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ACTIVITY LEVEL TESTIMONY IN U.S. COURTS: A LEGAL PROBLEM

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ABSTRACT

Discussions surrounding the possible implementation of evaluative activity level reporting and testimony in the United States have increased over the last few years. Several recent U.S. resources follow foundational work in the field produced by the international forensic science community. Notably absent from this literature is any substantive legal analysis of the admissibility of evaluative activity level testimony in U.S. courts. This article is the first to address the issue. After analyzing the principles of evaluative activity level testimony in light of U.S. evidence law, it concludes that such testimony would be admissible in only a narrow set of circumstances and a small number of cases. Evidence offered by the prosecution that supports the defense proposition (H_d) will often be inadequate or non-existent. When this occurs, H_d will fail to satisfy the foundation requirements of conditional relevance under Federal Rule 104(b), "fit" under Federal Rule 702(a), and scientific "knowledge" under Federal Rule 702(b). Given a timely objection, this failure of proof would lead to the legal exclusion of H_d, the conditional probability of the evidence, and the resulting likelihood ratio. In addition to legal challenges, evaluative activity level testimony would pose practical problems for both forensic practitioners and litigants. Accordingly, the U.S. forensic science community should carefully consider whether calls to invest significant time and resources to further explore the foundations and feasibility of evaluative activity level reporting and testimony in the United States is the best path forward.

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INTRODUCTION

In the last few years, discussions concerning evaluative activity level reporting and testimony (eALR&T)[1] in forensic science have steadily increased. International standards,[2] guidelines,[3] scientific papers,[4] and a recent book,[5] have all examined this emerging mode of forensic evaluation. These resources address the conceptual framework, terminology, and potential application of activity level evaluations to forensic casework. To date, the European and Australasian forensic science communities have produced most of this literature.[6] Concurrently,

[1] This article uses the term "evaluative activity level testimony" to describe testimony offered by an activity level expert. In the evaluative activity level approach, an expert formulates two or more (exclusive and exhaustive) propositions that represent the positions of the legal parties (based on case circumstances and background information); assigns the conditional probability of the evidence given those propositions (based on scientific data, case-specific experiments, knowledge, training, and experience); and calculates a likelihood ratio that provides evidentiary support for one of the two competing propositions (unless it is uninformative). This article uses the term "informal activity level testimony" to describe the type of activity level testimony most often encountered in U.S. courts, in which an expert provides an opinion about activity level issues given the evidence and case circumstances.

[2] ASS'N OF FORENSIC SERV. PROVIDERS, STANDARDS FOR THE FORMULATION OF EVALUATIVE FORENSIC SCIENCE EXPERT OPINION, 49 SCI. AND JUST. 161 (2009); FORENSIC SCI. REG., FSR-C-118, DEVELOPMENT OF EVALUATIVE OPINION (2021), https://assets.publishing.service.gov.uk/media/602407728fa8f5146f0769d9/FSR-C-118_Interpretation_Appendix_Issue_1__002_.pdf.

[3] EUR. NETWORK OF FORENSIC SCI. INST., ENFSI GUIDELINE FOR EVALUATIVE REPORTING IN FORENSIC SCIENCE: STRENGTHENING THE EVALUATION OF FORENSIC RESULTS ACROSS EUROPE (STEOFRAE) (2015), http://enfsi.eu/wp-content/uploads/2016/09/m1_guideline.pdf; Peter Gill et al., *DNA commission of the International society for forensic genetics: Assessing the value of forensic biological evidence—Guidelines highlighting the importance of propositions. Part II: Evaluation of biological traces considering activity level propositions*, 44 FORENSIC SCI. INT'L: GENETICS 102186 (2020); NAT'L INST. OF FORENSIC SCI., AN INTRODUCTORY GUIDE TO EVALUATIVE REPORTING (2017), https://www.anzpaa.org.au/ArticleDocuments/357/An%20Introductory%20Guide%20to%20Evaluative%20Reporting.PDF.aspx.

[4] *See, e.g.*, Alex Biederman et al., *Evaluation of Forensic DNA Traces When Propositions of Interest Relate to Activities: Analysis and Discussion of Recurrent Concerns*, 7 FRONTIERS IN GENETICS 215 (2016), HTTPS://WWW.FRONTIERSIN.ORG/JOURNALS/GENETICS/ARTICLES/10.3389/FGENE.2016.00215/FULL; Graham Jackson & Alex Biederman, *"Source" or "Activity" What is the Level of Issue in a Criminal Case?* 16(2) SIGNIFICANCE 36 (2019); HTTPS://ACADEMIC.OUP.COM/JRSSIG/ARTICLE/16/2/36/7029413?LOGIN=FALSE; Bas Kokshoorn & Maartje Luijsterburg, *Reporting on Forensic Biology Findings Given Activity Level Issues in the Netherlands*, 343 FORENSIC SCI. INT'L 111545 (2023); Bas Kokshoorn et al., *Activity Level DNA Evidence Evaluation: On Propositions Addressing the Actor or the Activity*, 278 FORENSIC SCI. INT'L 115 (2017); Duncan Taylor et al., *The Importance of Considering Common Sources of Unknown DNA When Evaluating Findings Given Activity Level Propositions*, 53 FORENSIC SCI. INT'L: GENETICS 102518 (2021); Duncan Taylor et al., *Structuring Cases into Propositions, Assumptions, and Undisputed Case Information*, 44 FORENSIC SCI. INT'L: GENETICS 102199 (2020); Duncan Taylor et al., *Evaluation of forensic genetics findings given activity level propositions: A review*, 36 FORENSIC SCI. INT'L: GENETICS 34 (2018); Duncan Taylor, *A Template for Constructing Bayesian Networks in Forensic Biology Cases When Considering Activity Level Propositions*, 33 FORENSIC SCI. INT'L: GENETICS 136 (2018).

[5] DUNCAN TAYLOR & BAS KOKSHOORN, FORENSIC DNA TRACE INTERPRETATION: ACTIVITY LEVEL PROPOSITIONS AND LIKELIHOOD RATIOS (CRC Press 1st ed. 2023).

[6] *See, e.g.*, ENFSI, *supra* note 3; FORENSIC SCI. REG., *supra* note 2; NAT'L INST. OF FORENSIC SCI., *supra* note 3.

there is a growing body of research that studies DNA transfer, persistence, prevalence, and recovery (TPPR).[7] A central purpose of this work is to provide information and data that will help inform activity level evaluations in legal settings.[8]

More recently, there has been an increased focus on implementing eALR&T in the United States. A study of U.S. forensic DNA practitioners' opinions on activity level reporting was recently published.[9] The Organization of Scientific Area Committees' (OSAC) Human Forensic Biology Subcommittee drafted proposed *Best Practice Recommendations for Evaluative Forensic DNA Testimony*.[10] The Texas Forensic Science Commission published an investigative report on the topic.[11] Finally, a recent NIST report[12] found it "vital that FSSPs [forensic science service providers] engage and educate criminal justice partners *prior* to the implementation of reporting findings given activity-level propositions, to ensure that end-users and factfinders are aware of

[7] *See, e.g.*, Peter Gill et al., *The ReAct project: Analysis of data from 23 different laboratories to characterise DNA recovery given two sets of activity level propositions*, 76 FORENSIC SCIENCE INTERNATIONAL: GENETICS 103222 (2025), https://doi.org/10.1016/j.fsigen.2025.103222; Francesco Sessa et al., *Indirect DNA Transfer and Forensic Implications: A Literature Review*, 14(12) GENES 2153 (2023), https://www.mdpi.com/2073-4425/14/12/2153; Roland A.H. van Oorschot et al., *DNA transfer in forensic science: Recent progress towards meeting challenges*, 12(11) GENES 1766 (2021), https://www.mdpi.com/2073-4425/12/11/1766; Roland van Oorschot et al., *Forensic trace DNA: a review*, 1(1) INVESTIGATIVE GENETICS 14 (2010), https://investigativegenetics.biomedcentral.com/articles/10.1186/2041-2223-1-14.

[8] *See* Peter Gill et al., *The ReAct project: Bayesian networks for assessing the value of the results given activity level propositions*, 76 FORENSIC SCIENCE INTERNATIONAL: GENETICS 103223, 1 (2025) ("The aim of the ReAct project was two-fold: a) To collect data from a large number of casework laboratories to simulate the different case-circumstances identified b) To prepare generalised Bayesian networks that could be used to compute LRs given the prescribed activities."); TAYLOR & KOKSHOORN, *supra* note 5, at 470 ("With the rise in knowledge about TPPR issues (both in court and by the forensic community) and the increasing focus on reporting given activity-level propositions, there has been an explosion of TPPR studies in the last 5 years.").

[9] Yoon Jung Yang et al., *American forensic DNA practitioners' opinion on activity level evaluative reporting*, 67 J. FORENSIC SCI. 1357 (2022).

[10] ORG. OF SCI. AREA COMM., HUM. FORENSIC BIOLOGY SUBCOMM., 2022-S-0024, BEST PRACTICE RECOMMENDATIONS FOR EVALUATIVE FORENSIC DNA TESTIMONY, HUM. FORENSIC BIOLOGY SUBCOMMITTEE (2022).

[11] TEX. FORENSIC SCI. COMM'N, FINAL REP. ON COMPLAINT NO. 23.67; TIFFANY ROY; (TIMOTHY KALAFUT, PH.D.; EVALUATION OF BIOLOGICAL/DNA RESULTS GIVEN ACTIVITY LEVEL PROPOSITIONS) (July 26, 2024), https://www.txcourts.gov/media/1458950/final-report-complaint-2367-roy-tiffany-073024_redacted.pdf.

[12] MELISSA TAYLOR ET AL., EXPERT WORKING GRP. ON HUM. FACTORS IN FORENSIC DNA INTERPRETATION, NIST IR 8503, FORENSIC DNA INTERPRETATION AND HUMAN FACTORS: IMPROVING PRACTICE THROUGH A SYSTEMS APPROACH, NAT'L INST. OF STANDARDS AND TECH. (2024), https://doi.org/10.6028/NIST.IR.8503.

how and when these evaluations can be performed, when they cannot be, and how the opinions should or should not be used."[13] In addition to cross-disciplinary engagement and education in the U.S., the report recommended that the Federal Government provide funding to support a foundation review and subsequent fiscal support for additional research and validation of activity level methods. Specifically, Recommendation 7.3 states:

> The federal government should fund collaborative efforts to review the foundations and principles of evaluating biological results when considering alleged activities. Based on the findings, additional fiscal support should be available to educate and guide DNA and legal communities on the review, research, selection, and validation of appropriate methods to account for DNA transfer, persistence, prevalence, and recovery when assessing biological results.[14]

While a growing body of evaluative activity level literature describes its scientific merit, utility, and application to casework scenarios, notably absent from these resources is any substantive discussion of its potential admissibility in U.S. courts.[15] This article is the first to address the issue.[16] Rather than analyzing the reliability and general acceptance of evaluative activity level testimony under the *Daubert* and *Frye* standards,[17] the scope of this article is limited to analyzing its admissibility under select provisions of modern U.S. evidence rules.[18] Although activity level evaluation is a mode of forensic interpretation applicable to both reporting and testimony, this article focuses on activity level testimony. After addressing the topic in light of relevant U.S. evidence law, it concludes that evaluative activity level testimony would be legally admissible in only a narrow set of circumstances and a small number of cases. This is because the

[13] *Id.* at 181 (emphasis original).
[14] *Id.* at 182.
[15] *See* TAYLOR & KOKSHOORN, *supra* note 5, at 472 ("There is very limited information on large-scale legal challenges to the process.").
[16] *Id.* ("We see the legal studies into the legal admissibility and bounds of activity-level evaluations as being an inevitable area of research that will need to occur at some point."). That day has arrived.
[17] Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579 (1993); Frye v. United States, 293 F. 1013 (D.C. Cir. 1923).
[18] Although beyond the scope of this article, legal counsel could also challenge the foundational relevance ("fit"), sufficiency, and reliability of extant DNA TPPR literature applied through activity level reporting and testimony to a given set of propositions and case circumstances.

prosecution's evidence, which *must* establish a factual basis for the defense proposition offered by its expert, will often be inadequate[19] or non-existent. If this occurs, the defense proposition will fail to satisfy the foundation requirements of conditional relevance under Federal Rule 104(b),[20] "fit" under Federal Rule 702(a),[21] and scientific "knowledge" under Federal Rule 702(b).[22] Given a timely objection, this failure of proof would lead to exclusion of the defense proposition, the conditional probability of the evidence, and in turn, the likelihood ratio (LR). Accordingly, the U.S. forensic science community should carefully consider whether calls to invest significant time and resources to further explore the foundations and feasibility of eALR&T in the United States is the best path forward.

I. ACTIVITY LEVEL EVALUATIONS

In the evaluative reporting framework, activity level propositions specify acts that allegedly occurred as part of the legal parties' different versions of an event of interest. Like casework performed at other levels of the hierarchy of propositions,[23] eALR&T adheres to the following principles of forensic evaluation:

(1) Interpretation of scientific findings is carried out within a framework of circumstances. The interpretation depends on the structure and content of the framework.
(2) Interpretation is only meaningful when two or more competing propositions are addressed.

[19] This article uses the term "inadequate" to describe two closely related evidentiary conditions: 1) evidence that is *misaligned* with or does not *fit* a relevant activity level issue; and 2) evidence that is *insufficient* to establish an evidentiary basis for an activity level proposition. Often, misaligned evidence will also be insufficient. Under Federal Rules of Evidence 104(b), 702(a), and 702(b), the admitted foundation evidence must be *adequate* to support the predicate facts assumed by an expert witness.
[20] FED. R. EVID. 104.
[21] FED. R. EVID. 702(a).
[22] FED. R. EVID. 702(b).
[23] *See* Roger Cook et al., *A hierarchy of propositions: deciding which level to address in casework*, 38 SCI. & JUST. 231-240 (1998).

(3) The role of the forensic practitioner is to consider the probability of the findings given the propositions that are addressed, and not the probability of the propositions.[24]

The second principle requires that an evaluative activity level expert[25] formulate two or more competing propositions that represent the positions of the parties. For legal clarity, this article describes these positions as the prosecutor's proposition (H_p) and the defense proposition (H_d).[26] An expert, based on empirical data and/or knowledge and experience,[27] assigns a conditional probability to the evidence given each proposition.[28] The probabilities are then divided and the resulting LR provides evidentiary support for one proposition over the other.[29]

For example, in a strong-arm robbery case where DNA evidence recovered from the victim's shirt is identical to the defendant's profile, H_p may be that the defendant forcibly grabbed the victim's shirt at the shoulder while pulling away her purse. Alternatively, H_d may be that the defendant, while recently greeting the victim, lightly placed his hand on her clothed shoulder. Once

[24] IAN W. EVETT & BRUCE S. WEIR, INTERPRETING DNA EVIDENCE: STATISTICAL GENETICS FOR FORENSIC SCIENTISTS 29 (Sinauer Assoc. Inc. 1998); ENFSI, *supra* note 3, at 23; TAYLOR & KOKSHOORN, *supra* note 5, at 16-19.

[25] In this article, the term "expert," when used in the evaluative activity level context, refers to a forensic practitioner who has obtained the requisite scientific credentials and qualifications; is employer-authorized to testify to evaluative activity level issues; and has been court-qualified as an expert witness in evaluative activity level testimony.

[26] "*H*" stands for "hypothesis." In the evaluative activity level context, modern usage prefers the term "proposition" over hypothesis. The text in this article will use the term proposition, while the notation for proposition will be "*H*." For purposes of this article, their meaning is intended to be identical. In addition, p = prosecution; d = defense. The prosecution and defense propositions are referred to elsewhere as (H_1, H_2), and (H_p, H_a) (a = alternative).

[27] TAYLOR & KOKSHOORN, *supra* note 5, at 54 ("Even when 'hard' data is not available to the scientist (i.e., data based on controlled scientific studies) then 'soft' probability assignments can be used. These assignments are when the scientist assigns a probability based on their understanding of the aspects of the event being considered and their experience in the dynamics of transfer and persistence in the discipline in which they work."); ENFSI, *supra* note 3, at 19 ("[D]ata can take, for example, the structured form of scientific publications, databases or internal reports or, in addition to or in the absence of the above, be part of the expert knowledge built upon experiments conducted under controlled conditions (including case-specific experiments), training and experience."); Graham Jackson et al., *The Nature of Forensic Science Opinion — A Possible Framework to Guide Thinking and Practice in Investigations and in Court Proceedings*, 46 SCI. & JUST. 1, 33, 37 (2006) ("Experience of similar situations, either through casework or through the scientist's own practical experimentation, would be of benefit at this stage. Good memory of the outcomes of these previous situations and experiments, and good organisation of that information, would be an essential attribute to help form robust probabilities. . . . The availability of published data, relevant to the case at hand, would greatly assist in the assignment of subjective probabilities.").

[28] TAYLOR & KOKSHOORN, *supra* note 5, at 126.

[29] Unless the LR is "1," in which case it is uninformative and provides no evidentiary support to either proposition.

these propositions are formulated and the conditional probabilities are assigned, an expert can report and testify to the resulting LR — or so the story goes. However, the legal status of evaluative activity level propositions — considering broadly applicable evidence rules and principles of proof — warrants a closer look.

II. EVALUATIVE PROPOSITIONS

Propositions are statements that are either true or false and that can be affirmed or denied.[30] They are generated from task-relevant case circumstances and background information.[31] Propositions must be mutually exclusive, meaning they cannot both be true at the same time.[32] One or more proposition pairs[33] should also be exhaustive, covering all *relevant* scenarios in a given case.[34] Once propositions are formulated, probabilities are assigned to the evidence conditioned on the truth of each proposition.[35] That is, an expert assigns the probability of the evidence *if* certain conditions hold or *if* certain information is considered.

