IN THE UNITED STATES DISTRICT COURT

FOR THE WESTERN DISTRICT OF MICHIGAN

SOUTHERN DIVISION

UNITED STATES OF AMERICA,

Plaintiff, No. 1:17cr130

vs.

DANIEL GISSANTANER,

Defendant.

Before:

THE HONORABLE JANET NEFF,
U.S. District Judge
Grand Rapids, Michigan
Wednesday, May 24, 2018
Motion Proceedings, Volume II

APPEARANCES:

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On behalf of the Plaintiff;

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REPORTED BY: MS. KATHY J. ANDERSON, RPR, FCRR

May 24, 2018

PROCEEDINGS, 9:15 a.m.

THE LAW CLERK: All rise. Court is back in session. Please be seated.

THE COURT: Good morning, everybody.

MS. KLOET: Good morning.

THE COURT: I apologize for the late start. I had a little problem with my computer.

This is the second day of an evidentiary hearing in case number 1:17cr130, the United States versus Daniel Gissantaner. Counsel are present, the defendant is present. Mr. Presant, are you prepared to put Ms. Smith back on the witness stand?

MR. PRESANT: Yes, Your Honor. The government's direct has concluded, but Ms. Smith is here in the courtroom prepared to submit to cross-examination.

THE COURT: Thank you. Ms. Smith, you're still under oath.

CROSS-EXAMINATION

BY MS. KLOET:

Q Good morning.

A Good morning.

Q I'm pulling up Defense Exhibit I. Do you recognize this document?

A Yes, this is one of the electropherograms that I generated.

Q And I have it up just to help us with the first segment of questions to cover some basic DNA concepts. Each individual carries typically two alleles at each locus, correct?

A Yes.

Q One from mother, one from father?

A Yes.

Q Is it possible for someone to carry three?

A Yes.

Q Is it possible for a single individual to have the same two alleles at one singular locus?

A Yes.

Q Okay. So it could be like a 15 and a 15 at D2, for instance?

A Yes, that's a homozygote. H-O-M-O-Z-Y-G-O-T-E.

Q Thank you. And that would appear on any PG like this one not as any two different 15s but as a larger amount of a single 15, is that fair to say?

A Yes, like at D16 there's just one peak that has an 11.

Q Okay. Thank you. And two individuals can have the same alleles at a particular locus, right?

A Yes.

Q Okay. So two different people could be a 12 and a 15 at one single locus.

A Yes.

Q Okay. And if they are in the same mixtures all you would

see at that locus is a 12 and a 15, right?
A Yes.
Q When you look at an EPG, when you're dealing with a mixture you can't tell with 100 percent certainty if a particular allele at one locus was contributed by the same individual who contributed, say, a 15 at another locus, right?
A Say that again, please.
Q Can you tell whether or not one allele at locus A was also -- is connected to another allele at locus B, for example?
A Each locus is looked at individually.
Q Can you tell whether the same contributor contributed two different alleles at two different loci?
A Yes, you examine each locus individually and then take the profile and as a whole and examine it overall.
Q Can you tell that with absolute certainty?
A There is never any absolute certainty.
Q Are you considering the weights when you're making that determination, whether the same individual contributed X and Y at two different loci?
A Yes.
Q Thank you. Talk a little bit about amplification. In the copying or amplification process some pieces of DNA copy better than others, right?
A Yes.
Q Okay. So you might just by chance have more of one

particular piece of DNA copied than another piece in the final amplified product.

A Yes. Generally the smaller loci amplify better than the larger loci. And it's based on the size.

Q Okay. That might result in a different proportion of each particular piece of DNA?

A Potentially, which is why you look at the profile as a whole.

Q Okay. I think that's a different concept, right, than stutter that we covered yesterday?

A Stutter is an artifact, yes.

Q And that happens during the copying, as a result of the copying process?

A Yes.

Q Okay. Thank you. During your interpretation an analyst or you as an analyst aren't actually seeing the tiny little base pairs of the DNA, correct, the little through the microscope?

A No, I'm looking at the printout.

Q Okay. Thank you. I have Defense Exhibit L on the screen. Do you recognize it?

A These are the worksheets that were generated by Ms. Urka, the original analyst when she performed the DNA analysis.

Q Can you tell by looking at the information in these pages how much approximately total DNA there was in this sample?

A 0.2344-nanograms.

Q Okay. Nanograms, is that within a certain quantity or is that just --

A Nanograms per microliter.

Q Okay. How many nanograms total do we have of DNA here in this sample? And I'm looking at page I guess it's marked page 1 but it's about five pages into the document.

A If you look at the number on there it does state that there's 0.2344-nanograms per microliter. We when we amplify shoot generally for around .7-nanograms or .75 and we amplify 15 microliters based on our protocols. And I believe Ms. Urka most likely amped around close to 3 microliters.

MR. PRESANT: I'm sorry, Your Honor. Ms. Kloet, would you mind just pointing to what part of that page you're looking at. I'm having trouble finding it.

MS. KLOET: Sure, no problem. I'm looking at it's marked page 1 but actually it's page 5 of the PDF. And three lines up where it's marked LS15-377. I believe that's corresponding to the sample in this case, correct? Would that be considered overall a low amount that you're dealing with?

THE WITNESS: No.

BY MS. KLOET:

Q Okay. I believe your testimony yesterday indicated that the majority of the DNA indicated it came from or was female, right?

A Yes.

Q Okay. Can you tell approximately, you can use a calculator if you need to, what was the proportion of female to male DNA in this mixture?

A It's actually on the same page.

Q Okay.

A If you look at the blue column, it shows that there was about 0.0370 nanograms of male present in this sample, and then if you look at the auto over Y column it shows that that proportion was about 6.336.

Q Okay. Approximately how many male cells are we talking about in an amount of that size, do you know?

A No, I do not know.

Q How many nanograms are in a cell?

MR. PRESANT: Objection. Nanograms of what?

MS. KLOET: Nanograms of DNA would be in a single cell.

THE WITNESS: I have no idea.

BY MS. KLOET:

Q Okay. If I told you, if I guessed it was .006 would you think that would be about accurate based on your experience as a forensic analyst?

A If that's what you say. I don't know for sure.

Q We can move on. Would you mind pulling up the policy manual, Government 11. MSP has set several guidelines for using the genetic analyzer, haven't they?

A Yes.
Q One of those guidelines has to do with injection time, correct?
A Yes.
Q Okay. What is that?
A The injection time?
Q Yes.
A That's the amount of time that the sample is actually going through the process to have it separated. Our standard injection time is set at 18 seconds. Sometimes if your DNA appears to be blown out you can inject it at a lesser time which would be the ten second injection. If you would like to try to bring your peaks up to a higher height, you inject it at 28 seconds.
Q Okay. The 28 seconds injection period was used in this case, right?
A I believe so, yes.
Q I have the EPGs that were generated in this case that you were just looking at back on your screen. Exhibit I if you would like to look at the paper document. It was your testimony yesterday that the saturation threshold for a person who is engaging in the STRmix analysis or an analyst is 25,000, is that correct?
A That's to run through the software.
Q Okay. And then if you could take a look at D8 in this

particular sample in the STRmix report. We were discussing that yesterday. I believe you testified there was, you determined there was saturation at this locus, true?

A Yes.

Q Okay. The largest RFU figure out of those three loci is 23,821. Right?

A Yes.

Q That's under 25,000.

A Yes.

Q So although it was under the saturation, the 25,000 you determined that there was saturation at this particular peak based on your individual judgment?

A Saturation is not just determined by how high I can get my peaks. I also testified that I prefer my peaks the highest be around 20,000 RFU because once you get over a certain RFU you start to see excessive artifacts in the sample, whether they be given allele calls or they be given off ladder calls. So that's a judgment call and a determination. And Ms. Urka was not trained in the STRmix software or what things are that you look at regarding a STRmix analysis. So she would be unaware that this may potentially be an issue when you're engaging in determining number of contributors and running things through the software.

Q Okay. So that was fair to say a judgment call based on your experience and training and education as an analyst, true?

A Yes.
Q Okay. You also testified that you create a different EPG for STRmix purposes than the one that was initially created by the first analyst, right?
A Yes.
Q And this before you right now is that EPG that you created for STRmix purposes, right?
A Yes. It has my initials on it.
Q Okay. Thank you. So if you could take a look at the locus right next to D8. There are 1, 2, 3, 4, 5, 6, 7 allele present here, right?
A Yes.
Q At least as displayed on the EPG.
A Yes.
Q Okay. And I think your testimony yesterday was by removing the filters that were present on that first EPG you can see all of these that you see here in this second STRmix EPG, right?
A Yes. By removing the stutter filters, the stutter peaks now become visible.
Q I think your testimony earlier was that typically a human individual donates two alleles at each locus, true?
A Yes.
Q So if we have 7 here it's possible that might be a fourth contributor.
A The number of contributors is determined by what is an

artifact. So if you look at the other EPG that was generated by Ms. Urka, those were deemed to be artifacts based on our stutter thresholds. So those would be filtered out anyway. So you are potentially correct, there could be I guess four contributors there based on the artifacts that are present. But STRmix also has those stutter thresholds incorporated into the software that meet our stutter threshold guidelines. And it does determine the potential ability for it to be a real type or an artifact type. Which is why you then in turn look at the genotype combination breakdown in the STRmix files.

Q So your conclusion is a product of a lot of different I guess parameters in your analysis.

A Yes.

Q Okay. With respect to STRmix specifically, I believe Mr. Nye testified that the state police started using STRmix in March of 2016, does that sound accurate to you?

A Yes.

Q Okay. When was the STRmix run in this case?

A I generated these EPGs on June 2nd of 2016. And the STRmix reports were generated on June 2nd in 2016 as well. So that's when they were run.

Q Okay. And just so the record reflects, you're referring to Defense Exhibit J to determine when they were run, right?

A Yes.

Q Okay. Thank you. Sorry about that. Yesterday towards the

end of the day you testified that you had been using the likelihood ratio as far back as 2006. Right?

A Yes.

Q Were you using it on complex mixtures of DNA or were you using it in another context?

A Both. I have used it for paternity, and I am one of the paternity analysts in Michigan so I do use it routinely here. And in St. Louis we used them mostly on intimate samples regarding sexual assaults where you can condition on the victim. So it would be a mixture of more than one person, could routinely be three or four people because you can condition on the victim.

Q And you were presenting a likelihood ratio in St. Louis in those cases?

A Yes.

Q Did you use them more frequently in the paternity situation?

A No. Because paternities are generally only run in criminal cases and there are a lot more sexual assaults that occur than criminal paternities. So they actually would be presented quite often based on sexual assaults. And they could be used in homicides as well because an intimate sample is considered any sample taken from the victim's body. So I can condition on the victim and assume those victims types are present. Which is part of a likelihood ratio which would be used.

Q So when you say you assume that victim is present, that's a conditioning profile like you referenced earlier, right?

A Yes. Meaning that as part of that mixture the victim is present in the mixture, and I'm assuming that makes sense, it's from her body part.

Q Okay. That type of information would assist you in making your analysis if you had a conditioning profile such as the victim in that case, right?

A Yes.

Q The more information -- your analysis is only as good as the information you get, fair to say?

A Yes.

Q Thank you. Refer to Defense Exhibit B, please. Do you recognize this document?

A I do. This is the report I generated for this case.

Q Okay. And do you set forth a likelihood ratio in this particular case?

A I do.

Q So likelihood ratio in a nutshell based on your testimony from yesterday gives two different scenarios of factual possibility?

A Yes. It's two different ways to consider the evidence.

Q Okay. And you choose the scenarios, right?

A Yes.

Q And here they were H1 and H2 as referenced on the first

page in the chart?
A Yes.
Q The first one is the probability that the profile of Daniel Gissantaner and two unrelated, unknown contributors.
A Correct.
Q The second one is the probability of that mixture having three unrelated, unknown individuals.
A Yes.
Q And that was based on your estimation of the number of contributors being three.
A Yes.
Q Thank you. If you were to increase the number of contributors four to five, with everything else remaining the same, it could potentially change the likelihood ratio, couldn't it?
A It absolutely would change the likelihood ratio.
Q And it could either increase it or it could reduce it potentially.
A Potentially.
MS. KLOET: Thank you. That's all I have, Your Honor.
THE COURT: Thank you. Any redirect, Mr. Presant?

REDIRECT EXAMINATION

BY MR. PRESANT:
Q Thank you, Your Honor.
THE COURT: Did you intend to offer Exhibit L?

MS. KLOET: I'm sorry, Your Honor. Yes, I would move to -- if the exhibit isn't admitted already from yesterday, I move to admit the exhibit. L, I think -- so L, yes, and V which was already in there by the prosecution. V as in Victor. The government already admitted that same report yesterday. I can admit it a second time or move to admit it a second time if you wish.

MR. PRESANT: So L and V are being offered?

MS. KLOET: L and V, yes.

MR. PRESANT: No objection.

THE COURT: They are admitted.

BY MR. PRESANT:

Q Ms. Smith, Ms. Kloet asked you some questions a few moments ago about whether or not you could visually see the molecules moving through the capillary electrophoresis in the genetic analyzer. Do you recall those questions?

A Yes.

Q You answered no, you couldn't see them.

A Yes.

Q Have you ever been able to visually see molecules before?

A No.

Q Why is that?

A They are less than microscopic. You can't -- that's why you have instruments to be able to detect and the methods to be able to detect the DNA present and separate it because it is so

miniscule.
Q They are smaller than can be detected by the human eye, is that correct?
A Yes.
Q Are you concerned as a scientist if you're working with molecules that you can't actually see with your own eyes?
A No.
Q Why not?
A Because these processes have been used for years and validated for years to be acceptable. And these are common practices in my field.
Q You're only building on the scientific work that has come before you in the hundreds of years that humans have been working on chemistry?
A Yes.
Q Ms. Kloet also asked you some questions about the quantity of DNA, the quantitation when you looked at Ms. Urka's worksheet. Do you recall those questions?
A Yes.
Q I want to ask you an open question with respect to quantity. When you quantitate DNA, not in this case, you didn't do the quantity in this case, correct?
A Correct.
Q But when you do the quantitation in other cases, what significance, if any, does the quantity of DNA you find have

for your analysis?

A The quantitation step is just an estimation of how much DNA is potentially a part of the sample. The only thing it tells me is a ball park region that's present so I know how much to amplify. So we shoot, or I shoot for about .7-nanograms per microliter. So if I have a zero, I'm going to amp all 15 microliters and try to get the best I can even though I may not most likely get anything. But we do not stop at quant. So no matter how low or high the value is, that sample is always taken forward. So I may also have a sample that quants which is typical for a known sample around 10 or 11-nanograms per microliter. Which then I still shoot for the same amount to go into my amplification to generate a profile.

Q Does the quantity of DNA detected in the lab give you any information about how the DNA got on to the evidentiary sample from which it was collected? Strike that. The evidentiary item from which it was collected?

A No.

Q And why not?

A It's just I can't tell you how the DNA got there. I'm just analyzing the sample that I have and can say whether or not the DNA was present.

Q Ms. Kloet also asked you some questions regarding the 25,000 RFU in the manual and your preference for 20,000 for doing STRmix analysis. You recall those questions?

A Yes.
Q And it has to do with the oversaturated D8 locus that you removed in your judgment according to the policy set in place by MSP within which you could exercise that judgment, correct?
A Yes.
Q Is the significance of the removal of that locus in this case, does that strictly relate to your determination of the number of contributors?
A No. It has to do with the artifacts that are potentially present. Unfortunately, with D8 and the TH01 locus, when they have homozygotes at those locations they attempt to possibly exhibit oversaturation or excessive artifacts because they are smaller locations that are tested. So it would not be uncommon actually for me to have a locus like TH01 or D8 above threshold so I can gain more information at the larger loci from additional contributors. I would still ink that locus and not run it through the software because it exceeds threshold and most likely has excessive artifacts to gain more information at the larger locations tested.
MR. PRESANT: Nothing further.
THE COURT: Thank you. Any recross?
MS. KLOET: No, Your Honor. Thank you.
THE COURT: Thank you, Ms. Smith, you may step down. Mr. Presant.
MR. PRESANT: That's the end of the evidence the

government intends to present in this proceeding, Your Honor.

THE COURT: Thank you. Ms. Kloet.

MS. KLOET: Your Honor, I reserved Dr. Julie Howenstine but I think in light of Ms. Smith's testimony she is not necessary. Dr. Lund is downstairs. He was directed not to observe the testimony in this case by his employer. Can I fetch him?

THE COURT: Yes. Give you five minutes to do that.

STEVEN LUND, DEFENSE WITNESS, WAS DULY SWORN

THE LAW CLERK: Please be seated. And state your full name for the record.

THE WITNESS: My name is Steven Peder Lund.

DIRECT EXAMINATION

BY MS. KLOET:

Q Dr. Lund, what is your current occupation?

A I am a mathematical statistician at the National Institute of Standards and Technology also known as NIST.

Q What is NIST?

A NIST is a national measurement lab located in Gaithersburg, Maryland.

Q Is that a federal government entity?

A Yes. It's part of the Department of Commerce.

Q How long have you been in that position?

A A little more than six years.

Q What are some of your duties and responsibilities there?

A I work with other scientists at NIST to help refine the questions they are asking, plan their experiments, analyze their data, and report their results.

Q Do you have any areas of special focus?

A I often work with the Biochemical Sciences Division, but in general, the Statistical Engineering Division in which I work is tasked with consulting with any of the scientists at NIST.

Q Where did you work before your current employment at NIST?

A I went to NIST straight from graduate school at Iowa State University where I served as a research assistant, teaching assistant, and a statistical consultant.

Q What did you do in those roles?

A So as a statistical consultant I worked with other graduate students and faculty members in refining their questions, planning their experiments, analyzing their data, and reporting their results; in a teaching assistantship, I instructed a course of about 30 students; in a research assistant I worked with my advisor to move towards publication of novel research.

Q Can you describe the higher education that you've completed?

A So I have a Ph.D. from Iowa State University in the field of statistics.

Q When did you complete that?

A January of 2012.

Q As part of that program did you complete a dissertation?

A I did.
Q What was that dissertation topic?
A It was "Statistical Methods for Identifying Differentially Expressed Genes Using Hierarchical Models."
Q Before you completed your Ph.D., did you complete a bachelor's program?
A Yes, I did. I graduated majoring in math and physics from St. Olaf College in Northfield, Minnesota.
Q Did you graduate with any distinctions?
A I did. Magna Cum Laude and I received an honors in physics.
Q When you were enrolled in school I think you referenced some research you did. What type of research was that?
A At St. Olaf or at Iowa State?
Q Start with St. Olaf.
A I was part of a summer undergraduate program, research program at the University of Milwaukee. I looked at how antimony molecules deposit on gold surfaces. I was part of a positron or positronium research group in the physics department at St. Olaf in the summers.
Q Did you engage in any research that involved computers in any respect, programming, developing?
A Yeah. I was tasked with the physics research involved coding to process data coming off of the instrumentation.
Q Have you been a member of any professional organizations?

A Yes. I have been a member of the American Statistical Association.

Q Are you an author or coauthor of any peer reviewed publications?

A Yes. About 25 or so.

Q Have any of your publications addressed genetics or DNA to any degree?

A Yes.

Q Have any of your publications addressed likelihood ratios?

A Yes.

Q While at NIST did you coauthor an article that discussed the likelihood ratio and its application or use with third parties?

A Yes.

Q Who was your coauthor for that article?

A Dr. Hari Iyer.

Q Does he also work with you at NIST?

A He does.

Q In your role at NIST or our professional capacities you held do you engage in or conduct trainings or otherwise provide assistance to practitioners in the field?

A Yes.

Q What type of -- in 2018 what type of that activity have you engaged in?

A We had a one-day course at a conference for pattern and

trace evidence where we were teaching practitioners or lawyers. We had about 50 attendees for a one-day course, and we have had I think about four of those courses over the past three years or so.

Q The one you just referenced, was there a sponsor of that?

A The National Institute of Justice.

Q Did your coauthor, Dr. Iyer, also serve as a panelist in that?

A This is for the courses, right. So he was a co-instructor and then also he separately from the course participated in two different panel sessions in that same conference, and yes, we were both participants.

Q Okay. Thank you. In 2017 did you have any presentations that had to do with statistics and the presentation of evidence?

A Yes. I would say on the order of four or five, there about.

Q Thank you. So these presentations, are they given only to other, these type of presentations only to other scientists like yourself?

A In some cases there is communication with other scientists or statisticians, and in some cases it's an open presentation to practitioners or whoever attends the conference or gathering.

Q Are there sometimes representatives of law enforcement?

A Yes.
Q How about lawyers?
A Yes.
Q I'm bringing up Defense Exhibit A. Is there a binder up there?
A Defendant's exhibit binder?
Q Yes. So if you could turn to the tab that says A. It's the same thing that's displayed on your screen. Do you recognize this document?
A Yes, I do. It looks like my CV.
MS. KLOET: Your Honor, the defense moves to admit Defense Exhibit A at this time.
MR. PRESANT: No objection.
THE COURT: It's admitted.
BY MS. KLOET:
Q Dr. Lund, have you ever testified in court before?
A No, I have not.
Q I would like to ask you some general concepts or questions involving general concepts of statistics and other related topics.
How do you define as a statistician probability?
A So there are different definitions; maybe the most common one is to think of probability in terms of a long run relative frequency. So how often a particular event would occur in a large collection of repeated instances. But there is also from

a subjective community articulation of probability is a measure of one's degree of belief in a particular proposition.

BY MS. KLOET:

Q So another way of putting it, would it be fair to say, it's a way to quantify someone's belief?

A Certainly.

Q In the course of your study and professional career, have you become familiar with the concept of a likelihood ratio?

A Yes.

Q Can you describe it in general terms for the Court?

A So as it's used in forensic science differs slightly from its technical definition in statistics. But the general sense is it's a ratio of two probabilities, so probability of some particular event or information under competing explanations or propositions. And its intent is to characterize the ratio of the plausibility of encountering that information under the competing propositions.

Q You indicated it was a little bit different in the forensic, in the forensic field. Could you elaborate on that a little bit?

A So in its strict definition from statistics, there would be only one model considered, the numerator in one and the denominator, so it's a simple hypothesis. So like you might ask is the mean zero or is the mean one. And say you have a normal distribution. And so the ratio would be what is the

probability of seeing this data if the mean were zero, divided by what is the probability of seeing this data if the mean were one. However, in real applications typically you don't have two exact values to specify, and so it might be something like is the mean zero or is it not zero. And then that goes to something that would be the generalized linear, sorry, the generalized likelihood ratio, which takes the value under one assumption divided by the maximum of the likelihood under any other, any other possible instances of the alternative.

