & HIGH TECH. L.J. 31, 49-51, 56 (2013) (noting some examples where such a right would not be beneficial).

14.   *See, e.g.*, Williams v. Illinois, 132 S. Ct. 2221, 2246 (2012) (Breyer, J., concurring) (noting such an example); *id.* at 2264 (Kagan, J., dissenting) (same).

15.   *See, e.g.*, Lee v. State, 418 S.W.3d 892, 894 (Tex. App. 2013), *petition for discretionary review refused* (Mar. 12, 2014).

16.   *See, e.g.*, United States v. Ramos-Gonzalez, 664 F.3d 1, 2 (1st Cir. 2011). Many mental illnesses would not be relevant, but some would.

17.   *See, e.g.*, *Bullcoming*, 131 S. Ct. at 2707.

18.   *See, e.g.*, Commonwealth v. Yohe, 79 A.3d 520, 542 (Pa. 2013) (concluding that a system using fewer analysts would cause more errors than an assembly line process); Jennifer Mnookin & David Kaye, *Confronting Science: Expert Evidence and the Confrontation Clause*, 2012 SUP. CT. REV. 99, 154 (2012) ("[D]raconian Confrontation Clause rules might well motivate laboratories to make . . . modifications [such as reducing the number of analysts]. But if these modifications took laboratories in directions inconsistent with the practices of science more generally, it is far from clear that these would be positive developments.").

evidence where the original analyst simply changed jobs,[19] relocated,[20] is on maternity leave,[21] or is deceased.[22] That could lead to a windfall for defendants.

This Article addresses the question at the heart of this issue: are machine-generated "statements" immune to the Confrontation Clause? And if machines can make statements of their own, how do we sort out the machine-generated statements from the statements by their operators? What about machines that operate with de minimis human control? Which of these, if any, are immune to the Confrontation Clause, where is the line, and how is that line determined?

To answer these questions, this Article takes a "weigh all sides" approach and considers multiple models, identifies cases and theories that support them, and assesses each model's weaknesses. This Article, though based on the study of several forensic and other machines, takes a machine-agnostic approach instead of tying analysis to specific machines because the details are everything, and the machines will vary in important ways from model to model and setting to setting (including non-lab settings).

In Part II, the Article highlights important portions of the Supreme Court's recent Confrontation Clause jurisprudence. Next, Part III describes the machine-generated testimony doctrine and cases from around the nation that address this doctrine, most of which have held that there is no right to cross-examine machine operators. Part IV reviews other areas of Confrontation Clause jurisprudence that might be instructive in addressing machine-generated statements, such as cases involving photographs and videos, interpreters, and dog handler testimony. Those cases, too, have generally held there is no right to cross-examine the operators of a camera, an interpreter who merely translates, or a canine, though there is an interesting twist as to the latter two groups of cases. Finally, Part V weighs several potential approaches to machine-generated testimony and describes their strengths and weaknesses. Ultimately, the Article concludes that several approaches are defensible, but argues that the approach that best adheres to the purposes of the Confrontation Clause focuses on the

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19.   *See, e.g.*, United States v. Moon, 512 F.3d 359, 361 (7th Cir. 2008).

20.   *See, e.g.*, State v. March, 216 S.W.3d 663, 664 (Mo. 2007); State v. Roach, 95 A.3d 683, 687-88 (N.J. 2014).

21.   *See, e.g.*, State v. Oliphant, 127 So. 3d 91, 102 (La. Ct. App. 2013).

22.   *See, e.g.*, Scott v. Mule Creek State Prison, No. ED CV 07-909 SVW PJW, 2010 WL 5563805, at *1 (C.D. Cal. Dec. 28, 2010), *aff'd*, 504 F. App'x 658 (9th Cir. 2013).

degree and nature of the operator's control over the machine. Under that model, there is no right to cross-examine the operators of many modern machines. In its final sections, this Article discusses the extent to which that result is troubling and considers alternative models that might extend the lifespan of the modern Confrontation Clause.

Machine-generated testimony does not exist in a vacuum, and there are other doctrines that may affect the use of machines to generate evidence. Though this Article remarks on some such parallel areas, they are not the focus here. One example is the question that divided the Supreme Court in *Williams v. Illinois*[23] as to whether a supervisor may—without violating the Confrontation Clause—testify in court based on evidence that, if admitted directly, would violate the Confrontation Clause. That divisive question requires its own separate article, and though the answer to that question could significantly affect the use of machine-generated testimony, it will not always do so, and courts are still working through what *Williams* means for Confrontation Clause cases.[24] Further, some machine-generated data that is likely to be at issue in a criminal trial should be viewed as being admitted for the truth of the matter asserted, as others have already articulated, and thus admission of that data should require the testimony of the data's underlying author (who, this Article argues, is not always just the machine).[25]

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23. *See generally* Williams v. Illinois, 132 S. Ct. 2221 (2012) (4-1-4 decision).

24. *See, e.g.*, DAVID H. KAYE, DAVID E. BERNSTEIN & JENNIFER L. MNOOKIN, THE NEW WIGMORE: EXPERT EVIDENCE § 4.12.11 (Aspen Publishers 2014); People v. Lopez, 286 P.3d 469, 483 (Cal. 2012) (Liu, J., dissenting) ("The nine separate opinions offered by this court in the three confrontation clause cases decided today reflect the muddled state of current doctrine concerning the [Confrontation Clause].").

25. *See generally* DAVID H. KAYE, DAVID E. BERNSTEIN & JENNIFER L. MNOOKIN, THE NEW WIGMORE: EXPERT EVIDENCE § 4.10.1 (Aspen Publishers 2014) (rejecting the argument that the otherwise-inadmissible underlying information is not being admitted for its truth but instead to help the jury evaluate the testifying expert's testimony, and thus a surrogate analyst/expert should be permitted to disclose the underlying information to the jury); *id.* at § 4.10.2 (addressing the harder question of whether an expert may *rely* on, but not disclose to the jury, otherwise-inadmissible evidence); *id.* at § 4.12.5 (addressing this question as it pertains to machine-generated data).

Finally, there are other avenues through which a defendant might seek protection in a given case, such as hearsay rules,[26] other constitutional rights,[27] and the requirement of establishing an evidentiary foundation.[28] Some courts have concluded, for example, that the rules of evidence and especially foundation requirements are the best (or only) proper way to challenge machine-generated data.[29]

However, the question of whether machine-generated data triggers the Confrontation Clause is an important separate question. First, as a definitional matter, it is important to identify the boundaries of the Confrontation Clause and how it should adapt (if at all) to fundamental changes in criminal trials. Second, to the extent that the machine-generated data doctrine is in tension with analogous doctrines under the Clause, that division undermines consistency and is generally jurisprudentially problematic. Thus, it is important to consider those parallels. Third, the availability of a right under the Confrontation Clause is important because it may trigger different analyses at trial and different standards of review on appeal.[30] And, as a practical matter, some judges may simply take objections founded on an alleged constitutional error more seriously. Finally, in at least some situations, the other protections that might require the testimony of a machine's operator before admission of the machine's data at trial—evidentiary requirements, for example—are simply not doing the job.[31] It is a fair critique that we should target any such failings

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26. *But see* Fed. R. Evid. 801(a) ("'Statement' means *a person's* oral assertion, written assertion, or nonverbal conduct, if the person intended it as an assertion.") (emphasis added).

27. *See, e.g.*, Gundersen v. Municipality of Anchorage, 792 P.2d 673, 674-76 (Alaska 1990) ("[W]e hold that due process requires that the defendant be given an opportunity to challenge the reliability of that [breath test] evidence in the simplest and most effective way possible, that is, an independent test [of the defendant's intoxication level].").

28. *See, e.g.*, Napier v. State, 820 N.E.2d 144, 150-51 (holding, based on a mix of Confrontation Clause and evidentiary foundation rules, that introduction of data generated by a breathalyzer without any accompanying testimony from the operator of the machine was error), *modified in part on reh'g*, 827 N.E.2d 565 (Ind. Ct. App. 2005) (reversing the prior opinion in part).

29. *See, e.g.*, United States v. Washington, 498 F.3d 225, 231 (4th Cir. 2007).

30. *See, e.g.*, United States v. Summers, 666 F.3d 192, 197 (4th Cir. 2011) (addressing different standards of review); *March*, 216 S.W.3d at 664 (same).

31. The existence of numerous machine-generated data cases that tackle the issue from a Confrontation Clause angle—instead of having required operator testimony at trial based on foundation requirements—provide some evidence of this potential problem. *See infra* Part III.

of evidentiary requirements directly, but that does not remove the value of also contemplating how the Confrontation Clause functions in an increasingly automated world or the other rationales for asking such questions. Accordingly, we turn now to the question of whether and to what extent the Confrontation Clause applies to machine-generated testimony.

II. Modern Confrontation Clause Jurisprudence

The Confrontation Clause of the Sixth Amendment states that "[i]n all criminal prosecutions, the accused shall enjoy the right . . . to be confronted with the witnesses against him."[32] It applies in both state and federal prosecutions.[33] The Supreme Court has noted that the relatively simple text of the Clause is susceptible to multiple interpretations, including that the Clause embraces "those who actually testify at trial, those whose statements are offered at trial, or something in-between[.]"[34] Similarly, judges and commentators alike have noted that the intended scope and history of the Confrontation Clause are less well-known than some other amendments; in other words, "the Confrontation Clause comes to us on faded parchment."[35] Nevertheless, the Court has made do, and five cases are the most relevant to machine-generated testimony.[36] Although the Supreme Court has not directly resolved the issue of how the Confrontation Clause applies to machine-generated data, these cases provide the foundation for answering that question. They also give shape to the modern Confrontation Clause right generally while defining its edges in areas such as witness statements during and after emergencies and the use of forensic reports that are signed by various parties.

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32. U.S. CONST. amend. VI.

33. Pointer v. Texas, 380 U.S. 400, 406 (1965); *see also* Crawford v. Washington, 541 U.S. 36, 42 (2004) (citing *Pointer*, 380 U.S. at 406).

34. *Crawford*, 541 U.S. at 42 (citations omitted).

35. California v. Green, 399 U.S. 149, 174 (1970) (Harlan, J., concurring) ("History seems to give us very little insight into the intended scope of the Sixth Amendment Confrontation Clause."); Jules Epstein, *Cross-Examination: Seemingly Ubiquitous, Purportedly Omnipotent, and "At Risk"*, 14 WIDENER L. REV. 427, 428, n.7 (2009) (collecting sources and noting "the lack of contemporaneous documentation of the Framers' motivations and intentions regarding [the Confrontation Clause]").

36. Readers looking for a full description of these cases have plenty of options to choose from. *See, e.g.*, THE NEW WIGMORE: EXPERT EVIDENCE *supra* note 25, § 4.12.11; Jennifer Mnookin & David Kaye, *Confronting Science: Expert Evidence and the Confrontation Clause*, 2012 SUP. CT. REV. 99, 103-17 (2012).

The first of those cases is *Crawford v. Washington*, decided in 2004.[37] In *Crawford*, a husband stabbed a man and claimed self-defense, but the wife's recounting of the event to police was arguably inconsistent with a self-defense theory.[38] The wife refused to testify, asserting a state marital privilege, so the State introduced her prior out-of-court statement.[39] The Court held that admitting the statement violated the husband's Confrontation Clause right.[40]

In so holding, the Court jettisoned[41] the then-twenty-four-year-old precedent, *Ohio v. Roberts*.[42] Under *Roberts*, the analysis focused on hearsay law and the reliability of the evidence.[43] The Court concluded in *Crawford* that this approach failed to adequately address the core concerns of the Confrontation Clause and stated that "[w]here testimonial statements are involved, we do not think the Framers meant to leave the Sixth Amendment's protection to the vagaries of the rules of evidence, much less to amorphous notions of 'reliability.'"[44]

Instead, the Court concluded that while the Confrontation Clause's "ultimate goal is to ensure reliability of evidence . . . it is a procedural rather than a substantive guarantee. It commands, not that evidence be reliable, but that reliability be assessed in a particular manner: by testing in the crucible of cross-examination."[45] The Court then announced the new standard for Confrontation Clause claims, though it declined to spell out the standard in full: "*Where testimonial evidence is at issue*, . . . the Sixth Amendment demands what the common law required: *unavailability* and *a prior opportunity for cross-examination*."[46]

The heart of *Crawford*, then, is the relatively undefined term "testimonial," for only evidence that crosses into that category triggers the requirements of unavailability and prior opportunity to cross-examine. Notably, *Crawford* also indicated a preference for clear lines in place of malleable, imprecise standards: "[The Framers] were loath to leave too much discretion in judicial hands.

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37. *Crawford*, 541 U.S. at 36.
38. *Id.* at 40.
39. *Id.*
40. *Id.* at 68.
41. *Id.* at 60-68.
42. Ohio v. Roberts, 448 U.S. 56 (1980).
43. *Id.* at 62-67.
44. *Crawford*, 541 U.S. at 61; *see also id.* at 51.
45. *Id.* at 61.
46. *Id.* at 68 (emphasis added) (footnote omitted); *see also* Richard D. Friedman, *Confrontation and Forensic Laboratory Reports, Round Four*, 45 TEX. TECH L. REV. 51, 57 (2012).

By replacing categorical constitutional guarantees with open-ended balancing tests, we do violence to their design."[47]

In the second Confrontation Clause case, *Davis v. Washington*, the Court again declined to adopt a comprehensive definition of "testimonial."[48] *Davis* involved two consolidated cases: in one case, a woman called 911 to report an ongoing emergency (domestic abuse), and in the second case police officers responded to an alleged incident of domestic abuse that had ended.[49] In both cases, the prosecution sought to introduce out-of-court statements— the 911 call and the statements of the woman in the second case.[50]

Justice Scalia, writing for the majority as he did in *Crawford*, reiterated that "[o]nly [testimonial] statements . . . cause the declarant to be a 'witness' within the meaning of the Confrontation Clause."[51] Statements are testimonial, he explained, when "the primary purpose of the interrogation is to establish or prove past events potentially relevant to later criminal prosecution."[52] Applying that test, the Court held that the statements in the 911 call were not testimonial because they reflected an ongoing emergency, were intended to help resolve that emergency rather than just to learn about a potential past crime, and were part of an exchange that was not significantly formal.[53] On the other hand, the statements in the second case were testimonial because they were "part of an investigation into possibly criminal past conduct," were somewhat formal (involving separate interviews of the man and woman in different rooms), and "the primary, if not indeed the sole, purpose of the interrogation was to investigate a possible crime."[54] In short, the statements "d[id] precisely *what a witness does* on direct examination."[55]

Finally, the Court cautioned in *Davis* that "[r]estricting the Confrontation Clause to the precise forms against which it was originally directed is a recipe for its extinction."[56] This warning

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47.   *Crawford*, 541 U.S. at 68 (citations omitted); *see also* Whorton v. Bocktin, 549 U.S. 406, 414 (2007) (criticizing Ohio v. Roberts, 448 U.S. 56 (1980) as "too 'malleable' in permitting the admission of *ex parte* testimonial statements") (quoting Crawford, 541 U.S at 60)).

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

49.   *Id.* at 817-21.

50.   *Id.*

51.   *Id.* at 821.

52.   *Id. at* 822; *see also* Michigan v. Bryant, 131 S. Ct. 1143, 1157 (2011).

53.   *Davis*, 547 U.S. at 827 (discussing each of these factors).

54.   *Id.* at 829-30.

55.   *Id.* at 830 (emphasis in original).

56.   *Id.* at 830 n.5.

parallels a remark in *Crawford* that "[a]ny attempt to determine the application of a constitutional provision to a phenomenon that did not exist at the time of its adoption . . . involves some degree of estimation . . . but that is hardly a reason not to make the estimation as accurate as possible."[57]

The third case, *Melendez-Diaz*, tackled the question of lab reports.[58] Justice Scalia, penning his third opinion in the testimonial trilogy, considered a case involving three "certificates of analysis" that stated the results of forensic tests performed on certain seized substances.[59] Those certificates reported the date the bags were analyzed, an identifying number, the officer who submitted the bags, a certification by the analyst that the substance was found to contain cocaine, how much the samples weighed, the defendant's name, analyst signatures, a notary public notarization, and other information.[60] While the details varied from certificate to certificate—such as the weight of the substance and the identifying number—most of the information was the same across all three documents.[61] The analysts who signed the reports did not testify at trial, despite the defendant's objection under the Confrontation Clause.[62]

The Court held that the lab reports were "within the core class of testimonial statements" under *Crawford* and *Davis*.[63] The Court first noted that the certificates were "functionally identical to live, in-court testimony, doing 'precisely what a witness does on direct examination.'"[64] Justice Scalia continued, explaining:

> [N]ot only were the affidavits "made under circumstances which would lead an objective witness reasonably to believe that the statement would be available for use at a later trial," but under Massachusetts law the *sole purpose* of the affidavits was to prove prima facie evidence of the

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57. Crawford v. Washington, 541 U.S. 36, 52 n.3 (2004).

58. Melendez-Diaz v. Massachusetts, 557 U.S. 305 (2009).

59. *Id.* at 307.

60. Appendix A, Memorandum and Order Pursuant to Rule 1:28, Commonwealth v. Melendez-Diaz, 921 N.E.2d 108 (Mass. App. Ct. 2010) (No. 05-P-1213) *available at* http://www.scotusblog.com/wp/wp-content/uploads/2008/02/07-591_ob.pdf (last visited Aug. 17, 2014).

61. *Melendez-Diaz*, 557 U.S. at 307.

62. *Id.*

63. *Id.* at 310 (internal quotation marks omitted).