After activity level findings are reported, an expert may be asked to provide testimony about the evaluation. Typically, the expert will describe the principles of forensic evaluation, the propositions, case circumstances, and sources of information used to complete the evaluation. The expert will then testify to the conditional probability of the evidence given the competing propositions of the prosecution, H_p, and the defense, H_d. Finally, the expert will testify to the LR, which provides the value or strength of the evidence favoring one of the two propositions.[36]

[30] ENFSI, *supra* note 3, at 24.
[31] ENFSI, *supra* note 3, at 21.
[32] ENFSI, *supra* note 3, at 24.
[33] TAYLOR & KOKSHOORN, *supra* note 5, at 98.
[34] TAYLOR & KOKSHOORN, *supra* note 5, at 103.
[35] TAYLOR & KOKSHOORN, *supra* note 5, at 167-74.
[36] Unless the evidence is equally likely given both propositions, and thus an uninformative "1."

III. LEGAL ISSUES

Propositions are equivalent to the legal issues in a case.[37] Legal issues must be supported by admitted evidence, and evidence must be relevant to be admissible.[38] Federal Rule 401 states that evidence is relevant if "(a) it has any tendency to make a fact more or less probable than it would be without the evidence; and (b) the fact is of consequence in determining the action."[39] The fact to be proved "may be ultimate, intermediate, or evidentiary . . . so long as it is of consequence in the determination of the action."[40] Thus, relevance is a logical connection between the evidence and a consequential fact (issue in dispute) that reflects the tendency of the evidence to provide support for or against that fact.[41]

Translating these legal principles into evaluative terms, if the evidence provides support for (i.e., makes more or less probable) either of the two competing activity level propositions (i.e., facts of consequence in determining the action) it is relevant. LRs exist on a continuous scale from zero to infinity, with number "1" being uninformative and arguably irrelevant.[42] If the evidence is

[37] TAYLOR & KOKSHOORN, *supra* note 5, at 110; ENFSI, *supra* note 3, at 21 ("The key issue(s) provide the general framework within which requests to forensic practitioners and propositions (for evaluative reporting) are formally defined."); Jackson et al., *supra* note 27, at 35 ("We have found that the specification of *propositions* begins with a consideration of the questions that are of importance. We deal [] with the types of *questions* usually associated with court proceedings.") (emphasis original).

[38] FED. R. EVID. 402.

[39] FED. R. EVID. 401.

[40] FED. R. EVID. 401 original advisory committee note.

[41] *See e.g.*, State v. Hutchins, 575 A.2d 35, 38 (N.J. Super. Ct. App. Div. 1990) ("The true test [for relevance] is the logical connection between the proffered evidence and a fact in issue, *i.e.*, whether the thing sought to be established is more logical with the evidence than without it.").

[42] Numerous judicial decisions have found that "cannot be excluded" or "inconclusive" DNA findings are relevant. *See, e.g.*, United States v. Mariano, 636 F. App'x 532, 538 (11th Cir. 2016) (inconclusive); United States v. Baylor, 537 F. App'x 149, 162 (4th Cir. 2013) (inconclusive); United States v. Kent, 531 F.3d 642, 651 (8th Cir. 2008) (cannot be excluded); United States v. Mitchell, 502 F.3d 931, 969-70 (9th Cir. 2007) (cannot be excluded); United States v. Hicks, 103 F.3d 837, 846 (9th Cir. 1996) (cannot be excluded); United States v. Donald, No. 3:21-cr-8 (VAB), 2023 U.S. Dist. LEXIS 188828, at *53-55 (D. Conn. Oct. 20, 2023) (inconclusive); State v. Barnett, No. 1 CA-CR 18-0763, 2020 Ariz. App. Unpub. LEXIS 323, at *9 (Mar. 19, 2020) (cannot be excluded); People v. Byrne, C097334, 2024 Cal. App. Unpub. LEXIS 7724, at *68-69 (Cal. Ct. App. Dec. 6, 2024) (Y-STR profile relevant because defendant "could not be excluded" as its source) ("Evidence is not irrelevant simply because there are innocuous explanations for the existence of the evidence."); Taylor v. State, 76 A.3d 791, 803 (Del. 2013) (cannot be excluded); Rogers v. State, No. 2091, 2021 Md. App. LEXIS 590, at *42 (July 12, 2021) (inconclusive); Clark v. State, 96 A.3d 901, 907

X times more likely ($\neq$ "1") if H_p (activity) is true than if H_d (activity) is true (or the converse), it is relevant. Therefore, the LR scale of zero to infinity is an appropriate forensic analog to Rule 401(a)'s directive that evidence is relevant if it has *any* tendency to make a fact more or less probable. Likewise, activity level propositions, typically formulated by an expert based on case circumstances (and/or direct input from the legal parties), also fit Rule 401(b)'s requirement that the fact (i.e., proposition/legal issue) must be "of consequence in determining the action." This is because propositions are contested issues in a case. However, if they are not contested, they have no consequence. Accordingly, they are not relevant and cannot be admitted into evidence.[43]

IV. ASSUMING VS. ASSERTING

A forensic expert's evaluative activity level testimony provides the strength of the evidence assuming (or conditioned on) the truth of competing propositions that represent the positions of the parties. As explained by Taylor & Kokshoorn, "The propositions are not assumed to be occurring, other than to consider the probability of obtaining the observations if one proposition was true compared to if a competing proposition was true."[44]

Consistent with this approach, U.S. evidence law permits an expert witness to *assume* the truth of factual predicates and to offer an opinion based on those assumptions without *asserting*

(Md. Ct. Spec. App. 2013) (inconclusive); Rodriguez v. State, 273 P.3d 845, 850-52 (Nev. 2012) (cannot be excluded); People v. Higgins, No. 72944-23, 2024 N.Y. Misc. LEXIS 24162, at *4-5 (N.Y. Sup. Ct. Dec. 5, 2024) (despite LR value in the "inconclusive range," defense expert's testimony would be "probative and helpful"); State v. Belt, No. 30445, 2024 S.D. LEXIS 172, at *11-12 (S.D. Dec. 18, 2024) (fact that inconclusive male DNA did not identify defendant did not render it non-probative under Rule 403); Jean v. State, NO. AP-76,601, 2013 Tex. Crim. App. Unpub. LEXIS 785, at *19-21 (June 26, 2013) (inconclusive).

[43] JACK E. WEINSTEIN & MARGARET A. BERGER, 1 WEINSTEIN'S EVIDENCE MANUAL § 6.01 LEXIS (database updated May 2024) ("If an item of evidence tends only to prove a fact not of consequence in determining the action, it is, according to the terminology of the Federal Rules, irrelevant.").

[44] TAYLOR & KOKSHOORN, *supra* note 5, at 56.

their truth.[45] Likewise, the common law allowed experts to respond to hypothetical questions about "facts concerning the events at issue in a particular case" of which they lack firsthand knowledge.[46] Activity level experts' knowledge of relevant facts comes from case circumstances and background information. Although such experts typically have no firsthand knowledge of the facts, they may still offer opinions that assume the truth of the propositions they formulate from those facts. However, if an expert's testimony goes further and asserts the truth of either the case facts or the propositions, it will likely run afoul of both the Sixth Amendment and the rule against hearsay.[47]

A. Facts Assumed by Experts

The relationship between the common law hypothetical question and the Federal Rules of Evidence[48] raises questions concerning the legal status of activity level propositions and their evidentiary requirements. If a litigant asks an expert a hypothetical question, all U.S. jurisdictions require that the facts assumed by the expert must be supported by admitted evidence.[49] However,

[45] Smith v. Arizona, 602 U.S. 779, 799 (2024); Williams v. Illinois, 567 U.S. 50, 57 (2012) (plurality opinion) ("Under settled evidence law, an expert may express an opinion that is based on facts that the expert assumes, but does not know, to be true.").
[46] *Williams*, 567 U.S. at 67.
[47] *Smith*, 602 U.S. at 795-99 (2024).
[48] In this article, all references to the Federal Rules of Evidence include, by implication, state-level evidence codes, which largely mirror the text of the Federal Rules.
[49] United States v. Moya, 5 F.4th 1168, 1190 (10th Cir. 2021); United States v. Stinson, No. 07-50408, No. 07-50409, 2011 U.S. App. LEXIS 17979, at *33 (9th Cir. Mar. 8, 2011); United States v. Munoz-Franco, 487 F.3d 25, 37 (1st Cir. 2007); Fluckey v. Chi. & Nw. Transp. Co., 838 F.2d 302, 303 (8th Cir. 1988); United States v. Hewitt, 663 F.2d 1381, 1391 (11th Cir. 1981); United States v. Breuer, 14 M.J. 723, 725 (A.F. C.M.R. 1981); United States v. Morgan, 554 F.2d 31, 33 (2d Cir. 1977); Heard v. United States, 348 F.2d 43, 45-46 (D.C. Cir. 1964); Carroll v. Magnolia Petroleum Co., 223 F.2d 657, 664 (5th Cir. 1955); United States v. Reveles, 41 M.J. 388, 394 (A.C.M.R. 1995); Ranger, Inc. v. Equitable Life Assurance Soc., 196 F.2d 968, 973 (6th Cir. 1952); Va. Beach Bus Line v. Campbell, 73 F.2d 97, 99 (4th Cir. 1934); Guzik v. United States, 54 F.2d 618, 619-20 (7th Cir. 1931); Phila. & R.R. Co. v. Cannon, 296 F. 302, 306 (3rd Cir. 1924); McWhorter v. State, 142 So. 3d 1195, 1254 (Ala. Crim. App. 2011); West v. State, 409 P.2d 847, 849-50 (Alaska 1966); State v. Clark, 543 P.2d 1122, 1125 (Ariz. 1975); Ince v. State, 93 S.W. 65, 67 (Ark. 1906); People v. Sanchez, 374 P.3d 320, 328 (Cal. 2016); People v. Manier, 518 P.2d 811, 814 (Colo. 1974); State v. O'Brien-Veader, 122 A.3d 555, 576 (Conn. 2015); Horton v. United States, 15 App. D.C. 310, 325 (D.C. 1899); Gen. Motors Corp. v. McNemar, 202 A.2d 803, 806 (Del. 1964); Smith v. State, 7 So. 3d 473, 501 (Fla. 2009); Jackson v. State, 575 S.E.2d 447, 449 (Ga. 2003); Barretto v. Akau, 463 P.2d 917, 921 (Haw. 1969); State v. Birrueta, 623 P.2d 1292,

modern evidence rules eliminate the need for hypothetical questions and permit experts to instead offer their opinions based on facts about which they have no firsthand knowledge.[50] One such rule is Federal Rule 703,[51] which describes the permissible bases for an expert's opinion and the legal status of the underlying facts.

Under Rule 703, experts may base their opinions on facts they have personally observed (i.e., firsthand knowledge), and/or facts they have "been made aware of."[52] These extrajudicial "learned" facts may include case circumstances or background information. They "need not be admissible for the [expert's] opinion to be admitted."[53] However, Rule 703 requires that they be the "kinds of facts or data" that "experts in the particular field would reasonably rely on . . . in forming an opinion on the subject…."[54] If basis facts are not admissible because, for example, they constitute testimonial hearsay, they can only be admitted — subject to judicial balancing — for a

1293 (Idaho 1981); People v. Johnson, No. 1-17-2789, 2020 Ill. App. Unpub. LEXIS 414, at *27 (Mar. 13, 2020); Henson v. State, 535 N.E.2d 1189, 1192 (Ind. 1989); Hubby v. State, 331 N.W.2d 690, 696 (Iowa 1983); State v. Perry, 1994 Kan. App. Unpub. LEXIS 534, at *4 (Apr. 22, 1994); Thomas v. Commonwealth, 170 S.W.3d 343, 352 (Ky. 2005); State v. Cass, 356 So. 2d 396, 399 (La. 1977); State v. Bunker, 351 A.2d 841, 844 (Me. 1976); Booth v. State, 608 A.2d 162, 182 (Md. 1992); Commonwealth v. Burgess, 879 N.E.2d 63, 75 (Mass. 2008); People v. Bowen, 130 N.W. 706, 709 (Mich. 1911); State v. Hanley, 26 N.W. 397, 399 (Minn. 1886); Williams v. State, 544 So. 2d 782, 787 (Miss. 1987); State v. Brown, 79 S.W. 1111, 1116 (Mo. 1904); State v. Thompson, 524 P.2d 1115, 1119 (Mont. 1974); Hoffman v. State, 77 N.W.2d 592, 597 (Neb. 1956); Van Fleet v. O'Neil, 192 P. 384, 386 (Nev. 1920); State v. Small, 102 A. 883, 885 (N.H. 1917); State v. Sowell, 61 A.3d 882, 890 (N.J. 2013); State v. Klasner, 145 P. 680, 683 (N.M. 1914); People v. Park, 876 N.Y.S.2d 94, 95 (N.Y. App. Div. 2009); State v. Anthony, 555 S.E.2d 557, 589 (N.C. 2001); Wanna v. Miller, 136 N.W.2d 563, 570 (N.D. 1965); State v. McKelton, 70 N.E.3d 508, 565 (Ohio 2016); Romano v. State, 909 P.2d 92, 117 (Okla. Crim. App. 1995); State v. Ollila, 728 P.2d 900, 901 (Or. Ct. App. 1986); Commonwealth v. Churchill, No. 2326 EDA 2021, No. 2327 EDA 2021, 2023 Pa. Super. Unpub. LEXIS 115, at *16 (Jan. 12, 2023); State v. Thornley, 319 A.2d 94, 97 (R.I. 1974); State v. King, 71 S.E.2d 793, 796 (S.C. 1952); State v. Swenson, 129 N.W. 119, 122-23 (S.D. 1910); State v. Ballard, No. E2017-00587-CCA-R3-CD, 2018 Tenn. Crim. App. LEXIS 373, at *22 (Dec. 20, 2018); Straker v. State, No. 08-14-00111-CR, 2016 Tex. App. LEXIS 10706, at *70 (Sept. 30, 2016); State v. Lingman, 91 P.2d 457, 463 (Utah 1939); State v. Jones, 631 A.2d 840, 846 (Vt. 1993); Simpson v. Commonwealth, 318 S.E.2d 386, 391 (Va. 1984); State v. Lathrop, 192 P. 950, 951 (Wash. 1920); State v. Evans, 66 S.E.2d 545, 549 (W. Va. 1951); Novitzke v. State, 284 N.W.2d 904, 907 (Wis. 1979); Lujan v. State, 423 P.2d 388, 392 (Wyo. 1967).

[50] *Williams*, 567 U.S. at 69; *see also* Crawford v. Rogers, 406 P.2d 189, 191 (Alaska 1965); Rabata v. Dohner, 172 N.W.2d 409, 419-40 (Wis. 1969) ("[T]he members of this court, based on their experience gleaned as practicing lawyers and trial judges, are satisfied that a mechanistic hypothetical question has the effect of boring and confusing a jury.").

[51] FED. R. EVID. 703.

[52] *Id.*

[53] *Id.*

[54] *Id.*

valid non-testimonial purpose.[55] After balancing, if the facts are admitted, the trial court must — upon proper request — give the jury a limiting instruction advising it that the underlying information must not be used for substantive purposes.[56] However, as discussed below, a recent U.S. Supreme Court decision on the government's use of basis facts requires trial courts to carefully scrutinize the reasons why such facts are offered.[57] As a result, courts will likely restrict the admission of basis facts in future cases.[58]

B. Activity Level Applications

Applying these principles to evaluative activity level testimony, task-relevant case information and data are surely the "kinds of facts or data" on which activity level experts would "reasonably rely . . . in forming an opinion."[59] In addition, these facts "need not be admissible for the [activity level] opinion to be admitted."[60] However, experts may disclose this information to the jury only if a party proponent offers it for a *valid* non-testimonial purpose, and its probative value substantially outweighs its prejudicial effect.[61] Nevertheless, activity level experts may testify about their core evaluative finding — the LR — and how (or whether) the evidence favors

[55] *Id.*; *see also* Smith v. Arizona, 602 U.S. 779, 794-95 (2024).
[56] FED. R. EVID. 703 advisory committee's note to 2000 amendment ("If the otherwise inadmissible information is admitted under this balancing test, the trial judge must give a limiting instruction upon request, informing the jury that the underlying information must not be used for substantive purposes.").
[57] *Smith*, 602 U.S. at 794-95.
[58] *See In re* Nickerson, NO. 03-23-00126-CV, 2024 Tex. App. LEXIS 5708, at *13 (Aug. 9, 2024) ("[E]vidence of the bases for an expert opinion must be considered for the truth of those bases if the opinion they support is to have any evidentiary value." (citing Smith v. Arizona, 602 U.S. 779, 795 (2024))).
[59] *Cf.* United States v. Wahib, 636 F. Supp. 3d 816, 830 (N.D. Ohio 2022) (FBI interview summaries are the type of material on which a medical expert would reasonably rely in forming an opinion); United States v. Dorsey, CR 14-328-CAS, 2015 U.S. Dist. LEXIS 90147, at *26 (C.D. Cal. July 6, 2015) (firearms expert could reasonably rely on police reports when forming opinion); People v. Soteras, 693 N.E.2d 400, 408 (Ill. App. Ct. 1998) (accident reconstructionist reasonably relied on police reports and witness statements); State v. Hendrix, 883 S.W.2d 935, 941-42 (Mo. Ct. App. 1994) (physician reasonably based opinion on police reports).
[60] FED. R. EVID. 703.
[61] *See Smith*, 602 U.S. at 794-95 (placing in doubt the continued validity of Rule 703's balancing test for forensic basis facts).

one proposition over the other. Likewise, experts may disclose their activity level propositions to the jury if it is clear they are simply *assuming* — but not *asserting* — the truth of those propositions. If so, the testimony would not exceed constitutional or evidentiary limits.[62]

Thus far, evaluative activity level testimony seems to fit comfortably within the legal framework provided by U.S. rules of evidence. Propositions equate to the relevant legal issues in a case. The LR scale from zero to infinity is analogous to the definition of relevant evidence in Rule 401. Rule 703 permits activity level experts to base their opinions on hypothetical questions, personal knowledge, or facts learned outside of court that need not be admissible for their opinions to be admitted.