And in forensics it's often a base factor which represents some weighting of possible models or explanations in the numerator versus some weighted combination of multiple models or explanations in the denominator.

BY MS. KLOET:

Q Thank you for normalizing it for us non statisticians in the room to the best of your ability.

As a statistician what does the term scientific measurement mean to you?

THE WITNESS: So a scientific measurement to me means the collection of data to establish the value of some property of an object or an event. And since -- through the comparison with some, some standardized unit, some standard unit. And since the comparison to a standard unit is never perfect, it always involves some characterization of uncertainty, and that uncertainty is characterized through a collection of

comparisons trying to understand the different factors that can affect its value and in providing some final estimate, not only of the value itself but how well that value is known through an uncertainty estimate.

BY MS. KLOET:

Q Thank you. Are there certain features or hallmarks of a scientific measurement?

A Certainly. Generally there would be a characterization of its traceability. So since measurements rarely involve direct comparison with the definition of a unit, the standardized unit, there is a traceability chain. So item A may not be compared to item C directly, but item A as compared to item B which compared to item C, each one of those comparisons involves an uncertainty. So through the chain of traceability you're trying to trace back how large the uncertainty is from each of those to get an aggregate uncertainty.

There is also assessments of repeatability and reproducibility, where repeatability is what is the variability of the results obtained when we repeat the measurement process in a similar circumstances as possible. So like the same person doing the same measurement on the same day using the same machine; and reproducibility might be when a different person uses a different machine then what type of variability is there among the results.

Q Thank you. In your opinion would you characterize a

likelihood ratio as a scientific measurement?
A I would not.
Q Why not?
A I have not seen in general the comparison through some standardized unit or in general thorough characterizations of things like traceability or repeatability or reproducibility.
Q When one is using the likelihood ratio or generating one is there a hard limit or a maximum figure?
A Infinity.
Q You testified earlier that you coauthored an article this past fall while in your capacity at NIST, correct?
A Yes.
Q Okay. If you could turn to tab Q in your binder. Does this appear to be the article that you're referring to?
A Yes, it does.
Q You also indicated that you coauthored this with Hari Iyer. You work closely with Dr. Iyer?
A I do.
Q Did you and Dr. Iyer take the same position in that paper?
A We did.
Q What position was that?
A We expressed some potential concerns over the use of likelihood ratios based on our perceptions of the recommendations or usage in the community and the understanding from practitioners in the field. In particular, we were

concerned over potential message that the community understands that if they do not characterize the evidence, if their explanation of the evidence does not include a characterization of the likelihood ratio that they are doing something wrong. Or that in some instances arguments have been made that a likelihood ratio if given should not contain a measure of uncertainty. And those are not consistent with our understandings of the principles of measurement science or of transferring information from one party to another.

Q Thank you. Early on in your testimony you referenced something called Bayes theorem. Do you discuss that theory in this article?

A We do.

Q What is it? How does it work?

A So maybe it would be helpful to break that into two parts. So Bayes theorem is a property of probability theory that dictates how one can update their current beliefs over, maybe -- we should start by there. Some aspect about which a person has uncertainty and they may have an initial collection of weights or plausibilities for each of those potential states of nature. And then upon encountering new information Bayes theorem provides constraints about how their understanding of how often that information could occur under each of the potential states of nature influences their subsequent perception that that state of nature is true. So how do you

update your beliefs in new information.

The article talks more about Bayesian decision theory, which then goes maybe to the second aspect of this which is if you have what your probabilities are across the different states of nature, so the different potential reality is that some aspect important to the decision you're going to make may have, and you have a collection of actions that you might take, so for decisions that you might make, and for each combination of what truth might be and action you might take, what consequence or reward you might receive; and so then Bayesian decision theory says after you've assigned a probability to each of these states of nature and a consequence for each of the states of nature under what action you might take, you should pick the action that gives you the best average reward or at least average consequence.

Q Thank you. That's a mouthful.

Does your article address the decision making processes that are involved in criminal and civil cases?

A It does.

Q Including the findings of forensic experts?

A It does.

Q In your article did you identify any concerns with using a likelihood ratio as a means of expressing evidence in court?

A We do.

Q What are they?

A So one of the concerns is that the likelihood ratio by its definition as used in the subjective Bayes decision theorem is a personal value. So it's not a property of the evidence itself but it's a property of a particular individual's perception of the evidence. And the concern is that if an expert provides that value, the audience may, may feel as though that is the unique interpretation for the information presented, or they may come to expect that any reasonable characterization of the facts used in arriving at that interpretation may lead to a sufficiently similar result.

But the concern is that we don't, we have -- from what we've seen, we haven't seen a systematic exploration of what the range of reasonable results might be for a given set of data. And so our article proposed one framework for doing so.

Q Thank you. So you testified earlier that there's not necessarily one single correct likelihood ratio in a given situation.

A Yes.

Q So there may be several. Do different models potentially generate different answers or different likelihood ratios?

A Yes.

Q Okay. What do you mean by model?

A So when you have a collection of data, that data doesn't directly provide a probability. You then in general fit some

probability model to that data to translate the data that you have into a probability. But for a given collection of data there's not one unique translation into a probability.

THE COURT: Okay. I'm going to interrupt. We have in this case a probability, a ratio of 49 million to 1. Okay.

THE WITNESS: Okay.

THE COURT: Based on this STRmix software operating on a DNA sample taken from a weapon. My understanding of what you've just said is that there may be other correct ratios which are not expressed as this 49 million to 1. Is that correct? Do I understand you correctly?

THE WITNESS: Yes, I believe so.

THE COURT: And I've got two questions for you. First of all, what is the subjective input that you reference, and secondly, what is the range of difference that can be introduced into the results, the LR?

THE WITNESS: So for the first -- so I have to state I am not an expert on probabilistic genotyping.

THE COURT: Well, I just want you to address the LR concept in general. You don't have to address it. I just used that as an example of what we are dealing with here.

THE WITNESS: Yeah. So in general when you're building a model you're trying to represent the behavior of many different aspects of a system. So from what I know just not from direct study, not from direct area of research but

maybe attending some talks, in the probabilistic genotyping there are things like the drop-in rate, the drop-out rate, stutter height ratios, and each of those have maybe some behavior that you start to learn about by collecting some data on your system. But then when you're going to get to a particular output from the model, you have to choose what distribution will represent that behavior. And even when we have, you know, the more data we have we hope the smaller the range is of different reasonable representations of that behavior in the model. But we never have exactly the right representation of that behavior and so there's always a range of reasonable representations that it could be. Does that address the question? So you know we can collect more data and try to get a narrower range but there's always some range because we never exactly understand the behavior of the components of a physical system.

And so for the second one, I do not have the information to characterize what the range is in a particular examination for probabilistic genotyping. That hasn't been my area of study. I haven't --

THE COURT: I get that. Is this subjective determination affected by one's experience? For instance, you weren't here but we heard one of the scientists from the Michigan State Police lab talk about the numbers of tests that she has run on DNA, and it's not important that it was DNA, but

is it your position that as an investigator's experience expands, if I've done a hundred tests I may have one objective or subjective determination, whereas if I've run 10,000 it may differ. Do I make myself clear on that?

THE WITNESS: Are you saying a hundred instances of a particular sample, like doing repeated measurements of the same thing or just over your career you have --

THE COURT: Right, right.

THE WITNESS: -- you have more experience.

THE COURT: The latter.

THE WITNESS: So it may be that as you get more -- so people who have done more of this have a narrower range of results. So that if you took the collection of experts who have done a hundred tests, they may agree with each other, their results may agree with each other less than those who have done 10,000 or more. You may end up get greater correspondence. I don't know the answer to that.

But the statement is for any given amount of data that somebody says, you know, I am representing in my model or incorporating information provided from, you know, and here's the collection of data that I'm using, there is never just one particular probabilistic interpretation that is most appropriate for that collection of data. You know, they can have their preferred methodology, the models that they are most familiar with or have been trained to apply to lead to a value,

but it doesn't mean that that value is the only value. You can ask a different expert this, you know, common concept that if you ask a group of ten statisticians to evaluate a given data set, you'll get 20 different answers. Because it's difficult to try to identify one particular approach as uniquely appropriate for a given collection of data.

THE COURT: Okay. Thank you.

BY MS. KLOET:

Q Your testimony with me just before the other questioning we were talking about whether different models can generate different answers. I think you've answered that, but just for purposes of continuity, can they?

A Yes.

Q Can the same model generate a different answer?

A So the same modeling framework with different tuning parameters could or if it's the result of, you know, it involves some complex integration so they rely on simulation to evaluate its fit, it could have different answers.

MS. KLOET: May I approach the witness, Your Honor?

THE COURT: Yes.

BY MS. KLOET:

Q I just handed you what's been marked as Defense Exhibit MM. Have you seen this before?

A This was sent to me about a day ago. Maybe it was two nights ago. So, yes, I have seen it.

Q Did you have an opportunity to review it?

A I have reviewed points that I was -- that were highlighted to me in an overview e-mail.

Q What is your understanding of the opinion expressed in this article or the results of this opinion?

A Well, so the part of the article --

MR. PRESANT: I'm going to object, Your Honor. The witness hasn't testified to who sent it to him or what points they asked him to review, and I think that's important especially given the limited scope of his testimony here today based on what he understood prior to receiving the subpoena in this matter.

THE COURT: Well, I also think we need to have some foundation in terms of where the article is from, if it's a journal, apparently it is, and at the very minimum, the title of the article. Dr. Lund, are you familiar with Forensic Science International Genetics?

THE WITNESS: I have reviewed an article for the journal once previously.

THE COURT: Okay. So you are familiar with this journal.

THE WITNESS: I have heard of the journal before.

THE COURT: And does it generally include peer review research papers?

THE WITNESS: It's my understanding, yes, that was my

role for the interaction with the journal was to be a peer reviewer.

THE COURT: And what is the topic of this particular article that you were asked to review? This one, not the one that you reviewed for the journal.

THE WITNESS: So it looks like this is akin to an inner lab trial. So in measurement science often you try to get an understanding for how well a value is known or understood by sending, asking different organizations or institutions to evaluate the same property of a common sample. So like you might take some solution, mix it up really well, take aliquots or part of that, send it off to different organizations and ask them to characterize some concentration and they report back with a value that they arrive at using their measurement process. And then you use that, those results to inform what's the variability or the range of interpretations from these different organizations.

THE COURT: Sounds like my high school chemistry class. Which is what we did. I never could figure it out. I was so far off the mark.

So what exactly does this article address then?

THE WITNESS: So the part that my attention was drawn to is in table 1 on page number 161 which the caption explains that there are different participating laboratories using the LRmixStudio software, except where marked by an asterisk, those

were using different softwares for the interpretation of some DNA mixture. And then table 1 is illustrating the likelihood ratio characterization reported by those participating labs.

THE COURT: And they vary considerably.

THE WITNESS: From the results reported here, among those using the same software, the largest result says it's three times ten to the 14, whereas the smallest is 2.6 times ten to the 3. So, you know, from something that's 2600 to something that's well beyond a billion, into the trillions.

MR. PRESANT: May I voir dire, Your Honor?

THE COURT: On what?

MR. PRESANT: On the witness's familiarity with this exhibit and how it came to his attention.

THE COURT: Not right now, no. Ms. Kloet.

MS. KLOET: Thank you, Your Honor.

BY MS. KLOET:

Q With respect to foundation just to note for the record, Your Honor, this journal is the same journal that published government's exhibit, the article at Government's Exhibit 4.

THE COURT: Okay.

MS. KLOET: Thank you.

BY MS. KLOET:

Q You just recitated some of the information, recited some of the information that's in this article. What are some of your takeaways as a statistician?

A At least in the scenario provided here that it seems like there is a range in the end results that if I were a receiver of any one of these results, it may not be consistent with my understanding of how well this value is agreed upon by the community. You know, I would want to understand what this range is when trying to interpret any one of these particular values.

MS. KLOET: Your Honor, I would move to admit Defense Exhibit MM.

THE COURT: Now you may voir dire, Mr. Presant.

MR. PRESANT: Thank you, Your Honor. Dr. Lund, you said Exhibit MM was e-mailed to you a day or two ago.

THE WITNESS: Is this, is that what the paper we have been talking about?

MR. PRESANT: It is, yes.

THE WITNESS: Yes, it was.

MR. PRESANT: Who was it e-mailed to you by?

THE WITNESS: Dr. John Butler.

MR. PRESANT: Dr. John Butler. And where did Dr. Butler get it from?

THE WITNESS: I think he monitors the literature fairly regularly, but I would presume he directly downloaded it from Forensic Science International Genetics.

MR. PRESANT: Was anyone else copied on that e-mail?

THE WITNESS: I think Hari was.

MR. PRESANT: Dr. Iyer was.

THE WITNESS: Yes.

MR. PRESANT: More to the point, was anyone from the federal defender or anyone who works with them, were they on that particular e-mail?

THE WITNESS: On the e-mail that I received, no. But I don't know if there was any additional e-mails.

MR. PRESANT: What about lower down the chain, did you see if that e-mail was sent by Dr. Butler to you at the request of defense counsel?

THE COURT: Could somebody tell me who Dr. Butler is first of all?

MR. PRESANT: Will you tell the Court please who Dr. Butler is?

THE WITNESS: Dr. Butler is a NIST fellow, so that's the most highly recognized position you can receive at NIST as a scientist, who I believe specializes in DNA mixture interpretation but has maybe shifted towards an advisory role for the forensic science program at NIST.

THE COURT: Okay.

THE WITNESS: I think he's written a collection of textbooks on DNA mixture interpretation.

THE COURT: Thank you.

MR. PRESANT: So back to my question. Did you receive any information that Dr. Butler sent you that article in

coordination with or at the request of defense counsel?

THE WITNESS: No indication was given on the e-mail chain that I received that there was any previous contact from the defense.

MR. PRESANT: So when you said an e-mail, your attention was drawn to specific points.

THE WITNESS: Yes.

MR. PRESANT: That was by Dr. Butler who is drawing your attention to those points?

THE WITNESS: That's right.

MR. PRESANT: And is it a coincidence then that defense counsel marked and showed you an exhibit that Dr. Butler just happened to send to you a day or two prior to your testimony?

THE WITNESS: Is it a coincidence that -- I'm sorry, can you repeat the question?

MR. PRESANT: Let me put it this way.

MS. KLOET: Object to speculation, Your Honor. I don't know where this is going.

THE COURT: I don't really know what the relevance of it is. What difference does it make where he got it?

MR. PRESANT: I'll tell you, Your Honor. I think there are a couple relevant points here. First of all, Dr. Lund is represented by counsel in connection with his appearance here today. And his counsel in communication with

me told me that it was very important to the United States government that the scope of his testimony be limited to that on which he was subpoenaed which did not include this article. Because this article was first given to me last night by e-mail via --

THE COURT: Is there something classified or something secret about this article?

MR. PRESANT: No. It has to do with the scope of what he's been subpoenaed here to testify to. And he said --

THE COURT: He's a statistician. He is testifying about what these statistics show. These are statistical values, aren't they, in this chart, this table?

THE WITNESS: Reported measurements.

THE COURT: They are statistical values, right?

THE WITNESS: I think so. Yes, I would call it data, yes.

THE COURT: So what's the problem?

MR. PRESANT: Well, he hasn't reviewed it carefully and I'm curious how it came to his attention.

THE COURT: I don't think it makes any difference, Mr. Presant.

MR. PRESANT: Very well, Your Honor.

THE COURT: Thank you.

MR. PRESANT: That's all I have.

THE COURT: Ms. Kloet.

MS. KLOET: Your Honor, has the exhibit been admitted?

THE COURT: Yes, it's admitted.

MS. KLOET: Thank you.

BY MS. KLOET:

Q Based on your research and your work in the field of statistics, specifically with like the use of the likelihood ratio, pardon me, are there other ways besides the likelihood ratio to communicate evidence to a jury?

A I believe so, yes.

Q What are some of those other ways or what would you suggest?

A So I would be interested in the development of alternatives that as opposed to emphasizing the interpretation of a particular individual that seek to provide, here is the body of information that we have collected through our training and experience, here are the subset of those that maybe are of similar complexity or say relevant to the case at hand, and what was the, what were the results returned by a particular process of comparison. So trying to emphasize not the self-contained meaning of any particular value, but to emphasize the relationships observed in comparison between actual data itself.

Q So could you summarize that a little bit?

A So you might, you might say, you know, what, what process was used to evaluate in this case. And whatever, in here,

could be STRmix. You know, has STRmix been used in the past to analyze samples where ground truth is known? Yes. Okay. And are there instances in the, in the neighborhood of the degree of complexity maybe of this particular sample? Yes. Okay. What was the output of the system in those cases? And, you know, one of the potential concerns is that we can't collect a bunch of data for every possible scenario, but maybe what could be done is, you know, are there instances where this process of comparison was utilized in applications where the sample is more complex than the one at hand. To try to get kind of a lower bound, a lower rate of performance. So what type of results were seen in instances where this was, you know a more complex mixture. What was the performance and things where it was less complex. So then you could kind of get a bracket of the behavior of the system and then use that information to try to represent the meaning of a particular result obtained in a single application.

Q Thank you. I think your summary may have been longer than your initial answer but I appreciate it.

A Sorry.

Q So you were just describing alternative ways to communicate evidence to a jury. Do you believe that these means have been fully -- alternative to likelihood ratios, do you believe personally that these means have been fully pursued?

A I do not.

Q Why not?

A My belief is that the community has found many strengths to the use of a likelihood ratio and that has become the predominant focus is to how do we arrive at, you know, at a likelihood ratio value we can support. And that in many instances, you know, it's seen as the role of the expert to not just say what the evidence is in an organized and understandable fashion but to go straight to what it means. And so it seems then like the at least within the statistical forensics community that emphasis is going to how do we produce a likelihood ratio value as opposed to are there other ways of explaining or presenting the information that underlies an LR characterization.

Q Thank you. At one point in time were you asked to, I'm sorry, Defense Exhibit P in your binder. Should be the same on your screen. P. as in Peter.

A Oh, P.

Q At one point in time were you asked to give an interview with a man named John Paul Jones?

A Yes.

Q Who is John Paul Jones?

A Another NIST employee who is the liaison to the International Association For Identification, and also does a lot of the coordination efforts for OSAC, the Organization of Scientific Action Committee.

Q Okay. Is he a NIST employee?
A Yes.
Q Okay. Is this representation here, Exhibit P, is this a written record of the interview you gave? Does it reflect the interview that you had?
A Yes.
MS. KLOET: Your Honor, I would move to admit Defense Exhibit P.
THE COURT: Which one is it again, please?
MS. KLOET: P. as in Peter.
THE COURT: Mr. Presant, any objection?
MR. PRESANT: Your Honor, the government has also marked as an exhibit but part of Exhibit P is cut off on page 2 on the left side. So I have no problem with it coming in but the government intends to offer the version it has marked as well.
THE COURT: Very well. It's admitted.
MS. KLOET: Thank you, Your Honor.
BY MS. KLOET:
Q Were you asked to undergo this interview after your article was published in the fall of 2017 about the likelihood ratio?
A Yes.
Q And did you change your position that you took in the paper in this interview?
A I don't think so, no.

Q This paper, the likelihood ratio paper from the fall of 2017, was that peer reviewed?

A Yes, it was.

MS. KLOET: One moment, Your Honor.

BY MS. KLOET:

Q I'm displaying a document marked as Government's Exhibit 28, and that's not in your binder. It's a government's exhibit that's been admitted. Do you recognize it?

A Yes. I also received a copy of this article about a day ago.

Q Okay. Have you had an opportunity to review it?

A I have read through it and discussed it with my coauthor, Hari, Dr. Hari Iyer.

Q Can you describe succinctly the content of the article?

A I would characterize this as a rebuttal to the paper that Hari and I had written.

Q How do you -- what is the rebuttal, could you summarize that?

A As I would characterize it, it says -- can we go to maybe the key points --

Q Sure.

A Is it possible to change the page on the --

Q I can give a hard copy.

A So as identified by the highlights section just preceding the abstract on the article, it says that everyone or all agree

that likelihood ratios should not be imposed on others. That this is not current practice. That presenting both an LR and the basis for it is the current best practice. LRs should not only be assigned where adequate empirical information is available. Even when an opinion is purely subjective it should be in the form of an LR. And that the LR is the single most informative summary of evidential weight.

And within its contents they identify the perception of misunderstandings of current practices as well as straw man argument saying that the argument we put forth or the prospectus put forth in the article that Hari and I, Dr. Iyer and I, authored are not reflective of anyone's implementation for the usage of LR.

Q How do you, how would you respond or how do you respond to the criticisms that are levied against your paper in this document?

A Well, so it seems there's a fair amount of agreement from both sides in that everybody knows that models can provide different answers, that nobody advocates for a juror to be compelled to use the, a likelihood ratio offered by an expert as their own weight of evidence, but there's an admission or a statement that a recipient of the information has a choice whether or not to accept an expert's LR. And it writes, if I could just, this is in the conclusions, the second paragraph on page 6. "Their argument supposes that forensic scientists

would impose their LR on the decision maker. In reality, however, the decision maker will only use the expert's LR if they agree or trust the experts to do better than themselves. They might defer to someone more knowledgeable but they are not obliged to do so."

So I agree with that statement that somebody is free to modify the information as it's presented to them or modify their interpretation of the presented information. However, the concern that we were trying to articulate in our paper is that when an authority figure expresses confidence in a particular LR value, that may give the audience an impression that any reasonable interpretation of the same collection of undisputed data or facts would result in a sufficiently similar characterization of the value.

And that from what we've seen, there hasn't been a presentation that would support that type of interpretation or to facilitate for the audience to understand what is the range of reasonable interpretations for a given collection of information. How far, how well do we really understand this quantity?

I would also -- it says, you know, that the Lund and Iyer proposal is the status quo. That's maybe a section heading on page 5. Which I interpret to be like this article that Dr. Iyer and I had authored, you know, isn't something to be concerned about because nobody is doing what they're worried

about and in fact the community is already practicing or the practices of the community as commonly implemented already address the concerns identified.