64. *Id.* (quoting Davis v. Washington, 547 U.S. 813, 830 (2006)).

composition, quality, and the net weight of the analyzed substance.[65]

Thus, the affidavits were testimonial statements, and the analysts who prepared them were witnesses for purposes of the Sixth Amendment.[66]

In *Bullcoming v. New Mexico*, the Court took one further step towards addressing the definition of "testimonial" under the Confrontation Clause.[67] The prosecution charged the defendant in that case with driving while intoxicated and submitted the defendant's blood sample for analysis.[68] The resulting report identified the analyst who conducted the test, the date and time the sample was drawn, the reason for the defendant's detention ("Accident"), and contained certifications from the nurse and officer as to the blood draw and chain of custody information.[69] The report also listed the defendant's blood-alcohol content ("BAC") as determined via gas chromatograph, certified that the analyst received the sample with seal unbroken, affirmed that the analyst followed lab procedures listed on the back of the report, and certified the analyst's findings.[70] The supervising lab employee also certified that the analyst was qualified to conduct the BAC test and that the "established procedure" for handling and analyzing the sample had been followed.[71]

At trial, the prosecution did not call the analyst who conducted the analysis to testify because he had recently been placed on unpaid leave for reasons unstated.[72] Instead, the prosecutor called a different analyst and introduced the BAC report through that analyst.[73] The New Mexico Supreme Court subsequently concluded that the analyst who prepared the report "was a mere scrivener" who "simply transcribed the results generated by the gas chromatograph machine."[74] That court further stated that the "true 'accuser' was the gas chromatograph

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65. *Id.* (quoting Crawford v. Washington, 541 U.S. 36, 52 (2004)) (internal quotation marks omitted).

66. *Id.*

67. Bullcoming v. New Mexico, 131 S. Ct. 2705 (2011).

68. *Id.* at 2710.

69. *Id.*

70. *Id.* at 2710-11.

71. *Id.* at 2711.

72. *Id.* 2711-12.

73. *Id.*

74. State v. Bullcoming, 226 P.3d 1, 8-9 (N.M. 2010) (citing, *e.g.*, United States v. Washington, 498 F.3d 225, 230 (4th Cir. 2007).

machine,"[75] and noted that the substitute analyst that testified in court could be cross-examined about the machine, the lab's procedures, and the BAC results.[76] Thus, the Confrontation Clause allegedly was not violated.

The United States Supreme Court disagreed. The primary holding in *Bullcoming* was that the analyst certified more than the BAC data; he also certified, via the report, that he: received the defendant's sample intact and sealed, performed a specific test by following lab protocols, and that there were no anomalies in that process that might have "affect[ed] the integrity of the sample or . . . the validity of the analysis."[77] The Court also concluded that the prosecution could not enter the testimonial report through the substitute testimony of another analyst that was familiar with the process.[78]

Justice Sotomayor provided the fifth vote in *Bullcoming*, but she did so with some reservations. In her concurrence, she highlighted the fact that *Bullcoming* did not present the question of whether one expert could offer his or her opinion in court based on underlying testimonial records that were not themselves admitted.[79] Justice Sotomayor also noted that "we do not decide whether . . . a State could introduce (assuming an adequate chain of custody foundation) raw data generated by a machine in conjunction with the testimony of an expert witness."[80]

In *Williams v. Illinois*,[81] the Court attempted to answer the first of those two questions. However, *Williams* was a fractured decision involving testimony of one analyst who relied on a DNA typing done by a non-testifying analyst from a different lab.[82] In a plurality opinion by Justice Alito, four Justices upheld the testimony against a Confrontation Clause challenge, concluding that the lab results were not introduced for their truth but instead to show the basis of the expert analyst's opinion, and thus the Confrontation Clause was not at issue given the non-truth use.[83] The plurality also stated that, even if the results were introduced for their truth, they were not testimonial because they were not for

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75. *Id.*

76. *Id.*

77. *Bullcoming*, 131 S. Ct. at 2714 (alteration in original) (quoting the lab procedures) (internal quotation marks omitted).

78. *Id.* at 2715-16.

79. *Id.* (Sotomayor, J., concurring in part).

80. *Id.*

81.   Williams v. Illinois, 132 S. Ct. 2221 (2012) (plurality).

82. *Id.* at 2229.

83. *Id.* at 2233-44.

the primary purpose of targeting a specific individual, they were created pursuant to an ongoing emergency (catching a rapist), and the results were reliable.[84]

Justice Thomas concurred in result only, providing the fifth vote; he rejected the plurality's reasoning in full but, under his own test, concluded that the results were not sufficiently formal and thus did not trigger the Confrontation Clause.[85] The four dissenting justices agreed with Justice Thomas that the plurality's test was incorrect and a departure from the Court's Confrontation Clause jurisprudence, but they also rejected Justice Thomas's formality test.[86] This 4-1-4 decision—with five votes rejecting the plurality's reasoning yet upholding the admission of the results only because the results were insufficiently formal for Justice Thomas—has generally led to confusion in state and federal courts about the impact of *Williams*.[87]

While *Williams* has some general import in terms of one expert testifying based on the results of another non-testifying expert, it does not shed significant light on the underlying question of when machine-generated results trigger the Confrontation Clause, nor does it clearly resolve when an expert may testify based on machine-generated data that the expert did not generate.[88] Even if it did, however, it remains relevant whether the underlying data is machine-generated or not, as that can shape various matters, including what an analyst may rely on and disclose to the factfinder.[89] In light of the open questions and

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84.   *Id.* at 2242-44.

85.   *Id.* at 2255-64 (Thomas, J., concurring).

86.   *Id.* at 2264-77 (Kagan, J., dissenting).

87.   *See, e.g.*, Marc D. Ginsberg, *The Confrontation Clause and Forensic Autopsy Reports—A "Testimonial*,*"* 74 LA. L. REV. 117, 135 (2013); *cf. Williams*, 132 S. Ct. at 2244 (Breyer, J., concurring) ("This case raises a question that I believe neither the plurality nor the dissent answers adequately . . . .").

88.   *See, e.g.*, THE NEW WIGMORE: EXPERT EVIDENCE, *supra* note 24, § 4.12.6 ("[N]or does [*Williams*] offer any potential further analysis of the issues surrounding machine-produced information relied upon by experts."); DAVID L. FAIGMAN ET AL., 4 MODERN SCIENTIFIC EVIDENCE § 31:38 (2013-14 ed.) ("Because *Williams* appears directly at odds with *Bullcoming* and *Melendez-Diaz*, and because it was a highly fractured opinion, it is difficult to know what to make of its ultimate scope. Moreover, some of the open questions left unresolved by those earlier cases persist—such as exactly who among those who come into contact with evidence must testify to satisfy constitutional requirements.").

89.   *See, e.g.*, 5 MODERN SCIENTIFIC EVIDENCE § 42:15 (2013-14 ed.).

general confusion after *Williams*, it is likely that the Court will speak again on the Confrontation Clause, and soon.[90]

III. MACHINE-GENERATED DATA AND THE RISE OF THE MACHINES

Under the machine-generated testimony doctrine, courts across the nation have held that machine-generated data does not trigger the Confrontation Clause because it is the machines—not the analysts operating them—that make the statements at issue, and machines are not "witnesses" within the meaning of the Confrontation Clause.[91] As is described further in Part V, this rise of the machines is arguably inconsistent with the treatment of forensic evidence in *Melendez-Diaz* and *Bullcoming*, and it is an exception that could swallow their holdings whole as machines become increasingly widespread and automated. This Part discusses the contours of the machine-generated testimony doctrine and cases promoting it, beginning with the doctrine's genesis in *United States v. Washington*.[92]

In *Washington*, a police officer pulled over an individual engaging in erratic driving and took him to a hospital where the defendant consented to giving a blood sample.[93] The sample was sent for analysis, and the forensic machines printed out approximately twenty pages of data.[94] Based on the data, the lab director issued a report stating the blood sample contained certain amounts of intoxicants.[95] The three analysts who actually

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90. *See, e.g.*, Richard D. Friedman, *Confrontation and Forensic Laboratory Reports, Round Four*, 45 TEX. TECH L. REV. 51, 82 (2012). In the course of editing this Article, the Court granted certiorari in *Ohio v. Clark*, No. 13-1352, 2014 WL 1882769, at *1 (U.S. Oct. 2, 2014).

91. *See infra* notes 92–120. *See also* Peter Nicolas, *But What If the Court Reporter Is Lying? The Right to Confront Hidden Declarants Found in Transcripts of Former Testimony*, 2010 B.Y.U. L. REV. 1149, 1192-93 (2010) (noting, while addressing a different issue, that "the Confrontation Clause encompasses only statements by people").

92. United States v. Washington, 498 F.3d 225 (4th Cir. 2007). Though other cases preceded *Washington*, in the post-*Crawford* world, *Washington* functions as the first test to adopt this analysis. *See, e.g.*, Joe Bourne, *Prosecutorial Use of Forensic Science at Trial: When is a Lab Report Testimonial?*, 93 MINN. L. REV. 1058, 1079-80 (2009) (describing *Washington* as "an analytical angle from which no other court had approached a *Crawford* issue pertaining to forensic science").

93. *Washington*, 498 F.3d at 227-28.

94. *Id.*

95. *Id.*

conducted the tests using the machines did not testify in court, but their supervisor testified based on the raw data.[96]

At trial, the defendant claimed a right to cross-examine the three analysts themselves, arguing that the lab director's reliance on raw data from tests he neither performed nor observed violated the Confrontation Clause.[97] The trial court disagreed and admitted the testimony.[98] The Fourth Circuit affirmed on appeal[99] and explained that:

> [T]he "statements" in question are alleged to be the assertions that [the defendant's] blood sample contained PCP and alcohol. But those statements were never made by the technicians who tested the blood. The most the technicians could have said was that the *printed data* from their chromatograph machines showed that the blood contained PCP and alcohol. The machine printout is the only source of the statement, and no *person* viewed a blood sample and concluded that it contained PCP and alcohol. . . . In short, the inculpating "statement"—that [the defendant]'s blood sample contained PCP and alcohol—was made by the machine . . . . But "statements" made by machines are not out-of-court statements made by declarants that are subject to the Confrontation Clause.[100]

The court also supported its conclusion on other grounds. First, the court concluded that there was no value in cross-examining the technicians: the machines made the statements, and the technicians would know only what the machine data had told them.[101] Second, the Fourth Circuit stressed that if the concern was the reliability of the data, that issue would be properly addressed through the process of authentication of the evidence,[102] and if the defendant wanted to question the technicians, he could subpoena them into court.[103] Finally, the court concluded that the statements made by the machines were not testimonial because "the machine's output did not 'establish or prove past events' and did

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96. *Id.* at 228-29.
97. *Id.*
98. *Id.* at 227.
99. *Id.* at 232.
100. *Id.* at 229-30.
101. *Id.* at 230.
102. *Id.* at 232 (discussing the requirements of laying a foundation).
103. *Id.* at 231 n.3.

not look forward to 'later criminal prosecution.'"[104] And so the machine-generated testimony doctrine was born.[105]

Many courts have found this doctrine persuasive.[106] In *United States v. Blazier*, the Court of Appeals for the Armed Forces went so far as to state that "it is well-settled that under both the Confrontation Clause and the rules of evidence, machine-generated data and printouts are not statements and thus not hearsay—machines are not declarants—and such data is therefore not 'testimonial.'"[107] In *United States v. Moon*, the Seventh Circuit endorsed *Washington*'s approach in a case involving raw data from an infrared spectrometer and a gas chromatograph.[108] As in *Washington*, *Moon* involved one expert testifying in court based on the raw data produced by analysis that a different analyst conducted.[109] The Seventh Circuit held that the conclusions the non-testifying chemist came to were testimonial, but the raw data from the machines was not.[110] Similarly, in *United States v. Lamons*, the Eleventh Circuit cited approvingly both *Washington* and *Moon*, holding that data produced by a machine memorializing telephone calls made was not testimonial because "the witnesses with whom the Confrontation Clause is concerned are *human* witnesses," and the data in *Lamons* was the statement of a machine.[111]

The endorsement of *Washington* has not been limited to appellate courts. In *United States v. Crockett*, a federal district court held that "[t]he instrument readouts and printouts" resulting from analysis of cocaine did not implicate the Confrontation Clause or hearsay rule.[112] Nor has support been confined to

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104. *Id.* at 232 (quoting Davis v. Washington, 547 U.S. 813, 822 (2006)).

105. *See, e.g.*, Joe Bourne, *Prosecutorial Use of Forensic Science at Trial: When is a Lab Report Testimonial?*, 93 MINN. L. REV. 1058, 1079-80 (2009).

106. *See, e.g.*, United States v. Drayton, No. PWG-13-0251, 2014 WL 2919792, at *6 (D. Md. June 26, 2014) ("[A] machine cannot bear witness against an accused within the meaning of the Confrontation Clause . . . . [O]nly a human may be a declarant . . . ."). *But see* United States v. Ramos-Gonzalez, 664 F.3d 1 (1st Cir. 2011) (concluding, without analyzing the machine-generated testimony doctrine, that the testimony of one analyst about, *inter alia*, the results of a test violated the Confrontation Clause).

107. United States v. Blazier, 69 M.J. 218, 224 (C.A.A.F. 2010).

108. United States v. Moon, 512 F.3d 359 (7th Cir. 2008).

109. *Id.* at 360-61.

110. *Id.* at 361.

111. United States v. Lamons, 532 F.3d 1251, 1260-61, 1263 (11th Cir. 2008) (emphasis in original).

112. United States v. Crockett, 586 F. Supp. 2d 877, 885 (E.D. Mich. 2008); *see also* Adams v. United States, No. 09-6152 (GEB), 2011 WL 1792562, at *3-4

federal courts.[113] For example, in *Hamilton v. State*, a Texas state court held that the raw data produced by DNA analysis was a machine-generated statement and "[t]he Confrontation Clause implicates statements made by persons, not machines."[114] In *People v. Lopez*, the Supreme Court of California held that "[b]ecause, unlike a person, a machine cannot be cross-examined, here the prosecution's introduction into evidence of the machine-generated printouts . . . did not implicate the Sixth Amendment's right to confrontation."[115] The Connecticut Supreme Court, relying heavily on *Washington*, reached a similar result.[116] Courts have reached analogous conclusions for, e.g., DNA results,[117] breathalyzer results,[118] urinalysis results,[119] and machine-generated data from equipment outside the lab.[120] Some courts have also

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(D.N.J. May 10, 2011) (addressing, as an alternative basis for the court's ruling, the merits of a 28 U.S.C. § 2255 habeas corpus claim that alleged error under the Confrontation Clause, and citing, *e.g.*, *Washington* and *Moon*).

113. *See, e.g.*, Leger v. State, 732 S.E.2d 53, 60 (Ga. 2012) (supervisor may testify about data generated by other analysts); People v. Brown, 918 N.E.2d 927, 931 (N.Y. 2009) ("The . . . report, furthermore, was not 'testimonial' . . . because it consisted of merely machine-generated graphs, charts and numerical data."); State v. Keck, No. 09CA50, 2011 WL 1233196, at *5-6 (Ohio Ct. App. Mar. 30, 2011) (no Confrontation Clause violation where one analyst testified to her analysis, which was based in part on the apparently machine-generated DNA results that another analyst produced); *cf.* State v. Ortiz-Zape, 743 S.E.2d 156, 162 (N.C. 2013) (citing *Washington* and *Moon* approvingly), *cert. denied*, 134 S. Ct. 2660 (2014); State v. Dilboy, 48 A.3d 983, 989 (N.H. 2012) (noting that testimony based on "raw data, such as graphic or numerical computer printouts, . . . [might] not . . . violat[e] . . . the Confrontation Clause").

114. Hamilton v. State, 300 S.W.3d 14, 21-22 (Tex. Ct. App. 2009).

115. People v. Lopez, 286 P.3d 469, 478 (Cal. 2012).

116. State v. Buckland, 96 A.3d 1163, 1172 (Conn. 2014) ("We hold that the machine generated data is not subject to the restrictions imposed by *Crawford*, *Melendez–Diaz* and *Bullcoming*.").

117. *See, e.g.*, State v. Gomez, 244 P.3d 1163, 1166 (Ariz. 2010); People v. Arauz, 2D CRIM. No. B242843, 2013 WL 3357931, at *5 (Cal. Ct. App. July 3, 2013), *cert. denied*, 134 S. Ct. 2664 (2014).

118. *See* Cranston v. State, 936 N.E.2d 342, 345 (Ind. Ct. App. 2010); People v. Dinardo, 801 N.W.2d 73, 79 (Mich. App. Ct. 2010); Wimbish v. Commonwealth, 658 S.E.2d 715, 719-20 (Va. Ct. App. 2008).

119. *See* Marshall v. People, 309 P.3d 943, 947 (Colo. 2013); United States v. Bradford, 2009 WL 4250093, at *9 (A.F. Ct. Crim. App. Nov. 23, 2009); United States v. Anderson, 2009 WL 4250095, at *5 (A.F. Ct. Crim. App. Nov. 23, 2009); United States v. Skrede, 2009 WL 4250031, at *3 (A.F. Ct. Crim. App. Nov. 23, 2009).

120. *See, e.g.*, Stultz v. Artus, No. 04-CV-3170 (RRM), 2013 WL 937830, at *9-10 (E.D.N.Y. Mar. 8, 2013) (automated message stating a payphone's phone number was a statement by a machine, which falls outside the scope of the Confrontation Clause); *cf.* Robertson v. Commonwealth, 738 S.E.2d 531, 532-33

reached the same results without specifically discussing machine-generated testimony, such as decisions based on the general observation that a supervisor may testify about tests performed by other analysts or the specific point that the supervisor may rely on raw data generated by other analysts.[121]

     Washington also has staying power; it was decided in 2007, before *Melendez-Diaz*, *Bullcoming*, and *Williams*, and the petition for certiorari was still pending when the Court issued *Melendez-Diaz*.[122] Though the Court granted petitions for certiorari in other cases and remanded them for reconsideration in light of *Melendez-Diaz*, the Supreme Court denied the petition in *Washington*.[123] In the wake of these various decisions, the Fourth Circuit has not overruled *Washington*.[124] Several courts have held that *Washington*'s approach is still sound after *Melendez-Diaz*,

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(Va. Ct. App. 2013) (en banc) (involving, but not addressing as such, machine-generated prices from a cash register).