C. The Hypothetical Question and Modern Evidence Rules

How then, do common law rules for the hypothetical question and Rule 703 work together when considering the legal requirements for evaluative activity level testimony? If a prosecutor[63] sponsors an expert's testimony, their opinion will probably not be elicited through the use of a hypothetical question.[64] Instead, consistent with Rule 703, the prosecutor will likely ask the expert several foundational questions about the general types of information and data they relied on in forming their opinion, and whether other experts in the field typically rely on such information. The prosecutor will then ask the expert whether they were able to form an opinion in the case, and

[62] *Id.* at 799. This is still true after Smith, where the Court noted the continued viability of hypothetical questions. In response to such questions, experts may assume the truth of predicate facts the offering party must later prove with independent evidence.

[63] This article examines evaluative activity level testimony from the prosecution's perspective because prosecutors are the legal party most likely to offer such testimony in U.S. courts. This perspective is taken simply for illustrative purposes; however, much of the same analysis would apply to its use by the defense.

[64] Although it would be perfectly permissible to do so. *See* FED. R. EVID. 702, 1975 advisory committee note ("The technique may be the familiar hypothetical question or having the expert attend the trial and hear the testimony establishing the facts."); *see also Smith*, 602 U.S. at 799.

how they went about doing that. The expert will likely reply, based on the case circumstances (which may or may not be admissible — or yet admitted), that they formulated and considered two competing propositions that represent the positions of the parties on the activity level issue. Next, the expert will describe the facts they assumed to perform the evaluation. Since the prosecutor did not ask the expert a hypothetical question, the legal question becomes: When a hypothetical is *not* used to elicit evaluative activity level testimony, does the common law requirement that independent evidence must be admitted to establish the facts assumed by an expert disappear? The answer is clearly "no."[65]

Although a prosecutor need not ask a hypothetical question to elicit activity level testimony, the legal rule that facts (i.e., the propositions) assumed by an expert must be established through independent evidence remains intact.[66] Rule 703's provision that the facts an expert relies on "need not be admissible for the [expert's] opinion to be admitted" means just that — and *only* that.[67] The rule simply eliminated the need *to admit* (reasonably relied on) *basis facts* before an

[65] *See* Novartis Corp. v. Ben Venue Labs., Inc., 271 F.3d 1043, 1051 (Fed. Cir. 2001) ("[W]here an expert's opinion is predicated on factual assumptions, those assumptions must also find some support in the record."); Adams v. United States, Civ. No. 03-0049-E-BLW, 2009 U.S. Dist. LEXIS 67255, at *10-11 (D. Idaho Aug. 1, 2009) ("While an expert may render an opinion based on inadmissible facts, the expert's opinions cannot be based on assumptions that have no basis in fact."); Crawford v. Rogers, 406 P.2d 189, 191 (Alaska 1965) (expert opinion need not be elicited through a hypothetical question but must be based on facts in evidence); State v. Powell, C.A. Case No. 18095, 2000 Ohio App. LEXIS 5829, at *29 (Dec. 15, 2000) ("[T]o the extent that the expert applies to the facts in evidence scientific principles, theories, calculations, measurements, or tables — which have qualified the witness as an expert — such principles, theories, calculations, measurements, or tables need not be in evidence *if the predicate facts are in evidence*.") (emphasis added); Rabata v. Dohner, 172 N.W.2d 409, 419-40 (Wis. 1969) (expert opinion need not be elicited through a hypothetical question but must be based on "evidence introduced at the trial"); *but see* David H. Kaye & Jennifer L. Mnookin, *Confronting Science: Expert Evidence and the Confrontation Clause*, 2012 SUP. CT. REV. 99, 29 (2013), https://elibrary.law.psu.edu/cgi/viewcontent.cgi?article=1288&context=fac_works, (confusing extrajudicial basis facts under Rule 703 with the separate foundation requirement to introduce independent substantive evidence to establish the relevance of facts assumed by experts as a predicate for their opinions).

[66] *See Adams*, 2009 U.S. Dist. LEXIS 67255, at *10-11.

[67] Hetrick v. Link, Civil No. 1:23cv961 (DJN), 2024 U.S. Dist. LEXIS 166885, at *5 (E.D. Va. Sept. 11, 2024) (Rule 703 controls only whether experts reasonably relied on inadmissible information in forming their opinions).

expert's opinion may be admitted.[68] It provides no end-run around the separate legal requirement that *predicate facts* must be established by admitted evidence.[69]

On this point, it is crucial to understand the legal difference between basis facts[70] referenced in Rule 703, predicate facts[71] referenced in Rule 104(b), and the roles they play in these rules. Rule 703 permits experts to use reliable — but often *inadmissible* — basis facts when *forming* (but not necessarily disclosing) their opinions.[72] Rule 104(b) requires that an expert's opinion — to be relevant — must first be based on *admitted* predicate facts.[73] Nothing in Rule 703

[68] *See* United States v. Waddell, 93-3982, 1994 U.S. App. LEXIS 16047, at *14-16 (6th Cir. June 22, 1994) (Although the trial court erroneously assumed the expert witness could not testify until the underlying facts on which he relied were admitted and presented to the jury — despite Rule 703's abandonment of that requirement — the expert's testimony did not satisfy Rule 702's *separate* requirement that such testimony must aid the jury. Because no predicate facts were introduced that supported the factual basis for the expert's opinion, the testimony did not aid the jury in understanding the evidence or in resolving the factual disputes, as Rule 702 requires. Therefore, the testimony was excluded under Rule 702.); *see also* Leonard v. State, 506 S.E.2d 853, 871 (Ga. 1998) (although experts may rely on hearsay to help form their opinions, "this does not provide a mechanism by which hearsay that forms the sole basis of an expert's opinion can be placed before the jury in violation of the basic rules of evidence. . . . [A]ssumed facts must be placed in evidence by testimony or other legal means.").

[69] *See Waddell*, 1994 U.S. App. LEXIS 16047, at *14-16; *Leonard*, 506 S.E.2d at 871; *see also* Cella v. United States, 998 F.2d 418, 423 (7th Cir. 1993) ("Under [Rule 703] expert testimony must be rejected if it lacks an adequate basis in fact."); *Novartis Corp*., 271 F.3d at 1051; *Adams*, 2009 U.S. Dist. LEXIS 67255, at *10-11; *Powell*, 2000 Ohio App. LEXIS 5829, at *29.

[70] Basis facts are information or data that experts have either personally observed or have been made aware of that they may reasonably rely on *in forming an opinion* on a subject that is the topic of expert opinion testimony. *See* FED. R. EVID. 703.

[71] *Predicate fact*, BLACK'S LAW DICTIONARY (12th ed. 2024) (Westlaw) (A predicate fact is "[a] fact necessary to the operation of an evidentiary rule." A predicate fact is also referred to as a foundational fact or an evidentiary fact.).

[72] *See* FED. R. EVID. 703; Water Pollution Control Auth. of Norwalk v. Flowserve US Inc., 3:14-cv-00549 (VLB), 2018 U.S. Dist. LEXIS 52168, at *40 (D. Conn. Mar. 28, 2018) ("While an expert may rely on inadmissible hearsay in forming opinions, the expert may not simply repeat information she read or heard without analysis." (citing United States v. Mejia, 545 F.3d 179, 197 (2d Cir. 2008))).

[73] Turner v. Burlington N. Santa Fe R.R., 338 F.3d 1058, 1062 (9th Cir. 2003) (lab report used by expert, not as data to inform his opinion but as substantive evidence of his ultimate conclusion, was inadmissible hearsay absent foundational testimony by the lab that conducted the testing); *Novartis Corp*., 271 F.3d at 1051; SEC v. McGinnis, Case No. 5:14-cv-6, 2019 U.S. Dist. LEXIS 242311, at *11 (D. Vt. Feb. 22, 2019) (although an expert may rely on inadmissible hearsay in forming an opinion, the sponsoring party must establish a factual predicate that supports the expert's conclusions); City of Phila. v. Workers' Comp. Appeal Bd. (Kribel), 29 A.3d 762, 764 (Pa. 2011) ("[A]n expert's opinion does not constitute substantial competent evidence where it is based on a series of assumptions that lack the necessary factual predicate."); *Powell*, 2000 Ohio App. LEXIS 5829, at *29 ("[T]o the extent that the expert applies to the facts in evidence scientific principles, theories, calculations, measurements, or tables — which have qualified the witness as an expert — such principles, theories, calculations, measurements, or tables need not be in evidence *if the predicate facts are in evidence*.") (emphasis added).

affects Rule 104(b)'s separate foundation requirement[74] that relevance is conditioned on the admission of essential facts.[75] In other words, "[w]hile an expert may render an opinion based on inadmissible facts, the expert's opinions cannot be based on assumptions that have no basis in fact."[76] Accordingly, Rule 703 does not negate the common law rule that an expert's factual assumptions must be based on admitted evidence regardless of whether their opinion is disclosed in response to a hypothetical question.[77] As one court succinctly stated, "While an expert may assume facts to form opinions, the expert's opinions themselves cannot constitute assumptions."[78]

[74] *See, e.g.,* Elcock v. Kmart Corp., 233 F.3d 734, 756 & n.13 (3rd Cir. 2000) ("Interestingly, though the foundation requirement for expert testimony is well developed in the case law and in the experience of trial lawyers and judges, neither our opinions . . . nor the evidence treatises themselves expressly ground this requirement in one of the Federal Rules of Evidence or in the legislative history or advisory committee notes accompanying the Rules. Like the case law and trial practice governing cross-examination for bias . . . the foundation requirement is a rule of evidence that can only be found in the interstitial gaps among the federal rules."); Damon v. Sun Co., 87 F.3d 1467, 1474 (1st Cir. 1996) (expert testimony must be based on legally sufficient evidentiary foundation); United States v. Satterfield, ARMY 20180125, 2019 CCA LEXIS 448, at *8-9 (A. Ct. Crim. App. Oct. 30, 2019) (without predicate evidence, expert's testimony was not relevant); People v. Valencia, 489 P.3d 700, 711 (Cal. 2021) ("The proper role of expert testimony is to help the jury understand the significance of case-specific facts proven by competent evidence, not to place before the jury otherwise unsubstantiated assertions of fact."); People v. Osborne, 538 N.E.2d 822, 825-26 (Ill. App. Ct. 1989) ("Before an expert is allowed to state his opinion, the facts upon which that opinion are based must be in evidence. Admissibility of expert testimony is conditional upon laying such a foundation."); Schlossman v. State, 659 A.2d 371, 379 (Md. Ct. Spec. App. 1995) (an expert's conclusions must be based on a legally sufficient foundation from facts established in the record); *In re* Welfare of E.A.A.M., A05-58, 2005 Minn. App. Unpub. LEXIS 383, at *7 (Oct. 11, 2005) ("An expert's opinions must be based on facts in evidence in order to have adequate foundation and the expert should not be allowed to speculate."); State v. Downey, 195 P.3d 1244, 1252 (N.M. 2008) ("Experts may, and often do, base their opinions upon factual assumptions, but those assumptions in turn must find evidentiary foundation in the record."); Marathon Corp. v. Pitzner, 106 S.W.3d 724, 729 (Tex. 2003) ("Expert opinions must be supported by facts in evidence, not conjecture."); Davenport v. Commonwealth, No. 1300-22-2, 2023 Va. App. LEXIS 827, at *9 (Dec. 12, 2023) (an expert's testimony lacks proper foundation if his opinion is based on facts not in evidence).

[75] *See* David S. Schwartz, *A Foundation Theory of Evidence*, 100 GEO. L.J. 95, 121 (2011), HTTPS://PAPERS.SSRN.COM/SOL3/PAPERS.CFM?ABSTRACT_ID=1641254 ("[F]oundation is a necessary precondition for relevance; evidence cannot be relevant unless it is 'well founded.'").

[76] Adams v. United States, Civ. No. 03-0049-E-BLW, 2009 U.S. Dist. LEXIS 67255, at *10-11 (D. Idaho Aug. 1, 2009); Leonard v. State, 506 S.E.2d 853, 856-57 (Ga. 1998) (trial court properly excluded testimony of defense DNA expert who would have based his opinion on predicate facts not admitted into evidence).

[77] *See Satterfield*, 2019 CCA LEXIS 448, at *8-9; People v. Leon, F077831, 2020 Cal. App. Unpub. LEXIS 6476, at *23 (Oct. 5, 2020) ("In order to present expert testimony, the proponent of that testimony must show that a sufficient factual basis exists for the predicate facts that make the expert testimony relevant."); United States v. Pena, 1:23-cr-00748-KWR, 2024 U.S. Dist. LEXIS 166635, at *7 (D.N.M. Sept. 13, 2024).

[78] Allscripts Healthcare, LLC v. Andor Health, LLC, CIVIL ACTION NO. 21-704-MAK, 2022 U.S. Dist. LEXIS 134924, at *128 (D. Del. July 29, 2022).

V. EVIDENCE RULES AND ACTIVITY LEVEL TESTIMONY

The legal principle that independent evidence is required to establish the predicate facts assumed by an expert originates from three separate but related provisions of U.S. evidence law. The first is the requirement of conditional relevance in Rule 104(b). The second is Rule 702(a)'s requirement that expert testimony must "fit" the issues in the case to help the factfinder. The third is Rule 702(b)'s requirement that expert testimony must be based on "sufficient facts or data" to qualify as scientific "knowledge."

A. Conditional Relevance

Federal Rule 104(b) governs the conditional relevance of evidence.[79] It states in full: "When the relevance of evidence depends on whether a fact exists, proof must be introduced sufficient to support a finding that the fact does exist. The court may admit the proposed evidence on the condition that the proof be introduced later."[80] The committee note to Rule 104(b) adds, "The judge makes a preliminary determination whether the *foundation evidence* is sufficient to support a finding of fulfillment of the condition."[81] However, in so doing, the court neither weighs the credibility of the evidence nor makes a preliminary finding that the prosecution has proved the conditional fact. Instead, "[t]he court simply examines all the evidence in the case and decides whether the jury could reasonably find the conditional fact . . . by a preponderance of the evidence."[82] If the court decides the jury could make this finding, the evidence is admitted. The

[79] *See* Schwartz, *supra* note 75, at 140 ("[C]onditional relevance is a requirement that foundations be complete rather than relying on generalizations to do the work of case-specific, evidenced facts.").
[80] FED. R. EVID. 104(b).
[81] FED. R. EVID. 104(b) advisory committee's original note (emphasis added).
[82] Huddleston v. United States, 485 U.S. 681, 690 (1988); United States v. Coplan, 703 F.3d 46, 81 (2d Cir. 2012) ("When faced with a question of conditional relevance, the district court should 'examine[ ] all the evidence in the case and decide[ ] whether the jury could reasonably find the conditional fact . . . by a preponderance of the evidence.'" (quoting Huddleston v. United States, 485 U.S. at 690))).

note concludes by explaining, "If after all the evidence on the issue is in, pro and con, the jury could reasonably conclude that fulfillment of the condition is not established, the issue is for them. If the evidence is not such as to allow a finding, the judge withdraws the matter from their consideration."[83] In other words, if there is adequate evidence in the record that could justify a jury finding, the issue is for them to decide.[84] However, if the evidence cannot justify such a finding (i.e., it is inadequate), the court must not allow the jury to even consider the matter.[85]

In 2012, the United States Supreme Court addressed the requirement of conditional relevance in *Williams v. Illinois.*[86] *Williams* involved a Confrontation Clause challenge to an Illinois State Police (ISP) DNA analyst's testimony that a DNA profile was "found in semen from the vaginal swabs of [the victim]."[87] ISP had outsourced the questioned sample to a contract laboratory, and the testifying analyst had no firsthand knowledge of the facts surrounding the profile's development.[88] Nevertheless, a four-justice plurality concluded that the ISP analyst's

[83] FED. R. EVID. 104(b) advisory committee's original note.
[84] *See* Schwartz, *supra* note 75, at 167 ("[T]he foundation standard of 'evidence sufficient to support a finding' is based on its potential probability of truth and its potential relevance. That standard asks only whether there is enough evidentiary weight or detail for a reasonable jury to conclude the evidence is probably true. . . . Foundation decisions are based on this potential quality of the evidence; and because foundation is a precondition of relevance, a ruling that evidence 'is relevant' shares this 'potential' quality: it is capable of being deemed relevant by the fact-finder.").
[85] *See* Hous. Unltd., Inc. Metal Processing v. Mel Acres Ranch, 443 S.W.3d 820, 833 (Tex. 2014) ("[I]f the record contains no evidence supporting an expert's material factual assumptions, or if such assumptions are contrary to conclusively proven facts, opinion testimony founded on those assumptions is not competent evidence."); *see also* Edward J. Imwinkelried, *The Gordian Knot of the Treatment of Secondhand Facts Under Federal Rule of Evidence 703 Governing the Admissibility of Expert Opinions: Another Conflict Between Logic and Law*, 3 U. DENV. CRIM. L. REV. 1, 24 (2013), HTTPS://DIGITALCOMMONS.DU.EDU/CGI/VIEWCONTENT.CGI?ARTICLE=1017&CONTEXT=CRIMLAWREV ("Assume that after reviewing the state of the record at the time the proponent proffers the opinion, the judge concludes that there is no admissible evidence of the fact stated in an essential secondhand report or that the independent evidence is too flimsy to sustain a rational inference. Even if the jurors chose to believe the independent evidence, they could not find the essential premise to be true. As under Rule 104(b), the state of the record calls out for the judge to make a peremptory ruling and exclude the expert opinion. It makes no sense to expose the jury to the opinion when it is clear that it would be irrational for the jury to find the existence of one or more of the essential premises of the opinion. It would hardly enhance the integrity of the factfinding process to give the jury an opportunity to make an undeniably irrational decision.").
[86] 567 U.S. 50 (2012).
[87] *Id.* at 61-62.
[88] *Id.* at 71-72.

testimony was "a mere premise of the prosecutor's question" that the analyst "simply assumed . . . to be true" when she testified that the profiles from the vaginal swab and the defendant's reference sample matched.[89] Because the analyst tacitly assumed the statement was true, her testimony did not violate the Confrontation Clause.[90] Moreover, the legal justification for the statement's admission was to help the factfinder *evaluate* the expert's opinion, not for the *truth* of the matter it asserted.[91]

The plurality's rationale in *Williams* would certainly permit activity level experts to assume the truth of competing propositions for the purpose of explaining their findings. So far, so good. However, a legal problem emerges with the next step in the process of proof.