And if I may, I would maybe dispute that claim insofar as, you know, we have been giving presentations on the order of 15 to 20 over the last three years, and that has led to conversations with some of the authors of this, the paper, and we have yet to been given one instance of, you know, a transcript from testimony or an example of a report that says, you know, with a conversation, you say you want this, and we are already doing that here. Look. Does this address the concerns? Can we agree that you know we are all doing this? Over three years we don't, nobody has ever handed us. So I have not yet seen a presentation of a likelihood ratio that gives some careful consideration to the influence that modeling choices may have.

BY MS. KLOET:

Q Thank you. I would like to address the concept of validation in science. Scientifically speaking, what is validation from your perspective?

A So I would say validation comes about, you have some, you have some theory or proposal and validation comes from conducting a sequence of tests where your theory or proposed representation has an opportunity to be disproved or to fail. So you collect more and more information and see if that

information can refute the theory or the assumptions that you're putting forth. And the community may have some threshold that they decide upon where if you passed so many validation tests we consider that theory or model to be validated. In a binary declaration as opposed to here's what the validation information that we have is to support they might say this model has been validated.

Q Thank you. If a single model purports to have been validated as you said, does that address all the concerns you expressed in your paper from last fall?

A I would say no.

Q Why not?

A The question is not whether the value offered is reasonable given the data that you have, but how, how well is that value known which would be informed by what other values might that attribute have. So what is the range of results given the collection of information, not can this particular value be refuted by the collection of information considered.

Q If multiple models purport to have passed validation, would that address the concerns in your paper?

A Providing the explanation of how those models were developed and what type of independence among them, or the attempt to have a broad collection of potential interpretations, and if among those that pass validation you're getting a very stable answer, that would certainly be valuable

information that our article was intended to request.

Q Are you aware of any research in the field that addresses the type of risks or dangers you're discussing today about using statistics such as the likelihood ratio in the courtroom?

A Are you talking about for studying variability or are you talking about, you know, a broader term of potential risks of --

Q Let me ask a different question. Are you familiar with a concept called the prosecutor's fallacy?

A Yes, I am.

Q Okay. Can you define it for the Court?

A So prosecutor's fallacy is a misunderstanding that when somebody speaks to the value of or the probability of the evidence under competing hypotheses or propositions, that they misinterpret it as the probabilistic characterization of the hypotheses themselves given the evidence. So they're being told the probability of A assuming B is correct but they interpret it as the probability of B assuming A is correct.

Q Have you ever personally observed or witnessed any, that type of issue that you just described?

A In my, in the interactions that I have had with other work employees at NIST, other scientists, or in the courses that we have taught, we found that this is a very common tendency. That people want to think you're providing a characterization that about the truth of the hypothesis as opposed to the

plausibility of the evidence under the hypothesis, or the frequency of occurrence of the evidence under the hypothesis.

So I think it seems like the natural tendency is to make the prosecutor's fallacy unless it's been carefully decomposed so that a person clearly understands the distinction between the two. And that's generally my experience has been it's difficult to articulate in a short conversation even.

Q So just back peddling a little bit to my earlier question. Generally speaking, are you aware of any research that touches upon that or research that touches upon risks inherent in using these type of statistics in a courtroom?

A I'm aware of some research activity by Dr. William Thompson from the University of California Irvine, or Brandon Garrett, a lawyer who participates in CSafe, that are trying to study how a lay audience responds to different characterizations for weight of evidence, including the use of likelihood ratios.

Q That study is underway?

A They, it's certainly ongoing research. They are continuing to conduct more surveys and different means of conveying the information.

Q Is there anything I haven't touched upon today that you would like the Court to know?

A Not that immediately comes to mind.

MS. KLOET: Thank you. Pass to the prosecution.

THE COURT: Mr. Presant.

CROSS-EXAMINATION

BY MR. PRESANT:

Q Let me start where Ms. Kloet left off. She asked you some questions about the prosecutor's fallacy, right? You weren't talking particularly about me, that's sort of a general statistical name for the fallacy?

A Yeah, that's a coined term from decades ago.

Q Is there a defense fallacy in statistics?

A I believe so.

Q An ecological fallacy?

A I believe there's a large list of fallacies.

Q Why have all these fallacies been named?

A Because they are known to have occurred, I would guess. And that they are considered to affect the decisions that are made. They occur and they are important.

Q And it's important when you're communicating mathematical ideas to do it carefully, correct?

A Yes.

Q So if you're a witness and there were a jury in the box there, you would want to explain the statistics or mathematics you were testifying to accurately, much like you are doing today before the Court, correct?

A Yes.

Q And it's possible to describe in words statistical findings without committing those fallacies, right?

A Yes.
Q So, Dr. Lund, you are not familiar with STRmix. Well, let me rephrase that. You haven't analyzed STRmix, correct?
A No.
Q You're not here today to offer an opinion on whether STRmix is a good model or a bad model, right?
A No.
Q Well, right, your answer --
A Sorry, sorry. You are correct, I'm not here to characterize whether STRmix is a good model or not.
Q You've already testified you're not an expert in probabilistic genotyping, correct?
A That is correct.
Q Do you have an opinion here today on the use of probabilistic genotyping at all?
A Insofar as it represents a model, I still have the opinion that when you use a model there isn't a unique answer. I don't have anything specific to the application of probabilistic genotyping outside of it, my understanding of it being probabilistic interpretation of evidence.
Q So my understanding, probably worse than yours, but my understanding as a lawyer is that probabilistic genotyping isn't a model, it's a theory that can be implemented in different models, is that right?
A I would agree. That's consistent with my understanding.

Q Okay. STRmix would be an example of one implementation of that theory in a model, right?
A I agree.
Q And you also don't have experience analyzing DNA mixtures, is that correct?
A Not in any human forensic context.
Q I appreciate that clarification. You don't have any experience analyzing human forensic samples of DNA, right?
A True.
Q Now, can we bring up Government's Exhibit 16 which is the same as I think Q. And it's a 3-page document. I'll represent to you that I have edited it down. That's the first page just because it's the cover of the magazine in which it was found. Do you recognize page 2 of Government's Exhibit 16?
A Yes, I do.
Q That's the same article we looked at before, it's just kind of a color copy, right?
A Yes.
MR. PRESANT: Your Honor, the government moves to admit 16.
THE COURT: Any objection?
MS. KLOET: I'm sorry, Your Honor. For clarification, are we admitting the first page and the second and the third? To let the Court know, my exhibit is a little bit different or Defense Exhibit Q is a little bit different in that it doesn't

have the first page as mine. But I don't have any objection. It looks like it's just the cover page to that issue.

THE COURT: Government's Exhibit 16 is admitted.

BY MR. PRESANT:

Q So if we look at -- first, Ms. Miller, can we look at this paragraph right here? Mr. Jones, or is it Dr. Jones or Mr. Jones?

A You know, I don't actually know.

Q I'll refer to him as Mr. Jones. Mr. Jones asked you why did you write this paper. Right?

A Yes.

Q And your response was what? I've got it on the screen too if that helps, but if you want to look at the hard copy, go right ahead.

A It says, "We view the role of an expert as helping other members of the judicial process make informed decisions. This requires communicating relevant facts in the case and any background subject matter that is available to the expert. How this is best done is an open and important question."

Q All right. If we go to the next page, Ms. Miller. And we look at this paragraph right here. Mr. Jones asked you, "Do you feel that LR," LR is likelihood ratio, right?

A Yes.

Q "Should not be used in courtroom testimony?" And what was your answer?

A "No, that is not our view."
Q So let me interrupt you right there. So your view is likelihood ratios can be used in courtroom testimony, not must but can be, is that right?
A In some cases that may be the -- yes.
Q Yes. So it's not forbidden in all instances.
A It is not forbidden in all instances.
Q That's because he asked you, "Do you feel likelihood ratios should not be used," and you said, "No, that is not our view." I'm going to let you finish the answer. I just kind of want to start with that sentence. Okay. I apologize. "We agreed there might be instances in which likelihood ratios could be used in courtroom testimony." Right?
A Yes.
Q All right. Now, would you please continue with the answer there.
A Okay. "While we did not consider it proven that likelihood ratios are the final answer, and recognize their limitations, they may be the best communication strategy currently available in many forensic applications if one accepts the idea that the role of the expert is to effectively summarize the relevant information in the form of a weight of evidence."
Q Okay. So far you've acknowledged that you haven't studied STRmix; you're not an expert in probabilistic genotyping; you haven't analyzed STRmix as a model to determine how it works or

whether it functions properly. Would you agree with me that based on those acknowledgments, which are candid in my view, and your statement here, that it may be the case that likelihood ratios could be the best communication strategy currently available to communicate the results of that model?

A Yes.

Q Now, there's this "if" clause here. I want to talk to you about this "if" clause. And the "if" clause again is, "If one accepts the idea that the role of the expert is to effectively summarize the relevant information in the form of a weight of evidence." I've read that "if" clause probably a hundred times in preparing for the hearing today. And I'll admit I struggled with it. Would you explain to the Court what you mean by that if clause?

A Yeah. So I think as a community we look to forensic experts, or turn to them to provide valuable information in reaching a decision. Because of their training and experience, they have access to data that we don't have information to or don't have access to. And so a question becomes is the role of the expert to provide access to what that information available to them is so that a recipient of that information can better understand the particular output occurring in a given case, or is the role of the expert is to characterize what that information means, their view on what it means.

Q Okay. So if there is, if the idea is the job of the expert

is to communicate what they can figure out based on their training and experience, the tools available to them and the information provided to them in a particular case?

A Are they asked to provide their personal interpretation of the information, or is their role to provide the information itself.

Q Okay. So I think that goes to actually something Ms. Kloet asked you about where you said something to the effect of after three years you have yet to see a likelihood ratio that was presented in that way, is that right? Is that what you testified to or do I have that wrong?

A Where you say in that way, meaning -- in what do you mean by in that way?

Q Well, a likelihood ratio properly explained to the jury in the way that you accept that it could be here.

A So the request in the article is that if an LR is provided, the range of plausible other interpretations is articulated and explored in some thorough manner. And what I'm saying is in those three years I have not been given an example of a report or a transcript of testimony that goes through a or that includes a careful examination of the influence of the various assumptions used in constructing a model to arrive at a probabilistic interpretation.

Q So you haven't been given that information. Have you sought it out? Have you looked at transcripts where likelihood

ratios have been presented in court?
A No.
Q Have you attended criminal trials where likelihood ratios have been presented to juries?
A No.
Q So there is no reason to think that you would have seen how likelihood ratios are actually presented in court during that time period, is that right?
A My expectation would have been that an easy way to settle the conversation as opposed to having back and forth in the published literature would have been to say, you know, we think we understand what you're requesting, and we believe we are already doing that. Here is an example of where we have examined the influence on the offered result due to various factors. Does this seem like what you're asking for? Can't we say we are already doing this? But I have not received any correspondence to that effect.
Q And is it possible that the reason why is because the people who have published these academic articles are people who work at NIST, people who work in the development of forensic science, and they spend their day working on math problems and not combing through transcripts of hundreds or thousands of criminal trials?
A So the audience includes the authors of this rebuttal paper, so Simone Gittelson worked at NIST for a few years but

also I believe been employed as a forensic scientist. I know of John, Dr. Buckleton, worked at NIST for two years or more, and certainly he is a renowned expert witness appearing in trials.

I believe Kristof Champeau (phonetic) is actively involved in testimony. So I feel like the community --

BY MR. PRESANT:

Q Someone should look at the transcripts basically is what you're saying?

A I think, I think the community that authored that list has direct knowledge of the contents of those transcripts and the manner in which reports are provided.

Q But you haven't looked at them yet.

A But I have not looked.

Q Let's move on. Let's pull up Government Exhibit 15, please. Ms. Kloet showed you I think it was Exhibit Q. I'm just going to use 15 because that way Ms. Miller can move through the document. It's easier for us. But 15 is also this paper that you coauthored with Dr. Iyer, "Likelihood Ratio As Weight of Forensic Evidence: A Closer Look," correct?

A Yes.

Q So before we get into the line by line of this paper, I want to talk about a few of the big picture ideas that Ms. Kloet asked you about as well. In the first one is this you use the word personal or personalized a lot in the paper,

right? And the Court asked you questions about subjective decision making too, right? Are those ideas somewhat equivalent, personalized and subjectiveness of the likelihood ratio?

A I think, yes.

Q So you understand that generally in DNA analysis, right, there's the collection of the sample, and then there's the building of the model that's used, and then the forensic scientist him or herself actually uses that model in a particular case. We agree on that general framework?

A I believe so.

Q When you talk about the subjective or personal nature of the likelihood ratio, you're not just talking about that forensic scientist at the end of the chain, are you?

A No. That could be one component of it.

Q It's a woman in this case so I'll refer to the forensic scientist as she.

A Okay.

Q She may have had input into the model that was personal to her, those were decisions she made, correct?

A I believe so.

Q But when the model was being built by whoever built the model, those people also made subjective or personal decisions about how to build the model, right?

A I believe so.

Q So your discussion of subjectivity or personalization goes to all of those decisions, not just the one person who uses it in the particular case, right?

A That's correct.

Q Now, another idea in this paper is the idea that there can be multiple models for the same data and that multiple models may produce different results on the same data, did I get that right?

A Yes.

Q In fact, isn't one of your arguments that you can actually have infinite number of models on a given data set, right?

A There theoretically exist an infinite number of models, yes.

Q Because you could put the number 1 in to some limitation, you could change that to a 2 and a 3 and 4, you can go all the way up to infinity, that's just one parameter, so there are an infinite number of parameters that can be tweaked on a particular model, right?

A I would say yes.

Q So then what you propose is I think you call it an uncertainty pyramid, right?

A Yes.

Q And the idea of the uncertainty pyramid is what?

A So the range of potential results that one may obtain for a given set of data is dependent on what assumptions one invokes

when modelling that data. The intent of the uncertainty pyramid was to see how that range changes as different assumptions are folded into the mix. So that one can start to understand the influence that the assumptions have had on the, you know, the characterization of the uncertainty of the result. So how much is our uncertainty shaped by the assumptions that we have invoked in analyzing the data. At any point asking what is the range of results that we obtain if we make these assumptions.

Q And so of the multiple models that are considered in the context of that uncertainty pyramid, it's not physically possible to consider an infinite number of models, right?

A Certainly that's the purpose of statistical sampling in general is to --

Q You aren't going to live an infinite number of days so you can't consider an infinite number of models, right?

A Nope.

Q In a finite hearing or finite criminal trial that might last three days or two weeks, you can't consider an infinite number of models on a data set, right?

A Infinite, no, not infinite.

Q So what do you have to do to solve that problem?

A So part of the key information is what you have been able to do. So certainly cannot, nobody can fit infinitely many models, but one can attempt to study this base by fitting as

many as time allows for. And, you know, there may be some reasoning for why one thinks that within the space of models that may exist these two are extreme points in a spectrum, so maybe you can start to understand the range by trying to find the two models that are very different from one another, although, satisfying whatever the criteria for being a reasonable model offered.

Or you might say I could fit five different models, those are the five that I could fit, there are others I couldn't fit, here's the range of results that we obtained among these five. If I fit additional models, you know, that range could expand. You know, we know the range is at least this big because we found models that pass this criteria that, you know, values range from A to B.

Q And your proposal is that you could introduce multiple models and explain the decisions, the theoretical framework that went into creation of those models so that the factfinder can then determine which model is best, right?

A I would say it's to understand how well the offered quantity is known. What range of results could it possibly occupy.

Q I appreciate that clarification. So you would then have to educate the factfinder on the background necessary in order to understand why certain decisions were made, correct?

A Maybe that you would have to educate them on the criteria

for assessing whether or not each of those models is considered reasonable.

Q So if we were reviewing probabilistic genotyping models like STRmix, we would have to give the factfinder background in probabilistic genotyping, in the statistical underpinning of that, the biological and chemical underpinnings of that in order to assess those different models being presented, right?

A I don't know to what detail you have to go into the composition of each of the models if there can be a general over-arcing criteria saying, you know, there are different, different ways of representing the behavior of these types of components, we don't have exact knowledge of any of those so we looked at a range, but we tested each, you know, combination of those representations that were considered by comparison with this body of validation data and we kept only those combinations that were consistent with that data or met whatever performance criteria required for the model to be declared reasonable. And so then among those that passed, here's the range that we observed.

Q Isn't it true that the people who built a particular model may have already considered alternative models in making their decisions about how to build their particular model?

A Certainly they may have explored that. I can't comment on that.

Q This whole discussion is very theoretical, right?

A Okay.
Q You agree with me on that?
A That somebody who has one model may have considered other models?
Q In determining how to build their model, right?
A In building their model, yeah. I don't know what the determining part. I don't know.
Q Okay. Let's look at the paper. Can we go to page 2, please?
A Yes.
THE COURT: We are still on Exhibit 15?
MR. PRESANT: Yes, Your Honor. Let's look at this paragraph. I'll bring it up on the screen. So consistent with your testimony here today, the paper says, "Even career statisticians cannot objectively identify one model as authoritatively appropriate." Is that right?
THE WITNESS: Yes.
BY MR. PRESANT:
Q And then you talk about how you developed this framework that explores a range of likelihood ratios, right?
A We describe as opposed to develop. We are not trying to claim that these are new ideas.
Q If I said develop I misspoke. You describe it.
A Yep.
Q So how can you be confident that your framework is

authoritatively appropriately?
A I appeal to common sense.
Q The same thing that someone who built one model might be doing, right?
A You would have to ask them.
Q Can we back out, Ms. Miller? Let's look lower down on this page.

So in this sentence here you're saying, "In the absence of an uncertainty assessment, likelihood ratios may still be useful as metrics for differentiating between competing claims when adequate empirical information is available to provide some meaning to the quantity offered by the expert." Did I read that correctly?

THE WITNESS: I believe so.

BY MR. PRESANT:
Q And then you go on to say, "Free of normative claims requiring the use of likelihood ratios, forensic experts may openly consider what communication methods are scientifically valid and most effective for each forensic discipline." Is that right?
A Yes.
Q So is that paragraph essentially saying that if there's a lot of empirical information and in a science such as DNA analysis where allele frequencies are well studied, and the chemical laboratory equipment has been validated properly, and

people who are experts in those particular disciplines have determined the best way to communicate those ideas, that that may be a proper use of likelihood ratios?

A So I would not say that is the intended meaning of those sentences.

Q Then would you tell me what the intended meaning is?

A Sure. So in the first sentence where it talks about, "Likelihood ratios may still be useful as metrics for discriminating (sic)," the idea there is that the value reported is like a score, so it provides maybe an ordering. As opposed to the number having a literal meaning. So like the ratio of two probabilities, you say it's just the result output by the system. To try to find the meaning of that value rather than looking at that value alone, you try to understand what does this system do in cases like the one that we are applying the system to now but in instances where we knew what the truth was. And it's, it's not then a, we tell you what the probability is, we tell you, you know, in case, say you have a thousand cases like this where, if we are talking about DNA say where the person of interest is known to be a contributor to the sample, and a thousand instances where they are known not to be a contributor to the sample. You have some ground truth thing. You say applying this system results in this set of a thousand scores for the instances where they are a known contributor to the sample, and a thousand, here are the other

scores that we have obtained when it's not. Now here's the score that we have obtained in this particular case. And so now then you look at how does that compare to the behavior of the system in each of those instances. From that comparison you then assess, the audience assesses what does it mean. So like if you say I've done a thousand comparisons where the person of interest is not a contributor to a mixture, and this system that was applied for the case never produced a result bigger than ten, say. And in this instance we saw a value of a thousand. And if we look at the behavior of the scores when the person is a contributor to the mixture, we tended to see scores that ranged from, you know, a hundred to a million. So the thousand is well within that range.

You know, it's that behavior then that informs the meaning of the value for the audience. So it's being represented as opposed to an interpretation, it's just a statement of what are the outputs of the system. That is what is meant by the first, by the first sentence.

Q That's the adequate empirical information.

A Yeah, that context of, you know, how has this system behaved in applications like the one at hand where ground truth is known.

Q The model has to be appropriately validated or studied before it can be used.

A So there's I would say there is a difference. So in

validation typically somebody would say because we have collected a sufficient body of information now we are justified in offering this precise interpretation of the, of the value. Whereas in the other one, there's not an exact meaning to it; it's coming, the meaning comes from, you know, the data displayed for the behavior of the system. And those are two different, those are two different things. In one I'm trying to give you a precise characterization of my personal interpretation of the meaning of what the data is, and in the other one I'm trying to give you a thorough insight as to what the behavior of the system is which would be the basis of my interpretation to facilitate you understanding that and arriving at your own interpretation.

Q Let's go to page 6, please.

A Okay.

Q Ms. Miller, if we can have this paragraph under 1.1 list of concerns. You wrote, "If it can be argued that LRExpert is sufficiently close to LRDM, then such a substitution may be acceptable to the DM and fit for his or her purpose." Is that right?

A Yes.

Q So the LRExpert is the likelihood ratio specific to the expert based on the work the expert has done, right?

A Yeah. The interpretation of an expert, yep.

Q And the likelihood ratio DM, DM stands for decision maker,

right?

A Yes.

Q That would be the jury or the judge depending on who is the decision maker, right?

A Yes.

Q You acknowledge here there are instances where it may be that the likelihood ratio expert is sufficiently -- where the expert is sufficiently close to the likelihood ratio for the decision maker, right?

A Certainly. If the range of plausible interpretations from study of different perspectives of it is very narrow, that may give confidence to the community that any reasonable interpretation is sufficiently similar and now we are in, everybody would be happy; there is no dispute that a different reasonable interpretation would substantially differ.

Q All right. Let's go to page 9. One of the examples you use in this paper is studying the refractive indices of glass windows, right?

A Yeah. It uses just a publicly available data set for an illustrative example.

Q And one thing you say is that in order to have a high degree of confidence in studying these glass windows, you would need, right, this is the confidence part that I just underlined you would need, "refractive index data from many windows with enough measurements from each window so as to convince oneself

that strictly limiting the set of plausible distributions to a location family will have only a negligible effect on the interpretation of the analysis." Right?

A Yeah. So the idea there is that a common implementation for a probability model is to say, you know, maybe the behavior for each window is not exactly the same. But maybe we will say it follows the same distribution with the same spread except the center shifts around. That sentence speaks to what would the empirical basis be in order to provide confidence that really the distribution of refractive indices in glass has or satisfies that constraint.

Q To have confidence in the model you need a lot of data.

A To justify the sole consideration of that assumption you would need a lot of data to say any other reasonable assumption is going to be sufficiently similar to the results produced by this.

Q And you're not an expert in DNA analysis but it may be the case that DNA is a field in which there is lots of empirical data that would give you confidence in the assumptions that could go into models, right?