121. *See* Smith v. State, 28 So. 3d 838, 854-55 (Fla. 2009) (per curiam) (discussing this issue and citing *Washington* and *Moon* approvingly); *id.* at 878-79 (Canady, J., concurring) (disagreeing with the Court's opinion only on other issues); Rector v. State, 681 S.E.2d 157, 160 (Ga. 2009) (holding that a toxicologist could testify about tests and results obtained by another doctor because the toxicologist "reviewed the data and testing procedure" and "[a]n expert may base [his] opinions on data gathered by others") (second alteration in original); State v. Roach, 95 A.3d 683, 694-99 (N.J. 2014) (an analyst who tested one DNA sample may testify about a DNA match based on results that depended, in part, on testing for a second DNA sample that another analyst generated); Commonwealth v. Yohe, 79 A.3d 520, 540 (Pa. 2013) ("[W]e hold that [the reviewing supervisor] is the analyst who determined Appellant's [blood-alcohol content]. Although he relied on the raw data produced by the lab technicians [who ran the machines] . . . he is the only individual who engaged in the critical comparative analysis of the results of the . . . tests . . . and determined Appellant's BAC."); *see also id.* at 541-42 (collecting cases); *cf.* United States v. Hamilton, 413 F.3d 1138, 1142 (10th Cir. 2005) (computer-generated header "was generated instantaneously by the computer without the assistance or input of a person" and so, in the context of the hearsay rules, there was no "statement" or "declarant") (collecting cases).

122. *See* United States v. Washington, 498 F.3d 225 (4th Cir. 2007), *cert. denied*, 557 U.S. 934 (2009).

123. *See* Washington v. United States, 129 S. Ct. 2856 (2009) (denial of cert. petition). This does not mean that the Supreme Court necessarily approved of the result in *Washington*, as there are many reasons a court of discretionary jurisdiction might deny review. The point only is that the Court had an opportunity to address the doctrine post-*Melendez-Diaz*, or at least to require the Fourth Circuit to reconsider in light of *Melendez-Diaz*, but declined to do so.

124. *See, e.g.*, United States v. Summers, 666 F.3d 192, 202-03 (4th Cir. 2011) (alleles were machine-generated data; distinguishing *Bullcoming* and *Melendez-Diaz*).

Bullcoming, and *Williams*.[125] For example, in *United States v. Darden*, a federal district court in Maryland (a court in the same federal circuit as *Washington*) held that *Melendez-Diaz* did not disturb the logic of *Washington*.[126] The Seventh Circuit has also adhered, post-*Williams et al.*, to its conclusion in *Moon*.[127] Other courts, considering the issue for the first time or upon reconsideration after the *Williams et al.* decisions, have also held that machine-generated data does not trigger a confrontation right.[128] Indeed, courts expressly considering the rationale in *Washington* appear to widely agree that raw data is not testimonial under the new post-*Crawford* line of cases.[129]

The rise of machines has not been without resistance, however. For example, jurisdictions that have adopted the machine-generated testimony doctrine or something similar have not done so without dissent.[130] And in *Young v. United States*, the D.C. Circuit found a Confrontation Clause violation where a supervisor gave surrogate testimony about DNA tests that she neither conducted nor was present for; in doing so, the court "emphasize[d] . . . that it is too simplistic to say that the DNA profiles and the [random-match probability] were not hearsay

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125. *See, e.g.*, United States v. Darden, 656 F. Supp. 2d 560, 563-64 (E.D. Ma. 2009); Hamilton v. State, 300 S.W.3d 14, 21 (Tex. App. 2009); United States v. Anderson, No. 2009-06, 2009 WL 4250095, at *5 (A.F. Ct. Crim. App. Nov. 23, 2009).

126. *Darden*, 656 F. Supp. 2d at 563-64.

127. *See, e.g.*, United States v. Maxwell, 724 F.3d 724, 726-27 (7th Cir. 2013).

128. *See, e.g.*, Oliver v. State, No. 14-09-00690-CR, 2010 WL 3307391, at *4 (Tex. App. Aug. 24, 2010); United States v. Drayton, Criminal No. PWG-13-0251, 2014 WL 2919792, at *8-9 (D. Md. June 26, 2014); People v. Lopez, 286 P.3d 469, 478 (Cal. 2012); People v. Revill, No. B233987, 2013 WL 6094307, at *9-13 (Cal. Ct. App. Nov. 20, 2013).

129. *See, e.g.*, United States v. Bradford, Misc. Dkt. No. 2009-07, 2009 WL 4250093, at *5 (A.F. Ct. Crim. App. Nov. 23, 2009) (not reported) ("A survey of the case law following the issuance of *Melendez-Diaz* reveals [that] the courts are focusing on the requirement that an expert testify and that he or she do so using the data produced by the labs as the basis for his or her testimony. The lab technicians were not required to be produced as witnesses."), *rev'd on other grounds by* 68 M.J. 371 (C.A.A.F. 2010).

130. *See, e.g.*, United States v. Washington, 498 F.3d 225, 232 (Michael, J., dissenting); State v. Roach, 95 A.3d 683, 698-701 (N.J. 2014) (Albin, J., dissenting); *cf.* Pendergrass v. State, 913 N.E.2d 703, 711 (Ind. 2009) (Rucker, J., dissenting) (not addressing the machine-generated testimony doctrine, but stating "despite whatever ambiguity *Melendez–Diaz* may have created on the question of who must testify at trial, it appears to me the opinion is clear enough that a defendant has a constitutional right to confront at the very least the analyst that actually conducts the tests").

because they were 'nothing more than the raw data produced by a machine.'"[131] Thus, though courts have widely concluded that machine-generated data does not require the testimony of the analyst who operated the machine, the consensus is not unanimous.

IV. PARALLEL DOCTRINES UNDER THE CONFRONTATION CLAUSE

This Part considers areas of Confrontation Clause jurisprudence that address analogous areas to the machine-generated testimony doctrine: photographs, videos, interpreters, and dog-handler testimony. These areas, just like machine-generated data cases, involve an assertion by one entity that is arguably attributable to (or at least influenced by) a separate entity. Under these cases, courts have frequently rejected Confrontation Clause claims seeking to cross-examine a camera operator, interpreter, or canine. However, they have not done so without dissent, and courts frequently require the testimony of a dog's handler when canine evidence is at issue.

This Part summarizes cases from around the country on these topics. In Part IV, we consider whether those parallel areas might offer guidance for analyzing machine-generated data. For example, if the raw print-out of a gas chromatograph is subject to cross-examination, shouldn't the print-out of a camera—a photograph—be as well? Similarly, if the digital output of a breathalyzer triggers a confrontation right, would the digital output of a surveillance camera? If neither photographs nor videos trigger a Confrontation Clause right, why should other machine-generated data?

Notably, although these separate doctrinal lines have parallels to machine-generated data, they are in some ways very different. Those differences are discussed in Part IV. Further, some

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131. Young v. United States, 63 A.3d 1033, 1046 (D.C. Cir. 2013) (quoting United States v. Summers, 666 F.3d 192, 202 (4th Cir. 2011)). The D.C. Circuit went on to state that "the [data at issue] do[es] not stand on [its] own but, instead, ha[s] meaning because [it] amount[s] to a communication by the scientists who produced [it]—the assertion, essentially, that the scientists generated these specific results by properly performing certain tests and procedures on particular, uncorrupted evidence and correctly recording the outcomes." *See also* United States v. Ramos-Gonzalez, 664 F.3d 1, 6 (1st Cir. 2011) (concluding, without analyzing the machine-generated testimony doctrine, that the testimony of one analyst about, *inter alia*, the results of a test violated the Confrontation Clause); *cf.* Martin v. State, 60 A.3d 1100, 1106 (Del. 2013) (lending some support to the right to cross-examine the operating analyst in machine-generated data contexts).

of these doctrines are in tension with the post-*Crawford* Confrontation Clause. However, the purpose of this section is not to critique these parallel fields. Instead, it is to identify potential anchors for analysis of machine-generated data. In the course of describing those proposals, Part IV identifies some problems with these anchors so as to avoid mooring the ship in treacherous waters.

A. *Photographs and Videos*

A photograph transcribes reality into a fixed image, but the angle, shutter speed, and other decisions made by the photographer shape that transcription.[132] Indeed, the notion that there is an authoring element to taking a photograph—a human contribution—is central to other legal issues, such as the copyrightability of images.[133] And at least for forensic photographs,

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132. One term used to refer to this is "camera perspective bias," and some studies have shown that camera perspective and depth of image alter interpretation of confessions. In one such study, individuals who viewed a video of a defendant's confession were more likely to believe the confession was coerced if the interrogator was visible in the video than if the interrogator was not visible. Additionally, the angle from which evidence, such as blood splatters, is photographed can alter perception and analysis of the evidence. As one court described it:

> Somewhat depends for exact likeness upon the nice adjustment of machinery, upon atmospheric conditions, upon the position of the subject, the intensity of the light, the length of the sitting. It is the skill of the operator that takes care of these, as it is the skill of the artist that makes correct drawing of features, and nice mingling of tints, for the portrait. . . . The portrait and the photograph may err, and so may the witness. That is an infirmity to which all human testimony is lamentably liable.

Cowley v. People, 83 N.Y. 464, 478 (1881). *See also* Heimbach v. Peltz, 121 A.2d 114, 116-17 (Pa. 1956); Commonwealth v. McKellick, 24 A.3d 982, 996 (Pa. Super. Ct. 2011) (Donohue, J., dissenting); Jennifer L. Mnookin, *Videotaped Confessions Can Be Misleading*, NEW YORK TIMES (July 13, 2014), http://www.nytimes.com/2014/07/14/opinion/videotaped-confessions-can-be-misleading.html; Dave Munger, *False confessions: Even judges are biased by camera perspective*, SCIENCE BLOGS (Mar. 15, 2007), http://scienceblogs.com/cognitivedaily/2007/03/15/false-confessions-even-judges/; *see generally* Jennifer L. Mnookin, *The Image of Truth: Photographic Evidence and the Power of Analogy*, 10 YALE J.L. & HUMAN. 1, 4, 20-27 (1998).

133. *See, e.g.*, Schrock v. Learning Curve Int'l, Inc., 586 F.3d 513, 519, 522 (7th Cir. 2009) (collecting cases discussing photographers' contributions to the originality of photographs and the derivative work right); Ets-Hokin v. Skyy

the images are often the photographer's assertion about reality: "*this* is the crime scene," "*this* is the wound at issue," "*this* is the defendant," and so on. If viewed as assertions by human operators, a photograph taken in anticipation of trial might be seen as testimonial and subject to the Confrontation Clause.

However, courts have often admitted photographs without any discussion of Confrontation Clause matters, and many cases hold that there is no requirement that the photographer be cross-examined prior to the admission of the photograph.[134] Courts have admitted, despite challenges based on the Confrontation Clause, images of lost evidence,[135] the crime scene,[136] the victim,[137] the crime itself,[138] and other matters.[139] These holdings stem, in part, from the view that photographs are often seen as demonstrative or

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Spirits, Inc., 225 F.3d 1068, 1073-77 (9th Cir. 2000) (collecting cases and describing the history of copyright protection for photographs). In the Copyright Office's draft of its copyright practices compendium, it states that "the Office will refuse to register a claim if it determines that a human being did not create the work." Compendium of the U.S. Copyright Office Practices 300 (3d ed. Aug. 19, 2014) (draft of the compendium); *see also id.* at 301 ("Similarly, the Office will not register works produced by a machine or mere mechanical process that operates randomly or automatically without any creative input or intervention from a human author.").

134. *See, e.g.*, Sevin v. Parish of Jefferson, 621 F. Supp. 2d 372, 383 (E.D. La. 2009) (addressing images from red-light cameras); People v. Williams, No. 302154, 2013 WL 163818, at *3 (Mich. Ct. App. Jan. 15, 2013) (photos of a victim's injuries and a shotgun the defendant allegedly possessed); State v. Williams, 913 S.W.2d 462, 465 (Tenn. 1996) (surveillance images taken by a store camera the cashier triggered during a robbery).

135. *See, e.g.*, United States v. Beach, 196 F. App'x 205, 209 (4th Cir. 2006) (per curiam) (photographs of seized evidence that police lost were not shown to "conceivably constitute the 'testimonial' statements that *Crawford* bars").

136. State v. Newcomb, No. 43578-1-II, 2014 WL 2601699, at *3 (Wash. Ct. App. June 10, 2014).

137. *See, e.g.*, People v. Ellis, 154 Cal. Rptr. 3d 378, 387-89 (Ct. App. 2013), *review granted and opinion superseded*, 301 P.3d 1176 (Cal. 2013); People v. Myers, 928 N.Y.S.2d 407, 410 (N.Y. App. Div. 2011); Williams v. State, No. 09-12-00350-CR, 2014 WL 1102004, at *5 (Tex. App. Mar. 19, 2014); Herrera v. State, 367 S.W.3d 762, 773 (Tex. App. 2012); Phipps v. People, 54 V.I. 543, 564-65 (2011).

138. *See, e.g.*, People v. Goldsmith, 326 P.3d 239, 250 (Cal. 2014).

139. *See, e.g.*, State v. Chavez, No. 1 CA-CR 08-0731, 2009 WL 4981849, at *3-4 (Ariz. Ct. App. Dec. 22, 2009) (addressing, *inter alia*, Confrontation Clause challenge to photographs of an individual, T.A., "throwing [gang] signs," through which the prosecution sought to show that T.A. was in a gang that was a rival to defendant's gang).

illustrative evidence, i.e., they merely illustrate verbal testimony and are not evidence in and of themselves.[140]

Similarly, except when they contain a person speaking in a testimonial capacity,[141] courts have often admitted videos without requiring cross-examination pursuant to the Confrontation Clause.[142] This is true even though, or perhaps because, videos may be seen as "better than eyewitnesses because films are perceived as never mistaken."[143] There are also many cases that involved the admission of video evidence without discussion of a right to confrontation, often because the video was viewed as merely demonstrative evidence.[144] As with photographs, courts have admitted, despite Confrontation Clause challenges, several types of videos, including recordings of field sobriety tests,[145] a

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140. *See, e.g.*, State v. Newcomb, No. 43578-1-II, 2014 WL 2601699 at *3 (Wash. Ct. App. June 10, 2014) ("[C]ourts regard photographs as demonstrative evidence . . . . The proper foundation for photographs requires only that some witness . . . be able to give some indication as to when, where, and under what circumstances the photograph was taken, and that the photograph accurately portrays the subject illustrated."); *see also* Jennifer L. Mnookin, *The Image of Truth: Photographic Evidence and the Power of Analogy*, 10 YALE J.L. & HUMAN, n.129 at 44-45; *cf.* People v. Thomas, 269 P.3d 1109, 1136-37 (Cal. 2012) (rejecting Confrontation Clause claim raised against the use of a police artist's drawings of the scene because the depictions were not admitted for their truth but instead only to illustrate witness testimony).

In some cases, the images have no apparent human photographer, such as for images from red-light cameras. *See, e.g.*, People v. Goldsmith, 326 P.3d 239, 249-50 (Cal. 2014); State v. Melsky, No. A-0193-12T2, 2013 WL 1776037, at *4 (N.J. Super. Ct. App. Div. Apr. 26, 2013) (per curiam).

141. *See, e.g.*, Coronado v. State, 351 S.W.3d 315, 324 (Tex. Crim. App. 2011) (concluding that "[v]irtually all courts that have reviewed the admissibility of forensic child-interview statements or videotapes after the *Davis* decision have found them to be 'testimonial' and inadmissible unless the child testifies at trial or the defendant had a prior opportunity for cross-examination") (collecting cases); *see also* State v. Hooper, 176 P.3d 911, 914-16 (Idaho 2007) ("Since the purpose of a forensic interview is to collect information to be used in a criminal prosecution, . . . the interview was the functional equivalent of a police interrogation [and the video was testimonial].").

142. *See, e.g.*, Amparo v. McDonald, No. C 09-0801 MMC (PR), 2012 WL 1094291, at *10 (N.D. Cal. Mar. 30, 2012) ("Because a camera is not a witness that is amenable to cross-examination, and because a photograph . . . is not a testimonial statement, the videotape here at issue does not implicate the Confrontation Clause.") (internal quotation marks omitted).

143. Jessica M. Silbey, *Judges As Film Critics: New Approaches to Filmic Evidence*, 37 U. MICH. J.L. REFORM 493, 516 (2004).

144. *See id.* at 507 (2004) (collecting cases).

145. Commonwealth v. McKellick, 24 A.3d 982, 985-89 (Pa. Super. Ct. 2011); Delgado v. State, No. 10-10-00164-CR, 2011 WL 4389956, at *3-4 (Tex. App. Sept. 21, 2011).

store camera's footage of a crime,[146] and other surveillance videos.[147]

B. Interpreters

Interpreters have met mixed results under the Confrontation Clause, but defendants generally have no right to cross-examine them. Some courts have held that an interpreter's translation of the defendant's statements triggers the Confrontation Clause,[148] but many others have held that an interpreter is merely a "language conduit" or agent for the defendant and, therefore, the defendant is the declarant and has no right to cross-examine/confront him or herself.[149] The language conduit and agency approaches differ in their underlying tests, but the end

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146. *See, e.g.*, State v. Wynn, No. 2011CA00244, 2012 WL 3068361, at *5-6 (Ohio Ct. App. July 16, 2012).

147. *See, e.g.*, Vaughn v. State, 13 N.E.3d 873, 874 (Ind. Ct. App. 2014) (videos of a confidential informant purchasing drugs were not testimonial because they "were not meant to be an assertion" and "merely showed the conduct of the CI and [defendant]"); State v. Perkins, No. 09–CR–0280, 2011 WL 2345291, at *3 (Ohio Ct. App. June 6, 2011) (video tape created by law enforcement of the defendant approaching the site of a drug transaction was not testimonial in nature because "the tape[] [was] merely being used to establish the context of a defendant's statements and not to prove the truth of the matter asserted [therein]"); State v. Smith, No. M2010-02077-CCA-R3-CD, 2012 WL 3776679, at *4 (Tenn. Crim. App. Aug. 31, 2012) (admission of video of drug transaction did not violate Confrontation Clause because some statements therein were made by defendant and some were not introduced to prove the truth of the matter asserted).