1. Weight

After finding the ISP analyst's testimony permissibly assumed the forensic profile was "found in semen from the vaginal swabs," the *Williams* plurality noted — in dicta — the prosecutor's obligation to introduce independent evidence to support that premise.[92] This need for proof affects both the weight *and* the admissibility of the assumed facts. Regarding weight, the plurality observed that the "[expert's] opinion would have lacked probative value if the prosecution had not introduced other evidence to establish the provenance of the profiles . . . ."[93] It also explained that "an expert's opinion is only as good as the independent evidence that establishes its

[89] *Id.* at 72 (plurality opinion).
[90] *Id.* at 72-75. Because *Williams* was a bench trial, the plurality assumed the presiding judge used the statement for its proper, non-substantive purpose. As such, its admission did not violate the Confrontation Clause. *Id.* at 72-74. However, the plurality also noted the dissent's argument that the statement was hearsay "would have force" if Williams had chosen to have a jury trial. *Id.* at 72.
[91] *Id.* at 77-78 (citing FED. R. EVID. 703 advisory committee's 2000 note).
[92] *Id.* at 81.
[93] *Id.* at 77.

underlying premises."[94] Moreover, "[I]f the prosecution cannot muster any independent admissible evidence to prove the foundational facts that are essential to the relevance of the expert's testimony, then the expert's testimony cannot be given any weight by the trier of fact."[95]

2. Admissibility

Regarding admissibility, the *Williams* plurality noted that "[i]f there were no proof that [the contract lab] produced an accurate profile based on that sample, [the analyst's] testimony regarding the match would be irrelevant."[96] And, of course, "[i]rrelevant evidence is not admissible."[97] It follows that when experts assume the truth of predicate facts for the purpose of forming and expressing their opinions, the admissibility of those facts depends on their relevance.[98] And their relevance, in turn, depends on adequate proof of their existence.[99] Accordingly, if an activity level expert assumes the truth of a proposition not supported by adequate proof, it must be stricken from

[94] *Id.* at 81.
[95] *Id.*
[96] *Id.* at 76.
[97] FED. R. EVID. 402.
[98] *See* United States v. Satterfield, ARMY 20180125, 2019 CCA LEXIS 448, at *8-9 (A. Ct. Crim. App. Oct. 30, 2019) (without predicate evidence, expert's testimony never became relevant); People v. Leon, F077831, 2020 Cal. App. Unpub. LEXIS 6476, at *23 (Oct. 5, 2020) ("In order to present expert testimony, the proponent of that testimony must show that a sufficient factual basis exists for the predicate facts that make the expert testimony relevant."); United States v. Pena, 1:23-cr-00748-KWR, 2024 U.S. Dist. LEXIS 166635, at *7 (D. N.M. Sept. 13, 2024).
[99] *Cf. Williams*, 567 U.S. at 76 n.8 (plurality opinion) (alluding to the connection between adequate proof of foundational facts and the requirement of due process); *see also* Moore v. Int'l Paint, L.L.C., 547 F. App'x 513, 515 (5th Cir. 2013) ("Expert testimony that relies on 'completely unsubstantiated factual assertions' is inadmissible." (quoting Hathaway v. Banazy, 507 F.3d 312 n.4 (5th Cir. 2007))); Guillory v. Domtar Indus., 95 F.3d 1320, 1331 (5th Cir. 1996) ("Expert evidence based on a fictitious set of facts is just as unreliable as evidence based upon no research at all. Both analyses result in pure speculation."); *see also* Schwartz, *supra* note 75, at 121 ("[F]oundation is a necessary precondition for relevance; evidence cannot be relevant unless it is 'well founded.'").

the record given a timely objection.[100] This is a straightforward application of conditional relevance.[101]

3. Basis Facts, Hypotheticals, and Proof

The United States Supreme Court's recent decision in *Smith v. Arizona*[102] rejected the principal rationale of the *Williams* plurality while reaffirming the requirement that hypothesized facts must be supported by independent evidence.[103] The *Smith* majority held that the testifying analyst's *disclosure* of certain basis facts — purportedly for a non-testimonial evaluative purpose — was actually for a truth-assertive purpose.[104] As such, the facts were inadmissible hearsay.[105] In support of its finding, the Court explained, "[I]f an expert for the prosecution conveys an out-of-court statement in support of his opinion, and the statement supports that opinion only if true, then the statement has been offered for the truth of what it asserts."[106] In so holding, the Court rejected the *Williams* plurality's reasoning that courts may admit basis facts to aid the jury's evaluation of an expert's opinion without regard for their truth.[107] Lower courts must now carefully consider whether purported basis facts are actually testimonial hearsay.[108]

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[100] *See* Viterbo v. Dow Chem. Co., 826 F.2d 420, 422 (5th Cir. 1987) ("In some cases . . . the source upon which an expert's opinion relies is of such little weight that the jury should not be permitted to receive that opinion."); *but see* Hous. Unltd., Inc. Metal Processing v. Mel Acres Ranch, 443 S.W.3d 820, 829 (Tex. 2014) ("'[I]f no basis for the opinion is offered, or the basis offered provides no support, the opinion is merely a conclusory statement and cannot be considered probative evidence, *regardless of whether there is no objection*.'" (emphasis added) (quoting City of San Antonio v. Pollock, 284 S.W.3d 809, 818 (Tex. 2009))).

[101] *See* Schwartz, *supra* note 75, at 142 ("A conditional relevance objection is fundamentally a claim that a generalization in the chain of inferences is inadequate to connect the evidentiary fact to the theory of the case, and must therefore be replaced with a specific well-founded fact.").

[102] 602 U.S. 779 (2024).

[103] *Id.* at 799.

[104] *Id.* at 795-99.

[105] *Id.* at 800.

[106] *Id.* at 795.

[107] *Id.* at 794-96.

[108] In a footnote, the Court added that "the mine-run of materials on which most expert witnesses rely in forming opinions—including books and journals, surveys, and economic or scientific studies—will raise no serious confrontation issues." *Id.* at 801 n.5.

The *Smith* decision is an unfavorable development for the admissibility of evaluative activity level testimony in U.S. courts. It will likely cause lower courts to restrict the amount of task-relevant case information that experts can share with juries. If basis facts are not admitted, the ability of juries to evaluate the quality and credibility of evaluative activity level testimony will likely be hindered.[109] Nevertheless, despite the *Smith* Court's rejection of the *Williams* plurality's "not for the truth" rationale, it reiterated the continued viability of hypothetical questions that take "the form of: 'If or assuming some out of court statement were true, what would follow from it?'"[110] However, the Court hastened to add that "[t]he State of course would then have to separately prove the thing assumed."[111] Thus, while *Smith* constricted the scope of admissible basis facts, it reaffirmed the principle of conditional relevance discussed in *Williams* and codified in Rule 104(b): Predicate facts hypothesized by expert witnesses must be supported by adequate proof.[112]

Applying the principles of *Williams*, *Smith*, and Rule 104(b) to evaluative activity level testimony, the prosecution — before resting its case — must offer evidence that adequately establishes the predicate facts (H_p and H_d) assumed by its expert.[113] If it cannot do so, the court

[109] *Cf.* TAYLOR & KOKSHOORN, *supra* note 5, at 17 ("Evaluations make use of observations that must consider multiple elements of uncertainty surrounding the events. It is therefore very important to the recipient of the evaluation's results that the framework of circumstances surrounding the event (as they are understood when carrying out the evaluation) and any assumptions that are being made are clearly stated.").
[110] *Smith*, 602 U.S. at 799.
[111] *Id.*
[112] *Id.*; *but cf.* Stecyk v. Bell Helicopter Textron, Inc., 295 F.3d 408, 414 (3rd Cir. 2002) ("A party confronted with an adverse expert witness who has *sufficient, though perhaps not overwhelming*, facts and assumptions as the basis for his opinion can highlight those weaknesses through effective cross-examination.") (emphasis added).
[113] *See In re* Nickerson, NO. 03-23-00126-CV, 2024 Tex. App. LEXIS 5708, at *12 (Aug. 9, 2024) ("[E]ven when experts testify about the bases for their opinions, their testimony still is legally insufficient to support a judgment 'if the record contains no evidence supporting [the] expert's material factual assumptions.' This rule means that there can be cases in which there is testimony stating the expert's opinion and testimony stating the expert's bases for the opinion but the expert's testimony is still legally insufficient." (quoting Hous. Unltd., Inc. Metal Processing v. Mel Acres Ranch, 443 S.W.3d 820, 829 (Tex. 2014))) (internal citation omitted).

must not allow the jury to consider those facts.[114] Thus, if the defense makes a timely objection and motion to strike, the propositions must be excluded from evidence.[115]

B. Rule 702(a): Expert Testimony Must "Help" and "Fit"

In Daubert v. Merrell Dow Pharmaceuticals, Inc.,[116] the United States Supreme Court noted Rule 702 requires that expert testimony must "assist the trier of fact to understand the evidence or to determine a fact in issue."[117] This provision requires that two conditions be satisfied. First, expert testimony must "assist the trier of fact."[118] If it fails to do so, the testimony is not relevant.[119] Second, expert testimony must relate to "a fact in issue."[120] To satisfy this requirement, it must be "sufficiently tied to the facts of the case"[121] and have a "valid scientific connection to the pertinent inquiry"[122] that will help the trier resolve the issue.[123] The Court described this concept as "fit," which it explained with the following example:

> The study of the phases of the moon, for example, may provide valid scientific "knowledge" about whether a certain night was dark, and if darkness is a fact in issue, the knowledge will assist the trier of fact. However (absent creditable

[114] *See* FED. R. EVID. 104(b) advisory committee's original note; *see also Hous. Unltd., Inc. Metal Processing*, 443 S.W.3d at 833 ("[I]f the record contains no evidence supporting an expert's material factual assumptions, or if such assumptions are contrary to conclusively proven facts, opinion testimony founded on those assumptions is not competent evidence."); *see also* Imwinkelried, *supra* note 85, at 24.

[115] *But see Hous. Unltd., Inc. Metal Processing*, 443 S.W.3d at 829 ("'[I]f no basis for the opinion is offered, or the basis offered provides no support, the opinion is merely a conclusory statement and cannot be considered probative evidence, *regardless of whether there is no objection*.'" (emphasis added) (quoting City of San Antonio v. Pollock, 284 S.W.3d 809, 818 (Tex. 2009))); *see also* Imwinkelried, *supra* note 85, at 27 ("Citing the view of the 703 majority in *Williams*, the defense could argue that it is illogical to treat the [expert's] opinion as substantive evidence absent such admissible corroborating evidence. Research reveals no case in which a defense counsel has pressed this argument, but post *Williams* it may be only a matter of time before someone does.").

[116] Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579 (1993).

[117] *Id.* at 591.

[118] *Id.* The Court also described Rule 702's requirement that expert testimony must "assist" the factfinder as testimony that is "helpful." The 2011 amendment to Rule 702 changed the word "assist" to "help." The amendment was stylistic only, with no change in meaning.

[119] *Id.*

[120] *Id.*

[121] *Id.*

[122] *Id.* at 591-92.

[123] *Id.* at 591.

> grounds supporting such a link), evidence that the moon was full on a certain night will not assist the trier of fact in determining whether an individual was unusually likely to have behaved irrationally on that night.[124]

Expert testimony not sufficiently tied to the facts of the case or that has no connection to the relevant issue lacks fit. As such, it is does not help the trier of fact and is therefore inadmissible.[125]

Daubert's fit requirement is located in Rule 702(a).[126] Rather than simply reiterating Rule 402's [127] general relevancy requirement, the concept of fit requires an adequate factual foundation[128] for expert testimony.[129] Because such testimony is difficult to evaluate, it can be both powerful and misleading.[130] Given its potential to both influence and mislead the trier of fact, expert testimony must speak clearly and directly to an issue in dispute. If it fails to do so, courts must exclude it under Rules 702 and 403.[131]

Whether expert testimony has adequate fit is a case-specific inquiry.[132] To that end, courts must determine whether such testimony is sufficiently linked to the facts in the case and has a valid scientific connection to the relevant issues.[133] Expert testimony based on assumptions that lack an

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[124] *Id.*

[125] *Id.* at 591-92.

[126] *See* Etherton v. Owners Ins. Co., 829 F.3d 1209, 1223 (10th Cir. 2016); State v. Salazar-Mercado, 325 P.3d 996, 1000 (Ariz. 2014); *but see* Commonwealth v. Aldan, No. 2017-SCC-0032-CRM, 2020 N. Mar. I. LEXIS 22, at *5 (N. Mar. I. Nov. 13, 2020) (finding 702's "fit" requirement in paragraph (d) of Rule 702).

[127] FED. R. EVID. 402.

[128] Essentially, Rule 702(a)'s "fit" requirement is a restatement of the need for conditional relevance applied to expert testimony. Fit could also be described as "foundational relevance."

[129] *See* Daubert v. Merrell Dow Pharm., 43 F.3d 1311, 1322 n.17 (9th Cir. 1995); Elcock v. Kmart Corp., 233 F.3d 734, 756 n.13 (3rd Cir. 2000) ("Rules 702 and 703 bear on foundation analysis, but neither Rule addresses it in explicit terms; nor do the advisory committee notes accompanying the Rules."); *see also* Neale v. Volvo Cars of North Am., LLC, Civil Action No. 2:10-cv-4407(DMC)(MF), 2013 U.S. Dist. LEXIS 28544, at *9 (D. N.J. Feb. 28, 2013) (expert's declaration excluded for failing to meet the "substantive foundation or fit required by Daubert"); St. Rose v. Mobile Paint Mfg. Co., CIVIL ACTION NO. 04-cv-114, 2010 U.S. Dist. LEXIS 157494, at *18 (D. V.I. July 19, 2010) (defendants challenged plaintiff's experts' opinions "as lacking the necessary 'fit' or foundational relevancy for expert testimony as required by Daubert").

[130] *Daubert*, 43 F.3d at 1322 n.17.

[131] *Id.*; FED. R. EVID. 403; *Elcock*, 233 F.3d at 756 n.13 ("Permitting [an expert] witness to offer an opinion unsupported by a sufficient factual foundation would significantly increase the risk of misleading the jury and confusing the issues, the very dangers against which Rule 403 defends.").

[132] Premier Dealer Servs. v. Allegiance, LLC, Case No. 2:18-cv-735, 2022 U.S. Dist. LEXIS 91731, at *5 (S.D. Ohio May 23, 2022).

[133] *See* Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 591 (1993).

adequate factual foundation does not fit the facts and issues in the case."[134] Without fit, expert testimony does not "help" the trier of fact, and thus fails to comply with Rule 702(a).[135] As such, it is inadmissible.[136]

C. Rule 702(b): "Sufficiency" and "Scientific Knowledge"

Rule 702(b) requires that expert testimony must be "based on sufficient facts or data." The committee note to Rule 702 explains the meaning of this phrase. It states, in part, "The language 'facts or data' is broad enough to allow an expert to rely on *hypothetical facts that are supported by the evidence*."[137] This guidance makes clear that litigants must establish an adequate evidentiary basis for their experts' factual assumptions. Relevant caselaw underscores that intent.[138]

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[134] *See e.g.*, Winn-Dixie Stores, Inc. v. Dolgencorp, LLC, 746 F.3d 1008, 1029 (11th Cir. 2014); Meadows v. Anchor Longwall & Rebuild, Inc., 306 F. App'x 781, 790 (3rd Cir. 2009); *Elcock*, 233 F.3d at 756 n.13; Pa. State Univ. v. Keystone Alts. LLC, No. 1:19-cv-02039, 2023 U.S. Dist. LEXIS 37154, at *11 (M.D. Pa. Mar. 6, 2023); Shannon v. Hobart, CIVIL ACTION No. 09-5220, 2011 U.S. Dist. LEXIS 12312, at *17 (E.D. Pa. Feb. 8, 2011); State v. Downey, 195 P.3d 1244, 1252 (N.M. 2008); Christopherson v. St. Vincent Hosp., 384 P.3d 1098, 1111 (N.M. Ct. App. 2016).