A I think there could be lots of data, and I don't know what the range of reasonable interpretations given that data is for any particular case. I have not studied that.

Q Right. But your point is more data is better.

A No. My point is whatever data you have there's a range of

reasonable interpretations and you don't know what that range is until you've studied it from different perspectives.

Q You need to have studied it carefully.

A From multiple perspectives, yes.

Q I'm attempting to frame my questions to elicit yes or no answers. But it's your testimony. I'm trying to simplify here. That's all I'm trying to do.

Let's go to page 10. Right there, Ms. Miller. Page 10 you're talking about multiple plausible models and you write, "It is possible for the criteria of a specific individual to be expressed in an objective manner." Is that right?

A Yes.

Q Page 20, please. Let's look at this bottom area. So this is the one part of this paper that actually refers to DNA, right?

A Yes.

Q And again, it's not because you studied DNA but this is part of the discussion where you're talking about different application of these ideas, right?

A Yeah.

Q And one thing you wrote here is, "One might expect to find the least degree of uncertainty in applications of probabilistic evaluation of high-template, low-contributor DNA samples, and we recognize that the community may be well

founded in its use of probability to facilitate knowledge transfer in such cases." Did I read that correctly?

A Yes.

Q You stand by that, that forensic DNA analysis might be an area where there's less uncertainty than in other forensic disciplines because again your paper just is sort of general to forensic science, right?

A Yes. Am I allowed to read the next sentence or is that not --

Q If you would like to, sure.

A Okay. So the following sentence to that quote it says, "We do not view this as an exception to the framework we present, but rather as a scenario in which extensive uncertainty evaluations would likely yield a degree of consensus leading most people to conclude an offered LR value is fit for the intended purpose." So the intent there was that the best case scenarios with DNA, there may not be a whole lot of modelling variability so if one were to go examine, they may find that the range is sufficiently narrow as to warrant its use. But --

Q You would have to go examine in order to do that, right?

A Yes, so we would have to study what the different perspectives are for a given application or a given electropherogram.

Q Lower down in the same block you wrote, "When an LR value is the output of a computer algorithm, one may reasonably

assume that, given the inputs, it is highly reproducible." Correct?

A Yes.

Q There are multiple ways to calculate an LR, and every time you get an LR it doesn't mean someone got there using a computer algorithm to do it, right?

A So that there are ways to arrive at an LR other than using a computer algorithm?

Q Right.

A Yes. Yes.

Q And if I read the sentence correctly, what you're saying is use of computer algorithm is preferable because it's highly reproducible.

A Yeah, the output, the output of a fixed body of computer code to fixed inputs we expect to be very stable.

Q Page 22, please. My last question actually looking at the paper itself. The end of your paper you talk about the scoring method, right?

A Yes.

Q And if I understand it correctly, you're saying, well, in some instances it might be better to use a scoring method which would still be a number, is that right?

A An ordering. Sometimes people use, for instance, the identification inconclusive, exclusion paradigm could also be seen as an ordering in that the strength of evidence is highest

for an identification articulation and exclusion is the lowest. So that still is ordering. That's not numeric. But I think it suffices to consider scoring method as a numeric output.

Q What about a verbal equivalency table where LRs were converted to verbal equivalent, would that be an example of a scoring method?

A If one looks at it just as the ordering, yes.

Q That's all I have for 15. You can take it down. All right. I would ask you to look at Exhibit MM which Ms. Kloet introduced. It's the paper you said you received by e-mail a day or two ago.

A Yep. Yep.

Q Government received by e-mail just last evening. The paper was very new to all of us.

A I don't know if it was Tuesday evening after my flight, after my flight had landed and I got to the hotel and checked my e-mail it was in my inbox. I don't remember the exact time at which it was sent.

Q Let's look at page 158, figure 1. In figure 1 do you know if that first indication of drop-in and 14 has been described accurately?

A No.

Q What about the drop-out at 16.3 to the right, do you have an opinion on that?

A I do not.

Q Do you know what's being described in figure 1, the 54 percent and the 100 percent and 48 percent?
A So not at this moment, no.
Q You haven't reviewed it carefully enough yet in order to have an opinion on that.
A Correct.
Q That's fine. You don't need to take the time now.
Let's go to page 161 Ms. Kloet asked you about. And Ms. Kloet asked you about this table 1 at the bottom, right?
A Yes.
Q The bottom, correct, not bottom right, just at the bottom.
A Yes. Yes.
MS. KLOET: Sorry to interrupt but just to make the record clear I think the Court was inquiring about that table.
THE COURT: Yes.
MR. PRESANT: Someone asked you questions about the table, right?
THE WITNESS: Yes.
BY MR. PRESANT:
Q I actually want to look at the title of the table. What is the title to the table?
A Table 1, you mean the caption?
Q Sure, the caption.
A Hypothesis and LR values obtained by each of the participating laboratories. All laboratories used the

LRmixStudio software, except those marked as with the single asterisk, which implies used EuroForMix or a double asterisk used DNAMIX. And then goes on to --

Q You don't have to read the legend. So I believe the point Ms. Kloet was trying to make is that these numbers here have a large variation, likelihood ratio, right?

A I believe that's her point. I may have to ask her.

Q And they do in fact have a large range of variation, right?

A I would characterize that as substantial, yes. To me.

Q That's fine. It's your testimony. If you want to say it's substantial --

A Okay.

Q And these varying values came from it looks like three different models. I'm not sure why they are all on the same table then, but the three models being LRmixStudio, EuroForMix, and DNAMIX. Right?

THE COURT: Well, but there's only one of the EuroForMix and one of the DNAMIX, all the rest are of the LRmixStudio software.

MR. PRESANT: You're correct, Your Honor. I appreciate that clarification. So mostly from one model or piece of software but a couple of the data points are from different pieces of software, right?

THE WITNESS: Yeah. I believe when I said a range, I restricted only to the subset of those indicating they were

analyzed using LRmixStudio.

BY MR. PRESANT:

Q I'm pointing it out but it's actually not important for my question. My question for you, first question for you is are any of those three software models STRmix?

A No.

Q Does the range of outputs of the model differ based on the model itself?

A It could.

Q If I told you that there's been testimony that the range of outputs for STRmix is within one order of magnitude, would that surprise you?

A Would it surprise me that that's the testimony?

Q That model could produce a range of outputs that only varied typically by one order of magnitude.

A It depends over what input factors are allowed to vary. It would not surprise me that some components of a model free to vary leads to an order of magnitude difference. I don't know what all factors are included in that variation.

Q And in here in this table 1 the range of orders of magnitude is much greater than that, it's I think 12 orders of magnitude, is that right?

A 11 if we restrict to the application of the same software. Because the lowest one was EuroForMix. So it's the second one which has a 10 to the 3.

Q You're absolutely right. Do you know who developed these software programs?

A No.

Q Do you know when they were developed?

A No.

Q If I told you that at least a couple of them were developed in the 1990s, would you have any reason to dispute that?

A No.

Q Do you know why there would be a paper published in 2018 studying software models from the 1990s?

A I don't know what the motivation of the authors are. Perhaps those are the ones that are utilized in case work in their countries. You would have to ask them.

Q Let's go to page 159, please. Can we look at this paragraph in the paper? The authors here wrote, starting this sentence, "In this sense, following the recommendations of the ISFG, a large majority of participants employed the likelihood ratio statistic as the most appropriate approach for statistical evaluation for the autosomal mixture profile." Did I read that correctly?

A I believe so.

Q Now, you filed or rather your attorney in this case filed a declaration just on Monday, is that right?

A I believe so.

Q You signed a declaration?

A I did.
Q In that declaration you wrote, "The article does not include," the article referring to the article you and Dr. Iyer wrote.
A Yes.
Q Correct? You say, "The article does not include any empirical research by my coauthor or myself intended to validate or invalidate a specific probability model including models used by the STRmix software, or other probabilistic genotyping models. I have never conducted empirical research on the reliability of DNA analyses including the reliability of STRmix software."
A That's correct.
Q Did I read that correctly?
A Yes.
Q Do you stand by that statement as you sit here today?
A Yes. I have never conducted empirical research into probabilistic genotyping.
Q Lower down you wrote, "I am unaware of any empirical studies conducted by other researches at NIST on the reliability of probabilistic genotyping for the STRmix software in particular." Do you stand by that statement as you sit here today?
A Yes, I do.
Q And the last paragraph, "I do not know any specific studies

that have either validated or invalidated results derived from STRmix software or compared the results of STRmix software probability assessments with the assessments of other plausible models." Do you stand by that statement as you sit here today?

A I do.

Q My last set of questions for you, Dr. Lund, actually do relate to that paper again but we are not going to look at that paper. Is one way of viewing your argument really philosophical in terms of the method by which a witness communicates to a jury?

A Philosophical in what sense?

Q The jury's ability to understand the information that the expert is attempting to convey.

A Yeah. Certainly it's with regard to what expectations the decision maker or the third party, the receiver of the information comes to expect to exist on the basis of what's said.

Q But ultimately that's not a scientific question, correct, that's a legal determination for the Court about the order and mode of the presentation of witnesses and evidence to a jury, right?

A I think certainly there are legal considerations to that. I would say that existence of measurement science is largely in part to or is largely to facilitate calibrated communication among individuals so that we can accurately understand what is

said by one party.

Q It's helpful for a Court to consider science but ultimately the way that evidence is presented is a legal determination for the Court, you would agree with that?

A Certainly. I have no authority to say what's permitted or what's not.

Q As we have discussed, it may be the case with certain areas of forensic science where if models are properly developed and studies that likelihood ratios may be the best method of communicating scientific evidence to a jury.

A Yeah, depending on what the meaning of best is.

MR. PRESANT: Nothing further, Your Honor.

THE COURT: Any redirect?

MS. KLOET: Just a couple, Your Honor.

REDIRECT EXAMINATION

BY MS. KLOET:

Q Could you open your defense binder to Exhibit P, please? The last page. P as in Peter.

A Thank you.

Q So I'm showing you the written record of the interview that you and Dr. Iyer had with John Paul Jones of NIST. And I just wanted you to pay attention or call your attention to a couple sentences here. If you can look in the very first paragraph, not the complete paragraph but the first paragraph. Could you read that final sentence for me, please?

A The thing that begins with of course?
Q No. Right before that it starts with it seems.
A You said this is on the --
Q Very top, it's the second --
A This is on the second.
Q On the back page. I'm sorry.
A I'm sorry, the last sentence on that first bulk of body of text. "It seems reasonable to think that LR, or likelihood ratio, are an improvement over the older paradigm, but it is premature to think of likelihood ratios as the final answer for all forensic disciplines."
Q And do you stand by that statement today, do you agree with it?
A That represents my perspective, yes.
Q Does it also represent Dr. Iyer's?
A I believe so, yes.
Q If you can go to the final full paragraph. The heading on that paragraph is, "Then what was the point of "urging caution" when using likelihood ratio, as the NIST press release mentions?" Can you read the sentence that starts with "in particular" and just complete the paragraph, please? It's about halfway through the paragraph.
A "In particular, experts should counteract potentially unwarranted reverence jurors may place on provided LR due to the mathematical machinery that often underlies LR

computations. Additionally, we feel that there are descriptive, rather than interpretive, means of communicating evidence that have not been fully pursued due to the current focuses on likelihood ratio development."

Q As you sit here today, do you agree with that statement?

A Yes, I do.

MS. KLOET: Nothing further, Your Honor. Thank you.

THE COURT: Any recross, Mr. Presant?

MR. PRESANT: No, Your Honor.

THE COURT: Thank you, Dr. Lund. You may step down. It's about 11:30 so let's, let me ask this. You have one more witness, Ms. Kloet?

MS. KLOET: That's correct, Your Honor.

THE COURT: Okay. It's 11:30. Let's take our lunch break now and come back at 12:15 ready to hear the defense final witness.

THE WITNESS: Thank you, Your Honor.

THE LAW CLERK: Court is in recess.

(Recess taken, 11:32 a.m.; Resume Proceedings, 12:31 p.m.)

THE LAW CLERK: All rise. Court is back in session. Please be seated.

THE COURT: Ms. Kloet.

MS. KLOET: Your Honor, the defense calls Nathan Adams.

THE COURT: I'm sorry.

MS. KLOET: The defense calls Nathan Adams. Would you like me to address the housekeeping issue quickly with respect to exhibits?

THE COURT: I'm sorry?

MS. KLOET: I would like to address a housekeeping issue quickly with respect to exhibits. Defense Exhibit Q which is the same as the Government's Exhibit 15 I don't think was ever formally admitted. I would like to -- I didn't previously move to admit that as Lund/Iyer's article. I would like to do so now.

THE COURT: Mr. Presant.

MR. PRESANT: Well, the government did mark 15. It intentionally did not offer 15, but I don't have a basis for objecting to Q.

THE COURT: It's admitted.

MS. KLOET: Thank you. If the Court is prepared the defense calls Nathan Adams as its final witness.

NATHAN ADAMS, DEFENSE WITNESS, WAS DULY SWORN

THE LAW CLERK: Please be seated. And state your full name for the record, spell any unusual spellings.

THE WITNESS: My full name is Nathaniel, I-E-L, David Adams.

DIRECT EXAMINATION

BY MS. KLOET:

Q Mr. Adams, could you describe your formal education, please?

A I have a bachelor's of science in computer science from Wright State University, and I'm currently working on master's of science in computer science.

Q And where are you working on that master's program?

A Also at Wright State.

Q Where is Wright State University?

A Outside of Dayton, Ohio.

Q While you were in your graduate program, was there a specialization you did there?

A Yeah. I focused on bioinformatics.

Q Did that specialization require additional course work beyond what was required for a standard computer science bachelor of science degree?

A It did.

Q What were some of those courses?

A They were biology or biology courses in genetics, and specifically in bioinformatics as in the course title.

Q Have you taken any courses in mathematics or in statistics?

A Yes, I have.

Q What are those courses?

A Between math and statistics, I have taken, in addition to

my high school math, trig and the like, I've taken college level calculus, linear algebra, discrete mathematics, statistics for engineers, and then a number of my courses have heavily focused on different mathematical concepts.

Q Did you take any courses in college or post graduate where you did any sort of data analysis as part of that course?

THE COURT: One second, please.

BY MS. KLOET:

Q My question was whether you took any courses during your college years or post graduate college years where you engaged in any data analysis as part of those course requirements?

A Yes, I took a number of courses that involve data analysis.

Q Did you take any courses in data mining during that time?

A Yes, I took courses with that specific title.

Q Please tell me about the experience you have if any with the intersection between computer science and biology or DNA principles.

A From my undergraduate experience I took a number of courses that studied either biology systems, chemical systems, or computer science topics. I took a number of courses that explicitly combined those using computer analytical tools to solve questions or address questions in biology. And in a number of additional courses I chose that as a project data set to explore data analysis within biology, well, on biology data. I was involved in --

Q Can I interrupt you for a second? You said you chose that as a data set. What did you mean by that?

A There's a large quantity of freely available biology data sets that can be downloaded. So when there are specific models or methods that we were learning in a classroom setting, it was often left to the students devices to choose an appropriate data set and perhaps even an answer, a question and answer to develop a model for that specific data set. So I would download DNA sequence data, protein sequence data, protein structure data, stuff like that.

Q While you were in your undergraduate program, were you a member of any associations?

A I was a member of a research group, the Bioinformatics Research Group.

Q Is that part of a department?

A It's run by computer science professor at Wright State.

Q Were you a student member of any larger organization?

A I was a student member for a time of two professional and scientific computing organizations.

Q What are those?

A One is IEEE, that's the Institute of Electrical and Electronic Engineers and the ACM which is the Association for Computing Machinery.

Q What types of projects were you involved in at the first one you listed, the Bioinformatics Research Group?

A We would alternate taking up projects. Most of the members of the group had computing backgrounds, some had biology, study biology sciences as well. On one particular project that I worked on was about molecular evolution studying genes that had been identified in a number of different species comparing and contrasting the differences of those genes to identify patterns of interest.

Q You mentioned you're enrolled in your master's program now. Where are you in that program?

A I have completed the required course work, required number of credits for course work, but I have, I have to submit and then defend my thesis.

Q What is your thesis? Have you chosen a topic?

A Yeah, the topic, the data set and computational problems that I'm working are related to the number of, estimating the number of contributors in a mixture.

Q In a mixture of what?

A Forensic DNA mixture.

Q What will your master's degree be in specifically if you graduate?

A The field would be computer science.

Q What type of research and/or studies have you done throughout the course of your master's program at Wright State for your thesis? I'm sorry. So narrow it to your thesis.

A For the thesis is again there's freely available data sets

online that anybody can download and utilize. And I have developed tools to simulate mixtures, mixed DNA samples following methods that were originally published a little over ten years ago, and in an attempt to apply those methods and techniques to a novel data set while also addressing computational, addressing the issue from a computational perspective.

Q Do you have a master's advisor?

A I have two advisors.

Q Who are those advisors?

A There's a computer science and engineering professor, Dr. Travis Doom, D-O-O-M, and professor of biology sciences, Dr. Dan Krane, K-R-A-N-E.

Q Are you currently employed?

A I am.

Q Where are you employed?

A Forensic Bioinformatics Services.

Q What is your position there?

A My title is a systems engineer.

Q What is Forensic Bioinformatics in the business of?

A We provide consulting services about forensic DNA, forensic biology testing that's been conducted. We will review materials generated during testing and analysis and consult with almost exclusively lawyers.

Q Who else works at Bioinformatics with you as a full-time

employee?
A I'm one of two full-time employees. The other is a biologist, our analyst, Carrie Rowland.
Q Are there part-time employees?
A We have several part-time employees.
Q What do they specialize in, just quickly?
A We have a bookkeeper, part-time bookkeeper, we have a separate part-time accounts manager who works with invoicing and the like. We have currently working there two interns, one is a biomedical engineer, and the other intern is a former forensic scientist whose gone back to school for computer science.
Q Does Dr. Krane work at Forensic Bioinformatics?
A He does. He's the president.
Q Does Forensic Bioinformatics have any outside consultants with whom it works or with whom you work more specifically?
A We have a number of colleagues who we collaborate with, some more than others. There's several principals to our organization, and then there's a number of long time colleagues of my boss and now myself I would like to think.
Q What are their areas of expertise?
A There's a wide variety. Depending on what particular issue we're addressing, we will call on the services of different folks. We have the principals of the company, there's I believe four, four professors, so one biologist, two computer

science and engineering professors, one who is, I always butcher this, a psychology, criminology and law I believe is his title. And we have a more business affiliated partial owner, part owner. And another forensic DNA consulting scientist.

Q How long have you worked there?

A Five years now.

Q Can you describe briefly but thoroughly your duties in that position, your daily duties in that position or normal duties in that position.

A My duties are evolving, but they generally deal with requesting and receiving materials generated during the course of DNA analysis, a forensic DNA analysis, effectively the case file or the bench notes of what the laboratory might have generated.

Q Do you review those materials that you receive?

A I do.

Q Go on.

A I'm one of the, well, I will typically review the electronic data that was generated during the course of testing, the output of the genetic analyzer, which is the basis of the electropherograms that have been discussed. There's a sequence to our reviews as there is a sequence to the DNA testing. So once we have reanalyzed the electronic data there's often questions about interpretation, evaluation of

standard operating procedures, protocols, comparison of what was done in this case, compared to both what's done in generally in the field, or more specifically, what this lab says they're supposed to do in their protocols. So there's a range of duties depending on what's needed in a particular case. But we also spend a fair bit of time doing education outreach, giving talks, lectures, participating in conversations. And when there's time and an issue, try to publish a paper.

Q Do you review the literature in the fields that touch upon your work at Forensic Bioinformatics?

A Yes. That's part of my regular duty.

Q You try to keep current on that.

A I do.

Q Do you ever review a validation study in the course of your employment there?

A Yes.

Q How about software systems themselves of any nature, do you ever do that?

A Yes, I review software.

Q Okay. In that position do you only review cases that deal with forensic biology?

A My company specializes in forensic biology. So there's forensic DNA and serology are typically the two components to that.

Q How many electropherograms do you think you've reviewed in the course of your career?
A Too many to count. Thousands.
Q How many biology laboratory's protocols or procedures do you think you've reviewed, just approximately?
A Likely dozens.
Q What has been your experience or extent of your experience with Probabilistic Genotyping Systems in the course of your employment?
A So now for, for most of the time that I've been, we call our company FBS, so if I make reference that's what I'm referring to, spent, it's an increasing part of my focus at FBS and goes back to shortly after I joined the company. There was an increasing conversation about probabilistic genotyping just in the general forensic DNA community. That caught my attention and in 2014 I attended a workshop which is kind of the milestone in my mind of when my attention really turned towards probabilistic genotyping.
Q What was that workshop about?
A It was introducing Probabilistic Genotyping Systems to forensic DNA analysts. It was put on by the Midwest Association of Forensic Scientists in St. Louis.
Q That was 2014?
A Yes.
Q Currently would you say you work on or with Probabilistic

Genotyping Systems or programs on a daily basis?
A Yeah. If not the systems themselves, then certainly the data and conclusions outputted by them.
Q And you've given testimony before on cases involving the use of Probabilistic Genotyping Systems, have you?
A I have.
Q Do you know how many times approximately?
A Six or seven.
Q Have you written reports or declarations in cases involving this type of material?
A Yes, I have.
Q Have you received any other training on Probabilistic Genotyping Systems?
A In addition to the general continuing education, the more informal stuff like webinars, reading articles, having conversations; a few months ago I attended the STRmix workshop, four-day workshop that's been mentioned a couple times.
Q When did you attend that?
A Several months ago. I believe it was March.
Q What was covered, just succinctly covered at that workshop?
A There was an overview of the principles of the underlying forensic DNA models that describe molecular DNA behaviors, how those fit together in STRmix. Overview of the underlying sampling algorithm of STRmix, and then a number of hands-on exercises that increased in complexity from replicating results

in Excel to fully running the software.

Q Did you receive any training on the calculation of a likelihood ratio manually and/or using STRmix?

A Yes.

Q Were you given or provided with a copy of STRmix to try yourself during that training?

A Yes. Attendees got a trial version.

Q Have you personally reviewed STRmix outside of that workshop that you just mentioned?

A Yes.

Q When was that?

A I reviewed the source code several weeks ago.

Q Did you do it any other time?

A About two, two and a half years ago.

Q Have you reviewed other probabilistic genotyping software systems?

A Yes.

Q What are those?