148. *See, e.g.*, United States v. Charles, 722 F.3d 1319, 1322-31 (11th Cir. 2013) (officer's in-court testimony about translation of defendant's answers during an interrogation violated defendant's right to confront the interpreter, who was the declarant of those statements, but no plain error in light of lack of prior binding precedent on that point).

149. *See, e.g.*, United States v. Orm Hieng, 679 F.3d 1131, 1139 (9th Cir. 2012); United States v. Budha, 495 F. App'x 452, 454 (5th Cir. 2012); United States v. Desire, 502 F. App'x 818, 821 (11th Cir. 2012); United States v. Romo-Chavez, 681 F.3d 955, 961 (9th Cir. 2012); Hernandez v. State, 662 S.E.2d 325, 330 (Ga. Ct. App. 2008); *see also Charles*, 722 F.3d at 1333 n.2 (11th Cir. 2013) (Marcus, J., specially concurring) (collecting cases); United States v. Skiljevic, No. 11-CR-72, 2013 WL 3353960, at *4-5 (E.D. Wis. July 3, 2013); People v. Malanche, No. F060845, 2012 WL 688069, at *5 (Cal. Ct. App. Mar. 2, 2012) (unpublished); People v. Jackson, 808 N.W.2d 541, 550-52 (Mich. Ct. App. 2011). For more discussion of a defendant's right to confront and cross-examine his or her own confession, see Mark A. Summers, *Taking Confrontation Seriously: Does* Crawford *Mean That Confessions Must Be Cross-Examined?*, 76 ALB. L. REV. 1805 (2012-13).

result is the same: the defendant is treated as the declarant.[150] In analyzing such claims under the Confrontation Clause or hearsay rules, courts have considered several factors: who supplied the interpreter; the interpreter's skill at translation and relevant qualifications; whether there is any indication that the interpreter had a motive to mislead or distort; whether there was any indication of inaccuracy in the translation; and whether the actions the parties took after the conversation were consistent with the translations.[151]

Three key issues reoccur in those results: who is the declarant of the translated material, when are the translations testimonial, and when are the translations used to establish "the truth of the matter asserted" therein?[152] Notably, with regards to the lattermost of those three issues, the Eleventh Circuit has held that translators implicitly assert that the translation provided is accurate: "when the translator created the transcripts, he or she represented that each English word, phrase, or concept corresponded to the original Spanish word, phrase, or concept."[153] Finally, some courts, even while recognizing that a defendant has a right to inquire into the translator's honesty and competency, have concluded that the Confrontation Clause does not require that such a right be achieved through cross-examining the translator.[154]

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150. *See, e.g.*, People v. Morel, 798 N.Y.S.2d 315, 318 (N.Y. App. Div. 2005) (describing the tests in the hearsay rule context: "[T]he agency approach . . . treats a translator's rendering of a declarant's statement as if it were the declarant's own once the agency relationship is established, as opposed to the conduit theory which attributes a translator's statements to the declarant so long as the translator's skill and fidelity to a proper translation is established[.]").

151. *See, e.g.*, *Charles*, 722 F.3d at 1324-25 & n.6; *Romo-Chavez*, 681 F.3d at 959-61; *Orm Hieng*, 679 F.3d at 1139; *Skiljevic*, 2013 WL 3353960, at *4-5; *Hernandez*, 662 S.E.2d at 329-30; *Jackson*, 808 N.W.2d at 552.

152. *See, e.g.*, United States v. Curbelo, 726 F.3d 1260, 1272-73 (11th Cir. 2013), *cert. denied*, 134 S. Ct. 962 (2014).

153. *Id.*

154. *See, e.g.*, *Morel*, 798 N.Y.S.2d 315, 319 (concluding that "the translator's willingness and capacity to render statements accurately from one language to another . . . is a purely state-law 'reliability' issue" and the translator was a mere language conduit); *Hernandez* 662 S.E.2d at 330 (citing *Morel*). An analogous problem is whether a court reporter's transcript of testimony raises Confrontation Clause problems. *See generally* Peter Nicolas, *But What If the Court Reporter Is Lying? The Right to Confront Hidden Declarants Found in Transcripts of Former Testimony*, 2010 B.Y.U. L. Rev. 1149 (2010) (discussing this issue).

C. *Canine Units*

Criminal defendants sometimes seek to "cross-examine" a canine working as either a drug-sniffing dog or a tracker.[155] Under the normal definition of "cross-examine," that request is impossible to fulfill, and so the defendant is asking either to exclude such evidence (presumably categorically) or to require the prosecution to bring the dog to court so the defendant may "be confronted with the witness[] against him,"[156] perhaps so the animal could be tasked with demonstrating its tracking or drug-sniffing abilities, which are the canine's relevant "testimony" in any event.[157] Courts have rejected this and other similar claims under a number of overlapping rationales: dogs are not capable of making testimonial statements;[158] the dog is not the witness, the handler is;[159] and dogs are not witnesses or declarants within the meaning of the Confrontation Clause and the rules of evidence.[160] Along the way,

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155. *Compare* State v. Washington, No. OT–12–032, 2014 WL 1343696, at *12 (Ohio. Ct. App. 2014) (drug-sniffing case), *with* State v. Keodara, 128 Wash. App. 1040, 1 (Wash. Ct. App. 2005) (tracking case).

156. U.S. CONST. amend. VI.

157. For an example of a case seeking to bring the dog to court, see United States v. Carroll, 710 F.2d 164, 168 n.1 (4th Cir. 1983).

158. *See, e.g.*, State v. Washington, 2014 WL 1343696, at *12 ("The dog sniff is not a statement, nor is the dog capable of making a testimonial statement. Therefore, appellant has no right to cross-examine the dog and his Sixth Amendment right to confront witnesses against him was not violated.").

159. *See, e.g.*, *Carroll*, 710 F.2d at 168 n.1; State v. Streeper, 747 P.2d 71, 75 (Idaho 1987); State v. Davis, 97 So. 449, 454 (La. 1923); State v. Wanczyk, 482 A.2d 964, 966 (N.J. Super. Ct. Ch. Div. 1984); People v. Centolella, 305 N.Y.S.2d 279, 282 (N.Y. Crim. Ct. 1969); Commonwealth v. Michaux, 520 A.2d 1177, 1181-82 (Pa. Super. Ct. 1987); State v. Bostick, 169 S.E.2d 608, 610 (S.C. 1969); *cf.* Terrell v. State, 239 A.2d 128, 136-37 (Md. Ct. Spec. App. 1968) (concluding that the accused has an opportunity to confront his accuser because the handler is merely testifying to his or her observations); State v. Storm, 238 P.2d 1161, 1186 (Mont. 1951) (Angstman, J., dissenting) ("It is an erroneous notion to regard the hounds as witnesses . . . . The witness is the trainer of the dogs and defendant's constitutional rights are protected and preserved by the right to cross-examine the owner and trainer of the dogs.") (citations omitted); State v. Brown, 88 S.E. 21, 23 (S.C. 1916) (not expressly addressing the Confrontation Clause, but concluding that "[t]he dog is not the witness").

160. *See, e.g.*, State v. Dickerson, 82 N.E. 969, 974-76 (Ohio 1907) (stating approvingly that "the dogs were not witnesses whom the accused had a right to confront at the trial, in any different sense than the tracks of a man accused may be described as to form, size, or any other characteristic by which he may be identified"); *Keodara*, 128 Wash. App. at 2 ("[The tracking canine] was not a 'declarant' for purposes of [the defendant]'s right to confront witnesses."); *see generally* Andrew E. Taslitz, *Does the Cold Nose Know? The Unscientific Myth of the Dog Scent Lineup*, 42 HASTINGS L.J. 15, 112-13 (1990) (collecting cases).

however, courts have accrued some dissenters, who have argued that the dog is the real witness, or even an inherently mute expert witness.[161]

Courts often emphasize, or even require, the presence of the handler's or trainer's testimony at trial in rejecting Confrontation Clause challenges.[162] As a practical matter, the handler's testimony is also necessary in most cases because, absent the handler's testimony, there is no evidence of the dog's alert.[163] The handler's testimony is also important because the actions of the handler can alter the results produced by the canine; in other words, the subtle (or intentional) cues of the handler can shape (or direct) the dog's tracking and alerts.[164]

Courts have frequently debated the appropriate circumstances in which canine tracking or alert evidence should be

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161. *See, e.g.*, State v. Davis, 97 So. 449, 457 (La. 1923) (O'Niell, J., dissenting) ("The ruling that [bloodhound] evidence is admissible . . . is violative of the fundamental right of an accused person to be faced by and to cross-examine the witnesses against him. . . . [T]he idea that the bloodhound does not testify is only skin-deep. The bloodhound, in such case, is a supposed expert witness, who cannot give any reason for his expert opinion . . . ."); *see also* Pedigo v. Commonwealth, 44 S.W. 143, 146-47 (Ky. 1898) (Guffy, J., concurring in part and dissenting in part) (addressing canine evidence and noting the inability to cross-examine the dog, who in reality is the witness); State v. Grba, 194 N.W. 250, 259 (Iowa 1923) ("[Canine] evidence is in the nature of expert testimony with no opportunity whatever to cross-examine the expert or find out from any source any reason for the conduct of the dogs . . . ."), *overruled by* State v. Buller, 517 N.W.2d 711 (Iowa 1994); *cf.* Brott v. State, 97 N.W. 593, 594 (Neb. 1903) (rejecting canine evidence on general evidentiary principles).

162. *See, e.g.*, *Davis*, 97 So. at 454 ("[S]uch evidence is not inadmissible on the ground that the dog is the witness and cannot be cross-examined, since it is the human testimony which makes the trailing done by the animal competent, and the defendant was confronted by the witnesses to such testimony . . . ."); *cf. Terrell*, 239 A.2d at 136-37 ("The trainer should be questioned to see if the dog was properly trained and the trail followed correctly . . . . It is the trainer who controls the dog, therefore, he should be the one to be examined and cross-examined."); State v. Barger, 612 S.W.2d 485, 490 (Tenn. Crim. App. 1980) ("The inability of the defendant to cross-examine the dog is not considered prejudicial, so long as its owner, trainer, or handler is made available for examination as to the dog's general qualifications and specific activities on the day in question."); *Wanczyk*, 482 A.2d at 967 (describing items the handler at issue would have to testify about).

163. *But see* Starkes v. United States, 427 A.2d 437, 439 n.2 (D.C. Cir. 1981) (noting that, in addition to the tracker's testimony, an onlooker testified at trial that he saw the dog—as it was tracking the trail—arrive at the location and identify the area in question).

164. State v. Brown, 88 S.E. 21, 23 (S.C. 1916) ("This control of the animal, that is supposed to have the instinct, by the man, who has not the instinct, destroys any value it may have as evidence . . . .").

used. Although much of this debate has centered on the Fourth Amendment question of when a dog's alert is sufficient to create probable cause or otherwise be introduced as evidence to support a search,[165] the issue has also arisen under a more general evidentiary posture.[166] Courts have required various showings to support canine evidence, including the following considerations: whether the dog actually possessed the ability at issue (to track or alert to certain circumstances); whether the dog is a pure blood of a stock characterized by acute scent and discernment; the dog's accuracy record in the field and in controlled tests; the dog handler's experience and training; and the circumstances of the alert/tracking (weather, was the track fresh, did other scents contaminate the area, handler actions during the dog's investigation, etc.).[167] Finally, in rejecting Confrontation Clause and related claims, courts have also expressly compared canine evidence to other items that cannot be cross-examined, such as scientific instruments[168] and photographs.[169]

V. POTENTIAL MODELS FOR MACHINE-GENERATED SPEECH

As Part III described, many courts have accepted the proposition that data generated by a machine: (1) is the statement of the machine only, (2) is not testimonial, and (3) for either or both of those reasons, such data does not trigger a right to confront and cross-examine humans involved, such as the machine's

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165. *See generally* Florida v. Harris, 133 S. Ct. 1050 (2013) (addressing whether a drug-detection dog's alert created probable cause for a warrantless search of a vehicle).

166. *See, e.g.*, *Streeper*, 747 P.2d at 75 (Idaho 1987) (rejecting a Confrontation Clause challenge to canine evidence but describing certain foundational requirements for such evidence); *Terrell*, 239 A.2d at 130 (addressing whether the evidence of tracking by a police dog was properly admitted into evidence and, as a separate issue, whether there was probable cause to arrest).

167. *See, e.g.*, *Starkes*, 427 A.2d at 439; *Streeper*, 747 P.2d at 75-76; State v. White, 642 S.E.2d 607, 614-15 (S.C. Ct. App. 2007) (collecting cases), *aff'd but criticized*, 676 S.E.2d 684 (2009); People v. Centolella, 305 N.Y.S.2d 460, 462 (N.Y. Crim. Ct. 1969); *see also Harris*, 133 S. Ct. 1050 (2013) (addressing dog-tracking); *see generally* 22A C.J.S. *Criminal Law* § 1026 (2014) (addressing dog-tracking evidence, foundation requirements, and collecting cases).

168. *See, e.g.*, *Centolella*, 305 N.Y.S.2d at 282 ("The animals are not witnesses against a defendant any more than a microscope or a spectograph.").

169. *See, e.g.*, *Starkes*, 427 A.2d at 440 ("With respect to appellant's observation that the dog could not be cross-examined, we point out that other demonstrative evidence such as photographs and exhibits also cannot be cross-examined.").

operator. As Part IV revealed, that result is consistent with the treatment of photographs and videos, but somewhat inconsistent with courts' treatment of canine evidence where the handler is considered the declarant and the right to confront and cross-examine him or her is seen as important. In this final Part of the Article, we consider those results, along with the interpreter cases, in terms of how they align with the post-*Crawford* world. In doing so, this Part begins with less complex areas and then continues across the spectrum to areas that are more debatable and divisive.

Whatever analytical model is adopted for machine-generated evidence, it should be able to address the wide variety of machines that produce potential evidence because they all present fundamentally the same question: who is speaking, the operator, the machine, those involved in the machine's creation and maintenance, or some combination of these? The list of machines that generate potential evidence is vast and includes gas chromatographs, fingerprint databases, digital scales, breathalyzers, GPS and other location data, software that logs actions, thermometers, photocopies, cash registers, TASERs, photographs and videos, and a host of other data-generating devices.[170] Thus, the description herein, though using some machine types as examples, is intentionally machine-agnostic. Developing a model for this broad range of machines involves two key questions that have animated the majority of cases adopting the machine-generated testimony doctrine: (1) does data generated by a machine involve an entity that falls within the scope of the Confrontation Clause; and (2) if so, is machine-generated data testimonial? We now turn to those questions.

A.   *Lab Certifications, Affidavits, and Formal Reports*

"We already know that the government may not introduce forensic laboratory *reports* or *affidavits* reporting the results of

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170. Examples of cases involving many of these machines are cited in Parts III and IV, *supra. See also* State v. Jennings, 9 A.3d 446, 457 (Conn. App. Ct. 2011) (cash register receipt that reported the value of 101 DVDs defendant was alleged to have attempted to steal); Ethridge v. State, No. 12-09-00190-CR, 2012 WL 1379648, at *18 (Tex. Ct. App. Apr. 18, 2012) (photocopy of an allegedly forged check; the defendant might have been arguing that the writings on the forged check were testimonial, but the court concluded that defendant's argument was unclear, *id.* at *20); *cf.* Mathews v. Broce, No. 5:11-CV-133 MTT, 2012 WL 3527073, at *6 (M.D. Ga. Aug. 15, 2012) (hearsay challenge to data stored on a TASER about the gun's use on a suspect); Merritt Baer, *Who Is the Witness to an Internet Crime: The Confrontation Clause, Digital Forensics, and Child Pornography*, 30 SANTA CLARA HIGH TECH. L.J. 31, 48 (2013).

forensic tests and use them as substantive evidence against a defendant unless the analyst who prepared or certified the report is offered as a live witness subject to cross-examination."[171] The key attribute for this category is that a person has asserted something in that report or affidavit. Similarly, when certifications attached to data are at issue—such as when an analyst asserts that the data was produced after adherence to certain protocols—courts should deem those assertions testimonial.

It is also clear that the hearsay rules, though relevant to the inquiry, do not directly define the scope of the Confrontation Clause.[172] For example, business records are not nontestimonial merely *because* they fall within the business records provision.[173] Similarly, courts should conclude that the fact that the modern definition of hearsay in rule 801 is a statement made by "a person"[174] does not restrict the Confrontation Clause to "person[s]."[175]

However, the Confrontation Clause itself arguably imposes that restriction. It is debatable whether the intended scope of the Confrontation Clause encompassed machine-generated data given the limited technology available at and around the time of the Clause's adoption (which included the thermometer and some other assertive tools).[176] However, unless the Confrontation Clause

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171. United States v. Maxwell, 724 F.3d 724, 726 (7th Cir. 2013) (emphasis added) (citing Bullcoming v. New Mexico, 131 S. Ct. 2705, 2710 (2011); Melendez-Diaz v. Massachusetts, 557 U.S. 305, 329 (2009) (reviewing for plain error)).

172. Crawford v. Washington, 541 U.S. 36, 61 ("Where testimonial statements are involved, we do not think the Framers meant to leave the Sixth Amendment's protection to the vagaries of the rules of evidence, much less to amorphous notions of 'reliability.'").

173. *Melendez-Diaz*, 557 U.S. at 324 ("Business and public records are generally admissible absent confrontation not because they qualify under an exception to the hearsay rules, but because—having been created for the administration of an entity's affairs and not for the purpose of establishing or proving some fact at trial—they are not testimonial.").

174. FED. R. EVID. 801(a) ("'Statement' means a person's oral assertion, written assertion, or nonverbal conduct, if the person intended it as an assertion.").

175. *But see* United States v. Washington, 498 F.3d 225, 231 (4th Cir. 2007) (appearing to define the scope of the Confrontation Clause based on the definition of hearsay in the Federal Rules of Evidence).