[135] *See Elcock*, 233 F.3d at 756 n.13; Winn-Dixie Stores, Inc. v. Eastern Mushroom Mktg. Coop., CIVIL ACTION No. 15-6480, 2021 U.S. Dist. LEXIS 107778, at *40-41 (E.D. Pa. June 9, 2021); Zeller v. J.P. Penney Co., Civil No. 05-2546 (RBK), 2008 U.S. Dist. LEXIS 25993, at *14-15 (D. N.J. Mar. 31, 2008).

[136] United States v. Waddell, 1994 U.S. App. LEXIS 16047, at *14-16 (6th Cir. 1994) (Although the trial court erroneously assumed the expert witness could not testify until the underlying facts on which he relied were admitted and presented to the jury — despite Rule 703's abandonment of that requirement — the expert's testimony did not satisfy Rule 702's *separate* requirement that such testimony must aid the jury. Because no predicate facts supporting a factual basis for the expert's opinion were introduced, the testimony did not aid the jury in understanding the evidence or in resolving the factual disputes, as Rule 702 requires. Therefore, the testimony was excluded under Rule 702.).

[137] FED. R. EVID. 702 advisory committee's note to 2000 amendment. (emphasis added).

[138] *See e.g.*, Petersen v. United States, Case No. 1:21-cv-00097-AKB, 2024 U.S. Dist. LEXIS 46507, at *9 (D. Idaho Mar. 14, 2024) ("[R]ule 702 instructs a district court to determine whether an expert had sufficient factual grounds on which to draw his conclusions."); Manion v. Ameri-Can Freight Sys., No. CV-17-03262-PHX-DWL, 2019 U.S. Dist. LEXIS 139421, at *11-12 (D. Ariz. Aug. 16, 2019) ("An expert may, in appropriate circumstances, rely on assumptions when formulating opinions. However, an expert cannot pass off those assumptions as opinions.") (internal citation omitted); Material Techs., Inc. v. Carpenter Tech. Corp., CIVIL NO. 01-2965 (SRC), 2005 U.S. Dist. LEXIS 32087, at *43 (D. N.J. June 28, 2005) ("A hypothetical fact that is relied on in an expert's opinion must be based on facts that have at least some evidentiary support . . . .").

In *Daubert*,[139] the Court emphasized that "the word 'knowledge' in Rule 702 connotes more than subjective belief or unsupported speculation."[140] Following *Daubert*, lower courts have held that when facts assumed by experts are "at most a working hypothesis" not established by the evidence, their assumptions are "not admissible scientific knowledge."[141] Rule 702's "knowledge" component requires that an expert's opinion must be based on more than personal beliefs, speculation, or conjecture.[142] "An expert's testimony is 'too speculative' when it is not 'based on sufficient facts or data.'"[143] Moreover, hypotheses may be plausible — and may even be true — but cannot help form the foundation for scientific "knowledge" under Rule 702 if not based on adequate *admitted* evidence.[144] Accordingly, "[a]n expert's opinion should be excluded when it is based on speculative assumptions not supported by the record."[145] In sum, courts "must determine whether the evidence is genuinely scientific, as distinct from being unscientific speculation offered by a genuine scientist."[146] And speculative testimony — whether offered by a scientist or a charlatan — is equally inadmissible.

In *GE v. Joiner*,[147] the United States Supreme Court reiterated *Daubert's* admonition against the admission of speculative assumptions offered by testifying experts. *Joiner* observed

[139] *Daubert*, 509 U.S. at 599.
[140] *Id.* at 590.
[141] Tamraz v. Lincoln Elec. Co., 620 F.3d 665, 670 (6th Cir. 2010); EPAC Techs., Inc. v. Harpercollins Christian Publ., Inc., NO. 3:12-cv-00463, 2019 U.S. Dist. LEXIS 1816, at *69 (M.D. Tenn. Jan. 4, 2019).
[142] *Tamraz*, 620 F.3d 665 at 670; Hayes Outdoor Media, LLC v. Southern Trust Ins. Co., 574 F. Supp. 3d 565, 569 (W.D. Tenn. 2021).
[143] Giacometto Ranch Inc. v. Denbury Onshore LLC, CV 16-145-BLG-SPW, 2024 U.S. Dist. LEXIS 104170, at *10 (D. Mont. Mar. 28, 2024); *see also* Moore v. Int'l Paint, L.L.C., 547 F. App'x 513, 515 (5th Cir. 2013) ("[A]n opinion based on 'insufficient, erroneous information' fails the reliability standard." (quoting Paz v. Brush Eng'r Materials, Inc., 555 F.3d 383, 389 (5th Cir. 2009))).
[144] United States v. Lang, 717 F. App'x 523, 535 (6th Cir. 2017); Rowe v. Gibson, 798 F.3d 622, 627 (7th Cir. 2015); *Tamraz*, 620 F.3d at 670; *Hayes Outdoor Media LLC*, 574 F. Supp. 3d at 570.
[145] Tyger Constr. Co. v. Pensacola Constr. Co., 29 F.3d 137, 142 (4th Cir. 1994); *accord* MLC Intellectual Prop., LLC v. Micron Tech., Inc., 10 F.4th 1358, 1368 (Fed. Cir. 2021); TK-7 Corp. v. Estate of Barbouti, 993 F.2d 722, 731-32 (10th Cir. 1993); Agri Sys. v. Structural Techs., LLC, No. 19-cv-02238-CMA-STV, 2023 U.S. Dist. LEXIS 85559, at *14 (D. Colo. May 16, 2023).
[146] Rosen v. Ciba-Geigy Corp., 78 F.3d 316, 318 (7th Cir. 1996).
[147] Gen. Elec. Co. v. Joiner, 522 U.S. 136 (1997).

that neither *Daubert* nor the Federal Rules of Evidence require a court to admit opinion evidence connected to existing data by nothing more than the *ipse dixit* of an expert.[148] Instead, "[a] court may conclude that there is simply too great an analytical gap between the data and the opinion proffered."[149] If so, it should exclude the expert's opinion.[150]

D. Rule 702's Activity Level Applications

Applying Rule 702 to evaluative activity level testimony, when an expert posits competing propositions, paragraph (a) requires that the testimony must help the trier of fact "understand the evidence" or "determine a fact in issue." To comply with this provision, an expert's testimony must be "sufficiently tied to the facts of the case" and have a "valid scientific connection" to "the pertinent inquiry."[151] Accordingly, if an expert's activity level propositions differ from the facts in evidence or diverge from the contested issues, the testimony lacks fit under Rule 702(a). As such, it is irrelevant and must be excluded.[152]

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[148] *Id.* at 146.

[149] *Id.*

[150] United States v. Reynolds, 626 F. App'x 610, 614 (6th Cir. 2015) ("Expert testimony is properly excluded if it 'is connected to existing data only by the *ipse dixit* of the expert. A court may conclude that there is simply too great an analytical gap between the data and the opinion proffered.'" (quoting Gen. Elec. Co. v. Joiner, 522 U.S. 136, 146 (1997))); Cook v. Sheriff of Monroe Cty., 402 F.3d 1092, 1111 (11th Cir. 2005) ("[A] trial court may exclude expert testimony that is 'imprecise and unspecific,' or whose factual basis is not adequately explained." (quoting United States v. Frazier, 387 F.3d 1244, 1266 (11th Cir. 2004))); Lanphere Enter. v. Jiffy Lube Int'l, Inc., 138 F. App'x 20, 22 (9th Cir. 2005).

[151] Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 591-92 (1993).

[152] *Id.* (citing United States v. Downing, 753 F.2d 1224, 1242 (3rd Cir. 1985)); *see also* Winn-Dixie Stores, Inc. v. Dolgencorp, LLC, 746 F.3d 1008, 1029 (11th Cir. 2014); Meadows v. Anchor Longwall & Rebuild, Inc., 306 F. App'x 781, 790 (3rd Cir. 2009); State v. Downey, 195 P.3d 1244, 1252 (N.M. 2008); Elcock v. Kmart Corp., 233 F.3d 734, 756 n.13 (3rd Cir. 2000); Lightfoot v. Union Carbide Corp., No. 98-7166, 1999 U.S. App. LEXIS 3329, at *7 (2d Cir. Mar. 1, 1999); Pa. State Univ. v. Keystone Alt. LLC, No. 1:19-cv-02039, 2023 U.S. Dist. LEXIS 37154, at *11 (M.D. Pa. Mar. 6, 2023); Shannon v. Hobart, CIVIL ACTION No. 09-5220, 2011 U.S. Dist. LEXIS 12312, at *17 (E.D. Pa. Feb. 8, 2011); Astra Aktiebolag v. Andrx Pharm., Inc., 222 F. Supp. 2d 423, 488 (S.D.N.Y. 2002).

Rule 702(b)'s "sufficiency" component requires that an expert's activity level propositions must be "supported by the evidence"[153] for the evaluation to qualify as scientific "knowledge."[154] If not, the expert's findings are inadmissible.[155] In addition, courts must exclude an expert's opinion if the gap between the data and the opinion is too great.[156] This might occur, for example, when the conditional probability of the evidence given H_d lacks a sufficient connection to the proposition because the factual basis for H_d is inadequate.[157] If so, the H_d-based findings are inadmissible.[158]

Rule 702's requirements that expert testimony must have both adequate fit and be "supported by the evidence"[159] directly affect the viability of evaluative activity level testimony in U.S. courts — *in particular, the admissibility of* H_d. If the prosecution's evidence fails to establish a "valid scientific connection" between H_d and the contested issues, or if H_d is not sufficiently tied to the facts in evidence, it lacks fit under Rule 702(a).[160] As such, it does not help the trier of fact

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[153] FED. R. EVID. 702 advisory committee note to 2000 amendment; Material Tech., Inc. v. Carpenter Tech. Corp., CIVIL NO. 01-2965 (SRC), 2005 U.S. Dist. LEXIS 32087, at *43 (D. N.J. June 28, 2005) ("A hypothetical fact that is relied on in an expert's opinion must be based on facts that have at least some evidentiary support . . . .").

[154] Tamraz v. Lincoln Elec. Co., 620 F.3d 665, 670 (6th Cir. 2010).

[155] *See id.* (expert's theory was at most a working hypothesis, not admissible scientific knowledge).

[156] Gen. Elec. Co. v. Joiner, 522 U.S. 136, 146 (1997); *see also* United States v. Reynolds, 626 F. App'x 610, 614 (6th Cir. 2015) ("Expert testimony is properly excluded if it 'is connected to existing data only by the *ipse dixit* of the expert. A court may conclude that there is simply too great an analytical gap between the data and the opinion proffered.'" (quoting *Joiner*, 522 U.S. at 146)); Cook v. Sheriff of Monroe Cty., 402 F.3d 1092, 1111 (11th Cir. 2005) ("[A] trial court may exclude expert testimony that is 'imprecise and unspecific,' or whose factual basis is not adequately explained." (quoting United States v. Frazier, 387 F.3d 1244, 1266 (11th Cir. 2004))); Lanphere Enter. v. Jiffy Lube Int'l, Inc., 138 F. App'x 20, 22 (9th Cir. 2005).

[157] *Compare* Burroughs Wellcome Co. v. Crye, 907 S.W.2d 497, 499 (Tex. 1995) ("When an expert's opinion is based on assumed facts that *vary materially from the actual, undisputed facts*, the opinion is without probative value and cannot support a verdict or judgment.") (emphasis added) (evidence was inadequate because it was *misaligned* with the expert's assumptions), *with* City of Phila. v. Workers' Comp. Appeal Bd. (Kribel), 29 A.3d 762, 764 (Pa. 2011) ("[A]n expert's opinion does not constitute substantial competent evidence where it is based on a series of *assumptions that lack the necessary factual predicate*.") (emphasis added) (evidence inadequate because it was *insufficient* to support the expert's assumptions).

[158] *Cf. Reynolds*, 626 F. App'x at 614.

[159] FED. R. EVID. 702 advisory committee's note to 2000 amendment.

[160] *See* United States v. Johnston, 23-cr-13 (NRM), 2025 U.S. Dist. LEXIS 59429, at *73-78 (E.D.N.Y. Mar. 30, 2025) (finding the prosecution's H_d, which assumed "unknown and unrelated" persons were the DNA contributors to samples recovered from defendant's bedding (rather than his biological children — the defense theory), had "no relationship whatsoever to the parties' actual disputes over the source(s) of DNA in these stains and the resulting

and is therefore irrelevant and inadmissible.[161] In addition, the prosecution must introduce "sufficient facts or data" to establish an adequate evidentiary basis for H_d under Rule 702(b). If it fails to do so, the expert's evaluation does not qualify as scientific "knowledge." Instead, it is mere speculation that may be excluded upon a timely objection.[162]

VI. THE EXISTENCE AND AVAILABILITY OF THE DEFENSE HYPOTHESIS (H_d)

The principles of forensic evaluation require that an activity level expert must adopt one or more mutually exclusive pairs of propositions that reflect the positions of *both* the prosecution (H_p) and the defense (H_d).[163] As noted above, propositions are based on task-relevant case circumstances, information provided by the parties, or both. Formulating H_p is a relatively straightforward task. Typically, an expert has access to relevant, case-specific information generated by criminal investigators. In addition, prosecutors and government-sponsored experts routinely communicate at key points during the pretrial phase of a case. This working relationship facilitates the discussion, revision, or reconstruction of H_p, as needed. As a result, prosecutors can routinely plan to offer independent evidence that supports H_p.

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inferences they will ask the jury to draw."). In so finding, the court explained, "[I]t is widely understood that for a likelihood ratio to 'fit' the purpose for which it is offered, an analyst must test competing propositions *that are actually in dispute at trial*." (emphasis original). As a result, the court concluded, "The defense's position is grounded in the well-established application of Rule 702 requiring the proponent of scientific evidence to demonstrate an articulable 'fit' between the testimony and a disputed issue at trial."

[161] *See id.* at 77-78 ("Here, [DNA analyst's] '1 in 1.0 quintillion' likelihood ratios considered only the government's 'persons of interest' against potential combinations of [defendant's wife] and two or three irrelevant unrelated persons. As such, her statistics will not aid the jury in resolving the parties' competing theories as to which three or four (or more) persons' DNA is in these areas of the comforter. Accordingly, the government has failed to meet its burden under Rule 702.").

[162] *But see* Hous. Unltd., Inc. Metal Processing v. Mel Acres Ranch, 443 S.W.3d 820, 829 (Tex. 2014) ("'[I]f no basis for the opinion is offered, or the basis offered provides no support, the opinion is merely a conclusory statement and cannot be considered probative evidence, *regardless of whether there is no objection*.'" (emphasis added) (quoting City of San Antonio v. Pollock, 284 S.W.3d 809, 818 (Tex. 2009))).

[163] TAYLOR & KOKSHOORN, *supra* note 5, at 98 ("The evaluation of our findings should always be balanced.").

An expert's task of formulating H_d, and the prosecutor's burden of producing evidence that supports it, is more daunting. Given the adversarial nature of the U.S. criminal justice system, the defense will rarely, if ever, choose to share its case theory with the prosecution's expert — including case-specific propositions relevant to activity level scenarios.[164] More fundamentally, the defense team has no legal obligation to share such information. Client confidentiality, trial strategy, and effective assistance of counsel are considerations that will almost always preclude collaboration with the prosecution's expert.[165] Nevertheless, the second principle of forensic evaluation *requires* the prosecution's activity level expert to formulate one or more propositions on behalf of the defense.[166]

A. Formulating H_d and the Problem of Proof

In the U.S. legal system, the government has the burden of proof in a criminal case,[167] and it must prove the defendant's guilt beyond a reasonable doubt.[168] In addition, the government has the burden of producing evidence that supports a submissible case.[169] When the prosecution rests

[164] *But cf.* Peter Gill et al., *Birgitte Tengs case: analysis and the wider implications for evaluation of DNA evidence given activities*, FORENSIC SCIENCE INTERNATIONAL: GENETICS 103279 (forthcoming 2025) (manuscript at 25), https://doi.org/10.1016/j.fsigen.2025.103279 ("Ultimately, fostering clear communication and collaboration among scientists, legal professionals, and the judiciary, is crucial to achieving a balanced evaluation of results in the context of both sub-source and activity level propositions."); Cook et al., *supra* note 23, at 233 ("The more information that is available to the scientist, then the more effective he/she can be in exercising judgement in relation to level II [activity level] propositions. In this regard there needs to be a degree of interaction between scientist, investigator and/or advocate which is probably not required for level I propositions.").

[165] *Compare* TAYLOR & KOKSHOORN, *supra* note 5, at 398 ("[I]n both an adversarial and inquisitorial system there is a need for both prosecution and defense to be involved and define their scenarios.") (emphasis added), *with* Gill et al., *supra* note 164 (manuscript at 25) ("While this dialogue [between the court, the parties, and the experts on relevant activity level issues] can be more readily facilitated within the investigative inquisitorial system, it may [be] challenging to achieve in the adversarial system, which operates within a more restrictive framework.").

[166] EVETT & WEIR, *supra* note 24, at 29; ENFSI, *supra* note 3, at 23; TAYLOR & KOKSHOORN, *supra* note 5, at 16-19.

[167] Mullaney v. Wilbur, 421 U.S. 684, 702 n.31 (1975).

[168] *In re* Winship, 397 U.S. 358, 364 (1970).