A I have reviewed the underlying, the foundational literature to a number of systems reading the articles that are written about it, as well as for freely available and open source versions I've evaluated a number of those to varying degrees since they are simply available online.

Several times I've, my company has been hired to review the forensic statistical tool, FST, which is a

probabilistic genotyping program that was or still is used by the New York City office of the chief medical examiner there at the city's lab, forensic DNA lab.

Q How many times have you reviewed FST?

A We have been retained to do it three or four times. I think not all of those have, have been finalized. Not all of those were finalized.

Q How many times did you review that program?

A I've spent two or three code reviews, what I would call it.

Q Have you ever heard of TrueAllele?

A Yes, I have.

Q Have you reviewed that?

A Not at source code.

Q Have you reviewed any materials related to TrueAllele?

A Yes, I have.

Q Like what?

A There's a number of articles that have been published in the literature about the underlying principles of TrueAllele. There's laboratories that adopt it including the parent company, Cyber Genetics have manuals for the use and operation of TrueAllele. There are validation studies that labs who bring TrueAllele online have to conduct. So I have reviewed those. I've reviewed data specific to particular samples and particular cases, how TrueAllele evaluated those evidentiary items for reference. I don't know if it's been mentioned but

TrueAllele is one of the chief competitors to STRmix.

Q Thank you. In your professional opinion as a computer scientist, what skills were necessary in order for you to perform these types of reviews of these various programs?

A Well, certainly any time you're reviewing source code it, you need to understand source code. You need to have a familiarity with the programming language in which it's written. And understanding the underlying principles and certainly the vocabulary of the field of forensic DNA is going to benefit any review.

Understanding how it's used by laboratories, by analysts is also helpful to understand how the data is intended to flow through the program, how it's evaluated before and after it enters and exits the program.

Q Do you need to have any familiarity with algorithmic design such as Markov Chain Monte Carlo?

A Well, it would help, yes.

Q And do you have any familiarity with that?

A Yes, I do.

Q Are you familiar with SWGDAM?

A I am.

Q Have you reviewed their guidelines for validation of probabilistic genotyping software systems?

A Yes, I have.

Q Are you a member currently of any professional

organizations?

A I am.

Q What are those?

A The ones that I mentioned earlier, IEEE, and ACM.

Q Have you won, during the course of your career or your post graduate career, have you won any awards or grants?

A Yes. As an undergraduate I won -- my senior design team that was tasked with conceiving and constructing a useful product, won the engineering school's award, recognition award which was presented to one team.

Q What kind of data did that deal with?

A The premise of the project was to add functionality to an open source. The name of the software is Osiris. It's developed by the federal government and freely distributed. It's an open source software program for the evaluation of the data that comes out of a genetic analyzer, the basis of the electropherograms. So we added, defined and added functionality to that software as well as developed a reporting framework that we felt would be conducive to forensic DNA case reviews.

Q Have you received any other awards or grants?

A Yes. Just recently we were -- I'm a member of a team who was awarded a grant from Columbia.

Q What is that grant for?

A It's for an investigation and evaluation of Probabilistic

Genotyping Systems, how they evaluate data.

Q You said you're a member of a team. How many people are on that team?

A There's six named members and there's likely people who will help out or perhaps graduate students who become the recipient of that grant money.

Q In what fields are those other six members?

A Myself and there's -- so in addition to myself, the other five members include a professor of computer science, a professor of biology, a criminal defense lawyer, a journalist, and a professor of statistics.

Q Have you conducted any sort of presentations or seminars in your professional career?

A Yes.

Q Have you given any of those presentations or seminars at NIST?

A Yes.

Q When was that?

A I gave a talk several years ago at I believe the name of the symposium is the Error Management Symposium at NIST, or put on by NIST. And I gave a talk that was on the management of bias in forensic science contexts.

Q Do you have any recent publications?

A Recently a letter to the editor of the "Journal of Forensic Sciences" was published.

Q Can you turn, you should have a binder over there that says defense exhibits to your right. Can you turn to tab E, please? Is this the document that you just referred to?

A Yes.

Q What is this? What was the purpose of writing this letter?

A To explain the basis for advocating, for advocating the use of for developing software standards for the field of forensic DNA and specifically probabilistic genotyping.

Q Did you have any coauthors on this letter?

A I did.

Q Who were they?

A Dan Krane mentioned before. Can I read their --

Q Sure. If you need to refresh your recollection go right ahead.

A Roger Koppl is a professor of finance and regularly works on the risks and merits of expertise and bias. Dr. Krane. Dr. Thompson is one of the principals of Forensic Bioinformatics, he's the professor of psychology, criminology, and law. I can find the -- there. It's the Department of Criminology, Law and Society, and a member of one of NIST's OSAC groups, as well as Professor Sandy Zabell who is a professor of statistics at Northwestern and a member of an OSAC group as well.

Q What was the position you took, briefly as possible, in this particular letter?

A That there's been, generally there's been an insufficient

or almost total lack of conversation about the merits of software standards in probabilistic genotyping system development, and that they are important. It's important to have those conversations.

Q And to what journal did you submit this letter?

A The "Journal of Forensic Sciences."

Q Was this letter submitted to peer review?

A It was.

Q Do you know the identity of the peers who authored that letter?

A I do not.

Q Reviewed that letter, pardon me.

MS. KLOET: Your Honor, I move that Defense Exhibit E be admitted into evidence.

THE COURT: Mr. Presant.

MR. PRESANT: Voir dire, please.

THE COURT: Sure.

MR. PRESANT: Mr. Adams, the letter marked Exhibit E is your only peer reviewed publication to date, is that right?

THE WITNESS: Published, yes.

MR. PRESANT: Well, what sort of publications are not published?

THE WITNESS: I stand corrected. The answer is yes.

MR. PRESANT: Okay. Thank you. What, the Court has seen a lot of published articles in the course of this

proceeding; you know, some of those are five pages long, some of those might be 80 pages long. This looks a little different. It's a letter to the editor, right?

THE WITNESS: Yes, sir.

MR. PRESANT: What's the difference between a research article that is published in a journal and a letter to the editor?

THE WITNESS: Most journals have gradations or categories of submissions to the journal. So I am familiar with JFS, this journal, and FSI Genetics have recognition for original research articles which is the sense of conducting an experiment, reporting those results.

MR. PRESANT: Adding something new to the scientific community.

THE WITNESS: Yes.

MR. PRESANT: And what's a letter to the editor by contrast?

THE WITNESS: A commentary.

MR. PRESANT: On what others have done, right?

THE WITNESS: Generally I would say a commentary. It could be on what others have done, what they're doing, what we should be doing, anything that somebody wants to call attention to to the readership of the journal.

MR. PRESANT: Is the peer review process for a journal article different than the peer review process for a letter to

the editor?

THE WITNESS: I haven't been a peer reviewer of either. I don't know.

MR. PRESANT: As an author of this letter do you know if it went through a different peer review process than a full journal article with original research would have?

THE WITNESS: I don't know.

MR. PRESANT: And there were five authors I think you said listed on this letter.

THE WITNESS: I count five.

MR. PRESANT: What was your role among the five authors in drafting this letter that was just over a page?

THE WITNESS: Drafting it.

MR. PRESANT: You did most of the writing.

THE WITNESS: I certainly drafted the original. There was what's been referred to as word smithing.

MR. PRESANT: Did any of the other authors, one of which I think was your supervisor, right, for your thesis?

THE WITNESS: Yes.

MR. PRESANT: FBS, Dr. Krane, did he make any substantive changes to your draft of the letter?

THE WITNESS: All of the authors made substantive contributions.

MR. PRESANT: No objection, Your Honor.

THE COURT: It's admitted.

BY MS. KLOET:

Q Thank you. Mr. Adams, could you turn, please, to Defense Exhibit B in your binder. Mr. Adams, what is this?

A This is my CV.

MS. KLOET: Your Honor, I move that Defense Exhibit B be admitted into evidence.

THE COURT: Mr. Presant.

MR. PRESANT: I would like to voir dire him on the qualifications in the CV. If now is the time I would take that opportunity. But to the document itself, I don't have an objection.

THE COURT: Well, let's just admit the document and you can voir dire him on his qualifications when he's offered as an expert.

MR. PRESANT: Thank you, Your Honor.

MS. KLOET: Your Honor, at this time I would move to offer Mr. Adams as an expert in computer science and forensic analysis as it relates to computer science as well as Probabilistic Genotyping Systems.

THE COURT: Okay. You're on, Mr. Presant.

MR. PRESANT: Thank you, Your Honor. Leave B up there, please. Mr. Adams, when I look at your CV I see the dates when your professional experience started and when your master's course started but you don't list a date you graduated with your bachelor's degree. What year did you graduate from

college?

THE WITNESS: I received my bachelor degree in 2014.

MR. PRESANT: And is there a reason you don't include that on your resumé?

THE WITNESS: No.

MR. PRESANT: Just an oversight?

THE WITNESS: Does it need to be?

MR. PRESANT: No. I'm just curious why there are dates for some but not others. But if there's no reason, there's no reason.

THE WITNESS: The educational background I have it there to demonstrate that my master's degree is, is in progress but incomplete.

MR. PRESANT: You've been working on your master's degree for four years now?

THE WITNESS: Yes.

MR. PRESANT: You started immediately after you graduated from college.

THE WITNESS: Yes, sir.

MR. PRESANT: How long do master's degrees usually take to attain in computer science at Wright State University; is it a 2-year program, a 4-year program, longer?

THE WITNESS: It's a fairly flexible program.

MR. PRESANT: Is there a time with which the degree is conferred on most of the people who enroll in the program, like

would you say a majority of people finish in two years?

THE WITNESS: We have a number -- I don't know.

MR. PRESANT: Did you testify previously that you expected your master's degree to be conferred in 2016?

THE WITNESS: It's possible.

MR. PRESANT: Was there a time in 2016 when you expected the degree to be conferred in 2016?

THE WITNESS: I sure hoped for it.

MR. PRESANT: Well, why do you think it hasn't been awarded when we are now sitting in 2018?

THE WITNESS: My own delays.

MR. PRESANT: And I guess would you explain what you mean by that? The delays. Has there been an issue in drafting your thesis?

THE COURT: Mr. Presant, I really, you know, I know where you're going with this. And I think it really just is wasting time. He doesn't have it. He's worked on it. There can be any number of reasons why he hasn't achieved it. But let's move on to what are some really significant issues involving qualifications as you see it.

MR. PRESANT: Thank you, Your Honor. The only point I was going to make was that the process of obtaining a master's thesis is having experts in the field evaluate your work and your ability to defend it. And that that hasn't occurred yet and yet he is in court testifying as an expert in his field.

That was the only point. But the Court's statement is well taken. I'll move on.

THE COURT: Point taken.

MR. PRESANT: But your thesis is on, you talked about it applying the work from ten years ago, right?

THE WITNESS: It's built on that, yes.

MR. PRESANT: And whose work was that specifically?

THE WITNESS: My boss's.

MR. PRESANT: Did you testify previously that the work is built on Dr. Buckleton's research as well?

THE WITNESS: It is, yes.

MR. PRESANT: So it is in fact built on Dr. Buckleton's research?

THE WITNESS: Yes.

MR. PRESANT: All right. You also testified about STRmix trainings that you've attended. There was one earlier this year and that was in fact taught by Dr. Buckleton, correct?

THE WITNESS: Yes, it was.

MR. PRESANT: You testified about one grant you just recently received. Have you received any other grants besides the one you testified to?

THE WITNESS: Not other than scholarships, no.

MR. PRESANT: Not grants to do research.

THE WITNESS: Correct.

MR. PRESANT: Do you hold any academic positions or have you ever held any academic positions?

THE WITNESS: I do not.

MR. PRESANT: And you have not ever.

THE WITNESS: In the sense of teaching position?

MR. PRESANT: Right. Position at a university where you would be responsible for teaching or doing original research in an academic discipline.

THE WITNESS: I have never been a faculty at a university.

MR. PRESANT: How much are you being paid to testify here today?

THE WITNESS: I'm salaried. My company is being paid, but I don't see any of that compensation.

MR. PRESANT: Did you enter into a contract to be paid for your testimony today or did the company?

THE WITNESS: There's been I believe two contracts related to this case, and I believe I signed one of them.

MR. PRESANT: Okay. Well only one was provided to me. May I approach, Your Honor?

THE COURT: Yes.

MR. PRESANT: Do you recognize the document I just handed you?

THE WITNESS: Yes.

MR. PRESANT: And is that the contract you signed

regarding your appearance here today?

THE WITNESS: I believe it pertains to a number of things including testimony.

MR. PRESANT: Okay. What other things does it pertain to?

THE WITNESS: Generally these contracts -- I would have to look at it more closely.

MR. PRESANT: Feel free to.

THE WITNESS: Would you like me to?

MR. PRESANT: Please.

THE WITNESS: So in addition to a day of testimony, there is the rest of, most of the rest of the contract is for consultation and review of materials relating to this case.

MR. PRESANT: And there are specific fees that have been agreed on for each of those things, right?

THE WITNESS: That looks like the quote that we provided, yes.

MR. PRESANT: What was the quote you provided?

THE WITNESS: I believe this was --

MR. PRESANT: Will you just read it for the record, please.

THE WITNESS: $7730 total.

MR. PRESANT: And what are the line items for each day of testimony and each thing you did for this case?

THE WITNESS: Would you like me to read the dollar

values?

MR. PRESANT: Please.

THE WITNESS: $113 hotel, $118 per diem at $59 per night, $200 extras parenthetical taxis, taxes, bag fee. $549 flight. $3,000 a day to testify. $3750-$250 an hour for review and consult for up to 15 hours. $7730 total.

MR. PRESANT: Thank you. So you're getting paid $3,000 to testify here today, correct?

THE WITNESS: My company will be, yes.

MR. PRESANT: But your company isn't party to this contract, you are the party to the contract who signed it, right?

THE WITNESS: I signed it.

MR. PRESANT: Now, you testified there was another company contract. I don't have it. What was that other contract regarding?

THE WITNESS: For the review of the source code several weeks ago.

MR. PRESANT: How much is your company charging for the review of the source code?

THE WITNESS: I don't recall the exact value. But I believe we billed about $10,000 for that.

MR. PRESANT: And that's the majority, vast majority of the work that FBS does, correct, is providing services to defense counsel in criminal cases?

THE WITNESS: That is most of what we do is consulting with defense attorneys, yes. Revenue wise at least.

MR. PRESANT: You testified here today that your undergraduate computer science degree you had a track in bioinformatics, correct?

THE WITNESS: Yes.

MR. PRESANT: Have you taken any courses in forensic science, academic courses?

THE WITNESS: No, I have not.

MR. PRESANT: You testified about some mathematical courses you took, calculus, and linear algebra, I think there may have been some others. But you've only ever taken one course specifically in statistics, right?

THE WITNESS: One titled statistics, yes.

MR. PRESANT: And that was statistics for engineers?

THE WITNESS: Correct.

MR. PRESANT: So is the point of that course to provide what engineers need to do, need to know in order to do statistics as opposed to maybe developing expertise, theoretical expertise in advanced statistical topics?

THE WITNESS: It's a required course for engineering accreditation.

MR. PRESANT: Introductory course.

THE WITNESS: It was -- I believe it was a 200-level course. So a second year course.

MR. PRESANT: Did that course cover the Markov Chain Monte Carlo method?

THE WITNESS: It did not.

MR. PRESANT: Have you ever taken a course where the Monte Carlo method was academically taught?

THE WITNESS: Yes.

MR. PRESANT: What course was that?

THE WITNESS: Systems simulations. I can't remember the title. I apologize.

MR. PRESANT: And was that an application of how that was used or did you actually study the theory, the development of the theory behind it?

THE WITNESS: It was a combination of both.

MR. PRESANT: What about Bayesian decision theory, was that taught in any of your academic courses?

THE WITNESS: Yes.

MR. PRESANT: Which one?

THE WITNESS: A number of the courses that I described under the data analysis conversation earlier. Machine learning, data mining both have heavy roots in Bayesian analysis.

MR. PRESANT: Well the roots behind them in terms of how the computer operates are Bayesian. But again you're not doing Bayesian proofs or theory in those courses, right?

THE WITNESS: That's not correct.

MR. PRESANT: It's not correct. You do actually do proofs like you would in a statistics course?

THE WITNESS: We did, yes.

MR. PRESANT: Now, you testified previously that you took one year of what would be called hard laboratory science in college, right?

THE WITNESS: I took a year of chemistry but I took other, at least three other laboratory courses.

MR. PRESANT: What were those other laboratory courses?

THE WITNESS: Off the -- well, no, I suppose it's more than that. It was a year of chemistry, I took units of micro biology, biochemistry; I don't believe my genetics course had a laboratory component, but human anatomy and physiology did. I took two units of that. And I can't recall if there's anything else off the top of my head.

MR. PRESANT: So then why did you testify previously that you only took one year of hard laboratory science, quote, unquote if you took all those other courses?

THE WITNESS: Did I say that?

MR. PRESANT: I can show you the transcript if you would like me to.

THE WITNESS: That might help conceptualize it.

MR. PRESANT: Can we bring up the Washington transcript? It's the defendant is Washington, the case in

Pennsylvania and we are on page 11. So it's this highlighted portion at the top here. You said, "So the requirements for a computer science degree at Wright State required a year of what we would consider hard laboratory science. That would be general chemistry or general biology. I took general chemistry." Does that sound like your testimony?

THE WITNESS: Yes, sir.

MR. PRESANT: So that's why I'm trying to understand is why you then testified that you had only taken one year of what you would consider hard laboratory science, now today you're saying well actually in college I took all these other scientific laboratory science courses as well.

THE WITNESS: In the beginning of this section says that the requirements for computer science degree requires a year of a science such as physics, chemistry, I believe biology, geology, a variety of topics that students can choose from. I had a year of chemistry. I also elected to take additional course work.

MR. PRESANT: They weren't required for the major.

THE WITNESS: No, not for the major.

MR. PRESANT: Okay. I understand. I appreciate the clarification. Have you ever studied population genetics?

THE WITNESS: I have.

MR. PRESANT: And where did you study that, in the genetics course?

THE WITNESS: Yeah, there was some in that. And then reading texts and papers.

MR. PRESANT: Now, you also previously testified that you weren't aware it was possible to get a degree in bioinformatics, is that right?

THE WITNESS: Yeah, I believe we discussed that a couple months ago. I believe that was discussed.

MR. PRESANT: Who was --

THE WITNESS: Not you and me.

MR. PRESANT: Discussed it.

THE WITNESS: There was an AUSA in the Jones case in New York.

MR. PRESANT: That was in November of last year.

THE WITNESS: That sounds right, yes, I believe so.

MR. PRESANT: And is that still your understanding, that it's not possible to get a degree in bioinformatics?

THE WITNESS: No, he corrected that misunderstanding.

MR. PRESANT: And have you after that testimony you do subsequent research and you agree that there are actually many such degree programs.

THE WITNESS: There's degree programs out there, yes.

MR. PRESANT: You also previously testified that you couldn't take a class where Bayesian theory or the Monte Carlo method were specifically taught. Do you remember that testimony?

THE WITNESS: I don't believe I would have said that you couldn't take one. I might have said I'm not aware of one specifically called Bayes theory.

MR. PRESANT: So you were asked a question in that Washington case, the transcript we were just looking at, question, "Have you taken classes in those areas? Answer. I'm not aware of classes specific to Markov Chain Monte Carlo. I'm not even aware of classes that are simply Bayesian statistics, but I haven't taken any courses exclusive to those." Does that sound like your testimony?

THE WITNESS: Yes, that sounds right.

MR. PRESANT: And your explanation of it today is what? That you're still not aware of any such courses?

THE WITNESS: I understand that there's courses that have that as a, those topics as a major focus, yes.

MR. PRESANT: Now, you've never developed software that analyzes or deconvolutes DNA mixtures, is that right?

THE WITNESS: I have developed software that simulates mixtures and evaluates mixtures. I have not developed anything that would be considered probabilistic genotyping.

THE COURT: One second, Mr. Presant. Go ahead, Mr. Presant. Sorry for the interruption.

MR. PRESANT: So your testimony today is that you have developed software that analyzes DNA mixtures, is that correct?

THE WITNESS: I have developed software that evaluates

them, yes.

MR. PRESANT: What's the difference between analyze and evaluates?

THE WITNESS: So I have developed software that evaluates aspects of mixtures for the purpose of estimating the number of contributors to them, which is a different application than the analysis of mixtures for the purpose of generating comparison statistics to a particular person's reference profile. I just want to make that clear.

MR. PRESANT: I want you to make your testimony clear no matter what the question is. So would you say that the software that you work on or that you developed, rather, interprets DNA mixtures?

THE WITNESS: In the sense of deconvolution, no.

MR. PRESANT: In what sense does it interpret DNA mixtures?

THE WITNESS: I guess I'm confused by the idea of interprets. It evaluates it, it takes measurements and makes decisions based on those.

MR. PRESANT: Okay. So your software wouldn't be software that would look at a mixture and come up with some sort of probability figure about likelihood of a known individual being in a mixture of unknowns, right, you haven't done that?

THE WITNESS: Correct.

MR. PRESANT: Okay. And you've never worked in a lab that does forensic DNA analysis, is that right?

THE WITNESS: The actual testing of the samples, no.

MR. PRESANT: Yes. Soup to nuts like the Michigan State Police forensic laboratory, for example, takes samples in, they do the chemistry in order to extract the DNA, they put it into an analyzer, they interpret the results; you never worked in a lab like that, right?

THE WITNESS: Correct.

MR. PRESANT: You've only ever worked on now we have this data, let's look at the data, right?

THE WITNESS: Our work begins with the output from the genetic analyzer as well as the documentation of bench notes, case files and the like.

MR. PRESANT: And the course you took in biology, was that introductory biology?

THE WITNESS: Micro biology.

MR. PRESANT: Micro biology, was that introductory micro biology?

THE WITNESS: I suppose. It was an undergraduate level.

MR. PRESANT: Did they in that course cover polymerase chain reactions?

THE WITNESS: I don't know where that's been covered. It's been covered in my courses.

MR. PRESANT: What about DNA extraction, has that been covered in your courses?

THE WITNESS: I don't think DNA extraction has, no.

MR. PRESANT: All right. So you wouldn't know if you were given a sample of DNA how to extract it, right, what the different considerations were?

THE WITNESS: Not without referencing the protocols.

MR. PRESANT: And the same thing for doing PCR, you wouldn't have independent knowledge if I gave you a sample sort of how many amplification cycles to run, what polymerase to select, would you know how to make those decisions?