176. *See also* Jennifer Mnookin & David Kaye, *Confronting Science: Expert Evidence and the Confrontation Clause*, 2012 SUP. CT. REV. 99, 155 n.142 (2012) ("Arguably, testimony relying on distributed cognition [which is a hallmark of science] is a modern phenomenon without clear Founding-era equivalents.").

is reimagined to provide a different sort of "confrontation" or "cross-examination," statements made purely by machines do not fall within either practice's current implementation because you cannot cross-examine a machine. Nor do machines themselves meet the other requirements of *Crawford et al.*: they do not create data with any primary purpose of their own, they do not act under oath or solemnly in the traditional understandings of those terms, and even concepts of their availability would be strained.[177] This Article proceeds on the premise that there is no right to cross-examine a machine and, thus, that statements made *solely* by machines do not trigger a cross-examination right.[178]

B.   *Humans Communicating Through or About Machines*

Moving down the spectrum, we encounter humans communicating through machines, such as through word processors, text messages, video- or audio-recorded interviews, and the like. The machine-generated testimony doctrine should not mean that information is deemed "machine-generated" merely because a machine was used in its maintenance, provision, or creation.[179] This is important for both definitional reasons and because of the significant difference in treatment that machine-generated and human-generated evidence receive in the eyes of many courts.

For example, if a historical record, such as of past driving infractions, is typed into a database by humans, the print-out of that record does not become "machine-generated" merely because the machine (a printer) literally generated it.[180] The underlying

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177. *See, e.g.*, Erick J. Poorbaugh, *Interfacing Your Accuser: Computerized Evidence and the Confrontation Clause Following* Melendez-Diaz, 23 REGENT U. L. REV. 213, 224-25 (2011) (contemplating whether "'things' can speak for themselves") (capitalization omitted).

178. It would be possible to reimagine the Confrontation Clause to provide a right to confront and cross-examine a machine. That approach may be the best way to apply the Confrontation Clause to the modern world. The issue is briefly addressed in the final portions of this Article, but it is a topic that requires separate discussion.

179. *Cf.* United States v. Lamons, 532 F.3d 1251, 1268 n.25 (11th Cir. 2008) ("[N]o one can seriously doubt the proposition that this opinion itself is a wholly human-generated statement, despite the fact that a machine—a word processor on a computer—aided its production.").

180. *But see* Commonwealth v. Carter, 80 Va. Cir. 527, 534 (Va. Cir. Ct. 2010) (concluding that a transcript of driving records that were entered by DMV clerks was not the statement of a witness because it was "generated by a machine and presented without human analysis or interpretation"). The transcript was also excluded because, *inter alia*, it was not created in anticipation

data entry of the humans is still a "statement" by the clerks who typed it in, and thus would be subject to the normal requirements of the Confrontation Clause. Similarly, if Cobham[181] had (anachronisms aside) typed his accusatory letter and printed it out, it would not become the statement of the printer; it would remain Cobham's accusations, communicated through the machine. In other words, the machine did not create the contents, a human did; the machine merely reported human input.[182]

Similarly, if an analyst writes down content displayed on a machine or other facts about what the machine did before, during, or after testing (the noises it made, error lights that did or did not illuminate, etc.), that process would transform the machine-generated data into a human's assertion about what that data was, which would be subject to the Confrontation Clause (if testimonial) just like a witness repeating what color the traffic light was when a drunk driver ran it, or a police officer repeating an eye witness's alleged description of the perpetrator.

For example, in *Robertson v. Commonwealth*, a customer tried to steal several items.[183] A store manager directed an employee to use a register's scanner to find the prices of the items.[184] The employee scanned the items, looked at the price displayed on the register, and wrote a list of the prices.[185] In that situation, the prices displayed by the register were statements by the machine, but the handwritten list was the statement of the human operator.[186]

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of a trial but instead for normal DMV purposes, such as issuing licenses and tax assessments.

181. *See, e.g.*, Crawford v. Washington, 541 U.S. 36, 44 (2004) ("Lord Cobham, [a historical defendant]'s alleged accomplice, had implicated [that defendant] in an examination before the Privy Council and in a letter. At . . . trial, these were read to the jury.").

182. *See, e.g.*, John C. O'Brien, *The Hearsay Within Confrontation*, 29 St. Louis U. Pub. L. Rev. 501, 521 (2010) (making a similar observation); *cf.* Christopher B. Mueller et al., 4 Federal Evidence § 8:13 (4th ed. 2014) ("Sometimes the output of machines is a direct and obvious reflection of human assertions or input, such as conversations captured by recording devices, printouts of business data, and the content of websites. In these settings, ordinary hearsay analysis is appropriate.").

183. Robertson v. Commonwealth, 738 S.E.2d 531, 532-33 (Va. Ct. App. 2013) (en banc).

184. *Id.* at 533.

185. *Id.*

186. The court concluded that the list, which was admitted at trial, was also a statement by the manager who oversaw the scanning and testified at trial. *Id.* at 537.

Also falling in this area are statements about labels attached to raw data. For example, if an analyst types in a defendant's name, sample number, or testing purpose, those entries are the analyst's statements. Some of them might also be testimonial, depending on the circumstances. They are not, however, statements of the machine just because the machine included them with the raw data the machine printed. Similarly, if a human types data into a machine and that machine generates a barcode, RFID tag,[187] or other digital marker, the data (now in barcode or other such form) does not become machine-generated when a second machine learns the relevant information via the barcode and prints out that data. A barcode or digital encoding of the defendant's name, sample number, etc., is still a statement by whoever typed that information into the machine that generated the barcode.

To illustrate this example, imagine that analyst Y wrote down in English the purpose for which a sample was to be tested, and analyst X translated it into Spanish. We would not say that the Spanish version is entirely the statement of X; it would remain, at least in part (depending on the court's theory of the interpreter's role), the statement of Y. So, too, when a machine translates the analyst-entered defendant's name, sample number, testing purpose, etc., into a computer language like a barcode. When a subsequent machine translates the barcode back into English (or whatever language) and includes it on the print-out of raw data, it is still, in part, the statement of the human analyst who initially entered it.

In these situations, the machine-generated testimony doctrine should be inapplicable because humans generated the relevant statements and machines merely repeated them. Some such statements might not be testimonial, as in the case of driving infractions recorded by the DMV for non-criminal purposes. Other statements, like Cobham's, will fall within the heart of the Confrontation Clause. But because, in the eyes of some courts, statements generated by a machine do not trigger Confrontation Clause rights—but human-generated statements do—it is significant whether the words are attributed to a human author.

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187. A radio-frequency identification ("RFID") tag is a device used to identify and track things through the use of radio waves. *See, e.g.*, *RFID Definition*, DICTIONARY.COM, http://dictionary.reference.com/browse/rfid (last visited Oct. 5, 2014); *see also RFID Tag Definition*, PC Magazine, http://www.pcmag.com/encyclopedia/term/56955/rfid-tag (last visited Oct. 5, 2014).

C. Automated Machines and Progenitors

As a result of technological advancements, numerous data-generating machines act without a human operator. Digital thermometers and weather stations track temperature and humidity, license plate scanners record vehicle plates, GPS and other motion-tracking devices log movement, and online software such as Google's Content ID continuously patrol videos uploaded to YouTube.com for copyright infringement.[188] This data can be vital in criminal trials: unusually high temperatures (from grow lights) may reveal a location where drugs are grown, license plates may reveal stolen cars, GPS logs may contradict alibis, and evidence of video uploads may be relevant in criminal proceedings for copyright matters.

The salient point for our purposes is not whether these particular devices do or do not require operator input in their day-to-day operation (a question that may vary from machine to machine). There are numerous machines that now—once built, programmed, and set in motion by a human—require only, at most, occasional oversight. The rest of the time, the machines do what they do without a human's touch. For these machines, given the lack of contemporaneous or near-contemporaneous human involvement in generating the data, that data should be treated as the machine's "statements."

We must still consider, however, the fact that people build machines, program them, and set them in motion. A machine that operates on its own and generates data about a target is only carrying out the analysis that the inventor, manufacturer, and programmer created it to undertake.[189] Those individuals, the machine's "progenitors," built the machine to make assertions of fact. The machine's ultimate assertions could be viewed as the

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188. *See, e.g.*, *License Plate Reader: LPR-HR*, PERCEPTICS, http://www.abajournal.com/magazine/Article/data_driven_latest_highway_techno logy_speeds_up_info_gathering_but_critics/ (last visited Aug. 14, 2014) (describing a license plate reader model with "95+% guaranteed read rate" that is "capable of reading all plate types day or night and in any kind of weather" to "capture state, province or country of origin ID"); How Content ID Works, GOOGLE, https://support.google.com/youtube/answer/2797370 (last visited Aug. 12, 2014) (describing the Content ID copyright infringement detection system).

189. *Cf.* CHRISTOPHER B. MUELLER ET AL., 4 FEDERAL EVIDENCE § 8:13 (4th ed. 2014) ("A moment's reflection leads to the conclusion that information produced by machines is, at one remove or many, a reflection of human design, engineering, programming, calibration, and purposeful input, all aimed at generating machine output. Hence machine-generated information is a legitimate concern of the hearsay doctrine.").

assertions of those progenitors because they set the machine in motion for that specific primary purpose: to make assertions on the progenitors' behalf. In other areas of the law, courts attribute the actions of machines to the humans who built them (e.g. product liability) or operate them (e.g. copyright in a photograph); the same could be true for the Confrontation Clause. A GC-MS (a common forensic machine), for example, is built to make assertions. Essentially, it is designed to assert what the sample it tested is made of.[190] When a GC-MS produces data, it is only following instructions specified by human agents to do what it was made to do, assert things; but for the existence of the GC-MS, humans might have made those same (or at least similar) assertions by recording the results of a chemical analysis they conducted.

Is the GC-MS truly speaking on its own? Machines can produce data in a variety of forms–graphical print-outs, electronic records and so on–but the machines are, in some form, only the last link in a long line of instructions given by human actors. Just as we attribute a photograph to the photographer and liability in some product liability cases to the manufacturer, we could attribute an assertive machine's data to the human progenitors. It is the progenitors' contributions and instructions that enabled the machine to make the assertions.

However, our fifth-grade grammar teacher did the same thing for each of us, as did other teachers, our parents, and so forth. A request to call any of them to the stand under the Confrontation Clause–based on their contributions to our ability to speak and accuse someone–would be futile. Although a machine, unlike each of us, has no choice but to follow the instructions it was given, the machine's progenitor gave that machine only general training about how to make assertions, not specific instructions about what to assert for a particular sample. The progenitors also provided only the potential to make assertions; the machine makes that assertion without the progenitor knowing anything about the tested samples. In these ways, though a machine "learns" and follows instructions in a different way than we do, the machine is not merely the mouthpiece for its progenitors as to a particular assertion for a particular sample. When a browser returns search results from, say, Bing.com, it

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190. For a simplified explanation of how a GC-MS functions, *see GCSE Bitesize: Analyzing Substances*, BBC, http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa/atomic_structure/analysing_substancerev2.shtml (last visited Aug. 14, 2014).

would be anomalous to consider the results as the assertions also of Bill Gates, one of the search engine's innumerable progenitors.

For these reasons, courts could reject the request to call manufacturers and engineers to the stand on the theory that they designed, built, and programmed the scale that ultimately displayed the weight of the cocaine the suspect had in his pocket. Courts could conclude that these contributions are not assertions in the sense of the Confrontation Clause nor are the progenitors "witnesses" within the Clause's meaning–their contribution to the real assertion, the machine's data, is too remote.[191] That result makes sense.

As a practical matter, for most machines, the progenitors also would not be a collection of speakers but a chorus of dozens, if not hundreds and thousands, of manufacturers, designers, programmers, technicians, managers, etc. The Supreme Court has already indicated that it is not necessary to call innumerable witnesses to the stand in the context of forensic assertions,[192] and other courts have been loath to require the testimony of multiple people involved in the chain of custody or maintenance of machines.[193] Significant practical difficulties would arise in any attempt to call dozens or more progenitors to testify as contributors to a machine's data.

We can also reach that same result another way, both for grammar teachers and machine progenitors: even assuming that progenitors do make assertions through machines in a sense that triggers the Confrontation Clause, those inventors, manufacturers, and programmers usually will not have "spoken" in a way that is testimonial.[194] Under the traditional test for what is testimonial,

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191. A distinction could be made for assertive machines–machines made to advance claims about aspects of reality. Where a machine is designed for the primary purpose of making assertions about reality, a court could, theoretically, carve out an exception to the Confrontation Clause. It is unclear where this exception would be grounded in the text of the Confrontation Clause, however.

192. Melendez-Diaz v. Massachusetts, 557 U.S. 305, 311 n.1 (2009) ("[W]e do not hold, and it is not the case, that anyone whose testimony may be relevant in establishing the chain of custody, authenticity of the sample, or accuracy of the testing device, must appear in person as part of the prosecution's case.").

193. *See infra* pp. 44-45.

194. *Cf.* Jennifer Mnookin & David Kaye, *Confronting Science: Expert Evidence and the Confrontation Clause*, 2012 SUP. CT. REV. 99, 151-52 (2012) ("The operator of a breathalyzer relies upon a machine he himself likely only partly understands–enormous technical knowledge is literally built into it. But that knowledge is not testimonial under any of the Court's definitions."); John C. O'Brien, *The Hearsay Within Confrontation*, 29 ST. LOUIS U. PUB. L. REV. 501,

described in *Davis*, *Melendez-Diaz*, and *Bullcoming*, the progenitors have not acted with a primary purpose of creating evidence for a trial. When they built the machine, there was no specific trial to contemplate, nor was there even a specific crime, victim, or defendant at issue (identified or otherwise). Though the machines might—if actually purchased and used—produce evidence for a trial, they might instead be used for a variety of purposes other than to produce evidence for a criminal trial. Purely hypothetical future trials and crimes do not satisfy the "testimonial" requirement.

Williams should not change that analysis because, though there is a grain of accuracy in the plurality's test for what is testimonial, it is only a grain. In *Williams*, part of the disagreement between the plurality and the other justices was the plurality's adoption of a definition of testimonial that required that the statement have "the primary purpose of accusing *a targeted individual.*"[195] Five other justices rejected this test in no uncertain terms.[196] The dissent's position is the better-reasoned analysis in this regard because the important question is whether there is a non-hypothetical trial or crime at hand, not an identified perpetrator. First, the plurality's test was not as target-agnostic as those justices suggested: the profile that would result from testing a DNA sample that was from a rape case obviously can, and hopefully will, incriminate someone. There is a clear target (the unknown person from whom the sample derives), a crime has occurred and is being investigated, and a trial is not only hypothetically possible but actually in the investigatory stages. That targeting is not theoretical: the analysts are running tests on a targeted biological sample to extract, hopefully, the perpetrator's DNA.

Second, the plurality's analysis assumes the targetless nature of the test (and accompanying quality of the analyst), and that assumption directly undermines a key rationale behind the Confrontation Clause—giving the defendant and the fact finder a chance to assess the declarant. Courts generally will not know

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516 (2010) (noting that a "declarant's lack of an intent to assert [a] matter sought to be proved seems totally at odds with the concept of a testimonial statement").

195. Williams v. Illinois, 132 S. Ct. 2221, 2243 (2012) (plurality) (emphasis added). *See also id.* at 2243-44 ("Similarly, no one at Cellmark could have possibly known that the profile that it produced would turn out to inculpate petitioner—or for that matter, anyone else whose DNA profile was in a law enforcement database.").

196. *Id.* at 2262 (Thomas, J., concurring); *id.* at 2273-74 (Kagan, J., dissenting).

whether the analyst has fabricated the result or framed the defendant, which is unlikely.[197] In either of those situations, the analyst who created the underlying profile has targeted *someone*, for whatever reasons, and not only knows but apparently intends the resulting profile to be potential evidence in a future trial. In other words, in the case of intentional sample contamination or drylabbing,[198] the analyst has selected a target to incriminate. By assuming otherwise, the plurality deprives the defendant of the chance to cross-examine that analyst; there is no certainty that cross-examination will reveal the malfeasance,[199] but it sometimes does[200] and, in any event, the chance to do so is why the Confrontation Clause exists.

The plurality might (correctly) respond to this observation by noting that the primary purpose analysis is "an objective test" in which the court "look[s] for the primary purpose that a reasonable person would have ascribed to the statement, taking into account all of the surrounding circumstances."[201] It is not focused on whether the analyst at issue actually did or did not fabricate the results and target someone. Would a reasonable person assume that a lab result was not fabricated? A reasonable person would know of the numerous forensic lab scandals, including dry-lab and fabrication incidents.[202] In light of those scandals and the reality that analysts do select targets in some cases, a reasonable person should answer that it is unclear whether the primary purpose of the analyst was to accuse a targeted individual. Further, because there is a non-hypothetical defendant (the sample tested came from a rape kit), a reasonable person would recognize that the test is targeting someone; the analyst (if he or she is honest and not fixing the results) simply does not know who.

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197. *See, e.g.*, *supra* note 7 (addressing examples of fabricated work, lab errors, and similar incidents).

198. *See, e.g.*, Melendez-Diaz v. Massachusetts, 557 U.S. 305, 319 (2009) (noting that "'drylabbing' [is] where forensic analysts report results of tests that were never performed") (citation omitted).

199. *See, e.g.*, *Williams*, 132 S. Ct. at 2250 (Breyer, J., concurring) ("In the wrongful-conviction cases to which this Court has previously referred, the forensic experts all testified in court and were available for cross-examination [yet admission of the faulty evidence was not prevented].").

200. *Id.* at 2246 (Breyer, J., concurring) (noting such an example); *id.* at 2264 (Kagan, J., dissenting) (same).

201. *Id.* at 2243 (citing Michigan v. Bryant, 131 S. Ct. 1143 (2011)).

202. *See, e.g.*, note 7.

For these reasons, the definitions of "testimonial" found in *Melendez-Diaz*, *Bullcoming*, and the other post-*Crawford* cases[203] should be followed by the lower courts, which should reject the requirement in *Williams* that the analyst must have targeted a known individual. Instead, courts should adopt a requirement that the data targeted someone generally, such as when a witness describes facts about a getaway car, gives a description of the defendant that the witness does not personally know, or when a dog tracks a scent of an unidentified perpetrator. That test should be deemed satisfied when there is a targeted sample from a known or suspected crime because the point of testing such a sample is to see whom the results might incriminate.