[169] *Mullaney*, 421 U.S. at 702 n.31; *cf.* Schwartz, *supra* note 75, at 126 ("[T]he foundation principle derives from the idea of a burden of production. Indeed, foundation is the burden of production applied on a more specific level of detail, to items of evidence rather than to a claim as a whole. That accounts for why the standard is the same for both: evidence sufficient to support a finding.").

its case, there must be sufficient evidence in the record from which a rational jury could find the defendant guilty.[170] If not, the defendant is discharged. In addition to these constitutional principles, the parties must also comply with the common law and rule-based proof requirements outlined above.

An activity level expert called by the prosecution must posit propositions that reflect the positions of *both* the prosecution (H_p) and the defense (H_d).[171] Typically, a prosecutor will have little problem introducing adequate evidence that supports H_p. Often, such proof will be established by testimony from the victim and witnesses that mirrors the action, activity, or scenario described in H_p. Absent direct evidence, circumstantial evidence may also support H_p.

Acquiring and introducing evidence that supports H_d is more problematic.[172] Activity level guidance documents acknowledge that defense counsel will often not provide an H_d to the prosecution's expert.[173] When that occurs, they recommend the expert adopt — on behalf of the defense — one or more "reasonable"[174] or "relevant"[175] propositions that *likely* reflect the defendant's position on the activity level issue.[176] A recent and developing solution in Europe is

[170] Jackson v. Virginia, 443 U.S. 307, 319 (1979).
[171] TAYLOR & KOKSHOORN, *supra* note 5, at 98.
[172] *But cf.* Cook et al., *supra* note 23, at 238 ("There may be a need for direct interaction between scientist, investigator and defence team in order to formulate the pair [of propositions] which will be of greatest assistance to the court.").
[173] FORENSIC SCI. REG., *supra* note 2, at 24-25; NAT'L INST. OF FORENSIC SCI., *supra* note 3, at 3; *see also* TAYLOR & KOKSHOORN, *supra* note 5, at 117.
[174] ENFSI, *supra* note 3, at 11; NAT'L INST. OF FORENSIC SCI., *supra* note 3, at 3; *see also* TAYLOR & KOKSHOORN, *supra* note 5, at 103.
[175] FORENSIC SCI. REG., *supra* note 2, at 24-25; *see also* TAYLOR & KOKSHOORN, *supra* note 5, at 118.
[176] ENFSI, *supra* note 3, at 13.

to conduct proxy H_d activity level experiments to assign probabilities given *non-specific propositions*.[177] Finally, the expert may decline to offer an activity level opinion.[178]

From a scientific perspective, these may be reasonable solutions to the problem of an unknown H_d. However, from a legal perspective they fail to solve the problem of proof. What an expert considers to be a reasonable or relevant proxy H_d becomes mere speculation in court where evidence is the coin of the realm.[179] Thus, the scientific solution for a missing H_d can lead to a legal gap in proof that results in exclusion of the hypothesized facts.[180] As Thomas Huxley once observed, it is "[t]he great tragedy of science — the slaying of a beautiful hypothesis by an ugly fact"[181] — or in this case, by a *missing* fact. The potential disconnect between the scientific and legal use of information was noted early in the development of the Case Analysis and Interpretation literature, where Cook and Evett observed:

> It has been stated that the framework of circumstances is made up from the information that is put to the scientist. But, of course, all of that information must later be put to a court of law when it may, or may not, be accepted: if it is accepted then it is evidence, if it is not then it can no longer form part of the framework of circumstances within which the scientist carried out the interpretation. If that occurs then the interpretation must be reappraised.[182]

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[177] *See* Gill et al., *supra* note 7, at 15-16; Gill et al., *supra* note 8; Gill et al., *supra* note 164 (manuscript at 25) ("If there is no specific defence proposition, a non-specific proposition should be used in conjunction with a proxy experimental design. The interpretation of results given activity propositions should adopt a conservative approach.").

[178] Gill et al., *supra* note 164 (manuscript at 20) ("The scientist can describe the various routes of DNA transfer, but in the absence of specific propositions and associated data, is unable to help the court with the question of strength of support of the alternative propositions based solely on DNA."); TAYLOR & KOKSHOORN, *supra* note 5, at 117, 417; AN ACTIVITY LEVEL EVALUATION BY A FORENSIC EXPERT, NETH. FORENSIC INST., MINISTRY OF JUST. AND SECURITY (June 2023).

[179] *See e.g.*, Rosen v. Ciba-Geigy Corp., 78 F.3d 316, 319 (7th Cir. 1996) ("[T]he courtroom is not the place for scientific guesswork, even of the inspired sort.").

[180] *See* TAYLOR & KOKSHOORN, *supra* note 5, at 472 ("There is a need for legal research into the admissibility of evaluations presented that consider activities: *Whether there are bounds on the role of the scientist to make assumptions* or the use of background information.") (emphasis added).

[181] Thomas Henry Huxley, Presidential Address at the British Ass'n, Biogenesis and Abiogenesis (1870), *in* 8 THOMAS HENRY HUXLEY, COLLECTED ESSAYS 229 (Cambridge U. Press 2011).

[182] Cook et al., *supra* note 23, at 234.

The authors further noted, "This means that the interpretation is more vulnerable to change if, later, that information fails to become evidence."[183] Cook and Evett's analysis was on the mark. In U.S. courts, if an H_d is not supported by adequate proof, it is inadmissible — and that will often be the case.

B. Strategy and Practice

Legal challenges aside, the prosecution's burden of offering evidence that supports H_d also presents strategic and practical problems. From a strategic perspective, most prosecutors will likely choose not to implicitly endorse a proxy defense position (H_d) by offering evidence in its favor only to later refute that proof during trial. This inherently conflicted approach could also confuse the jury, which may reasonably question why the prosecution offered evidence supporting a position that it later sought to disprove. From the prosecution's point of view, the evidentiary payoff (from a favorable LR) may not justify the cost of implicitly endorsing H_d. In other words, from a trial strategy perspective, the show may not be worth the price of admission.

Alternatively — and more practically — the prosecution will often have no evidence that supports an activity level H_d. This is because the defense proposition is unknowable, unavailable, non-existent — or all three. H_d will be unknowable because the prosecution often has no insight or access to the defense theory of the case. Despite reciprocal discovery in most jurisdictions, the defense has no obligation to disclose its trial strategy to the prosecution — including its position on activity level issues.[184] H_d will be unavailable because even if the prosecution knows the H_d, it has no access to the most frequent source of that evidence — the defendant. The prosecution is

[183] *Id*.
[184] *See* Gill et al., *supra* note 164 (manuscript at 18-19) ("Actively involving the defense in an experimental design can be seen as imposing a requirement for them to propose an alternative explanation for how the DNA was transferred, even when no specific alternative is available to consider.").

legally barred from contacting, communicating with, or calling the defendant as a witness — even to offer evidence in his favor. Finally, in many cases, evidence that supports H_d will be non-existent, simply because the scenario never factually occurred.[185] Given these problems of proof, strategy, and practice, the question arises: Absent admissible evidence that adequately establishes H_d, what becomes of the LR?

VII. THE LR IS LOST

As a general rule, courts must exclude an expert's opinion that relies on hypothesized facts if, at the time it is offered, the facts are not in evidence.[186] Despite this rule, trial courts exercise reasonable control over the mode and order of examining witnesses and presenting evidence.[187] This means that trial judges have discretion to admit predicate facts assumed by an expert conditioned on the proponent attorney's good-faith assurance that evidence establishing those facts will be forthcoming.[188] However, if no such evidence is later offered, and opposing counsel makes a timely objection and motion to strike,[189] the court must exclude the hypothesized facts.[190]

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[185] *Cf.* Moore v. Int'l Paint, L.L.C., 547 F. App'x 513, 515 (5th Cir. 2013) ("Expert testimony that relies on 'completely unsubstantiated factual assertions' is inadmissible." (quoting Hathaway v. Banazy, 507 F.3d 312, 319 n.4 (5th Cir. 2007))); Guillory v. Domtar Indus., 95 F.3d 1320, 1331 (5th Cir. 1996) ("Expert evidence based on a fictitious set of facts is just as unreliable as evidence based upon no research at all. Both analyses result in pure speculation.").

[186] *See* Panter v. Marshall Field & Co., 646 F.2d 271, 296 (7th Cir. 1981); Johnson v. Toscano, 136 A.2d 341, 346 (Conn. 1957); Kingsbury v. Hickey, 642 P.2d 339, 342 (Or. Ct. App. 1982); Butler v. Pittsburgh, 537 A.2d 112, 115 (Penn. Ct. App. 1988); Crawford v. Deets, 828 S.W.2d 795, 799 (Tex. Ct. App. 1992).

[187] *See* FED. R. EVID. 611(a).

[188] *See* FED. R. EVID. 104(b) ("The court may admit the proposed evidence on the condition that the proof be introduced later."); Annotation, *Modern Status of Rules Regarding Use of Hypothetical Questions in Eliciting Opinion of Expert Witness* § 6c, 56 A.L.R. 3d 300, LEXIS (database updated weekly) (collecting cases).

[189] Tabieros v. Clark Equip. Co., 944 P.2d 1279, 1335 (Haw. 1997); Peterson v. Schlottman, 392 P.2d 262, 264 (Or. 1964); *but see* Hous. Unltd., Inc. Metal Processing v. Mel Acres Ranch, 443 S.W.3d 820, 829 (Tex. 2014).

[190] *See* People v. Casey, No. 347260, 2020 Mich. App. LEXIS 3112, at *22 (Apr. 30, 2020) (DNA expert permitted to offer opinion based on her experience and hypotheticals *if the factual basis for the hypotheticals was in evidence*); *see also* State v. Centeno-Sarabia, No. 2 CA-CR 2023-0186-PR, 2023 Ariz. App. Unpub. LEXIS 900, at *5-7 (Oct. 25, 2023); State v. Briseno, 1 CA-CR 11-0665, 2013 Ariz. App. Unpub. LEXIS 762, at *9-13 (July 9, 2013); State v. McKinney, 268 A.3d 134, 154 (Conn. App. Ct. 2021); State v. Boatman, 277 So. 3d 190, 192-93 (Fla. Dist. Ct. App. 2019); People v. Escort, 91 N.E.3d 483, 487-89 (Ill. App. Ct. 2017); State v. Soderbeck, A14-1275, 2015 Minn. App. Unpub. LEXIS 571, at *11-12 (June 22, 2015); State v. Taylor, A20-1606, 2021 Minn. App. Unpub. LEXIS 863, at *13-15 (Nov. 1, 2021); State v. Ret, A22-0377, 2023 Minn. App. Unpub. LEXIS 120, at *10-11 (Feb. 21, 2023); State

Applying these principles to evaluative activity level testimony, if the prosecution's expert offers a proposition that is not (and will not be) supported by adequate proof, it is subject to exclusion by the trial court. For example, in a strong-arm robbery case, H_d may be that the defendant and the victim had recent social interaction during which a specific act of physical contact occurred. If the prosecution fails to offer adequate proof that H_d *took place as posited*, the court must exclude the proposition upon a timely objection and motion to strike.[191]

The legal basis for the objection is that there is an inadequate factual foundation for H_d.[192] The legal rationale is threefold. The expert's hypothesized facts (H_d): 1) fail to satisfy Rule 104(b)'s conditional relevance requirement (H_d is irrelevant because it has inadequate evidentiary support);[193] 2) fail to satisfy Rule 702(a)'s requirement that an expert's testimony must "help" the factfinder (because there is inadequate *fit* between H_d and the evidence); and 3) fail to satisfy Rule 702(b)'s requirement that an expert's opinion must be based on "sufficient facts and data" to qualify as "scientific knowledge." In addition, the lack of proof creates an analytical gap between

v. Coreas, A22-1086, 2023 Minn. App. Unpub. LEXIS 523, at *11-12 (Jan. 26, 2023); DeLeon v. State, No. ED111372, 2024 Mo. App. LEXIS 302, at *11-21 (May 7, 2024); State v. Hopkins, No. 21 MA 0115, 2023 Ohio App. LEXIS 3486, at *22-23 (Sept. 29, 2023); Jackson v. State, NO. 14-22-00602-CR, 2024 Tex. App. LEXIS 2523, at *7-8 (Apr. 11, 2024); State v. Simpson, 443 P.3d 789, 796 (Utah Ct. App. 2019); Sample v. Commonwealth, No. 220445, 2024 Va. LEXIS 5, at *22 (Feb. 8, 2024); Clark v. Commonwealth, 892 S.E.2d 685, 697-700 (Va. Ct. App. 2023); State v. Albarran, No. 46162-5-II, 2015 Wash. App. LEXIS 2937, at *23-25 (Dec. 1, 2015); State v. Bennett, No. 35297-8-III, 2020 Wash. App. LEXIS 1835, at *39-40 (Apr. 30, 2020).

[191] *See Tabieros*, 944 P.2d at 1335; *Peterson*, 392 P.2d at 264; *see also* Glass v. Anne Arundel Cty., 38 F. Supp. 3d 705, 716 (D. Md. 2014); myService Force, Inc. v. Am. Home Shield, CIVIL ACTION NO. 10-6793, 2013 U.S. Dist. LEXIS 59141, at *46-47 (E.D. Pa. Apr. 25, 2013).

[192] United States v. Barker, 27 F.3d 1287, 1292 (7th Cir. 1994) ("[P]roper foundations must be laid to introduce … the opinions of expert witnesses…."); United States v. Echols, 104 F.4th 1023, 1029 (a general foundation objection does not preserve for appeal specific subcategories of this objection, such as an "inadequate foundation" to introduce expert testimony); United States v. Anderson, 673 F. Supp. 3d 671, 676 (M.D. Pa. 2023) ("'[E]xpert testimony based on assumptions lacking factual foundation in the record is properly excluded.'" (quoting Meadows v. Anchor Longwall & Rebuild, Inc., 306 F. App'x 781, 790 (3rd Cir. 2009))); Vasquez v. Mabini, 606 S.E.2d 809, 811 (Va. 2005) ("Expert testimony founded upon assumptions that have no basis in fact is not merely subject to refutation by cross-examination or by counter-experts; it is inadmissible." (citing Virginia Financial Assoc. v. ITT Hartford Group, 585 S.E.2d 789, 792 (2003) "Failure of the trial court to strike such testimony upon a motion timely made is error subject to reversal on appeal." (citing Countryside Corp. v. Taylor, 561 S.E.2d 680, 682 (Va. 2002))).

[193] *See generally* Schwartz, *supra* note 75, at 144 ("Any assessment of relevance requires the presence of 'evidence,' and that evidence must be well-founded: case-specific, assertive, and probably true. The foundation for that evidence includes all case-specific facts that must be true in order for the evidence to be relevant.").

the (absent or misaligned) data and the expert's opinion, which makes it excludable *ipse dixit*. As a result, H_d is inadmissible speculation.[194]

If the trial court sustains the objection and strikes H_d, its ruling has a cascading effect on the expert's activity level testimony that results in the total collapse of the evaluative framework.[195] Excluding H_d renders the conditional probability of the evidence given H_d irrelevant since that probability is now untethered to a relevant case fact. In the words of Rule 401(b), neither H_d nor the conditional probability of the evidence given H_d are "fact[s] of consequence in determining the action" any longer.

Judicial exclusion of H_d and the conditional probability of the evidence given H_d, also impact the LR's relevance. Propositions and conditional probabilities are a "package deal." Neither can survive — in the evaluative framework or in in the courtroom — without the other. Likewise, the "parent" propositions (H_p and H_d), and the conditional probability of the evidence given those propositions, are necessary conditions for the "offspring" LR they produce. If separated in the evaluative framework, balance is lost. If separated in the courtroom, relevance is lost. In other words, if the trial court excludes H_d, the conditional probability of the evidence given H_d becomes irrelevant because its conditioning scenario (H_d) has been reduced to a legal nullity. Without the conditional probability of the evidence given H_d, the LR, in turn, must also be excluded as the "progeny" of that probability and the parent propositions — one half of which (H_d) is now a legal

[194] *See id.* at 125 ("Speculation" is the thought process of substituting generalizations or hypotheses for facts that are missing or unsupported by evidence."); *see also* Tyger Constr. Co. v. Pensacola Constr. Co., 29 F.3d 137, 142 (4th Cir. 1994) ("An expert's opinion should be excluded when it is based on assumptions which are speculative and are not supported by the record."); Vasquez v. Mabini, 606 S.E.2d 809, 811 (Va. 2005) ("Expert testimony founded upon assumptions that have no basis in fact is not merely subject to refutation by cross-examination or by counter-experts; it is inadmissible.").

[195] *See e.g.*, People v. Collins, 438 P.2d 33, 38-39 (Cal. 1968) (conviction reversed in part because expert's statistical testimony rested on an "inadequate evidentiary foundation.").

nullity. When the smoke clears, only H_p and the conditional probability of the evidence given H_p remain standing in the legal rubble. The LR is lost.

VIII. SPECULATIVE SCENARIOS VS. REASONABLE INFERENCES

With the potential for such dire consequences, one might naturally ask: Can the court simply infer H_d from the general mass of non-specific facts admitted into evidence? The answer requires a careful review of the logical limits of legal inference in U.S. courts. The government may prove its case by direct or circumstantial evidence; the law makes no distinction between either form of proof.[196] However, inferences drawn from circumstantial evidence must be reasonable.[197] In *Tose v. First Pennsylvania Bank, N.A.*,[198] the United States Court of Appeals for the Third Circuit described the legal distinction between a reasonable inference from the evidence and mere speculation. In a widely cited passage, the court stated:

> The line between a reasonable inference that may permissibly be drawn by a jury from basic facts in evidence and an impermissible speculation is not drawn by judicial idiosyncracies [sic]. The line is drawn by the laws of logic. If there is an experience of logical probability that an ultimate fact will follow a stated narrative or historical fact, then the jury is given the opportunity to draw a conclusion because there is a reasonable probability that the conclusion flows from the proven facts. As the Supreme Court has stated, "the essential requirement is that mere speculation be not allowed to do duty for probative facts after making due allowance for all reasonably possible inferences favoring the party whose case is attacked."[199]

Courts have broadly followed this passage when considering whether a factual narrative supports a reasonable inference to an ultimate fact, or whether the inference is speculative.