THE WITNESS: Not that I would be comfortable dropped right in a forensic lab today.

MR. PRESANT: And while you testified on Ms. Kloet's examination that you had reviewed forensic procedure manuals for forensic laboratories, you have never actually worked under such manuals, right?

THE WITNESS: Correct.

MR. PRESANT: Now, the only other, you've only testified in federal court once before today, that was the Jones case in New York.

THE WITNESS: Yes.

MR. PRESANT: And that federal judge refused to consider you an expert in bioinformatics or forensic DNA, is that right?

THE WITNESS: There was some conversation about that. Probably be best for me to refer to the transcript.

MR. PRESANT: So you wouldn't dispute anything the judge said in the transcript, if he said, "While he does have sound work experience in that area," referring to bioinformatics, "I don't believe at this stage his experience is sufficient to qualify him as an expert in bioinformatics."

THE WITNESS: I believe that's what the judge said.

MR. PRESANT: In the Washington case, the one in Pennsylvania where the defendant was Washington, I know you've also testified in Washington that's why I want to clarify, the judge also said that you weren't qualified in DNA, is that right?

THE WITNESS: I'm sorry, this is the Pennsylvania Washington case?

MR. PRESANT: Correct.

THE WITNESS: There's additional comments in that one, and I would refer to the transcript.

MR. PRESANT: You would refer to the transcript there as well. Okay.

Your Honor, the government does not object to Mr. Adams being qualified in computer science and reviewing code. The government does object to the other in which he was tendered, I believe it was probabilistic genotyping and forensic science. I can argue that but I think the Court has

seen all the arguments in the briefing.

MS. KLOET: Your Honor, may I respond?

THE COURT: Yes.

MS. KLOET: I'm offering Mr. Adams as an expert in computer science and forensic analysis and Probabilistic Genotyping Systems as it applies through computer science and notions of software programs. The software doesn't exist in a vacuum. Software exists to -- it's applied across several disciplines, could be meteorology, it could be video games, it could be logistics. This is one of those disciplines. So to the extent to which he is qualified on those subjects, I would ask he be qualified through the auspices of computer science.

THE COURT: As limited by counsel, he's, he is accepted as an expert.

MS. KLOET: Thank you.

BY MS. KLOET:

Q Mr. Adams, I understand you just heard the colloquy about the limitations on your testimony with respect to probabilistic genotyping software or software systems.

With respect to your experience, your professional experience and your education, can you define as succinctly as possible what you, how you would define or -- probabilistic genotyping software systems.

THE WITNESS: Probabilistic genotyping is an attempt to get away from earlier, more threshold based approaches that

conclude that a data element is either present or absent, and assigns weighted values to various explanations of the observed data.

BY MS. KLOET:

Q What kind of results does a, for purposes of brevity, I'll say PGS for probabilistic genotyping going forward, what type of results does a program like that generate, what form do they take?

A The Probabilistic Genotyping Systems that I'm familiar with output a likelihood ratio.

Q And, again, succinctly as possible, what is a likelihood ratio to you?

A It's a comparison of the relative weights of support for the evidence given competing hypotheses.

Q Are you familiar with the concepts of inclusion or exclusion as they apply to DNA?

A Yes.

Q How does the likelihood ratio relate to that concept or those concepts?

A The likelihood ratio is a comparison of these competing explanations. Since it's a ratio represented as a fraction, if the likelihood ratio as a whole is greater than one, that suggests the numerator is larger than the denominator, therefore there's more support for the numerator. So if the numerator, which it traditionally is, is the inclusionary

explanation of the data, that is support for inclusion, for a conclusion that that compared genotype is included. The opposite of that where the denominator is more supported is a likelihood ratio less than one, sometimes substantially less than one, but still greater than zero. That the denominator, the exclusionary hypothesis, the exculpatory hypothesis is better supported. And then a likelihood ratio of one suggests that the numerator and denominator are equivalent or equal, and there's no more support for one versus the other.

Q Would you characterize a likelihood ratio figure as having a cutoff or being more of a spectrum as related to inclusion and exclusion?

A I would consider it a spectrum. There is no upper limit.

Q Can a likelihood ratio that's generated by PGS software give a conclusive answer to the question of whose DNA may be in a mixture?

A No.

Q Why not?

A The systems and the structure of the likelihood ratio is intended to compare the relative support for one of these hypotheses versus the other. One of the explanations, excuse me, one of the support for the evidence given those explanations. And the support, these probabilities are calculated by underlying models that run through calculations and are involved or generated, some of the input data is

generated from a series of samples that have been taken at various points. So we have allele frequencies that are established generally. We have DNA testing that's conducted by a particular lab, and we have uncertainty that surrounds these. So there's a wide spread acceptance. I haven't heard anybody dispute it that there's no ground truth to a likelihood ratio.

So the conclusion that any particular value is the actual correct value is, we can't know it because there's no ground truth for a controlled sample that this particular value is the correct value to be outputted by our system.

BY MS. KLOET:

Q Thank you. Do you in your practice, in your work, regularly see likelihood ratios that are very large?

A Yes.

Q How large have you seen them?

A We see them regularly exceeding the trillions, quadrillions, getting up into the words that people typically don't hear, decillions, octillions, nonillions. They can go up quite high especially with the newer testing kits.

Q If you run a program like STRmix more than once on the same sample or some data that's based on the same sample, will it produce the same result each time?

A Usually not.

Q Why not?

A The intention of, one of the intentions of STRmix is to

accommodate something that Mr. Lund was touching on earlier today, that there's, there can be difficulty in conclusively answering a lot of the mathematical problems that we might be able to describe formulaically. We need to perform sampling, we need to perform assimilation. So there is going to be a random selection of possible answers, and an evaluation of is this a sufficient sample.

So if you take two samples even from the same population, you're likely to get slightly different values. At the very least you should get some, somewhat of a different value. And so these successive simulations or samplings like taking polls, even if you poll the same group of people you're going to come up with slightly different numbers based on the subset that you actually talk to.

Q So if you ran a STRmix program again on a particular set of data, could the likelihood ratio be lower the next time you ran it?

A It could.

Q Could it be higher?

A It could.

Q You may have heard some testimony yesterday from one of the government witnesses that an incorrect estimate as to the number of contributors will always result in a likelihood ratio that is conservative to the defendant. Do you agree with that statement?

A No.

MR. PRESANT: Your Honor, I'm going to object. I think that misstates the testimony. I think she should just also ask the witness what he knows as opposed to her confronting him with her summary of prior testimony.

MS. KLOET: I'm happy to rephrase my question, Your Honor.

THE COURT: Okay. Rephrase.

BY MS. KLOET:

Q Will an incorrect estimate as to the number of contributors in a particular sample always result in a likelihood ratio figure that is conservative as, as it applies to the defendant?

A No.

Q Why not?

A There's -- why do I --

Q What do you base that, your opinion on?

A It's been said in a number of articles, it's been published in a number of articles; I could go into some underlying principles of it.

Q If you could turn in your binder to Exhibit PP. I'll give you my copy. May I approach the witness, Your Honor?

THE COURT: Yes.

MS. KLOET: This didn't make it into your binder. Mr. Adams, do you recognize that document?

THE WITNESS: Yes, I do.

BY MS. KLOET:

Q Can you describe it for the Court, please?

A It's an article published in "Forensic Science International: Genetics" several years ago. Do you want me to read the title?

Q Sure, thank you.

A The title is, "The effect of varying the number of contributors on likelihood ratios for complex DNA mixtures."

Q Have you read this article?

A Yes, I have.

Q And what is the thrust of this article?

A The title --

Q Let me rephrase. What was an important takeaway or takeaways for you from this article?

A The title is a good description of what the article is. It's an evaluation of how varying the number of contributors can affect the likelihood ratio calculated for a single sample, and effectively there is an effect of varying the number of contributors you assume are present in a mixed DNA profile when calculating likelihood ratios.

Q Can you show me where in that document it indicates what you just stated? You can turn the pages.

A Throughout the whole document it describes what's going on, but there's on page 96 I believe the fifth sheet that I have here, table 3 discusses known, knowably incorrect assessments

of the number of contributors and the effect on the likelihood ratio calculation.

Q And what does that table indicate?

A It suggests that if you're over, underestimating the number of contributors to a mixed DNA profile there are observed occurrences where the likelihood ratio gets higher and a number where it gets lower.

Q Thank you.

MS. KLOET: Your Honor, at this time the defense moves to admit proposed Exhibit PP.

THE COURT: Mr. Presant.

MR. PRESANT: The objection here is this was handed to me this morning as we sat in the courtroom. The government hadn't seen it before despite the fact that there was a lot of literature submitted in support of the briefing, and had it been handed to me before the proceeding commenced, I would have asked Dr. Buckleton or one of the other government's earlier witnesses to address it. And so it seems to be a little bit of a gotcha by the defense that I'm now getting an article published in 2015 for the first time after the government has presented its evidence, and seeing the hour in the day I'm not sure there's going to be sufficient time for rebuttal in order to explain how if at all this article has any application on what was done in this case.

THE COURT: Ms. Kloet.

MS. KLOET: Your Honor, this article was not previously provided because it's being offered to rebut what I understood Dr. Buckleton's testimony to be yesterday. And perhaps I misunderstood or misheard it. But as I understood it, was what I previously phrased the question as he testified that there is no circumstance where an error in the number of contributors could generate a likelihood ratio that would be prejudicial to the defendant.

THE COURT: That was my understanding of the testimony too. And the objection is overruled. The exhibit is admitted.

MS. KLOET: Thank you.

BY MS. KLOET:

Q Mr. Adams, I would like to talk to you about the concept of validation which we have talked a lot about over the last couple of days. Generally speaking, and succinctly as possible, what is a validation study in your experience?

A Validation study within the forensic DNA community or just generally?

Q Generally speaking. Start there.

A The premise of validation is to go through a series of tasks to evaluate whether a novel product to process works as intended, appropriately solves the problem it's intended to address.

Q If it's important, why is it important?

A It's important to have some degree of confidence that a

newly developed or newly adopted method, way of doing things works appropriately, works as you understand it to work and as you expect it to work.

Q What is the importance of validating software that calculates a likelihood ratio such as Probabilistic Genotyping Systems?

A It's inherently difficult to -- perhaps I should start from another aspect.

For some systems it's intuitively straightforward to observe if they are working correctly. Previously there was an analogy to driving a car. That if you get in your car and you drive your car and you arrive at your destination safely and soundly, the vehicle worked as expected. Likelihood ratios are difficult to do. There's no innate ground truth. We don't have a particular destination to arrive at to that we know that when we arrive there our process has appropriately worked.

So for developing software that calculates, that is intended to address degrees of uncertainty, and which, as there's been much conversation as well, likelihood ratios are inherently difficult to understand and convey, there's a difficulty in determining when we have arrived at a properly working software product.

Q Thank you. How does one base his or her confidence in a software program?

A For a rigorous validation study would involve the

identification and execution of a number of tasks intended to inspect and evaluate that system. This is general to the development of all processes and products. But it's, might have qualitatively more importance to do for systems that have difficult to assess outputs.

Q Are there specific industry standards and practices used in the field of software development and testing for validation of software programs?

A Yes, there are.

Q Who sets these standards?

A There's a number of standards setting bodies that deal with software standards. There's the IEEE that we have mentioned before is known for developing standards, many of which developing standards specific to the development, maintenance, testing, inspection of software. And many of these standards have gone on to be adopted by international organizations like the ISO organization, which is the international standard setting body, and have also been adopted by countries formally at a federal level or at a federal departmental level have adopted IEEE standards, or ISO has set standards from, developed by other organizations and those have been adopted. So there's a wide variety of who set them and where they have been set. Organizations are also free to develop their own standards, but obviously there's a good baseline to adhere to with ones that are recognized at national, international

levels.

Q Can you give some examples of I think you referenced government organizations or countries that utilize these standards. Can you give some examples of those?

A Yes. There's a number of federal agencies or departments do recognize specifically IEEE standards, but have published their own standards as well. Sometimes within a standard specific to a particular industry there might be industry specific language and then a general reference to a general standards document saying that this is how generally software should be developed. And these are the specific things to know about its application in here.

So the Food and Drug Administration has validation guidelines for software for medical devices; for safety critical systems in nuclear power plants there are similar guidelines from the Nuclear Regulatory Commission; the State of Michigan has validation guidelines and many of these reference IEEE standards directly. Some of them reference another kind of paradigm of standards which is the CMMI model which is, stands for the Capabilities Model Maturity Integration.

Q Where was that developed?

A That was developed at the Software Engineering Institute at Carnegie Mellon University, but it's since become kind of a spinoff organization separate from the university. But these methods involve outside appraisals, appraisals by outside

personnel of your organization of your methods, your documentation, your standards and guidelines. And effectively assign you a scale, a grade on to what quality level you adhere to. They have a scale from zero to five. But so as opposed to validating a particular product specifically, that approach evaluates a development organization as a whole to demonstrate that when this organization developed software, they developed it to this minimum level of criteria.

And so there's references to IEEE, to CMMI throughout state, federal governments, private organizations.

Q Thank you. Could you give some examples of types of software programs that this guidance could apply to?

A There's a particular IEEE standard that's about verification and validation of software systems. It's IEEE standard 1012-2012. There's a more recent version as well updated in 2016. But that, like many IEEE software standards, opens with a brief statement that says that this standard applies to all software. So it certainly could be used for the development of apps for your Smart phone, for navigation systems in airplanes, for navigation systems in cars, for video games, for anything that has a software component, that component can be managed with an IEEE standard process.

Q Are these standards that you reference, are they publicly available?

A Yes. Anybody can order them.

Q So let's talk about the standards themselves a little bit. What's one of the preliminary considerations -- I understand there is probably many of them, correct, is that fair to say?

A Many considerations?

Q Many standards.

A There's many standards, yes.

Q So let's just talk about some of the ones you may consider most important in this context.

A Okay.

Q Can you give me an example of a standard that you're referencing?

A I mentioned IEEE standard 1012-2012. There's that describes processes that can be undertaken for software validation. There are certainly a component of validation is going to be the generation and examination of software test documentation which is codified in another standard, IEEE standard 829. There's a standard that generally describes the, it's called Software Life Cycle Management, so how your software is conceived all the way through replacing it with something else is described in a standards document.

So this is unification of terminology and explanation of what steps connect to each other, various tasks that should be undertaken at various points in time. So those are three that have been directly referenced in forensic DNA guidance materials, those three IEEE standards.

Q When you say specifically referenced, where were they specifically referenced?

A In 2016 there was a publication by ISFG which was mentioned yesterday at least, the Guidelines for the Validation of Probabilistic Genotyping Systems by ISFG.

Q Should be a document on your screen. Do you recognize that?

A Yes, that's the article that I'm mentioning.

MS. KLOET: Your Honor, I believe for the record, this was previously admitted.

THE COURT: As what? Number or letter?

MS. KLOET: It was Government's Exhibit 23 was the channel through which it was admitted. It's also Defense Exhibit BB.

So, anyway, you were saying that in forensic science there are references to IEEE. Are those references expressed in this article?

THE WITNESS: Yes.

BY MS. KLOET:

Q Let me ask you first. Have you had a chance to read this article?

A Yes.

Q Okay. Now you can answer the second question. Are those standards referenced in this article?

A Yes, they are.

Q In what sense?
A I believe it's on the next page, there's a statement about how they are --
Q I'm sorry to interrupt you. You can see it if it's hard to see on your screen at BB.
A I believe the third paragraph of the first page, but -- it says, "International industry standards apply to software validation, verification and test documentation." And citation 16 and 17 are two IEEE standards documents.
Q Okay. Thank you. Is there anywhere else in this document that you wish to call to the attention of the Court with respect to this topic?
A The next sentence suggests that these general standards can be simplified and extrapolated to forensic genetics, and that citation number 18 I believe is to a standard that the FDA published in or around 2002 about standards for medical devices, software that run medical devices.
Q Are there any other points in this article you would like to highlight before we move on?
A Not regarding software standards.
Q Is there something that should -- are there different levels of standards depending on the type of issue you're dealing with?
A You would expect at the very least the scope, depth, breadth of the activities that you're undertaking in order to

ensure adherence to a particular development, process, or plan would be, would get more attention, would get more energy and effort the more important that product is, that software program is.

Q What do you mean by the more important that software program is? Is there some sort of analysis that is undergone to make that determination?

A There's discussion in these documents and these IEEE standards documents and other documents that suggest a risk analysis is appropriate to undertake when constructing software products. So this risk analysis would be what are the consequences of failure of the software; if this software malfunctions, what can happen? There's gradation of both the severity and the expected frequency of software failures.

Q Can you briefly describe for the Court the gradation that you just referred to?

A So the severity can be ranked in terms of the degree that the consequences affect someone or something. So these are often described in terms of financial loss or damages, loss of human life or physical, physical damage to a person or property. Environmental damage is often discussed.

And then once it's identified, what the consequences of these failures could be, we also should take a look into quantifying if possible the expected rates of these occurring. It's much different to have a program that is moderately

failing regularly than it is to have a program that will catastrophically fail infrequently. Those are qualitative decisions that, sometimes qualitative, oftentimes can be quantitative valuations and considerations that can be made when identifying if we should adopt a program, how we should adopt it, if we need to double back and perform more thorough evaluations, things like that.

Q How does that determination then inform the verification and validation process you referred to earlier?

A Right. So the verification and validation process, at least as I speak of that, unless I specify otherwise, be safe to assume that I'm talking about the one outlined in the IEEE 1012. That process is laid out as effectively chapters of software development, and that's not to say that once you complete a chapter you can't go back. But within these chapters of software development you have the definition of software behaviors, you have turning it into an actual program, testing it; just very briefly that's what we need to do when we are developing software. And based on the what we call the integrity level which is influenced by the risk analysis, the high integrity level systems should have more attention paid to their quality assurance processes during development and validation of that software. So we have sometimes a particular task should be done by every software program that's being developed, but by the developers of every software program.

But higher integrity level software systems suggest that more attention, more in-depth investigation should be made into those.

Or there's just entirely different tasks that should be done by different integrity levels. So this goes back to the airline or navigation system is likely to have a different integrity level than a game on your Smart phone.

Q So I understand you either directly or indirectly referenced possible outcomes or consequences of an ostensible failure, is that a fair statement?

A Those are the ones generally considered.

Q Consequences to whom?

A To the stake holders.

Q Who are the stake holders in a forensic DNA analysis?

A That's been, that's been discussed and a couple answers have been given.

Q When you say that's been discussed, who has it been discussed by?

A It's certainly been mentioned before that stake holders are affected by the operation of these systems. I'm thinking specifically of the draft guidance out of the Forensic Science Regulator, the United Kingdom's Forensic Science Regulator. I'm not sure that we have had a conclusive decision defining comprehensively who could be affected by software failures in this regard.

Q In the context of forensic DNA analysis, and what you know about it in your professional experience, could a stake holder include a person or persons accused of a crime?

A Yes.

Q Let's talk about other aspects of verification and validation. I think you modified that phrase to include the word independent. What do you mean by that?

A Independence is a concept that has a couple of different facets to it. It's suggested by IEEE that software development processes that need to adhere to integrity levels 3 and 4 out of 4, the higher of the two integrity levels should be conducted, their verification and validation inspections, confirmations, audits, whatever you want to call it, should be conducted by independent personnel or an independent organization. And that's from a variety of perspectives. There's, as they list it, there's managerial independence, technical.

Q What is managerial independence?

A To ensure that there's not a managerial pressure that could be exerted on whoever is reviewing the product or the process. Suggesting that you need to accept this as the way it is because your boss wants you to.

Q I think you were starting to give other examples or dimensions of independence. What are those?

A There's financial independence as well.

Q Can you describe that?
A Whoever is conducting the investigation, if they are financially dependent on the original developer, then there is the potential for I suppose what you could call a conflict of interest that they might be hesitant to call out particular deficiencies of the software development process if their paycheck could be affected by it.
Q Is there any other dimension of independence?
A There's a technical component as well.
Q What is that?
A So if you have people who are not actually separated, that if they have a whole lot of overlap of the technical knowledge about the particular product, then they might share biases or favoritism to particular components of the development process. If your buddy in the desk next to you is the one who wrote it, then you might know how he thinks it should work but perhaps not how it should work.
Q Without some level of independence in the validation and verification process, what type of assurances would one have that a software program works properly?
A Without independence?
Q Without the type of independence you just described, yes.
A Well, we would presumably have very similar assurances. We just, we ourselves wouldn't be sure that they were actually adhered to as rigorously as they should have been. It's

unlikely that someone with, for example, the financial independence is simply going to refuse to conduct something like this. Unless they are declaring it's for a conflict of interest reason.

Q Just give me one moment. So can you just explain for me exactly, not precisely, but generally what is being evaluated in this V&V process, what is being looked at?

A There's a long list of materials that we expect rigorous software development practices to generate and to require at various stages of the process. So one of the early, other than this risk analysis, one of the early things that we expect a software program to have even before it's an actual program, while it's still a concept, is a list of behaviors that it is supposed to adhere to, that it's supposed to execute during its operation. So these are called requirements.

And a translation of requirements to more technical notation can be called specifications. So the specifications of the system are the detail formalized perhaps mathematically annotated behaviors of the system before any code actually gets written.

Q Are there, is the concept of issue tracking or tracking problems involved or related to the V&V process in any way?

A Sure. So there's a number of other perhaps not stages but inputs and outputs of the system activities undertaken during the software development process. And generally validation

activities are checking to ensure that the appropriate tasks during software development were undertaken; that we have, we know our expected software operations that when we turn them into code, when we program our program, and start evaluating it, comparing the program against its requirements to make sure that its actual behaviors match its intended behaviors, its previously stated behaviors, that nothing got lost or improperly introduced during the translation from concept to program.

Surely issues will arise, so you can refer to them as issues. Depending on what they are, there is different jargon terms to refer to them. If there's a behavior that was defined in a requirement as a requirement that is, is deviant or deficient or perhaps entirely missing, that could be considered a defect, that the program is not adhering to its intended or advertised requirements.

Q So these broad concepts we talked about, or you've talked about just now, are these concepts that you would characterize as a necessary component of a reliable software program?

A Some of them are necessary to maintain consistency between any more than a single person developing the software program. That as programs increase in complexity, effectively nontrivial programs, especially ones that are intended to be developed over the course of years and maintained for years, should have these, these tasks should absolutely be undertaken for them.

Q So zooming out to the 10,000 perspective, in your opinion why do these types of standards exist in the software field?