Applying that test to machine progenitors, courts should conclude that the progenitors' contribution to the test result is not testimonial. The progenitors of most machines will have designed, built, and programmed them with no crime, specific sample, or specific criminal trial in mind. In other words, their work will be, at best, in anticipation of hypothetical future criminal trials. Thus, courts should conclude that machine progenitors contribute to the "speech" of a machine in a way that is too attenuated under the Confrontation Clause and, in any event, is also not testimonial. Progenitors are normally not covered by the Confrontation Clause.

It is not hard to imagine exceptions to those general rules. If a machine or software was designed, programmed, or otherwise calibrated to investigate a particular event or entity, that could be a formal action undertaken with the primary purpose of generating evidence and thus could be considered testimonial. If the progenitor's contribution to the machine's output was also so significant that the progenitor was essentially a co-author of the results, that could subject the progenitor to cross-examination. In the next two sections, that question is addressed directly: when, if ever, is a human's contribution (whether from a progenitor or the machine's operator) to a machine's data sufficient to subject the human to the requirements of the Confrontation Clause?

D. Maintenance and Calibration Records

Maintenance and calibration records fall in the portion of the spectrum in which humans play an active role in the day-to-day operation of machines, but where courts should still have no

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203. *See also* Michigan v. Bryant, 131 S. Ct. 1143, 1155 (2011) (describing the test as whether the statement was for "a primary purpose of creating an out-of-court substitute for trial testimony").

difficulty concluding that they generally are not subject to the Confrontation Clause. The first area in this range is records that establish that a particular machine has been inspected, calibrated, or otherwise maintained and found to be in proper working order. Though these records are made as formal assertions that would normally be used for their truth at trial, courts should conclude that they generally will not trigger a Confrontation Clause right because the statements in them are not testimonial.

Many courts that have considered the issue have come to this conclusion.[204] Maintenance and calibration records, when made as part of a routine process, are created "to ensure the reliability of such machines—not to secure evidence for use in any *particular* criminal proceeding. The fact that the scientific test results and the observations of the technicians might be relevant to future prosecutions of *unknown* defendants [is], at most, an ancillary consideration . . . ."[205] This test might be clearer if the emphasized words were replaced with "non-hypothetical," to clarify the test's distance from the *Williams* particular-identified-defendant requirement. The focus should be on whether there is an identifiable *non-hypothetical* use of the statement in a future criminal trial, not whether that use involves a specific, identified defendant.

Applying that test, the creator of calibration and maintenance records can reasonably foresee that the records might be used in a future case, but the existence of the future case is purely hypothetical. No case yet exists as to the records being

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204. *See, e.g.*, Cranston v. State, 936 N.E.2d 342, 346 (Ind. Ct. App. 2010) ("[T]his Court has routinely held that Datamaster inspection certificates are non-testimonial documents presenting no confrontation problems of their own."); Matthies v. State, 85 So. 3d 838, 844 (Miss.), *cert. denied*, 133 S. Ct. 317 (2012) (concluding that most courts to consider the issue have held that inspection, maintenance, and calibration records are non-testimonial and collecting cases on that point); State v. Michaels, 95 A.3d 648, 662 (N.J. 2014) (collecting cases); *see also* People v. Pealer, 985 N.E.2d 903, 908 (N.Y. 2013), *cert. denied*, 134 S. Ct. 105 (2013); People v. Hulbert, 939 N.Y.S.2d 661, 663 (N.Y. App. Div. 2012); Commonwealth v. Dyarman, 73 A.3d 565, 569 (Pa. 2013), *cert. denied*, 134 S. Ct. 948 (2014); John C. O'Brien, *The Hearsay Within Confrontation*, 29 ST. LOUIS U. PUB. L. REV. 501, 521 & n.155 (2010); *cf.* McCarthy v. State, 285 P.3d 285, 294 (Alaska Ct. App. 2012) (Mannheimer, J., concurring) (collecting cases, but arguing that calibration results may actually be testimonial); People v. Doe, 959 N.Y.S.2d 839, 844 (Sup. Ct. 2012) (analogizing the physical lifting of a fingerprint to machine maintenance and calibration records, which "do not violate a defendant's Confrontation Rights").

205. People v. Pealer, 985 N.E.2d 903, 907 (N.Y. 2013) (emphasis added), *cert. denied*, 134 S. Ct. 105 (2013).

created; as far as the record-creators know, there has been no report of a crime, no crime itself, no targeted sample, nor is there— as connected to calibration or maintenance of the device—a victim, crime scene, or defendant.[206] Because the records lack a non-hypothetical target, they are not accusatorial or testimonial.[207]

If, however, a technician were to calibrate or inspect a machine for a specific, non-hypothetical test, the result should change. Suppose, for example, that a police officer is about to conduct a breath test at the station and the officer asks the calibration technician to prepare the breathalyzer. In that situation, even if the technician does not know who the defendant is, the prosecutorial wheel has begun to turn and the technician knows it: there is an alleged crime, and future use is not hypothetical but instead planned. In that situation, a calibration record has both an evidentiary character (the device is about to accuse or exculpate a defendant based largely on the device's proper calibration and maintenance) and "the primary purpose of the [creation of the record] is to establish or prove past events potentially relevant to later criminal prosecution."[208] The maintenance/calibration record would thus be testimonial.

E. *Humans Operating Machines: Placers, Preparers, and Button-Pushers*

Being testimonial is only part of the equation; the "statements" at issue must actually be subject to the Confrontation Clause. Are the progenitor's programming and the technician's calibration and maintenance properly encompassed by the Confrontation Clause, which is concerned with "witnesses" and those who "bear testimony" against the accused?[209] In other words, is the data generated by a machine the "statement" of the machine, the humans involved contemporaneously in the creation of the statement, or both?

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206. At any given time, there are presumably crimes that have not yet been identified or are about to be investigated. However, as to the primary purpose that the person is calibrating or maintaining the machine, there is no specific crime or victim at issue. The calibration and maintenance are for general use, not a specific future use.

207. *See, e.g.*, PAUL C. GIANNELLI ET AL., SCIENTIFIC EVIDENCE § 6.04(e) (Matthew Bender 5th ed. 2013) (noting that intoxilyzer calibration records created before a suspect is stopped, much less arrested, have a quality-control function).

208. Davis v. Washington, 547 U.S. 813, 822; (2006); *see also* Crawford v. Washington, 541 U.S. 36, 52 (2004).

209. *See, e.g.*, Crawford v. Washington, 541 U.S. 36, 51 (2004) (quoting 2 N. WEBSTER, AN AMERICAN DICTIONARY OF THE ENGLISH LANGUAGE (1928)).

That question lies at the heart of the machine-generated testimony doctrine, and its answer is debatable. Though humans operate the machines (to varying extents), the machines often do the heavy lifting in creating the data. Given the machine's significant, if not predominant, contribution to the resulting "statement"—the raw data—most courts have concluded that the machine is the speaker.[210] And if the statements are attributed to only the machine, the post-*Crawford* Confrontation Clause presumably does not apply to them because you cannot, in the traditional sense, cross-examine or confront a machine.[211]

However, there are approaches that would attribute some machine speech to their human assistants. In this section, we consider three such categories of machine-human pairings: (1) humans directing the machine at some specific target (a given sample, a specific area to be recorded, etc.), (2) individuals who collect and prepare a sample for later analysis, and (3) machines that produce data with little more than the push of a power or start button.

Both this section and the next section address not just operators of machines, but also progenitors and technicians who create, program, calibrate, or maintain a machine for a specific anticipated use, such as designing software to infiltrate a particular network, or calibrating a breathalyzer for a specific, imminent breath test. In all of these situations, humans contribute to the imminent use of the machine to generate evidence and, in doing so, exercise control that, to varying degrees, dictates the "statement" that the machine will make.

We begin with directing a machine to a specific sample or area for analysis. Suppose an analyst places a white rock taken from the defendant—which is suspected to be cocaine—in the testing machine. Another analyst sets the parameters and runs the test, and the machine provides data about the rock, but the machine did so only because someone provided the sample to the machine. Is directing the machine's attention to the specific sample—but doing no more—an action that falls under the Confrontation Clause?

Most likely not. These actions can be likened to any other physical action and are primarily non-assertive conduct that, despite impacting the resulting machine-generated data, are not within the ambit of the Confrontation Clause's concern with

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210. *See supra* Part III.
211. *See* United States v. Moon, 512 F.3d 359, 362 (7th Cir. 2008).

bearing testimony. Removing the machine from the picture simplifies the question: if one analyst gave a substance to a second analyst and, after testing via beakers and boilers, the second analyst declared that the substance was cocaine, we would not attribute that declaration of results to the first analyst.[212] The same should be true for individuals providing samples to machines. In both situations, one person provides the sample to the testing entity (the second analyst or the automated machine); that action is non-assertive conduct that is at least one step removed from the creation of the statement. Thus, courts should not attribute data to an individual who merely directs a machine's attention to a sample.

Further, when placing an item in a machine that requires additional action to display data, the analyst has not yet caused the machine to make any assertion. If further action is required, such as pushing the start button, it is the person who actually does so to whom the statement (arguably) would be attributed.[213] In that way, the mere act of directing a machine's attention at a sample, but doing no more, is akin to A handing B a sample for B to test. Accordingly, courts should reject the claim that the individuals who placed the sample in the machine (but did no more) are the co-authors of the raw data the machine produces.

What about individuals who collect a sample from the crime scene or prepare the sample for analysis at a later time? They should not trigger a Confrontation Clause right because, if all they do is collect and prepare evidence, they have not made any assertions. They collect the sample or prepare it so someone else may make an assertion about it. If, however, the collectors and preparers create certificates or the equivalent in the course of collecting and preparing items, those statements may be testimonial and covered by the Clause. However, simply collecting and preparing evidence through physical actions does appear, on its face, to be assertive conduct.[214]

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212. As indicated earlier in this Part, we might attribute other things to the first analyst, though. Suppose the first analyst wrote the defendant's name on the evidence bag for the white rock. When the second analyst learns the defendant's name from that bag and then repeats it in the second analyst's report, we should attribute the statement in part to the first analyst.

213. If the machine displays data automatically, such as on a scale that automatically displays weight without further intervention, then that action is akin to the next category: operators who generate data by merely pushing the equivalent of a start button on a machine.

214. *Cf.* Jennifer Mnookin & David Kaye, *Confronting Science: Expert Evidence and the Confrontation Clause*, 2012 SUP. CT. REV. 99, 152 (2012)

Whether that mere button-pusher should be deemed a co-author of the machine's statement is our final question in this section. In this category of machines, the operator's contribution to the resulting raw data is limited to putting the sample in the machine (which we have already considered) and pushing start. In this situation, courts again are widely in agreement that the resulting data is a "statement" by the machine, which is not covered by the Confrontation Clause.[215]

That result is consistent with the cases rejecting application of the Confrontation Clause to photographs, videos, and interpreters.[216] If there is no right to cross-examine the person who pushed the camera's start-button-equivalent (and potentially even made subjective decisions about angle, lighting, lens use, etc.), it would be incongruent if there were a right to cross-examine an analyst who pushed the start button on an automated forensic machine. Similarly, if there is no right to cross-examine an interpreter—who actually makes subjective decisions in translating[217]—why would there be a right to cross-examine an analyst who made no such decisions?

The result also makes some intuitive sense: the operator exercises no control over the machine's creation of data, and so the proper parties to be viewed as a co-author of the machine's assertions are the machine's progenitors—they exercised the relevant control over the machine's speech, to which the operator contributed nothing. The progenitors are the source of the assertion, but their contribution is (as described previously) attenuated and nontestimonial. Though courts' common references to the machine being the witness in such situations are technically incorrect—it would be better to say the progenitors are the ones making the assertion—the result is the same: no person making an assertion acted in a testimonial manner, and the machine (to whatever extent it is viewed as a separate entity from the progenitors, perhaps as a sum of the parts) is not subject to confrontation under *Crawford*.

Finally, there are some instances where the operator's contribution to the resulting assertion would not be testimonial. If a store manager installed a surveillance camera and aimed it at the

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("[V]irtually no one who has thought about the intersection of forensic science and the Confrontation Clause thinks [calling, e.g., roughly a dozen analysts involved in a DNA test to testify] makes sense.").

215. *See supra* Part III.
216. *See supra* Part IV.
217. *See* United States v. Charles, 722 F.3d 1319, 1324-25 (11th Cir. 2013).

cash register, the resulting videos would fall into this category: a machine, with little-to-no human interaction beyond the manager setting the machine in motion, would generate data. The manager's initiation of the recording process would usually not be testimonial because, although the manager might intend to create evidence that could be used in a future trial (such as to catch a future robber), he or she would not have a non-hypothetical use in mind (unless there was, for instance, a recent history of cash register shortages the manager specifically intended to catch). Even assuming that the manager did have an evidence-generation purpose in mind, setting up a camera in your own store is arguably not sufficiently formal or solemn to be testimonial (especially in Justice Thomas's eyes). Thus, the resulting video feed should be deemed neither the statement of the manager who installed it nor testimonial. Courts are on defensible ground in concluding that data produced by a human operator that essentially pushed a "start" button is immune from the Clause's requirements of confrontation and cross-examination.

This result renders a significant number of machines immune to the Confrontation Clause. For all machines that are sufficiently automated that the operator need only push start, there will be no right to confront or cross-examine that operator nor, for the reasons discussed earlier, most anyone else involved at a prior stage.

F.   *Humans Operating Machines: Humans Exercising Control*

All that remains is the category of machines where there is some level of human control beyond simply setting the device in motion. This area poses the most difficult Confrontation Clause questions for machine-generated data. Through selecting the parameters of the test, choosing how the data will be displayed, and controlling the machine in other ways, some operators greatly shape the assertion the machine will make. Thus, courts could consider the machine and operator as co-authors of the resulting statement. Just as an interpreter's translations are often attributed to the defendant and a dog's handler is seen as the key witness for a dog's alert,[218] so too—either as a matter of logic or as a legal fiction—could a machine's data be attributed to its handlers (or otherwise require their testimony). Progenitors, calibrators, and maintenance technicians who prepare a device for a specific

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218. *See infra* pp. 57-58. However, as discussed later in this Part, it is somewhat problematic to rely on these other doctrines.

investigation could be placed in this same category because they similarly shape a machine's data by preparing the machine for a specific, non-hypothetical use.

On the other hand, choosing the parameters of the test, selecting the way the data will be displayed, and other such actions are physical actions that, viewed in isolation, will often be non-assertive conduct. Why should non-assertive conduct that creates—but does not define the contents of—assertions be attributed to the non-assertive actor? Given that the machine or its progenitors define the contents of the assertion, courts could conclude that they are the only declarant, not the human operator. Courts are on strong ground in reaching this alternative conclusion, and they could draw support from the photo, video, and interpreter cases in rejecting a right to confront the machine's operator.

At the heart of the debate between these two dueling conclusions is the determination of whether controlling a machine for the purpose of making an assertion—but via actions that are themselves non-assertive—exposes human assistants to the Confrontation Clause. The amount of control the human assistant exercises will vary from machine to machine, and the amount of control is important: if the operator is not exercising "sufficient" control, attributing the assertion to the operator would be solely a fiction. However, where operating decisions are made by a human controller and are made for the express purpose of generating an assertion, the resulting assertion could be attributed, in part, to the operator. The human is, after all, using the machine for that express purpose: to generate an assertion about the sample. On that basis, courts could view that resulting assertion (the data) as partially attributable to the human. The statement is also partially the machine's. But, because the statement is partially attributable to the human assistant, the defendant would have a right to confront and cross-examine that individual.

It is difficult to compare this model to examples outside the machine-generated phenomenon. If Carl, through threats and extortion, coerced Dan not to tell police anything about Carl's involvement in a crime, Carl would be exercising some control over Dan. When Dan gave a statement to the police, if we knew that Dan was altering the story because of the threat, we might consider Dan's statement as partially a product of Carl's control—as partially attributable to Carl speaking through Dan even though Dan has not repeated any of Carl's statements. But it is doubtful that a defendant would have a right to cross-examine Carl just because Dan subsequently told a story that Carl influenced. In this

example, that lack of a right to cross-examine Carl is only strengthened by the fact that Carl did not tell Dan what specific story to tell, and thus many of the details in the resulting story were not directly shaped by Carl. Dan also exercised his own judgment in deciding whether to obey Carl's orders. The lack of an ability to cross-examine Carl in this scenario might indicate that there is similarly no right to cross-examine a human assistant who merely shapes a machine's data.

But machines are much more affected by their controllers than Dan. If an operator decides to run one test or display results in one way, the machine generally cannot do otherwise. This is not a matter of whether the operator has made a good decision or bad decision, such as running the wrong test. Nor does it matter whether, at a later date, someone could look at the raw data and see that the incorrect test was run. What matters is that the story is not just the machine's; the machine has yielded, and must yield, important decisions to the operator, and thus the resulting data is not solely the product of the machine (or those who manufactured and maintained it). In that situation, the raw data is at least in part the product of multiple authors, including the machine and the operator.[219]

As another comparative exercise, operating the machine could be likened to interrogation because the operator, by either pushing start or setting the operating parameters, effectively asks the machine the question that prompts it to generate a statement in response. Just as an interrogator's non-assertive question usually shapes the answer given, so too does the operator of a machine direct the machine, through non-assertive physical actions, towards a category of answers.[220] However, in the context of a conversation or even an interrogation, though the question directs the declarant's attention to a topic, the statement in response is still a distinct item. The question might need to be admitted as evidence for other reasons, such as to give proper context to the answer, but that does not make the question part of the answer. If the question to a witness is not part of the witness's answer, it could be reasonable to view a "question" to the machine—setting the

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219. As described earlier, the data is also the product of the progenitors and technicians who calibrated, maintained, etc., the device. Their contributions, however, will normally not be testimonial (and might be too attenuated to be deemed assertions).

220. As voice-recognition technology improves, analysts might even conduct forensic analysis by asking machines questions or giving them vocal commands.

operating parameters or pushing start—as not part of the machine's answer either.