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[196] United States v. Porras-Burciaga, 450 F. App'x 339, 340 (5th Cir. 2011); United States v. Dabit, NO. 19-143-JWD-RLB, 2024 U.S. Dist. LEXIS 92461, at *35 (M.D. La. May 23, 2024).
[197] Guile v. United States, 422 F.3d 221, 226 (5th Cir. 2005).
[198] 648 F.2d 879 (3rd Cir. 1981).
[199] *Id.* at 895 (quoting Galloway v. United States, 319 U.S. 372, 395 (1943)).

A legal corollary to *Tose*'s "logical probability" principle is the rule against inference stacking. In 1875, the United States Supreme Court in *United States v. Ross* declared, "No inference of fact or of law is reliable drawn from premises which are uncertain. Whenever circumstantial evidence is relied upon to prove a fact, the circumstances must be proved, and not themselves presumed."[200] The *Ross* Court added that "[t]he law requires an open, visible connection between the principal and evidentiary facts and the deductions from them, and does not permit a decision to be made on remote inferences."[201] The rule against "inference stacking" is still widely applied across U.S. jurisdictions.[202]

With these principles in mind, *Tose* is the starting point for exploring the outer limits of a permissible inference from the evidence to an activity level H_d. The salient question is whether there is a logical probability that "an ultimate fact will follow a stated narrative or historical fact."[203] Under *Tose*, a logical probability equates to a reasonable probability.[204] In the activity level context, whether an inference from the admitted facts to an H_d is reasonable under *Tose* depends, in part, on the content and specificity of the evidence-based narratives. It also depends on whether the facts support an inference that it is logically probable that H_d occurred. If they do, the inference is reasonable.

An H_d formulated as the simple negation of H_p, or otherwise limited to the factual content of H_p, would likely do the trick. In that case, H_d simply relies on the non-occurrence of the facts supporting H_p, which are already in evidence. However, most evaluative activity level literature

[200] 92 U.S. 281, 283-84 (1875).
[201] *Id.* at 284.
[202] *See* W.E. Shipley, Annotation, *Modern Status of the Rules Against Basing an Inference Upon an Inference or a Presumption Upon and Presumption*, 5 A.L.R. 3d 100, LEXIS (database updated Apr. 29, 2024) (collecting cases).
[203] *Tose*, 648 F.2d at 895.
[204] *Id.*

cautions against using simple negations of H_p as the H_d.[205] One expert notes that a "simple negation of the first proposition rarely provides a suitable alternative proposition"[206] because it "is vague and does not provide the information required to evaluate the results."[207] A foundational paper in the field also warns that a negation "gives the court no idea of the way in which the scientist has assessed the evidence with regard to the second proposition."[208] A prominent guidance document takes a different position and concludes that the negation of an activity level H_p is "acceptable provided the context is clear from the case information."[209]

As noted above, relevant evidence has "any tendency" to make a fact "more or less probable" than it would be without the evidence.[210] But evidence must first exist before it can aspire to relevance.[211] Adequate proof of the predicate facts is a foundational requirement for both the relevance and the admissibility of expert testimony.[212] Rule 104(b) states that "proof must be

[205] Cook et al., *supra* note 23, at 234 ("[T]he simple use of 'not' to frame the alternative proposition is unlikely to be particularly helpful to the court.").
[206] Taylor, Kokshoorn & Biederman, *supra* note 4, at 35.
[207] Taylor, Kokshoorn & Hicks, *supra* note 4, at 4.
[208] Cook et al., *supra* note 23, at 234.
[209] Gill et al., *supra* note 3, at 5.
[210] FED. R. EVID. 401(a).
[211] *See* Schwartz, *supra* note 75, at 99 (explaining that relevance is not a sufficient condition for admissibility; rather, it is a concept subsidiary to foundation, which consists of case-specific, assertive, and probably true facts that embody our fundamental understanding of admissible evidence); *see also* FED. R. EVID. 401 advisory committee note ("Relevancy is not an inherent characteristic of any item of evidence but exists only as a relation between an item of evidence and a matter *properly provable* in the case.") (emphasis added).
[212] *See* Damon v. Sun Co., 87 F.3d 1467, 1474 (1st Cir. 1996) (expert testimony must be based on a legally sufficient evidentiary foundation); United States v. Satterfield, ARMY 20180125, 2019 CCA LEXIS 448, at *8-9 (A. Ct. Crim. App. Oct. 30, 2019) (without proof of predicate facts, expert's testimony was not relevant); People v. Valencia, 489 P.3d 700, 711 (Cal. 2021) ("The proper role of expert testimony is to help the jury understand the significance of case-specific facts proven by competent evidence, not to place before the jury otherwise unsubstantiated assertions of fact."); People v. Osborne, 538 N.E.2d 822, 825-26 (Ill. App. Ct. 1989) ("Before an expert is allowed to state his opinion, the facts upon which that opinion are [sic] based must be in evidence. Admissibility of expert testimony is conditional upon laying such a foundation."); Schlossman v. State, 659 A.2d 371, 379 (Md. Ct. Spec. App. 1995) (an expert's conclusions must be based on a legally sufficient foundation from facts established in the record); *In re* Welfare of E.A.A.M., A05-58, 2005 Minn. App. Unpub. LEXIS 383, at *7 (Oct. 11, 2005) ("An expert's opinions must be based on facts in evidence in order to have adequate foundation and the expert should not be allowed to speculate."); State v. Downey, 195 P.3d 1244, 1252 (N.M. 2008) ("Experts may, and often do, base their opinions upon factual assumptions, but those assumptions in turn must find evidentiary foundation in the record."); Marathon Corp. v. Pitzner, 106 S.W.3d 724, 729 (Tex. 2003) ("Expert opinions must be supported by facts in evidence, not conjecture."); Davenport v. Commonwealth, No. 1300-22-2, 2023 Va. App. LEXIS 827, at *9 (Dec. 12, 2023) (an expert's testimony lacks proper foundation if his opinion is based on facts not in evidence); *see also* Schwartz, *supra*

introduced sufficient to support a finding that the fact [in our case, H_d] does exist."[213] In addition, Rule 702(a) and (b) require that expert testimony must rest on an adequate factual foundation to make it both helpful and epistemically sufficient. The court must then decide whether the jury could reasonably find the necessary fact(s) by a preponderance of the evidence.[214]

Once the predicate facts are adequately established, they must support an inference that it is logically probable that H_d occurred.[215] The mere *possibility* that H_d occurred will not suffice.[216] As explained in *Ross*, when circumstantial evidence is relied on to prove a fact, the circumstances must be proven — not simply presumed.[217] Moreover, there must be an "open, visible connection" between the evidentiary facts (i.e., the existence of a *specific* activity level scenario) and the deductions drawn from them.[218] "Inferences are unreasonable when they require 'a degree of speculation and conjecture that renders [them] a guess or a mere possibility.'"[219] Expert opinion only has force when based on facts that sustain it,[220] and speculative facts lack probative force.[221]

note 75, at 143 ("Foundation is the point in an inferential chain up to which case-specific, evidenced facts are required. Relevance is the point at which generalizations are permitted to take over and complete the link to the theory of the case."). However, generalizations must be "reasonable" to be legally permissible. And to be reasonable, they must be logically probable. *See Tose v. First Pa. Bank, N.A.*, 648 F.2d 879, 895 (3rd Cir. 1981).

[213] FED. R. EVID. 104(b).

[214] Huddleston v. United States, 485 U.S. 681, 690 (1988).

[215] *Tose*, 648 F.2d at 895.

[216] *Cf.* United States v. Summers, 414 F.3d 1287, 1294-97 (10th Cir. 2005); United States v. Jones, 44 F.3d 860, 865-66 (10th Cir. 1995); United States v. Jones, 49 F.3d 628, 632-34 (10th Cir. 1995); United States v. Villegas, 906 F.2d 635 (11th Cir. 1990); State v. Shatalov, A177429 (Control), A177430, 2023 Ore. App. LEXIS 574, at *3-7 (June 28, 2023); State v. Simmons, 516 P.3d 1203, 1206-07 (Or. Ct. App. 2022); State v. Garibay, 478 P.3d 1006, 1009-11 (Or. Ct. App. 2020); State v. Shipe, 332 P.3d 334, 336-38 (Or. Ct. App. 2014); State v. Cook, 335 P.3d 846, 848-51 (Or. Ct. App. 2014); State v. Mills, 274 P.3d 230, 232-33 (Or. Ct. App. 2012); State v. Fry, 228 P.3d 630, 632-34 (Or. Ct. App. 2010); State v. Lupercio-Quezada, 198 P.3d 973, 977 (Or. Ct. App. 2008); State v. McNabb, 194 P.3d 164, 166 (Or. Ct. App. 2008); State v. Clelland, 162 P.3d 1081, 1082 (Or. Ct. App. 2007); State v. Conklin, 162 P.3d 364, 365-67 (Or. Ct. App. 2007); State v. Bivens, 83 P.3d 379, 383-85 (Or. Ct. App. 2004); State v. Cristobal, 238 P.3d 1096, 1101 (Utah Ct. App. 2010); Hightower v. State, 477 P.3d 103, 106-07 (Wyo. 2020).

[217] United States v. Ross, 92 U.S. 281, 283-84 (1875).

[218] *Id.* at 284.

[219] United States v. Cox, 505 F. App'x 692, 693 (10th Cir. 2012) (quoting United States v. Bowen, 527 F.3d 1065, 1076 (10th Cir. 2008)).

[220] Galloway v. United States, 319 U.S. 372, 396 (1943).

[221] *Id.*

An expert's "reasonable," "relevant," or "proxy" H_d that adds factual content beyond that included in H_p, but which has inadequate evidentiary support in the narratives or historical facts of the case, fails to satisfy *both* the rules of evidence outlined above and the rules of inference set forth in *Tose*.[222] A specific activity level proposition cannot be inferred from circumstances that make its occurrence merely possible or plausible.[223] In particular, an evaluative activity level H_d that has no "open, visible connection" to the admitted evidence fails to meet the legal thresholds for both adequate proof and reasonable inference.[224] In short, specific H_d scenarios cannot be inferred from the general mass of non-specific case facts or formulated from mere possibilities into proxy propositions. They must be proven — not simply presumed. In most cases involving evaluative activity level testimony, the prosecution's burden of producing adequate proof — which also supports a reasonable inference that H_d occurred — will range from difficult to impossible.

[222] Gill et al, *supra* note 164 (manuscript at 22) assert: "The scientist can assist the court by providing results from proxy experiments to evaluate results given non-specific propositions, provided it is shown that such experiments are conducted in a manner that neither prejudices the defendant nor reverses burden of proof. The procedure outlined above is not speculative; instead it ensures that any evaluations or conclusions drawn from the experiments are scientifically grounded, and consistent with the principle of conservativeness. This approach supports the defendant's position without compromising the scientist's role as a neutral evaluator." Unfortunately, this approach will not work in the U.S. legal system. *See, e.g.*, United States v. Johnston, 23-cr-13 (NRM), 2025 U.S. Dist. LEXIS 59429, at *73-78 (E.D.N.Y. Mar. 30, 2025) ("[I]t is widely understood that for a likelihood ratio to 'fit' the purpose for which it is offered, an analyst must test competing propositions *that are actually in dispute at trial*.") (emphasis original). Non-specific H_d propositions based on proxy experiments would not be "actually in dispute at trial." As such, they would be *legally speculative*, having inadequate evidentiary support. Assuming a timely objection is made, "non-specific propositions" would not be admissible in U.S. courts for the legal reasons explained above.

[223] *See* Schwartz, *supra* note 75, at 146 ("As an epistemological matter, fact-finding must be grounded in a good faith attempt to reconstruct what happened rather than to imagine plausible scenarios that may have happened. That requires, not only from the offering party, but also from the fact-finder, that fact assertions deemed to influence probabilities be anchored in probable truth. Possible truth is not an anchor, and to rely on an infinite regress of possible truth or unevidenced opinions about 'plausible scenarios' is epistemologically no different from a juror deciding a murder case by something he read in a mystery novel.").

[224] *See* Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 591-92 (1993); United States v. Ross, 92 U.S. 281, 284 (1875).

IX. POTENTIAL ACTIVITY LEVEL APPLICATIONS

Thus far, the prospects for admissible evaluative activity level testimony in U.S. courts look bleak. H_d can pose significant problems of proof, strategy, and practice for the prosecution. Despite these daunting challenges, activity level testimony may still be feasible in limited circumstances.[225] In each of the four examples that follow,[226] the evidence may support an expert's H_d.

The first and most obvious example is an H_d that simply negates H_p. In this scenario, the prosecutor introduces evidence that supports H_p. This *same* evidence should also be adequate to support its negation, H_d. If so, both propositions, the conditional probability of the evidence given the propositions, and the resulting LR will be admitted and considered by the jury. However, this may be a Pyrrhic victory. Although H_d meets the admissibility threshold, its lack of independent substantive content will likely hinder both the expert's evaluation and the jury's consideration of its merit. As noted above, "a simple negation is not desirable as it is vague and does not provide the information desired to evaluate the results."[227] Accordingly, this activity level use case has limited utility.

In a second example, suppose a suspect gives the police a pretrial statement that includes a specific activity level scenario that allows the expert to formulate an H_d. To obtain the necessary level of detail, investigators would likely need to provide the suspect with case facts and circumstances he may not have otherwise known. However, investigators often choose not to share

[225] This presumes that the information, data, and assumptions used to generate conditional probabilities for activity level evaluations will survive Daubert/Frye admissibility challenges.
[226] The potential use of evaluative activity level testimony in a rebuttal case is not addressed in this article. For an extensive treatment of that topic, see TEX. FORENSIC SCI. COMM'N, *supra* note 11 *passim.*
[227] Taylor (2020), *supra* note 4, at 4; *see also* Taylor et al., (2020), *supra* note 4, at 35; TAYLOR & KOKSHOORN, *supra* note 5, at 104.

information with a suspect that he could use to concoct a fraudulent defense. Regardless, even if the suspect provides a detailed account of his alleged activities, prosecutors often choose not to admit such statements at trial for strategic reasons: Admission could establish an evidentiary basis for an activity level narrative that would support the defense theory. This would alleviate the defendant's need to testify, sparing him from cross-examination. Trial strategy aside, the prosecution's offer of a defendant's pretrial statement that describes a specific activity level scenario would likely provide adequate evidence to support H_d.

In a third example, suppose that a crime victim's testimony places the defendant at a relevant place and time, acting in a manner specific enough to establish H_d. For example, in an attempted kidnapping case, the victim alleges that the defendant grabbed her hand while trying to forcibly pull her into a car. This testimony would support an H_p formulated from these facts. If the victim also testifies that shortly before the attempted crime, she and the defendant both handled the same pen to sign separate bar tabs, the evidence will likely support an H_d developed from these facts. In this example, the victim's testimony supplies adequate proof of *both* H_p and H_d. As such, the defendant need not testify to establish a factual basis for H_d. The evidence would allow the jury to consider both activity level propositions.

It bears repeating that the prosecution must establish an adequate evidentiary foundation for H_d by a preponderance of the evidence. In addition, that evidence must be sufficiently specific to warrant a reasonable inference that H_d occurred. In the activity level literature, some H_d examples merely place the defendant and the victim in the same social setting before the crime was committed but fail to describe any further contact or interaction.[228] Without a more specific

[228] *See generally* Gill et al., *supra* note 164 (manuscript at 17) ("[T]he term 'social contact' is defined here in a very broad sense: it means some kind of unspecified, indirect contact within a social environment like a shopping centre where the transfer event may be secondary or a higher order - *it is speculated that* the victim and defendant visited at

factual basis, general evidence like this would fail to satisfy the legal requirements of both adequate evidence and reasonable inference, precluding the admission of H_d.[229]

In a fourth and final example, suppose the defendant declines to give police a pretrial statement, but testifies at trial consistent with the prosecution expert's proxy H_d. If this occurs, the defendant's testimony would provide the evidence needed to support the proposition. This might happen when an activity level LR strongly favors H_d. If so, the defense, having acquired the expert's report through pretrial discovery, may decide to take advantage of the favorable LR by embracing the proxy H_d. When a defendant is willing to take the risk of testifying to receive the reward of a strongly supported H_d, his testimony will likely support admission of the proposition.

X. DISCOVERY, DYNAMIC DEFENSES, AND ACTIVITY LEVEL AUDIBLES

So far, this article has largely focused on specific legal problems that evaluative activity level testimony may encounter in U.S. courts. Stakeholders should also consider how discovery rules, defense strategies, and laboratory resources may affect its utility. What follows is not an exhaustive review of these issues but merely serves to highlight them for further discussion.

Criminal discovery rules generally require that "material" information and data created or compiled by the parties must be disclosed to the other side.[230] This includes scientific reports and findings from evidence examination and interpretation. Like other forensic reports, activity level

different times and never met each other.") (emphasis added); Taylor et al., (2018), *supra* note 4, at 35; Taylor (2020), *supra* note 4, at 4-5 (proposition examples using unspecified "social interaction" as the activity).