A There's a number of motivations for adhering to standardized processes. One of them is simply organizational efficiency. That if you can anticipate what another party is doing when you're constructing software, then you can plan around that. And hopefully be more efficient and productive in your work.

Another one is the recognition that ad hoc or underdeveloped standards or processes can lead to defects that have significant consequences.

Q When you say consequences, would one of those consequences potentially be a failure of the software?

A Yes. Either a failure of a component or a complete system failure.

Q Can you think of any notable failures of software, specific examples?

A Yes. There's a couple that I regularly mention. In the '90s there were several software failures for space vehicles. One of them was the Mars Climate Orbiter which was supposed to be an unmanned probe sent to Mars, and we effectively lost it. The investigation into the loss of the complete mission failure because the probe was lost was it either crashed into Mars or it shot off into space.

That was a software failure that was due to a unit

conversion problem. One contractor developed a software module that worked in standard units, and another contractor developed a module that worked in metric. They didn't interface properly and so as adjustments were sent to the probe it veered off course.

There was an outright explosion of a French rocket that was unmanned, again, thankfully, but intending to put up a communication satellite, so both of these losses were considered to be in the hundreds of millions of dollars due to the expense that went into them.

One of the case studies that's especially for medical devices and the importance of software quality in the medical field is a life safety issue occurred in a radiation therapy machine; the Therac-25 in the 1980s was a new, an update to an older machine; the older machine had hardware safety interlocks preventing overdosing, and overdosing of the radiation that's being outputted by the machine. The Therac-25 got rid of the hardware and the locks for software only, and due to a bug in it, a defect, overdoses could occur without the operator knowing. Sometimes repeatedly administered. And ultimately caused the death of at least six people directly through radiation poisoning.

Q Do software engineering standards like the ones you described earlier, do they, are there any specific to Probabilistic Genotyping Systems?

A No.
Q When you reviewed the guidelines -- you testified earlier you reviewed the SWGDAM guidelines. What did it tell you about the validations of Probabilistic Genotyping Systems, at least from their perspective?
A The SWGDAM guidelines don't have an emphasis or even really a mention of software development principles.
Q You and I believe at least one other witness referenced a UK Forensic Science Regulator. Could you turn to Defense Exhibit LL?
A I don't have anything in my --
MS. KLOET: That's because I have all copies. May I approach, Your Honor?
THE COURT: Yes.
BY MS. KLOET:
Q Can you identify this document for me?
A It's the draft guidance from the Forensic Science Regulator for DNA Mixture Interpretation Software Validation.
Q What do they recommend with respect to this matter, in this document?
A In regards to software, software standards?
Q Yes.
A There's a recognition that the standards that do exist and are common to DNA laboratories do not have much to say about software, and suggest a greater involvement with IEEE standard

17025, which is software life cycle processes. So there's a recognition that there's a deficiency and directly suggests following the software life cycle processes described in that standards document. And there are a number of tasks explicitly mentioned in this guidance about software construction and validation.

Q Thank you. Would you please turn to page 26 of that document? You have a hard copy, don't you?

A I do.

Q Okay. Does the Court have a hard copy?

THE COURT: Yes, I do.

MS. KLOET: Okay. We are having technical difficulties so we will proceed the old fashioned way for now.

Can you describe for me what's on this page?

THE WITNESS: It's a section headed Software Development and Testing.

BY MS. KLOET:

Q Have you had an opportunity to read this?

A I have.

Q Can you summarize what it stands for or what it says?

A It suggests there's approaches to ensuring software quality during the construction phase as well as the testing phase of software development.

Q And this document is released by what entity?

A I believe they are affiliated with but independent of the

home office of the United Kingdom, the Forensic Science Regulator.

MS. KLOET: Your Honor, at this time I would move to admit Defense Exhibit LL.

THE COURT: Mr. Presant.

MR. PRESANT: Voir dire please, Your Honor. Mr. Adams, regarding LL, what's the date of LL, what's the date on the document? There is a copyright date on it, right?

THE WITNESS: October, I believe of 2017. Around there.

MR. PRESANT: Now, you reviewed the version of STRmix at issue in this case, we haven't gotten there yet but you reviewed it, right?

THE WITNESS: I'm sorry?

MR. PRESANT: You reviewed the version of STRmix at issue in this case, correct?

THE WITNESS: Yes, sir.

MR. PRESANT: That's version 2.3.07.

THE WITNESS: Yes, sir.

MR. PRESANT: When was that piece of code released?

THE WITNESS: The code was released to me two weeks ago.

MR. PRESANT: No, I'm sorry. When was it, when was it released for use?

THE WITNESS: The program was written and released

back in 2015.

MR. PRESANT: So that code was written in 2015 but this is a late 2017 guidance document, correct?

THE WITNESS: Yes, it is.

MR. PRESANT: Is it appropriate in your view to apply guidance documents from the future to past versions of code?

THE WITNESS: I think that the significance of the document is that there were standards in existence in 2015 that were not adhered to but are recognized by this document.

MR. PRESANT: Where does it say what was in place in 2015 in this document?

THE WITNESS: Section 1.6, I believe, references the software life cycle.

MR. PRESANT: I'm looking on page 10 on 1.6, right?

THE WITNESS: On the next page, 1.6.2, I apologize. I gave the wrong standard number earlier. The one I gave was for the vocabulary, and the life cycle process is the standard number 12207. But the years following the colon for the standards referenced in 1.6.2 and 1.6.3 describe when these standards were last modified or when they were determined to be their effective date. So 2005 for the vocabulary, 2008 for the life cycle processes, and then the other international standard that's BS 15288.

MR. PRESANT: So those are standards that are contained in other documents that are being referenced here but

there are different standards, right?

THE WITNESS: They're these British standards. It is not this Forensic Science Regulator document.

MR. PRESANT: Right. It's a separate document. That's all I'm asking.

THE WITNESS: They are different documents, yes.

MR. PRESANT: This document, though, was in 2017.

THE WITNESS: Correct, it came out in 2017.

MR. PRESANT: So what I'm trying to figure out -- let me ask it this way. Code develops over time, right?

THE WITNESS: It can.

MR. PRESANT: There are new versions that are released for code; that's a common thing in software development generally.

THE WITNESS: It can be.

MR. PRESANT: And then standards develop over time as well, correct?

THE WITNESS: Yes, sir.

MR. PRESANT: Different regulators create new rules; this is all we do here in the court is deal with rules that are developed over time, same thing in forensic science or in computer science, rules evolve as well, right?

THE WITNESS: Correct.

MR. PRESANT: My question for you is is it appropriate to look at a piece of software developed at one point in time

and used at one point in time and judge it by standards contained in a future governing document?

THE WITNESS: I have a hard time accepting that best practices at the time you're making your consideration should not be relied upon.

MR. PRESANT: Okay. Is another way of saying that that you should, when you're developing a piece of software you should rely on the best practices that were in place at the time you were developing it?

THE WITNESS: Of course that's true, yes.

MR. PRESANT: Okay. And then on the front page of this document also there's the word consultation. Do you see that?

THE WITNESS: Yes, I do.

MR. PRESANT: Do you know what that means?

THE WITNESS: It's my understanding that it's a draft for public comment.

MR. PRESANT: And that's what that box indicates below, that people should respond with comments to what they think of this proposed document, right?

THE WITNESS: Yes, sir.

MR. PRESANT: So this is not the final document that the regulator has even adopted as of late 2017, correct?

THE WITNESS: That's correct.

MR. PRESANT: We're of course in the United States

right now, not the United Kingdom, and this is a United Kingdom document, is that right?

THE WITNESS: It is.

MR. PRESANT: And then on page 26 that Ms. Kloet asked you about in laying a foundation, there's a sentence, the last sentence of 6.6.1, would you read that for the Court?

THE WITNESS: That starts with this requires?

MR. PRESANT: Yes.

THE WITNESS: "This requires that the software developed is tested, and that errors are corrected iteratively within a quality framework to ensure that the end product performs to the required standard."

MR. PRESANT: Now, it says the quality framework. It does not say IEEE, correct?

THE WITNESS: It does not require IEEE.

MR. PRESANT: In your view IEEE is a quality framework, right?

THE WITNESS: It could be used as one.

MR. PRESANT: But there are other quality frameworks as well.

THE WITNESS: Absolutely.

MR. PRESANT: Your Honor, the government objects on the basis of relevance considering this is a document that postdated the release of the STRmix version at issue in this case. It's a draft document. It hasn't even been adopted as

final by the regulator. The regulator doesn't govern the jurisdiction that we are in right now.

THE COURT: Well, it's admitted for what it's worth. And subject to the commentary by counsel.

BY MS. KLOET:

Q Mr. Adams, generally speaking, what kinds of questions should be addressed in your opinion when evaluating Probabilistic Genotyping Systems specifically?

A One of the large concerns that I have is -- let me back up. A lot of focus is paid to the inclusionary or exclusionary trends for probabilistic genotyping conclusions about mixtures and donors and non donors. So there's the idea that we can test a lot of samples with known donors and compare them to non donors, and if you include known donors and exclude non donors your system is working well. But that's the first step. You also have an actual value that is outputted. And ensuring that that value is correct because it demonstrates, it can demonstrate a different weight, a higher or lower value, can suggest greater or less confidence or whatever is attempted to be conveyed by reporting that value.

So the correct calculation of that value specifically, not just that it's above or below one but that it's actually the correct output is of great significance to me, and it's difficult because of not having those ground truths to rely upon.

Q You likely heard testimony the last couple of days regarding artifacts such as stutter. Is there anything specifically that someone evaluating a probabilistic genotyping system under the auspices of standard computer software review principles should be looking at with respect to that particular concept?

MR. PRESANT: Government objects on the basis of qualifications. And if it's easier, Your Honor, procedurally I'll put in a standing objection that if he's asked about modeling biological phenomenon like stutter or drop-in or drop-out, or the other biological topics that we have covered that he isn't qualified to opine on how those things should be modelled because he doesn't have sufficient training in those biological topics and I believe it to be outside of the scope of the Court's prior ruling.

THE COURT: Well, I'm not so sure you're correct about that, Mr. Presant, because the question is stated in the form of standard computer software review principles. So I think the question is proper and the witness may answer.

MS. KLOET: Do you remember the question?

THE WITNESS: Could I have it again?

BY MS. KLOET:

Q I'll try to recall it. You've heard some testimony over the last couple of days if you were in the courtroom ostensibly about artifacts such as stutter. What can you tell me about --

now I'm forgetting the question. What can you tell me about how that is implicated by the concepts that you just described with respect to software validation generally as it applies to Probabilistic Genotyping Systems?

A Well, the understanding of what particular models are intended to be implemented is going to be a core focus when you're comparing what is actually implemented and consequently what the likelihood ratio result represents. So these are those underlying assumptions, however well defined, that are going to form the basis of the result.

Q So under these standards software guidance and/or principles, whatever the correct terminology is, would it be an important consideration to look at modelling of things such as stutter artifacts?

A All of those things should be codified in requirements. The important characterization, important characterization -- important characteristics of forensic DNA mixture interpretation should be considered and written down and tested against when the software has been constructed.

Q So you had a chance to review the version of STRmix utilized in this case, correct?

A Correct.

Q How long was that review?

A It was over the course of two days.

Q Approximately how many hours?

A Maybe a little over 20 hours.
Q What did or what materials did your review entail or activities, just generally speaking then we will narrow it down a little bit more specifically.
A What materials did I receive?
Q Yes.
A I was provided a computer that had the source code on it as well as the net beans environment. Net beans is a software development environment for the JAVA programming language which STRmix is written in.
Q Were you provided validation records in the course of this review?
A I was provided a user manual and three documents that comprise this version's developmental validation.
Q What is the version that you reviewed?
A Version 2.3.07.
Q You just testified that you reviewed the source code. What is source code as a software scientist, can you explain that to the Court?
A Source code is what we think about when we think about programming languages or programming software typically. Because humans speak in natural language and computers only work on binary code, we need to have an intermediate between a natural language and a binary language, since one is in zeros are fairly unintuitive and inefficient program, and we have

constructed programming languages that represent computing concepts that we can piece together as a sort of hybrid human machine language. So it's how we construct software programs. It's how we write computer instructions.

Q Does a review of source code tell you anything specific about the program itself?

A It tells us the actual instructions that have been given to the computer to be run as a program.

Q You also testified that you received three documents that were offered as validation records, is that correct?

A Yes.

Q Are those important to review?

A Yes, documentation is very important to review.

Q Why?

A It demonstrates what, what was done, what was intended to be done, perhaps what wasn't done, as well as informing us about all of the tasks that were engaged in. So testing, review, communication, things like that are very important to trace when we are trying to evaluate the quality of a particular system.

Q After you conducted your review over the course of those two days, did you write a report?

A Yes.

Q Defense D, please. Can you turn to your binder to tab D, D as in David. Can you identify this document for me?

A Yes, it's my statement.

Q Is this the statement that you prepared following your review of the source code in this case and the related materials in this case?

A Yes, it is.

MS. KLOET: Your Honor, the defense moves to admit Defense Exhibit D.

THE COURT: Mr. Presant.

MR. PRESANT: Your Honor, no objection. I just would note on record that D as well as Government's Exhibit 18 are already admitted and are subject to the protective order that the Court has entered in this case. And one of the permissible uses under the protective order of course is presenting it to the Court, but the documents should not be filed on the public record at any time.

THE COURT: Okay.

MS. KLOET: I have no issue with that, Your Honor.

THE COURT: Okay. You know what, it's 2:30. We are going to take an afternoon break at this point and I think probably the questioning with regard to this report is going to be relatively lengthy. So let's come back in 15 minutes at quarter of 3:00.

THE LAW CLERK: All rise. Court is in recess.

(Recess taken, 2:28 p.m.; Resume Proceedings, 2:49 p.m.)

THE LAW CLERK: All rise. Court is back in session. Please be seated.

THE COURT: Mr. Adams.

BY MS. KLOET:

Q Hello, Mr. Adams. If Exhibit D for the defense is not open in your binder, could you make sure you're there?

A It is.

Q Thank you. So we were talking about your most recent review of the source code in this case. Have you previously reviewed the source code for STRmix?

A A different version, yes.

Q Can you tell us where that review took place?

A In Australia.

Q As a computer scientist do you have any concerns about the -- did you sign an NDA to review the source code in this case?

A Yes.

Q Did you sign an NDA to review the source code in the Australian case?

A Yes.

Q As a computer scientist, do you have any concerns about the code not being available without an NDA?

MR. PRESANT: Objection, relevance.

THE COURT: You may answer.

THE WITNESS: The nondisclosure agreement or the requirement of these materials being protected by a

nondisclosure agreement makes it difficult for me to work with other folks on projects about STRmix and whatever the protected materials are. So, yes, it is a concern to me. I can't, I can't call up a biologist or a statistician and say, hey, what do you think about this if it's something that I learned during the protected review.

BY MS. KLOET:

Q In your review of version 2.3.07 in this case, did it appear to you that the principles of software validation and verification that we discussed today or to which you testified today were employed as applied to that particular program?

A Some, some principles that we discussed and could be mapped to particular standards, but certainly not all. And I would characterize it as not particularly many.

Q What were some of those standards that were missing or not met?

A A quantified objective evaluation of the scope of testing is something that I haven't seen or heard reference to which is ultimately one of the most important things that I think generally in software, but specifically for this type of software, it's important to know exactly how well it has been tested. So I understand there's concept and the idea, the premise this STRmix had been tested many times. It's a very general word testing, and it isn't particularly differentiated; different types of testing aren't typically differentiated in

those kinds of conversations. Sometimes it just means they put mixtures through it and see what came out when the mixtures were deconvoluted which is due to the difficulty with the ground truth is perhaps not quite testing. It's studying, evaluating but it's not quite what a software developer might consider to be testing. And there is other things addressed both today and as well as in my declaration that were missing and perhaps do exist or were missing and we don't know if they exist.

Q Let's focus on a few parts of your observations as a result of that review. You testified earlier to the concept of risk analysis and I think integrity levels. In your review of the STRmix program, were you provided with any information that an integrity level assessment was performed?

A I haven't seen an integrity level assessment or a risk analysis.

Q In your review of the version 2.3.07 of the STRmix program, were you provided with any requirement or specification documents?

A Not in the sense that I understand them. I understand that something called requirements might exist. I'm not exactly sure what it is or how it exists.

Q Can you elaborate on that a little bit?

A Requirements are most useful when they are an essential document that are accessible and language in a format

accessible to whoever needs input on those requirements. So for a system that requires input from biologists and statisticians and software developers, perhaps computer scientists with the algorithm design, we would like to see a requirements document that has point by point with subchapters of this particular aspect of the program as opposed to do X, Y and Z. And that language ideally should be testable. It should be verifiable. We should be able to test against it to have hopefully clear fail/pass criteria on how we test it, how much we test it, how we identify the different degrees of testing are sufficient. And then the related specifications documents as well. I haven't heard any mention of those.

Q Did you observe any specification documents in the course of your review in this case?

A No.

Q You also testified earlier about the matter at issue tracking or bug tracking I think you referred to it. In your review did you find evidence of issue tracking in accordance with the generally accepted software standards you previously testified to?

A Not issue tracking. There might be a little confusion about Github, what Github is. It was mentioned yesterday, I believe. That G-I-T-H-U-B service.

Q As a threshold matter can you explain generally what Github is?

A Right. It's an implementation and a free service of GIT which is a version control system. Version control system is like tracked changes in Word so that you can see what used to be there, that it was struck out, and new text was inserted. Source code documents can be similarly tracked. But a full software program might involve hundreds or thousands of source code documents so you need a system to help automate and manage the modifications that you make to your system as you're developing it or as you're maintaining it, and need to make updates and upgrades or fixes for defects.

A component of this is that their issues can be associated with modifications to your program. So to resolve an issue you might have to modify your program. So Github does have the capability of working as an issue tracker, but I would think it's primarily known as a version control system. So those two are related but definitely discrete concepts.

So I understand that there's references that this version of STRmix was or at least partly maintained in a Github repository. I'm not quite sure what the issue tracking capabilities were at this stage of development.

Q Was that offered to you or provided to you at the time of your review?

A No.

Q As a result of your work or as a result of your review in this case, do you have notice of any actual defects in this

version?

A There's several defects that are generally known and published, and one problem that I identified as known to MSP as well and several possible issues in this program.

Q If you could turn to Defendant's Exhibit AA in your binder, please, which is also displayed on the screen. Have you seen this document before?

A Yes.

Q What is it?

A This is a document that I've seen from Dr. Buckleton's website that describes problems that were identified and fixed in STRmix.

Q Are there any -- is there any language on this document that affects or implicates the version that you reviewed in this case?

A Yes.

Q Where is that language?

A Number 3 was previously identified as affecting this case.

Q Is there anywhere else in that document?

A So it's difficult to tell because these aren't fully fleshed out descriptions of what the issues are so they're not formal notices of defects. They are not explicit references to how requirements were improperly implemented or failed to be implemented. So going off, going off the versions that are in the effect column, you can see that the version used in this

case was affected by most of these defects.

Q How is it that you first became aware of the existence of this document? How did you first -- how did it first come to you?

A I don't know. I must have found it on his website or was linked to it on his website.

Q Is it fair to say it would be a publicly available document or it was at the time you accessed it?

A Yes.

MS. KLOET: Your Honor, the defense moves to admit Exhibit AA.

THE COURT: Mr. Presant.

MR. PRESANT: Yeah, I think there was testimony about Exhibit 14 being an updated version of that document, but I think the foundation has been laid. So no objection.

THE COURT: It's admitted.

MS. KLOET: Thank you.

BY MS. KLOET:

Q So I would like to call your attention to number 4 that's listed on this summary here. The language in this, in the left hand text column references something called a miscode. What is a miscode in software?

A It's not a term that I'm familiar with outside of the STRmix software development team. But I understand it to be an inappropriate decision made during the programming of the

system.

Q So just to be clear, is miscode a word that you've only seen in the context of STRmix with respect this -- of software.

A I haven't seen it used elsewhere in software.

Q Thank you. My initial question was as a result of your work generally or your review that you performed in this case, do you have any notice of any actual defects in that version that we just talked about this one? Are there any other defects that you have notice of?

A So it's difficult to identify something affirmatively as a defect because that, like I said earlier, you benefit from having these testable criteria defined in requirements. If you don't have the requirements, it's difficult to identify precisely what the behavior of the software is supposed to be. I can make inferences, I can read the manual, but unless there are -- and this is why a central document is very helpful with it; it's difficult for me to positively identify something as a defect. There is -- there are problems more colloquially I can describe with the system that were apparent upon inspection. There were one or two that were discussed in STRmix training that I was at. And --

Q Let me stop you right there. You just said there were one or two problems, and we will use that term for purposes of brevity. What were those problems that you observed during the training?

A So I didn't observe one of them but one of them was shared as a problem with STRmix that had been fixed, and I believe that's a reference to something that was also mentioned in the materials provided to us in this case; the use of STRmix at a particular time could cause it to redo its result to effectively not have any random sampling upon successive executions of it; you're expecting a result with an order of magnitude but it was giving you the exact same result. And I believe it was limited to the hours of midnight to 1:00 a.m., which is kind of an odd situation. And the change request indicates that it was fixed and I understand it to be rectified. I don't have any indication of that.

Q So is that a problem you became aware of through your specialized STRmix training that you attended that was sponsored by STRmix?

A Yes.

Q Okay.

A Yeah.

Q Is that particular problem identified on Defendant's Exhibit AA, that summary that you retrieved from you think the website?

A The random --

Q Yes.

A The time and random numbers is not listed in this document.

Q Thank you. Were there any other errors or problems, pardon

me, that you observed in your review in this specific case?

A Specific to this version of STRmix version 2.3?

Q Yes.

A There were a couple that I addressed in the declaration. There's one that's identified in the state police protocols.

Q If you can go to Defense Exhibit N as in Nicholas, page 118. Do you recognize this document? It's an excerpt of a larger document.

A It looks like a laboratory manual.

Q Okay. What can you tell me about the error that you observed vis-a-vis MSP?

A The page that I turned to don't, doesn't have the text of it.

Q If you need a different page we can retrieve it.

A Page 118. Okay. So it's described under this general STRmix protocol section of what I believe is 211, and towards the end of the, of this section of the protocols it describes that an analyst typically should not run STRmix twice. One of the indicators for or to run it twice is if you hit this first, for this first bullet point, and suggests that STRmix might not consider all of the potential genotypes at a particular locus; so if it is not considering all potential genotypes and someone with a not considered genotype is compared to the evidentiary item, STRmix has no weight to assign that and it will zero out the overall likelihood ratio.