On the other hand, unlike a declarant answering a question where the possible responses are limitless, a machine "chooses" its answer from a limited number of choices dictated by how the machine was programmed. In this sense, the machine is much more heavily influenced by the question the operator poses than is the person interrogated by a police officer. Further, it is debatable whether the answer given to a question (whether the answer comes from a machine or a person) is really separate from the question; the answer could be said to incorporate the question. If I ask you where you were at 5:00 p.m. on October 10th, your answer of "at the track" incorporates the question and is understood as "at 5:00 p.m. on October 10th, I was at the track."[221] Similarly, the fairly leading question posed by some operators of machines could be said to be incorporated in the answer the machine gives. However, once again, it seems unlikely that a defendant would have the right to confront and cross-examine an interrogator who posed only non-assertive questions that shaped the declarant's answers.[222] Though there is no perfect analog elsewhere in the Confrontation Clause for the work that a machine does, these exercises suggest that any attribution of the machine's data to the human assistants would be rather *sui generis* (as with interpreters and dog handlers) and arguably a legal fiction.

Adopting, for now, the proposition that this attribution is appropriate, how much operator control would be enough to trigger it? There are at least two different ways to fence-off this area: (1) humans exercising a certain threshold of control over the machine's output, or (2) a standard requiring that humans make subjective decisions that affect the analysis. If subjective decision-making is enough to deem the human a co-author of the machine's raw data, then button-pushers may cross that threshold when they decide which machine or tool they will use to run the test. For example, if, hypothetically, a test using litmus paper would produce equivalent results to those produced by a machine that

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221. *Cf.* Michigan v. Bryant, 131 S. Ct. 1143, 1160-61 (2011) ("In many instances, the primary purpose of the interrogation will be most accurately ascertained by looking to the contents of both the questions and the answers. To give an extreme example, if the police say to a victim, 'Tell us who did this to you so that we can arrest and prosecute them,' the victim's response that 'Rick did it,' appears purely accusatory because by virtue of the phrasing of the question, the victim necessarily has prosecution in mind when she answers.").

222. *Cf. id.* at 1160 n.11 ("An interrogator's questions, unlike a declarant's answers, do not assert the truth of any matter.").

requires only the push of a button, deciding to use the machine over the litmus paper is a subjective decision about the analysis. Yet, for the reasons discussed previously, it is arguably problematic to attribute the raw data to the operator when the operator merely pushed start. Among other problems, the analyst has exercised no control over the analytical tool used, she has simply chosen which tool to "ask."

That problem is less significant if the test is whether the operator exercised a certain level of control over the machine's output. Simply selecting a machine exercises no control over that machine's assertion process; it exercises control over the data on the macro level, but not on the micro level as to that machine's actual method of making the assertion. In other words, it might change the results, but not because it changes how the specific machine "speaks." Similarly, those who prepare a sample exercise control over the resulting data, but they do not exercise control over the testing machine directly, which is used at a later step. Changing the sample before it reaches the machine, such as by contaminating it or swapping in a different substance, changes the right answer, and the machine (which is designed to give the answer that correctly mirrors reality, e.g., what the sample is actually made of) has changed its assertion accordingly. But it does not change how the machine makes that assertion. Thus, neither simply choosing a machine nor preparing a sample would be sufficient to deem the operator or preparer a co-author of the raw data.

A control-based test also better models when a statement should be attributed to multiple sources: it is more reasonable to do so when one of the sources exercises control over the other's statement than when one simply exercises subjective judgment that somehow affects the resulting statement. Further, focusing on control avoids another problem: if lab protocols or scientific principles specify how a test should be run, confusion could arise when following those pre-defined rules—would that be subjective decision-making by the analyst?

Suppose, however, that a lab supervisor seeking to duck the threshold of a control test designated two GC-MS machines as "the GC-MS that operates at temperature X" and "the GC-MS for temperature Y." Suppose also that selecting the temperature range used in a GC-MS is a decision that exercises sufficient control over the raw data to meet the control test. In that situation, an operator would choose the machine based on the preferred temperature, thereby exercising control over the data on the macro level, but

would fall short of the threshold for exercising control on the micro level (over the specific GC-MS's analysis, which the analyst has not changed at all because each GC-MS is already set to use the desired parameter).

That result is acceptable under the control test because the goal is not to artificially capture all machine data, but to capture only the data where the machine is not the only "speaker." If I choose whether to ask a friend who is a staunch Democrat for advice on who to vote for instead of a friend who is a Republican, I have exercised (on the macro level) more than *de minimis* control over the answer I will receive even though I have exercised almost no control (on the micro level) over what the chosen friend will say. So, too, if I ask a former boss who fired me—instead of a former boss who promoted me—to write me a letter of recommendation. In these examples, as with choosing the "temperature Y" GC-MS over the "temperature X" GC-MS, the resulting speaker is not controlled, though the resulting data is.[223]

To the extent that we might seek a way to address control over the data on the macro level, the Confrontation Clause—which asks who is the relevant declarant on the micro level—does not help. If it did—if the relevant question was "who is exercising sufficient control over the resulting data"—then the parties who cross that threshold would include individuals who are potentially several steps removed from the operator-analyst's actual use of the machine. The list would include those who collected the evidence, others in the chain of custody, and individuals who prepared a sample for testing.[224] That result is problematic for the reasons noted earlier in this Part, and it would also be in tension with the Court's view of the Confrontation Clause in *Melendez-Diaz*.[225]

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223. If the lab supervisor changed the parameters for the machines for a specific, non-hypothetical test, the result would change. In that situation, the supervisor would be a co-author by exercising control over a specific non-hypothetical statement. By setting the GC-MS machines at fixed temperatures for all uses, the lab supervisor acts more like a calibrator than an operator because the supervisor is preparing the machines for foreseeable, but only hypothetical, use as opposed to any specific sample, investigation, or crime.

224. For example, Justice Breyer included a summary of DNA lab work preparation in *Williams*. *See* Williams v. Illinois, 132 S. Ct. 2221, 2245 (2012) (Breyer, J., concurring).

225. *See, e.g.*, Melendez-Diaz v. Massachusetts, 557 U.S. 305, 311 n.1 ("[W]e do not hold, and it is not the case, that anyone whose testimony may be relevant in establishing the chain of custody, authenticity of the sample, or accuracy of the testing device, must appear in person as part of the prosecution's case.").

But how much control is enough? Should it be "more than *de minimis*" control? Substantial control? Some other threshold? A "more than *de minimis*" approach is a threshold that courts already use in other contexts, and it makes some sense to the extent that *de minimis* contributions by the operator-analyst do not shape the machine's data, thereby leaving the machine/progenitors as the only declarant(s).[226] However, that result would still require imprecise case-by-case testing for each machine, and the "*de minimis*" threshold answers the "how much is enough" question somewhat arbitrarily. Whatever the threshold is, it will raise difficult questions; for example, if an analyst selects the magnification level for an electron microscope's printed images of a sample, is that enough control? Is choosing the unit of measurement, such as pounds instead of kilograms, *de minimis*?

As an alternative approach, courts could look to the "language conduit" interpreter cases under one of several analogies. Just as there is no right to cross-examine the interpreter, who is merely a conduit through which language passes and is translated, so too would there be no right to cross-examine the operator, who is merely a conduit for the proper operation of the machine. Under that theory, courts would attribute to the machine the operator's contribution in the same way that they attribute the interpreter's contribution to the defendant. Alternatively, the sample could be viewed as continually asserting its properties in a language that requires translation ("My BAC is 10%."), and the machine and operator would be merely a conduit for translating that information to a form that can be used in court. A DNA sample, for example, is already the defendant's DNA profile or not; if we could perceive it in the way the translator (the machine) does, we would know the answer without any analysis.

Applying a language-conduit-style theory to machine-generated data would, as it does with interpreters, leave open the possibility that defendants would be entitled to cross-examine operators who did not act as a mere conduit for normal operation of the machine. This test would also filter out humans communicating through machines, e.g. via word processors, because the operator would then be acting as more than a mere conduit. However, this approach presumably would not use the actual factors from the language conduit cases as they pertain to

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226. *See* United States v. Lamons, 532 F.3d 1251, 1264 n.23 (11th Cir. 2008) ("[C]ertain statements involve so little intervention by humans in their generation as to leave no doubt that they are wholly machine-generated for all practical purposes.").

seemingly unrelated issues, e.g. whether the parties acted in a manner consistent with the translation. A language conduit approach should also omit that doctrine's use of notions of reliability: relying on the reliability of the translator (or machine) and whether the translator (operator-analysts) had any motive to fabricate would be in tension with the post-*Crawford* Confrontation Clause that is divorced from assurances of reliability.[227] However, even as revised, this test would raise the difficult case-by-case questions that plague the control test. And, like the control test, it depends on the underlying theory that the non-assertive actions by some human assistants merits deeming them co-authors of the statement merely because the purpose of using the machine is to generate an assertion.

Both the control test and conduit test could also have unexpected breadth. For example, suppose a burglar broke into a building and, in the course of doing so, cut a padlock. A suspect is brought into custody along with his cutting shears. A forensic analyst receives the cut lock and the shears and, using the same brand of lock, cuts the lock to compare the tool marks to those on the lock from the crime scene. Are the tool marks left on the test lock the statement of that analyst? The analyst merely undertook a physical process, selecting and cutting the lock, and has not yet compared them. The tool marks are functionally "raw data" from the shears, and the analyst is the operator of that tool. Are the raw data tool marks to be considered an assertion by the analyst?

The control test might answer yes to that question. The analyst exercised control over the intensity and frequency of the force used in the cutting (e.g. one hard push versus multiple cumulative pushes), and did so in an arguably formal setting (a lab undertaking investigation into a known crime) for the purpose of generating evidence that could be used in a future trial. Although cutting tools are not machines in the normal sense of that word, they are not so different in complexity from other things that are, such as an analog scale or a thermometer.

That problem, assuming it is a problem, could be addressed with a new requirement: devices, to qualify for the *sui generis* machine-generated data exception, must (a) be designed to make assertions about reality, and (b) have been used in that

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227. *See, e.g.*, United States v. Blazier, 69 M.J. 218, 223 (C.A.A.F. 2010) ("While 'reliability' is the end, the right of confrontation is the means, and it is the means (rather than the end) that the Sixth Amendment insists upon."); *cf.* United States v. Charles, 722 F.3d 1319 (11th Cir. 2013) (reconsidering and criticizing the language conduit theory in light of *Crawford*).

assertive capacity for the data at issue. That definitional limitation would exclude tool marks from many tools because they are not made for the purpose of generating assertions about reality. But, without that definitional limitation, the control test and even the conduit test could encompass the assertive physical actions that do not involve classic assertive machines. For some, that flexibility would be a strength. For others, it sinks the entire theory of attributing raw data to human operators because the tests sweep in too much.

Perhaps because of the difficulty in line-drawing, judges have, with few exceptions, concluded that essentially all machine-generated data does not trigger the Confrontation Clause.[228] That approach is defensible. First, it is the cleaner line to draw in the sand as it is easy to apply: all machine data, minus examples such as the word processor letter, are deemed statements of machines. Second, by emphasizing in *Bullcoming* that the analyst there certified "more than a machine-generated number," the Court arguably suggested that the machine-generated number was not concerning under the Confrontation Clause.[229] Third, the parallel cases on videos and photographs offer an additional column of support, though it is limited support because these cases are often based in part on the idea that photos and videos are merely demonstrative evidence.[230] That premise is debatable when pictures and videos—such as of the crime, the victim's wounds, and of the crime scene—serve as substantive evidence of guilt that goes beyond accompanying testimony.

A stronger argument that machine assistants are not subject to confrontation and cross-examination is the fact that the data produced by machines is the result of a physical process external to the machine operators. A GC-MS is simply a tool, albeit a sophisticated one, and the results of its analysis depend upon a series of physical, non-assertive steps. The results of other physical non-assertive processes are not usually seen as "statements" of the person that initiated them.[231] And just as a non-assertive question is

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228. *See supra* Part III.

229. Bullcoming v. New Mexico, 131 S. Ct. 2705, 2715 (2011); *see also* THE NEW WIGMORE: EXPERT EVIDENCE, *supra* note 25, § 4.12.5.

230. *See supra* Part IV.

231. As one commentator described this argument, "at a theoretical level, it is hard to distinguish most of the records deemed to be computer-generated from footprints left in the mud outside the scene of a crime." Erick J. Poorbaugh, *Interfacing Your Accuser: Computerized Evidence and the Confrontation Clause Following* Melendez-Diaz, 23 REGENT U. L. REV. 213, 226 (2011).

distinct from an answer, so too are the human assistants' non-assertive physical actions distinct from the machine's assertion.

Thus, courts are on strong ground in concluding that, except as to humans communicating through machines, machines are the real declarants and the Confrontation Clause does not reach them. Courts could adhere to that path because: (1) the operator contribution to most machines is *de minimis*; (2) the courts reject the premise that non-assertive actions made to enable another to make an assertion render the operator a co-author; or (3) drawing lines for sufficient operator involvement is difficult and potentially arbitrary, and the Supreme Court has cautioned against Confrontation Clause tests that are too malleable.[232]

This result is the status quo and, though constitutionally sound, is disconcerting. It reduces the amount of exposure analysts have to cross-examination and confrontation because, instead of a constitutional right to confront and question analysts, there are only evidentiary rights of lesser potency that, as seen in *Roberts* and indicated in *Crawford*, are less predictable and easier to satisfy in ways that do not involve the analyst who is most likely to know if he or she ran the right test, followed procedures, cut corners, fabricated the evidence, etc.[233] Cross-examination has exposed some forensic errors, and there are forensic errors—both from sloppy work and from malfeasance—to expose.[234] Surrogate analysts are not a reliable way to catch those errors because, unless the surrogates are complicit in the inadequacy or malfeasance they will not know about those issues (and if they are complicit, the surrogate surely will not reveal that fact). A broad shield against cross-examining the only people who are likely to know about errors and fraud is in tension with the Supreme Court's concerns in *Melendez-Diaz* and *Bullcoming* that forensic results are powerful evidence that is sometimes flawed and should be subject to cross-examination.[235]

Further, as machines become increasingly automated, the Confrontation Clause will shrink further under the status quo model. There is little limit to what machines will be able to do in

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232. Crawford v. Washington, 541 U.S. 36, 61 (2004).

233. States could also interpret their constitution in a manner creating such a constitutional right, but unless the state constitutions contained a different-in-scope confrontation clause, they could meet the same problems that led courts to conclude the federal Confrontation Clause does not encompass machine-generated data.

234. *See supra* note 8.

235. *See, e.g.*, Melendez-Diaz v. Massachusetts, 557 U.S. 305, 318-19 (2009); Bullcoming v. New Mexico, 131 S. Ct. 2705, 2714-15 (2011).

time, and they already do many tasks that were once accomplished by human analysts that would have been subject to cross-examination.[236] It is not difficult to imagine a lab where evidence collected from the crime scene by a forensic drone is tagged with a digital marker and fed through a series of automated machines in an assembly line of analysis, producing data with minimal human oversight. Again, that outcome is not inherently bad—it might decrease both errors and opportunities for malfeasance—but it would, under a model that treats all machine-generated data as the statement of a machine, reduce further the utility of the Confrontation Clause as it pertains to forensic science, which is often an important piece of trials for the most serious criminal matters. That result is inconsistent with the Court's apparent desire in *Davis* to prevent the Confrontation Clause from having an expiration date[237] and the principles expressed by the majority in *Melendez-Diaz* and *Bullcoming*.[238] An alternative model that declines to categorically classify data from forensic machines as machine-generated would be more in line with the purpose of the Confrontation Clause.[239]

Perhaps the only clear non-arbitrary boundary that can be drawn is between humans communicating through machines (e.g., writing letters in a word processor) and humans using machines for everything else. What that approach gains in simplicity it loses in flexibility, and it would be just as easy to attribute all machine data to the humans who pushed start or set the parameters. However, both approaches fail to respond, as categorical rules, to the variety of machines and levels of control operators exercise from case to case.

A case-by-case approach would be more protective of the right to confrontation. By attributing machine-generated testimony to the controlling analysts, the model would preserve the right to cross-examine some analysts and thereby potentially expose their errors. It would also recognize that forensic machines are simply sophisticated tools that humans use to make assertions about the

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236. *See, e.g.*, *supra* notes 3-6 (noting machine advances).

237. *See* Davis v. Washington, 547 U.S. 813, 830 n.5 (2006) ("Restricting the Confrontation Clause to the precise forms against which it was originally directed is a recipe for its extinction.").

238. *See supra* note 8 (listing the many examples of forensic errors and fabrication).

239. *Cf.* State v. Lopez, 45 A.3d 1, 18-19 (R.I. 2012) (analyzing the extent to which an allele table depicting information about DNA analysis was created by an analyst based on machine-generated data as opposed to data generated by a machine an analyst operated).

world. If analysis was pursued with chemistry vials, would the resulting data be statements of the beakers and solutions that the chemist used? In that regard, and in light of the ever-increasing capabilities of automated forensic analysis, this approach would also extend the lifespan of the Confrontation Clause.

The Confrontation Clause offers no clear answer to the question of attribution for machine-generated data. Both approaches described herein—either attributing machine-generated data to human agents or declining to do so and attributing the data to only the machine or its progenitors—are defensible. By attributing some machine-generated data to the controlling analysts, courts could preserve the function of the Confrontation Clause despite the increase in semi-automated machines. That result is consistent with the purposes of the Clause as well. Courts, however, have taken the other path, and the reach of the Confrontation Clause has contracted meaningfully.

G. *Flawed Counterarguments for Machine-Generated Testimony*

Although there are difficult questions surrounding the machine-generated testimony doctrine, some questions should not be seen as presenting the difficulty that courts sometimes ascribe to them. Three such issues warrant brief mention. They are the theory that: (1) the analyst who operated the machine had no way of knowing that the results would implicate the defendant, and thus the data was not testimony "against an accused" under the Confrontation Clause,[240] (2) there would be no value in cross-examining analysts who perform hundreds of tests and are unlikely to recall any particular one,[241] and (3) analysts could not testify to anything except how they ran the tests because it was the machines that made the actual statements about the results.[242]

Courts should not find these claims persuasive. First, the fact that an analyst does not know the result of the test in a criminal case does not change that it is a test run to generate

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240. *See* People v. Doe, 959 N.Y.S.2d 839, 843 (Sup. Ct. 2012) ("[H]ere, the criminalist who lifted the print and who was unavailable, or any other criminalist who could have lifted the print, would have no way of knowing that it would later implicate defendant as having his prints on the note.").