[229] *See* Burroughs Wellcome Co. v. Crye, 907 S.W.2d 497, 499 (Tex. 1995) ("When an expert's opinion is based on assumed facts that vary materially from the actual, undisputed facts, the opinion is without probative value and cannot support a verdict or judgment."); *see also* Hous. Unltd., Inc. Metal Processing v. Mel Acres Ranch, 443 S.W.3d 820, 832-33 (Tex. 2014) ("Courts must 'rigorously examine the validity of the facts and assumptions on which [expert] testimony is based[.]' If an expert's opinion is unreliable because it is 'based on assumed facts that vary from the actual facts,' the opinion 'is not probative evidence.'" (quoting Whirlpool Corp. v. Camacho, 298 S.W.3d 631, 637 (Tex. 2009))).

[230] *See, e.g.*, Brady v. Maryland, 373 U.S. 83, 87 (1963). Discovery rules also specify materials, objects, information, and data the parties must disclose to each other. *See, e.g.*, FED. R. CRIM. P. 16(a)(1) (E) & (F).

evaluations would be subject to legal discovery. As such, prosecutors in all U.S. jurisdictions would be required to provide these reports to defense counsel (and vice versa) in advance of trial to avoid surprise and permit reasonable preparation and use.

Armed with the prosecution's activity level findings, defense counsel has advance notice of the government's proxy H_d. That information holds great strategic value. A known prosecution H_d helps the defense formulate its theory while also allowing it to sidestep the government's case.[231] Equally important to consider, legal disclosure practically *commits* the prosecution to its expert's H_d.[232] This commitment is the inherent result of the substantial time and resources needed to conduct a new activity level evaluation. Reevaluations of H_d on the eve of trial would often be impractical — if not impossible — to perform in a timely manner while also adhering to scientific best practices, quality measures, and legal deadlines.

Activity level evaluations require advanced knowledge and training, access to an ever-growing body of literature, meticulous analysis of task-relevant facts, and the time needed to fully integrate ever-evolving case information with a new or revised H_d.[233] Reevaluations late in the pretrial phase of a case may require new propositions, additional research, revised probability assignments, and the construction of new Bayesian networks. A sensitivity analysis, findings and conclusions, report writing, and technical and administrative reviews would follow. Late-stage revisions to an activity level report could violate discovery rules, strain laboratory resources, and affect the overall quality of the evaluation.

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[231] Except when the prosecution expert's activity level LR supports H_d and the defense decides to strategically offer evidence tailored to that scenario.

[232] *But cf.* R. Cook and IW Evett, *A Model for Case Assessment and Interpretation*, 38 Sci. & Just. 151-156 (1998) ("[I]t is important to recognise that the alternative [proposition] addressed and the expectations will not necessarily remain constant through every case. . . . There will be cases is which [] a reappraisal *is* necessary . . . .") (emphasis original).

[233] *See* TAYLOR & KOKSHOORN, *supra* note 5, at 148 ("[E]ven the seemingly simplest of evaluations has an enormous amount of background planning, thought and assumption that goes into the evaluation.").

Activity level "audibles" called during trial could cause even more serious problems. An expert's ad hoc, on-the-stand revision of an H_d could violate discovery rules,[234] accreditation requirements,[235] and laboratory policies on report writing and technical review. In addition, an "off-the-cuff" amendment or real-time replacement of H_d would raise serious scientific and legal concerns about the accuracy and reliability of the new findings. Even if an expert considers the number of "reasonable" or "likely" defense scenarios to be relatively small, countless factual variations of those scenarios would alter the conditional probability of the evidence and the resulting LRs.[236] On this point, Taylor and Kokshoorn explained:

> We must recognize that it is not possible to perform a formal evaluation of the case findings on the stand. Acquiring the task-relevant information, setting propositions and assigning a probability to the findings given the set of task-relevant information, while basing yourself on relevant scientific studies, are simply not something that can be done on the fly. Such an evaluation requires a thorough study of the relevant literature, assigning probabilities based on that data and performing sensitivity analyses to make sure that the evaluation (and the resulting LR) is robust. It is therefore important that all parties in a jurisdiction understand that such issues are best put to the scientist before the trial.[237]

Finally, even if a suspect gives the police a pretrial statement that includes an activity level H_d, the defense has no obligation to advance that proposition at trial. Instead, it retains the right to

[234] An exception may apply if the defense "opens the door" for the expert to consider one or more new scenarios during cross-examination. In that case, the evidentiary doctrine of curative admissibility may apply, but the decision to offer a revised evaluative opinion under these circumstances would be ill-advised.

[235] *See, e.g.*, ISO/IEC 17025:2017, 7.8.7.1 ("The laboratory *shall document* the basis upon which the opinions and interpretations have been made.") (emphasis added); ANSI NAT'L ACCREDITATION BD., ANAB AR 3125, 7.8.1.2.1, https://anab.qualtraxcloud.com/ShowDocument.aspx?ID=12371. ("The results *shall* be provided in a written report or through electronic access.") (emphasis added).

[236] *See* TAYLOR & KOKSHOORN, *supra* note 5, at 53 ("The possible activities that could have taken place . . . are virtually endless.").

[237] *Id.* at 372; *see also* MELISSA TAYLOR ET AL., EXPERT WORKING GRP. ON HUM. FACTORS IN FORENSIC DNA INTERPRETATION, NIST IR 8503, FORENSIC DNA INTERPRETATION AND HUMAN FACTORS: IMPROVING PRACTICE THROUGH A SYSTEMS APPROACH, *supra* note 12, at 156 (Recommendation 6.3) ("DNA experts should not perform new evaluations of the DNA results on the witness stand because these evaluations have not been reviewed, reported, or disclosed to all parties."); TEX. FORENSIC SCI. COMM'N, *supra note* 11, at 66-67 ("[T]he Commission recommends the following: ("(7) Decline to offer ad-hoc pseudo evaluations on the stand by following by *ENFSI 2022 Best Practices Manual* on how to respond in circumstances where additional information would be needed to provide a proper evaluation.").

revise, reconstruct, or completely reject the statement *during* trial — effectively turning H_d into a real-time moving target for the prosecution. Although strategic shifts like this may affect the credibility of the defense, they render the suspect's pretrial statement less relevant[238] to pending case issues. Factual additions, subtractions, or other alterations to an H_d have a direct effect on the probability of the evidence given the revised proposition and the resulting LR. The upshot of these concerns is that evaluative activity level testimony is vulnerable to not only legal objections and resource limitations, but also to dynamic and evolving defenses that can quickly render such testimony irrelevant and inadmissible.

CONCLUSION

Much thoughtful work and intellectual effort has created a logical framework for eALR&T in forensic science. Building on the hierarchy of propositions and the principles of forensic evaluation, activity level experts have produced a significant body of important scientific literature. These resources provide a theoretical structure, best practice recommendations, and practical considerations for using eALR&T in forensic casework.

To date, the European and Australasian forensic science communities have produced most of these resources. However, the potential adoption of eALR&T in the United States has recently become a regular topic of conversation in forensic circles. These discussions have begun to produce resources heavily influenced by foundational work in the field pioneered by international experts. An OSAC draft standard, a survey of U.S. forensic practitioners, an investigative report

[238] The defendant's pretrial statement may become less relevant, but not irrelevant. Although a defendant's abandonment of his pretrial activity level position (formulated by an expert as H_d) may render the LR derived from the activity level evaluation irrelevant, the defendant's decision to abandon that position may affect the credibility of the entire defense. Thus, the original H_d remains relevant, but for a non-scientific reason.

by the Texas Forensic Science Commission, and a recent NIST report all explore best practices, attitudes toward, and the potential use of eALR&T in the United States.

Implementing eALR&T in the U.S. would prove a challenging task. Movement toward any new forensic modality raises many questions to consider and even more actions to take. These include: accurately describing and characterizing a method; validating its scope, capabilities, and limitations; creating broadly applicable standards and guidelines; drafting laboratory policies and standard operating procedures; generating and leveraging an accurate, comprehensive body of data that will inform conditional probabilities and populate Bayesian networks; training practitioners to competence; and creating new proficiency tests, certification programs, and scopes of accreditation — to name a few. Affirmative steps toward implementing eALR&T would require an underfunded and overburdened U.S. forensic science system[239] to devote significant time and resources to this effort. Given these challenges, any serious movement toward implementation without carefully considering the hurdles outlined above would put the scientific cart before the legal horse. Science may take the lead, but the law will always have the last word. Without a clear legal path forward, the journey toward implementation could be costly, prolonged, and ultimately unsuccessful. Although evaluative activity level testimony may be admissible in limited circumstances, the forensic community should carefully consider whether its potential use in a small number of cases would justify the time and resources needed to fully implement this approach.

[239] *See* U.S. DEP'T OF JUST. REP. TO CONG.: NEEDS ASSESSMENT OF FORENSIC LABORATORIES AND MEDICAL EXAMINER/CORONER OFFICES 3 (2020) ("A 2017 analysis of a subset of publicly funded, accredited laboratories' workloads and expenditures estimated that forensic laboratories nationwide would require an additional $640 million annually to reach an optimal balance of incoming laboratory requests and casework reported (workload inputs and outputs) and maintain the ideal balance of capital investments and personnel.").

The American criminal justice system is built on the adversarial model of legal adjudication deeply rooted in English common law. Under this model, the legal parties have the responsibility to investigate the facts, develop a case theory, and call witnesses (including experts) to give evidence in their favor. The U.S. rules of evidence, which govern the role of expert witnesses,[240] were developed in that context with the *explanation* of scientific issues in mind,[241] rather than simply the *interpretation* of the evidence given those explanations.[242] This historical point is not

[240] Ronald J. Allen, *A Note to My Philosophical Friends About Expertise and Legal Systems*, NW. U. SCH. OF L. PUB. L. AND LEGAL THEORY SERIES 3 (2015), https://ssrn.com/abstract=2597330 ("The law of evidence regulates the interactions of the various participants in the legal system: trial judge, jurors, attorneys, parties, and witnesses (both lay and expert) and constructs the framework for a trial. It allocates both power and discretion to each of the actors.").

[241] *See, e.g.*, FED. R. EVID. 702 advisory committee's note to 2000 amendment ("When facts are in dispute, experts sometimes reach different conclusions based on competing versions of the facts."); Diaz v. United States, 602 U.S. 526, 533 (2024) (reviewing the history of the "ultimate issue rule" in the United States and noting commentators' *rejection* of the ideas that: 1) the rule usurped the jury's role because a witness's credibility and judgment are always for the jury to determine; and 2) the rule was impracticable and misconceived because it excluded the most necessary testimony on the issues where the jury should have help, if needed); United States v. Sherwood, 98 F.3d 402, 408 (9th Cir. 1996) (fingerprint source identification); Foreman v. Allen, No. 1:23-cv-00390-JLT-EPG-HC, 2023 U.S. Dist. LEXIS 200280, at *69-70 (E.D. Cal. Nov. 27, 2023) (expert's testimony that the murder was sexually motivated and involved "non-consensual sexual assault" was permissible testimony on an ultimate issue); United States v. Williams, NO. 06-00079 JMS/KSC, 2013 U.S. Dist. LEXIS 120884, at *22-23 (D. Haw. Aug. 26, 2013) (DNA source attribution); United States v. McClusky, 954 F. Supp. 2d 1224 (D. N.M. 2013) (DNA source attribution); United States v. Kiel, CAUSE NO. 1:13CR51-LG-RHW-2, 2018 U.S. Dist. LEXIS 229788, at *21 (S.D. Miss. Aug. 16, 2018) (DNA analyst's testimony that defendant was the major contributor to a DNA sample did not invade the province of the jury; such testimony is permitted by Federal Rule of Evidence 704); McKinney v. United States, No. 22-4924, 2024 U.S. Dist. LEXIS 102428, at *26 (E.D. Pa. June 10, 2024) ("When a medical expert testifies as to causation, they must testify that 'the result in question actually came from the cause alleged.'. . . 'It is not enough to say that the alleged cause 'possibly', or 'could have' led to the result, that it 'could very properly account' for the result, or even that it was 'very highly probable' that it caused the result.'" (quoting Albert v. Alter, 381 A.2d 459, 470 (Pa. Super. Ct. 1977))); Revis v. State, 101 So. 3d 247 (Ala. Crim. App. 2011) (firearms/toolmarks source identification); United States v. Davis, 602 F. Supp. 2d 658 (D. Md. 2009) (DNA source attribution); Williams v. State, 209 So. 3d 543, 558-60 (Fla. 2017) (medical examiner's testimony concerning cause of death was admissible since it was within his expertise and did not invade the province of the jury); Ryburn v. State, No. 22A-CR-2415, 2024 Ind. App. Unpub. LEXIS 182, at *23 (Feb. 16, 2024) ("[A]lthough an opinion of identity may imply or lead to an inference of guilt, it does not embrace the ultimate question of guilt because it does not reach every element of the charged offense."); State v. Hilpipre, No. 22-2033, 2024 Iowa App. LEXIS 361, at *7 (May 8, 2024) ("[A]n expert may explain why child victims of sexual abuse may delay reporting in general."); State v. Hodges, No. 112,679, 2016 Kan. App. Unpub. LEXIS 34, at *22 (Jan. 15, 2016) ("[A]n expert witness may provide an explanation of an interviewee's behavior during the expert's interview of that person."); State v. Higgins, No. 72944-23, 2024 N.Y. Misc. LEXIS 24162, at *5 (N.Y. Sup. Ct. Dec. 5, 2024) (courts should be wary to not exclude testimony merely because it invades the jury's province); State v. Hill, 449 S.E.2d 573, 581 (N.C. Ct. App. 1994) (DNA analyst's testimony that 4/6 matching DNA probes was a rare event was permissible expert testimony on an ultimate issue); State v. Bines, No. 51957-3-I, 2004 Wash. App. LEXIS 1175, at *10 (June 7, 2004) (DNA analyst's testimony refuting defendant's DNA transfer theory was a permissible inference from the evidence within the analyst's expertise and did not invade the province of the jury).

[242] The foundational literature on Case Analysis and Interpretation explains the relationship between propositions and explanations. For example, Evett et al, note that "the process of generating propositions often involves the creation

an endorsement of the current state of informal activity level testimony in U.S. courts. Rather, it helps explain why such testimony evolved to its present state — in concert with the common law and modern rules of evidence. However, the appropriate *scientific limits* on informal activity level testimony are a separate matter from the *legal latitude* given such testimony by U.S. evidence rules and caselaw.[243] This distinction is a current and lively topic of debate in the U.S. forensic community. Those discussions should continue.

Setting legal concerns aside, it is important to emphasize there is nothing conceptually "wrong" with eALR&T.[244] Its scientific pedigree is well-established as a logical approach to forensic interpretation that can "help the trier of fact to understand the evidence or to determine a fact in issue."[245] Evaluative activity level testimony simply applies the hierarchy of propositions and well-established principles of forensic evaluation to level-appropriate case issues. Despite the inevitable legal challenges,[246] nothing prevents its use for purely investigative or intelligence purposes.[247] However, when considering whether to adopt and implement eALR&T in the United

and critical evaluation of explanations." *See* Ian W. Evett et al., *More on the Hierarchy of Propositions: Exploring the Distinction Between Explanations and Propositions*, 40(1) SCI. & JUST. 3, 4 (2000).

[243] Scientific disciplines are, of course, free to develop and implement modes of evaluation, interpretation, and testimony that impose greater limitations on their practitioners than do relevant legal principles. Indeed, they may be obligated to do so.

[244] The central problems highlighted in this article are proof and practicality, not the scientific merit of evaluative activity level testimony. However, there may be case-specific legal challenges to offering conditional probabilities derived from extant TPPR studies. Such challenges may focus on experimental design, the overall "fit" or relevance of certain studies to case-specific propositions or probabilities, and the reliability of an expert's assumptions connecting study data to case circumstances. *See e.g.*, Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 591-92 (1993) ("Rule 702's 'helpfulness' standard requires a valid scientific connection to the pertinent inquiry as a precondition to admissibility.").

[245] FED. R. EVID. 702(a).

[246] *See* TAYLOR & KOKSHOORN, *supra* note 5, at 472 ("We expect that as the use of activity-level evaluations becomes more widespread, particularly in countries that have adversarial legal systems, challenges to their introduction into will occur. . . . [I]t could be that study from a legal viewpoint, and presentation of findings within legal literature is what is needed. This would be similar to challenges to a number of aspects in other forensic evidence evaluations, such as the evaluation of DNA evidence.").

[247] *See* ENFSI, *supra* note 3, at 13 ("When no proposition can be specified, the forensic practitioner should provide an intelligence, an investigative or a technical report as deemed appropriate in the context of the case, making sure that they are not misleading to the reader.").

States, the aspirational is not necessarily the operational.[248] Optimal scientific applications must always compete with legal limitations and practical considerations. Accordingly, given evaluative activity level testimony's limited utility in U.S. courts, the American forensic science community should carefully consider whether calls to invest significant time and resources to fully explore its foundations, principles, and casework applications is the best path forward.

In the final analysis, balancing the small number of cases in which evaluative activity level testimony would likely be feasible, practical, and legally admissible, against the time and resources needed to build, maintain, and sustain this approach, it is difficult to make a cogent case for its implementation in the United States. Instead, forensic stakeholders may find the best path forward is to analyze, improve, and refine informal activity level testimony and to carefully define and observe its scientific and legal limitations.

[248] *Cf.* TAYLOR & KOKSHOORN, *supra* note 5, at 398 ("Ideally in a mature system there are … open avenues of conversation with the defence community, in both the openness to explain the evaluations but also for the defence to provide information that assists in forming their propositions."). In comparison to this notional model, the U.S. criminal justice system is far from "ideal."