241. *See, e.g.*, People v. Lopez, 286 P.3d 469, 480-81 (Cal. 2012) (Werdegar, J., concurring, joined by three other California Justices) (addressing annotations made by lab assistants).

242. *See, e.g.*, People v. Brown, 918 N.E.2d 927, 931-32 (N.Y. 2009) ("These technicians would not have been able to offer any testimony other than how they performed certain procedures.").

evidence for foreseeable use at a criminal trial. All evidence tends to incriminate some and exculpate others. That evidence is exculpatory to some (because the fingerprint or DNA profile identified does not match one suspect's biometrics) does not change that it incriminates the true perpetrator simultaneously. For this reason and those noted in discussing the *Williams* plurality's "targeted" test, courts should not find this counter-argument persuasive.

Next, although someone who performs any task hundreds of times is unlikely to remember a specific performance, he will remember if he routinely fabricates data or fails to follow testing procedures, and the specter of potential cross-examination will help dissuade some from doing either. Thus, to the extent that courts consider policy and practicality considerations under the Confrontation Clause, this counter-argument is not persuasive because the ability to cross-examine and confront the operator-analyst will have benefits.

Finally, for similar reasons, the argument that the only thing the analyst can testify to is his or her testing procedures (because the machine made the statements) is not persuasive. That "only thing" is exactly why the analyst's testimony is needed. The analyst can say whether he or she followed procedure or fabricated evidence, either specifically or as a general matter, and can also indicate his or her competency. The analyst need not be intentionally sloppy to realize on the stand that he or she made a mistake; even a careful analyst, under the crucible of cross-examination, might realize that a different path was required. Again, to the extent policy and practicality considerations matter, this counter-argument is not persuasive.

H.   *The Problem of Source and Implicit Assertions*

Suppose a court concludes that machine-generated data is not a statement to which the Confrontation Clause applies or that such data is not testimonial. At least two problems remain in admitting the raw data: what specific person or object is its data about, and does the data include an implicit assertion by the operating analyst? The data, to the extent that it is purely machine-generated, cannot reveal source information: a human's assertion that the data pertains to, e.g., blood sample XYZ is often required.

Some courts have noted this problem of source,[243] but not all of them view it as problematic under the Confrontation Clause.[244]

An assertion that the data came from testing a specific sample will be testimonial in many cases because it will be made to link a sample to forensic tests run in the context of generating evidence pertaining to a non-hypothetical crime. Accordingly, even where no Confrontation Clause right arises as to the machine-generated data, the prosecution should generally need to proffer a witness who can attest, from first-hand knowledge, that the data came from testing the specific sample at issue.[245] Similarly, if the prosecutor wants to show that the sample was still sealed immediately before it was tested, that proper testing protocols were actually followed during the test, etc., the data, if machine-generated, cannot do so today—a human must so assert, and that assertion will often be testimonial. The obvious person to call for

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243. *See, e.g.*, People v. Lopez, 286 P.3d 469, 494 (Cal. 2012) (Liu, J., dissenting) ("[The surrogate analyst who testified at court] purported to offer his own independent analysis of the gas chromatography results. But his testimony had no value without the critical link between defendant's blood sample and the test results."); Young v. United States, 63 A.3d 1033, 1038 (D.C. Cir. 2013) ("[A]ll [the testifying supervisor, who was not present during the testing,] could say from personal knowledge was that she compared electropherograms [machine-generated data] and they matched; she could not say from personal knowledge whose electropherograms they were or how they were derived."); United States v. Drayton, Criminal No. PWG-13-0251, 2014 WL 2919792, at *11 (D. Md. June 26, 2014) (concluding the testifying supervisor—who did not run the tests at issue—appeared to lack "the requisite knowledge to tie [the defendant] to the Sample" and recommending that "in the future the Government would be wise to provide a witness with personal knowledge of the provenance of materials on which an expert relies"); s*ee also* State v. Ortiz-Zape, 743 S.E.2d 156, 170 (N.C. 2013) (Hudson, J., dissenting), *cert. denied*, 134 S. Ct. 2660 (2014); Cranston v. State, 936 N.E.2d 342, 345-46 (Ind. Ct. App. 2010); THE NEW WIGMORE: EXPERT EVIDENCE, *supra* note 25, § 4.12.5.

244. *See Lopez*, 286 P.3d at 478-79 (concluding that information pertaining to the "Booking #," "Lab Number," "Sample Sealed," "Subject's Name," and "Arresting Officer," was not testimonial under the Confrontation Clause because it was not sufficiently formal or solemn as the analysts involved had not "signed, certified, or swor[n] to the truth of the contents" and the report said "FOR LAB USE ONLY"). This result is problematic. Forensic analysis undertaken in connection with investigation into a crime—and especially analysis that expressly notes that there is an arresting officer and therefore directly relate to the potential loss of liberty for someone—is not unlike interrogation.

245. *See, e.g.*, Richard Friedman, *Thoughts on Melendez-Diaz: The Product of Machines*, THE CONFRONTATION BLOG (Dec. 18, 2008, 1:43 AM), http://confrontationright.blogspot.com/2008/12/thoughts-on-melendez-diaz-product-of.html (discussing these problems as "the input proposition" and "the output proposition").

these purposes is the operator-analyst who unsealed the sample, ran the test, followed procedures, and ultimately produced the data.

Next, are there implicit testimonial assertions by the analyst-operator in the raw data an analyst submits to a supervisor or court? If, for example, an analyst using a forensic machine submits data about a sample, a court could conclude that the submission of the data implicitly asserts that it is about the sample at issue and that it is not somehow fraudulent. These assertions would, presumably, be more pronounced and solemn where the operator signaled his or her approval of the data, such as by signing or initialing it. Courts are not in agreement on the validity of this proposition, however.[246] Notably, if the data is an implicit assertion by the non-testifying operator, it will also often be testimonial because it was prepared to analyze a specific sample that is relevant to a criminal investigation.

This argument could find limited support in other areas of Confrontation Clause jurisprudence. First, if an interpreter implicitly asserts that his or her translation of the statements at issue is accurate,[247] a lab analyst who produces data from operating a machine could be said to implicitly assert that he or she produced accurate results. As the Eleventh Circuit stated in *Curbelo*, a case addressing that issue for interpreters, "[w]e doubt the prosecution in *Bullcoming* or *Melendez–Diaz* could have avoided the

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246. *Compare* Young v. United States, 63 A.3d 1033, 1046 (D.C. Cir. 2013) ("[T]he [data at issue] do[es] not stand on [its] own but, instead, ha[s] meaning because [it] amount[s] to a communication by the scientists who produced [it]— the assertion, essentially, that the scientists generated these specific results by properly performing certain tests and procedures on particular, uncorrupted evidence and correctly recording the outcomes.") *with Lopez*, 286 P.3d at 478 (emphasis added):

> Turning first to the laboratory report's pages 2 through 6, they consist entirely of data generated by a gas chromatography machine to measure calibrations, quality control, and the concentration of alcohol in a blood sample. Even though nontestifying analyst Peña's signature appears on the laboratory report's second page (the printout of the machine's calibrations) and the remaining pages bear the handwritten initials "JRP" (presumably Jorge Peña's initials), *no statement by Peña, express or implied, appears on any of those pages.*

247. *See* United States v. Curbelo, 726 F.3d 1260, 1272-73 (11th Cir. 2013), *cert. denied*, 134 S. Ct. 962 (2014) (addressing this point as to an interpreter's translation).

Confrontation Clause simply by admitting the numeric or chemical results of the blood-alcohol or cocaine tests without an analyst's certification about how he arrived at those results."[248]

Some courts have reached a similar conclusion. As one court stated, "it is too simplistic to say th[at a machine-generated] printout of" DNA profiles and related information "were not hearsay because they were nothing more than raw data produced by a machine. '[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].'"[249] Machine-generated results "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 specific results by properly performing certain tests and procedures on particular, uncorrupted evidence and correctly recording the outcomes."[250]

However, this "implicit-assertion" approach reaches too far. If a custodian of record produces a compilation of relevant records, the same rationale could lead courts to conclude that the custodian implicitly asserted that the records were the only relevant items. Or, a technician who pulled recorded inmate phone calls for a criminal proceeding could be required to testify because that technician implicitly asserted that those were the only relevant

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248. *Id.* at 1273. However, *Curbelo*'s support is limited by the court's conclusion in that case that the translator's implicit assertion that the translation was accurate was not shared with the jury, even though the transcripts were introduced at trial. *Id.* at 1274. The Eleventh Circuit's conclusion here is strange. If the interpreter's assertion that the translation is accurate is implicit in the translation itself, *see id.* at 1272 ("The translator's only assertion *in the transcripts* is his or her *implicit* statement that the translation was accurate.") (first emphasis added), and the translated transcript was admitted as evidence, *id.* at 1265 ("the Government provided the jury an English-language transcript"), then that implicit assertion of accuracy is also before the jury in the translation itself. Perhaps *Curbelo* was simply a harmless error holding, the idea that the implicit assertion of accuracy was insignificant because another participant/defendant in the conversations reviewed them and testified to their accuracy, but the court did not so describe its holding in concluding that "the transcripts' admission did not violate the Confrontation Clause." *But see id.* at 1274 ("Here, by contrast, the Government did not introduce the transcripts on the weight of the translator's certification, but on Diaz's testimony.").

249. *Young*, 63 A.3d at 1046 (quoting THE NEW WIGMORE: EXPERT EVIDENCE, *supra* note 25, § 4.12.5) (alterations in original) (internal quotation marks and footnotes omitted).

250. *Id.*

calls.[251] It could even lead to the right to cross-examine individuals who undertake more ministerial or mechanical actions in a forensic setting,[252] such as extracting a substance to be analyzed from a sample[253] because, in that process, the technicians could be said to implicitly assert that the result was not fabricated or otherwise in breach of lab protocols. However, requiring testimony from all of these individuals would be in tension with the Court's observation in *Melendez-Diaz* that the Sixth Amendment does not require testimony from every person involved in the chain of custody.[254] It would also be treating unspoken assertions as solemn/formal. For these reasons, the concept of implicit assertions of accuracy triggering the Confrontation Clause is problematic.

Notably, these are technological problems: if the machine had the capability to scan and verify an unadulterated seal, the machine could make that assertion. Similarly, if the machine self-selects its parameters, no human need make that assertion either. Even the problem of source could be solved by convoluted (but not unimaginable) technology: a drone using 3D laser scanning maps a crime scene,[255] uses forensic-based algorithms to identify a potential sample at the crime scene, collects it, tags it with a digital identifier, sends the sample to a lab, and the lab analyzes it with automated machines. With no humans vouching for the source, the machines make the source assertion instead. This example is science fiction today, though some of the parts exist in isolation. Thus, even the problem of source and related concepts can be resolved by technology. This is not inherently a problem, but it challenges the role the Confrontation Clause will play in the future and, in some instances, the present. In the interim, however, the problem of source is best solved by calling the analyst who operated the machine.[256]

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251. *See, e.g.*, State v. Estell, No. 1 CA-CR 11-0846, 2012 WL 6176790, at *5-6 (Ariz. Ct. App. Dec. 11, 2012).

252. *See, e.g.*, United States v. Boyd, 686 F. Supp. 2d 382, 386 (S.D.N.Y.), *aff'd*, 401 F. App'x 565 (2d Cir. 2010).

253. *See, e.g.*, Aguilar v. Commonwealth, 699 S.E.2d 215, 217 (Va. 2010) (finding no Confrontation Clause violation when one expert relied on, *inter alia*, human-operated robotic extraction and processing of DNA samples by another technician).

254. Melendez-Diaz v. Massachusetts, 557 U.S. 305, 311 n.1 (2009).

255. *See* Li, *supra* note 5.

256. *Cf.* THE NEW WIGMORE: EXPERT EVIDENCE, *supra* note 25, § 4.12.5 (discussing the problem of source and noting that, even as to machine-generated data, without the testimony of an operating analyst a surrogate witness cannot link the sample to the defendant or testify that proper procedures were followed during the test); Richard Friedman, THE CONFRONTATION BLOG, *Thoughts on*

I.   *Adapting the Confrontation Clause to the Rise of Machines*

At least one option remains: the Confrontation Clause might evolve. As automated machines increasingly rise to perform the tasks that once were undertaken by human witnesses, the accused's right "to be confronted with the witnesses against him" might expand to allow "confronting" machines.[257] Although the Confrontation Clause seeks to ensure reliability through confrontation and cross-examination, where those tools are not feasible in the traditional sense (how do you cross-examine a machine?), the Clause might be interpreted to promote reliability through analogous means.

Such an approach would not be unheard of; as noted previously, courts could look to the models used for interpreters[258] or canine evidence.[259] Just as there are special requirements for admission of canine evidence, so too could there be special requirements for data generated by forensic machines. Courts could adopt those requirements from the canine or interpreter tests and apply them to forensic machines or, alternatively, they could effectively constitutionalize a version of evidentiary requirements or discovery rules.[260] Finally, other commentators have suggested potential ways the Clause might respond to scientific evidence in particular, such as by requiring the analyst who prepared the report to testify when available.[261]

These models all seek to preserve the thrust of the Clause, confrontation and cross-examination, in an era the Framers did not necessarily foresee. Failure to meet the governing test—for

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Melendez-Diaz: The Product of Machines, The Confrontation Blog, (Dec. 18, 2008, 1:43 AM), http://confrontationright.blogspot.com/2008/12/thoughts-on-melendez-diaz-product-of.html (discussing these problems as "the input proposition" and "the output proposition").

257. U.S. CONST. amend. VI.; *cf.* Merritt Baer, *Who Is the Witness to an Internet Crime: The Confrontation Clause, Digital Forensics, and Child Pornography*, 30 SANTA CLARA COMPUTER & HIGH TECH. L.J. 31, 49 (2013) (noting that "digital evidence will only exacerbate [problems such as those under the Confrontation Clause], as we collect and retain drastically more data, and rely more heavily upon intelligent Internet-based analysis systems to process that data").

258. *See supra* Part III.

259. *See, e.g.*, Starkes v. United States, 427 A.2d 437, 439 (D.C. Cir. 1981); State v. Streeper, 747 P.2d 71, 75 (Idaho 1987); *cf.* Florida v. Harris, 133 S. Ct. 1050 (2013).

260. *Cf.* United States v. Budziak, 697 F.3d 1105, 1112 (9th Cir. 2012).

261. *See, e.g.*, THE NEW WIGMORE: EXPERT EVIDENCE, *supra* note 25, §§ 4.10.2, 4.12.2, 4.12.10.

example, failing to establish the accuracy of the machine, adherence to testing protocols, and that the data was generated from the defendant's sample—could, as a constitutional matter, require exclusion of the evidence. Reinterpreting the Confrontation Clause in these ways would raise many questions: would anyone other than the operating analyst have to testify to satisfy these requirements? What protection would such a right give to defendants in light of existing evidentiary rules and other constitutional provisions? Would this right also apply to dog handlers, interpreters, photographers, and videographers? But, in light of the rise of the machines, such a reimagined Confrontation Clause might be necessary. As one dissenting California justice phrased it:

> The United States Supreme Court has not decided whether machine-generated results invariably lie beyond the reach of the [C]onfrontation [C]lause, and I express no ultimate view on this issue here. I simply note that as a result of ever more powerful technologies, our justice system has increasingly relied on ex parte computerized determinations of critical facts in criminal proceedings— determinations once made by human beings. A crime lab's reliance on gas chromatography may be a marked improvement over less accurate or more subjective methods of determining blood-alcohol levels. The allure of such technology is its infallibility, its precision, its incorruptibility. But I wonder if that allure should prompt us to remain alert to constitutional concerns, lest we gradually recreate through machines instead of magistrates the civil law mode of ex parte production of evidence that constituted the "principal evil at which the Confrontation Clause was directed."[262]

VI. CONCLUSION

The rise of the machines presents difficult questions based on technological changes. Should the right to cross-examine really depend on whether a gas chromatograph selects its own operating parameters, or whether a scale or breathalyzer prints out results instead of requiring someone to write them out by hand? One answer is to attribute such data to the machine/progenitors *and* the

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262. People v. Lopez, 286 P.3d 469, 494 (Cal. 2012) (Liu, J., dissenting) (quoting Crawford v. Washington, 541 U.S. 36, 50 (2004)).

operator. However, the Confrontation Clause does not clearly require that answer, and it is reasonable to conclude that data from human-operated machines is not attributable to the operator. In light of those dueling options, it is more consistent with the Confrontation Clause's goals if courts adopt a model that preserves a right to cross-examine human operators in circumstances where the operator exercises control over the machine. Although today's forensic tools are increasingly complex, the right to cross-examine should not be lost in so many circuit boards.

Under the current interpretation of the Confrontation Clause, however, the right to cross-examine some individuals, especially in the forensic setting, faces an approaching extinction. Science increasingly delivers machines possessing fully automated processes such that the only people who contribute to the machine's speech are the progenitors. This effective expiration date on a portion of the Confrontation Clause is a possibility the Court disfavored in *Davis*,[263] but that, in time, will arrive. It is not unusual for constitutional rights to contract and expand in the face of technological change; Fourth Amendment jurisprudence has long recognized that fact.[264] The current status quo is, nonetheless, troubling. For now, that expiration has not arrived because some machines still require analyst input; the dawn of fully autonomous machines has not yet arrived. But the horizon is a familiar orange, and the sun is steadily ascending; the rise of the machines has only begun.

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263. Davis v. Washington, 547 U.S. 813, 830 n.5 (2006) ("Restricting the Confrontation Clause to the precise forms against which it was originally directed is a recipe for its extinction.") (internal quotation marks omitted).

264. *See generally* Riley v. California, 134 S. Ct. 2473 (2014) (addressing the search-incident-to-arrest doctrine as applied to evolutions in cell phone technology).