Q What does that tell you about the potential effect on the likelihood ratio?
A Well, sometimes during case work STRmix doesn't consider all of the potential genotypes, but you will -- the diagnostic as it's described for identifying that behavior is a likelihood ratio of zero. So there's not been a demonstration to me that this behavior does not happen when LRs are non equal to zero.
Q So I think you just testified that it tends to indicate STRmix doesn't consider all potential genotypes. Is that an accurate --
A That's reading from the manual.
Q Okay.
A Would you like me to read that particular section?
Q You can. I'm just trying to understand better how that could potentially affect a likelihood ratio in a given case.
A If, if STRmix is supposed to break apart and assign appropriate weight to different potential genotypes, and it doesn't do that, then that's going to affect the weights of the genotypes that it did consider.
Q And would that in turn potentially affect the likelihood ratio that is generated from a run of the STRmix program?
A Yes.
Q Thank you. Were there -- you heard Dr. Buckleton testify yesterday, I think, that you have a misunderstanding of some principle. How would you respond to that?

A It is definitely a complex problem that is replicated throughout the STRmix code several times, and --

Q I'm sorry to interrupt you. But you're referencing this precise issue that we just discussed before I asked that question, right?

A Well, I'm thinking about a different misunderstanding.

Q Okay. So why don't you tell me --

A I don't think I misunderstand this. I understand that Dr. Buckleton considers this to be a diagnostic. I consider this to be a possible diagnostic of problematic behavior.

Q Okay.

A Which exists. So, sorry, the misunderstanding that I understood was mentioned yesterday was about MCMC evaluations.

Q Okay. And do you understand the criticism and, if so, could you paraphrase that for the record?

A One of the problems is finding common language in all of this. So if I could outline what I understand the problem to be is that I wrote something in my declaration; I understand that Dr. Buckleton conferred with Dr. Taylor about that particular thing, that particular statement I made. Dr. Taylor provided a book chapter which I then read. So this is a series of steps to go through in order to try to identify if we have common ground.

One of the -- and it could be a problem with the implementation of this particular functional code. It is

something that I would rather at this point talk with someone else about before I make a particular conclusion whether or not this is a defect and a desirable behavior, the one that I referenced in my declaration that Dr. Buckleton pointed out yesterday.

Q But you're not permitted to do that under the terms of the NDA in this case, are you?

A It would hinder my ability to do so, yes. And my motivation for further looking into software behaviors of this particular version of STRmix effectively concludes with this case.

Q Were there any other problems that you observed in your review of the STRmix software in this case?

A There were a number of other issues to varying degrees of severity. Not having the requirements and specifications against which I could evaluate test coverage and scope, what's appropriate to test, which components were tested, how they were tested, the overall order of the code which I understand is perhaps the basis of the claims that I'm making mostly stylistic concerns, which I disagree with, but the cleanliness of the code was not necessarily orderly or what I would hope to see with a professionally developed and well maintained software product. There were a number of locations of code that used to exist but had been functionally removed from the software so it was laying there as an artifact of a process

that used to exist, which on some level was helpful to me because I could identify that the system had changed, the system had been changed. There was one way of doing things that was functionally removed but still left in the text of the source code and then a new method was implemented.

So in terms of being able to identify when and where and what the development was, that was mildly helpful, but overall it's suggestive of a difficult to maintain code base.

Q With respect to what could be characterized perhaps as a simply cosmetic problem, does that give you any concerns about the software overall?

A Characterizing the manner in which the code is maintained? Just the orderliness?

Q Yes.

A It's, it's a cosmetic problem in the sense that maintaining a clean house or a clean restaurant is a cosmetic problem. Of course it's pleasant to look at but it's also pleasant to work in, it's easier to work there if you don't have artifacts, old things laying around. The not knowing why or when something was changed, or necessarily who changed it, or if you want to revert back to the old way of doing things, as that's suggested by the presence of this nonfunctional code. There's a number of reasons to not have it, and it's generally frowned upon in production code. It should be -- it was notable to me that the code that appeared to be developed by outside parties did not

have that particular feature in it. So the non STRmix code that was included and used by STRmix but not developed by their team does not have that as a characteristic of it.

Q When you say that, for purposes of clarification, what do you mean by that? When you say that particular section of the code that was not developed by STRmix did not have that. What is that?

A The portions of the overall STRmix package that were not developed by in-house, by that team, did not have the cluttered commented out, nonfunctional code throughout it as the STRmix code appears to.

Q So were some portions of the code developed by STRmix and some appeared not to have been?

A Correct, yes.

Q From your review, could you identify in every instance by name who wrote the code?

A No.

Q Why not?

A A number of -- so it's my understanding that -- I also might have a little bit of a misunderstanding -- that there are several organizations who develop the code; that's ESR and Duncan Taylor who, I apologize to Dr. Taylor, but he might get lumped in with ESR, and Niche Vision, which is a software company in Ohio who licenses and distributes STRmix. There's also reference made to a company called Orbit who, depending on

what I look at, Orbit appears to enter the software development process of STRmix at the stage or sometime later depending on what document I'm looking at.

The code developed by two people at Niche Vision is described as developed by them with contact information, and generally appears to be tidy, well maintained code. There is not, there's not many attributions of who wrote the rest of the code throughout the program, which could indicate who you need to speak to if you need to maintain or modify it at a later date, assuming it's not just a monolithic, one-man project.

Q So I think you're still on Defense Exhibit D in your binder. Can you please turn to page 30? D as in --

A D as in dog?

Q Yes. 30.

A Okay.

Q On this page it indicates there is a section called 4.4 code style, right?

A Yes.

Q Can you talk about some of your observations and conclusions as expressed in this section of these three paragraphs of this section of your report?

A Starting from the top, code style is not necessarily the cleanliness of the code so much as it is the particular method of construction and maintenance of it. So this is not someone telling you so much as clean your room, but this is how you're

going to clean your room, but more appropriately it might be this is how we assemble things here. This is how we build things to ensure consistency. If somebody else comes in to look at it, they understand what they're looking at.

The second paragraph describes how there's not consistent authorship declared throughout the code. So it looks like some portions of the code are written by these Niche Vision employees, Mr. Alali and Mr. Faris. And other portions of the code simply have no indication as to who wrote them, when they were written, when they were modified, how they were modified, this kind of lineage of how the software developed over time. And ultimately we are going to be concerned with why modifications were made, was it a feature edition, was it fixing a bug, was it fixing a bug that we don't know about. Those are things that could be documented somewhere, that might be documented somewhere but I haven't seen.

Q The third paragraph references a package called DyNamix, correct?

A Yes.

Q What is DyNamix?

A It seems to be the central package to the functionality of STRmix that has been discussed the past two days. So this is the deconvolution and the likelihood ratio calculation portion of the program. There's a fairly substantial portion of the program that's dedicated to software licensing to, like you buy

a license and you load it on to your computer and you load it into STRmix to make sure it's not a pirated copy of the software. But I didn't spend much time looking at that because I was interested in the deconvolution and statistical calculation sections.

The other portions of the program are segregated from DyNamix. So they can interact, but this DyNamix is a kind of stands in the center.

Q In your report who did you -- who did you indicate you determine that DyNamix was attributed to?

A It was attributed in the code to these three names: Admin as an administrator, Owner and Dude. But I didn't see any people's names other than, I'm sorry, within the DyNamix package, I suppose.

Q To step back for a minute I think part of your testimony today was about how you discovered a bug or learned of one at your STRmix training, right?

A Correct.

Q And that wasn't published in those seven miscodes I believe was your testimony that you found on the website.

A That's right.

Q Do you have any concerns about the fact that you learned of an error that was not published in that document?

A Yes. I am.

Q Why is that?

A The dissemination of inappropriate or knowably incorrect behavior is something that is important to not just the users of the software but anybody who has an interest in the software.

Q Can problems in coding or issues that arise in the source code potentially affect the likelihood ratio?

A Yes. But I wouldn't limit it to the source code.

Q Can you expand upon that?

A Problems anywhere throughout the software development process can affect the final conclusion reported by the software. So there's been conversation about models, so the selection of the appropriate model, the correct translation of mathematical concepts into requirements language that is then translated in to source code. So there's a number of translations that need to occur. You need to actually design your program. Of course, you need to conduct some sort of tests however they are described. So having insufficient testing processes, incomplete test coverage, inappropriate testing methodologies, all of these things can affect the overall quality of the software in terms of identifying whether inappropriate behaviors exist which could affect the final calculation.

Q Could it affect the final calculation or the likelihood ratio potentially in a way that hurts the defense or defendant in the context of its use in criminal cases?

A That's possible.
Q I think you testified earlier that you had an opportunity to review some validation records or documents, three documents related to validation records, right?
A Yes, ma'am.
Q What was your impressions of those documents?
A The materials were provided as a zipped file over e-mail labeled as something along the lines of developmental validation. I believe we had requested these originally and they had, they were provided I believe on the second day of my review of the source code, but I had access to them for the entirety that I was writing my report. When I received them, I believed them to be materials about the validation of the development of STRmix, but it seems they are more along the lines of the SWGDAM style definition of developmental validation.
Q What would you say to the fact -- what would you say to someone who says that they ran this particular software program on all these different samples and therefore it's been validated. In the context of your review, is that enough?
MR. PRESANT: Objection. Clarification on what are these samples.
THE COURT: I think you need to rephrase.
MS. KLOET: Sure, I'll rephrase. What would you say to the fact that -- I'll be more specific. Dr. Buckleton

testified that they ran this program, STRmix, or that in the developmental validation process many times. What would you say to that as it relates to software validation?

THE WITNESS: From what I've seen from what was done, there aren't objective, quantified descriptions of the actual coverage of the tests conducted. So until that's done, it's going to be difficult to evaluate the scope and thoroughness of any validation activity.

BY MS. KLOET:

Q In your professional opinion, should the likelihood ratio generated by STRmix program be relied upon?

A No, I don't think there's a basis for it.

Q Thank you. Is there anything else that we haven't covered today that you wish the Court to know?

A No.

MS. KLOET: Your Honor, at this time I would like to move to admit Defense Exhibit D. I don't think I've done so yet.

THE COURT: Mr. Presant.

MR. PRESANT: I thought she had.

THE LAW CLERK: I have D admitted.

MS. KLOET: Okay. I tend to forget so wanted to make sure.

MR. PRESANT: For what it's worth.

THE LAW CLERK: But not N. Did you mean to admit N?

That's fine if not. I'm just telling you what I have listed.

MS. KLOET: I don't think Defense Exhibit N is necessary in light of the fact that the government has submitted the entire MSP policy manual. Thank you.

CROSS-EXAMINATION

BY MR. PRESANT:

Q Mr. Adams, at the beginning of Ms. Kloet's examination she asked you a question regarding the interpretation of likelihood ratios and whether you could ever look at any likelihood ratio and say conclusively the defendant's DNA is in that mixture and your answer was no, you can never say conclusively that it is. Correct?

A Via likelihood ratio.

Q Via likelihood ratio. So and that's just because it's a probabilistic statement, right?

A Generally, yeah.

Q So, for example, are you familiar with the Mega Millions or the Power Ball?

A The Lotto.

Q Those are Lottos, right. What are the odds of winning one of those, the Jackpot, do you know?

A Pretty high.

Q Pretty high. So like 1 in the tens or maybe hundreds of millions?

A Okay.

Q Does that sound reasonable?
A Sure.
Q So if I bought a lottery ticket today, would you be able to say conclusively that I was not going to win the lottery?
A If it was a valid ticket I could not say that.
Q Right. Because it's, there's just some probability and so the best evidence of whether or not I would win is just whatever the probability of that ticket being the winning ticket is, correct?
A In a fair system, that seems like a reasonable conclusion.
Q Now, you also testified about these IEEE standards, and is it fair to say, summarize your testimony you think they are important, IEEE standards, correct?
A That they are important?
Q Yeah.
A I think they are, yes.
Q Do you acknowledge that no governing body has stated that the IEEE standards apply to probabilistic genotyping software?
A With the exception -- a government body?
Q A governing body. A body that is responsible for the forensic DNA community. Are you aware of any that has said IEEE standards, Probabilistic Genotyping Systems have to comply with these?
THE COURT: Is there a body that is responsible for the forensic DNA community?

MR. PRESANT: I think the Court has heard testimony that SWGDAM is the prevalent body that governs probabilistic genotyping in the United States. And there are other bodies like the ISFG, and perhaps some others that are influential on the implementation of these.

THE COURT: Okay.

THE WITNESS: So the guidance bodies that you just mentioned.

BY MR. PRESANT:

Q Correct. Or any others that you're aware of.

A Well, so the -- they have been recognized but I haven't seen any say that they need to be adhered to, that specifically IEEE needs to be adhered to.

Q In the Jones case I asked you about earlier you were asked "The IEEE that you are a member of, that doesn't govern the forensic DNA community, right?" And you answered, "It's a professional organization. It does not govern forensics." Do you still agree with that statement here today?

A I do.

Q Now, we already looked at the -- well strike that. May I approach, Your Honor?

THE COURT: Yes.

MR. PRESANT: I'm handing you a document that's been entitled IEEE Standard for System and Software Verification and Validation, and it says it was approved on March 29th of 2012,

is that right?

THE WITNESS: I don't see the approval date. But -- I see 25 May 2012.

BY MR. PRESANT:

Q I have 29 March 2012. Do I have a different version than you?

A I don't know. Could you point that to me?

Q I do apparently have a slightly different version than you. I apologize about that. Oh, you just have a different cover page.

A Okay.

Q 29 March 2012, do you see that?

A Okay. Yes, I do.

Q Are you familiar with this document based on your review of the IEEE standards?

A Yes, sir.

Q Would you flip for me to the third page? I guess it's my third page so it would be your fourth page. It's the page that at the top states Notice and Disclaimer of Liability Concerning the Use of IEEE Documents.

A Yes.

Q Do you see that?

A I am there.

Q Would you read the sentence at the beginning of the fourth paragraph there?

A Of the fourth paragraph, the existence after IEEE standard?
Q Yes.
A "The existence of an IEEE standard does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the IEEE standard."
Q So is that sentence basically saying it's possible for there to be other ways to code properly besides complying strictly with the IEEE standard?
A Not just code but produce software in general, yes, there's many ways to develop reliable software.
Q That's consistent with the FSR document we looked at earlier where it said something about you need a quality standard but it didn't specifically say IEEE, right?
A Not that it must be IEEE, correct.
Q Can we turn back to that document? I think it was LL. Yeah, LL. Do you have it in front of you?
A I will get there.
Q I think we can put it up on the screen too.
A Okay. The FSR draft.
Q Yes, correct. Can we go to page 15 if it's up on the screen? What's on the top of page 15, what section is that?
A 522, desired performance parameters.
Q Do you have an opinion on whether STRmix complies with the desired performance parameters outlined here?

A I would have to go over them point by point.
Q And you haven't done that already?
A I didn't compare the entirety of this guidance to STRmix, no, I did not.
Q Okay. So unless you went over point by point, you wouldn't have an opinion.
A I think that's my opinion, that I would need to go over this.
Q What about page 23? I don't know if we can zoom in on that paragraph a, 6.5.2a. That's the section regarding conceptual validation, correct?
A Yes.
Q And starting from the second sentence of a, it states, "This is ideally achieved through publication in a peer-reviewed journal, with details of the statistical model together with an evaluation of various aspects of the model's performance." Do you agree with that statement that that is an appropriate way to conceptually validate a piece of DNA mixture interpretation software?
A I think it's an impressive component of that conceptual validation.
Q And would you agree that STRmix meets that component?
A I think that's the community's belief.
Q The general probabilistic genotyping community believes that STRmix complies with 6.5.2a.

A Yes, that's my belief.
Q That's your belief as well?
A No. It's my understanding of the community.
Q Okay. So then my follow-up question is what's your opinion?
A Of this standard or whether STRmix is in conformance to the standard?
Q The second one.
A I haven't spent a lot of time thinking about this.
Q So you don't want to offer an opinion on that here today?
A Not today.
Q Let's go to page 24, please. 6.5.3a, I'm going to start reading after the italicized portion in footnote 31. It says, "This requires a functional computer implementation of the model, which can be tested utilizing user-defined test criteria that can demonstrate whether or not outputs correlate with expectations for given inputs and the software's intended functionality. Such testing should utilize a variety of ground-truth cases for which the composition is known." And it goes on from there.

Do you have an opinion on whether STRmix complies or STRmix as implemented by the Michigan State Police, rather, through their internal validation study, complies with that portion of this proposed guidance document from the UK?
A I don't -- so the -- pivoting on the word correlate is

correlate with expectations is what I'm going to focus on here when I say yes.

Q Your opinion is yes, STRmix does comply with it?

A I don't have any problem with accepting that MSP's internal validation is addressing 6.5.3.

Q Okay. And I don't want to quibble with you, but I don't know if there is a difference between, yes, I agree with that, and I don't have any problem with it.

A This is, this is tough. There's not a whole lot of firm fixed criteria here. There's not a lot of firm fixed criteria in validations of STRmix describing exactly what answers are supposed to be reported out.

So we can know, as has been discussed, we can know what certain components of the system are supposed to be precisely when we perform various calculations. This "functional computer implementation of the model, which can be tested utilizing user-defined test criteria" that suggests an objective and verifiable, falsifiable value that if your system outputs something within the appropriate range there might be a give and take; it might be a precise value that must be outputted. Then that's fine.

Q That's fine in that STRmix has implemented through the Michigan State Police's internal validation has complied with that, that's what you meant by that's fine, right?

A No, I mean that's fine in that's good. That's a good idea.

We should be requiring that. That's consistent with software testing policies.

Q Okay. What I'm trying to get you to is in your opinion do you believe that STRmix version 2.3.07, all my questions from here on out will relate to that version unless otherwise stated, as implemented by the Michigan State Police through their internal validation study complies with this particular provision we are looking at. It can be a yes, a no, or I'm not prepared to offer an opinion on that. I will accept any of those answers.

A And only those answers?

Q Well, I suppose that's up to the Court, not up to me.

A I would rather reserve final judgment on this.

Q That's fine. I'll move on to my next question.

A Okay.

Q On page 25, can we look at footnote 32? One of the sources cited here is Taylor et al., 2015 that this particular guidance document is relying on. Have you reviewed that paper?

A I'm sure I have. Honestly, him and Dr. Buckleton, Dr. Bright, their team are very prolific writers so it's hard for me to keep straight which article is which.

Q You know Dr. Buckleton is one of the authors of that particular article?

A It wouldn't surprise me.

Q Page 26, please. This provision, 6.6.1 we looked at it

before, a different question this time. Do you believe STRmix complies with 6.6.1? Yes, no, you don't want to offer an opinion, or whatever other appropriate answer you would like to give.

A The language here is pretty vague in that it gives a checklist item which doesn't describe the scope of that task. So I would say it doesn't matter a whole lot if there is any adherence to this particular item.

Q This standard doesn't matter?

A I'm saying this 6.6.1 needs to be clarified in scope in order to convey relevant information.

Q 6.6.3, do you think STRmix complies with that provision?

A It likely does not.

Q Do you know if units or parts of the code, important parts of the code comply with 6.6.3?

A It's my understanding that some of the functionality of STRmix is reproduced in Excel. So that I believe could satisfy 6.6.3 for those components or units, whatever subdivision of the code you want to call them. I don't know, like I said, the scope and coverage of those reproductions.

Q Well, I'll get to why you might not know in a second. But first let's finish with this document, 6.6.5, please. My question there is not with respect to STRmix but just again here 6.6.5 talks about an appropriate standard, correct, but it does not specifically reference the IEEE, is that right?

A It doesn't reference any standard.
Q By the way, are you familiar with Microsoft software?
A Yes.
Q Widely distributed, used in this court, in our office, probably in your office too, right?
A I would accept that.
Q Does IEEE, I'm sorry, does Microsoft comply with IEEE in developing its software?
A There's -- so as we discussed earlier, there is many standards. So there is some IEEE standards that Microsoft will comply with. I have no idea how many they claim to comply with.
Q Would it surprise you to learn that Microsoft does not comply with IEEE standards?
A I know that's not true.
Q You know it's not true in what way?
A That there are certain specifications for the representation of data structures, for example, network communications that I've seen that there are references to in Microsoft documentation of their products.
Q Okay. So there what you're saying is Microsoft you're aware complies with some of the IEEE standards, right, that was just your testimony?
A Yes.
Q My understanding of your criticism of STRmix is that it

doesn't comply with all of the IEEE standards in your judgment, is that a fair summary of your testimony?

A It's my concern that STRmix appears to have no central standard.

Q Is it your testimony that STRmix does not comply with any of the IEEE standards?

A Well, that's a concern, but that would be a way to satisfy my concerns. The IEEE standards are not what I'm saying STRmix needs to adhere to; I'm saying that it's a useful template to get a relative judgment of software quality.

Q Okay. So I think that's important right there. That's kind of getting to the clarification. Your assertion is not that STRmix has to comply with all of the IEEE standards, is that right?

A That is not my assertion. That is correct.

Q Okay. And likewise, therefore, you see no problem if a large software company like Microsoft complies with some but not others; your point is that it should be done in a logical fashion, right?

A That -- that's -- failing to comply with a single standard could have very significant effects. I'm not going to make that broad generalization.

Q It depends on the standard, right?

A It depends on the standard, it depends on the company, it depends on the utility of the software. You know, if we are

talking about managing a lot of the Internet's activity and adhering to particular networking standards, that's going to be something different than another standard that doesn't have a significant commercial or life safety implication.

Q It all depends, right?

A They are relative, yeah.

Q You've written about how open source software is preferable, right?

A There's advantages to it.

Q Okay. You would prefer to be open source; I think Ms. Kloet asked you questions, wouldn't it be easier if it were open source, freely available?

A I tried to be very careful at advocating a particular position on that topic.

Q Now, what about 6.6.8 here? Doesn't 6.6.8 point out that the use of the open source software presents additional challenges with regard to software development and testing because it may not have been written specifically for the intended application?

A I see that.

Q Do you agree with that?

A I don't know what open source software they are talking about. If they are talking about open source Probabilistic Genotyping Systems, then the same challenges apply to all systems.

Q Isn't this whole guidance document about DNA mixture interpretation software, so isn't that the type of software they are talking about?

A No. I mean if the type of open source software that they are referencing in 6.6.8 was specifically intended to solve probabilistic genotyping, or address probabilistic genotyping issues, or to be used as a probabilistic genotyping system, then this whole document applies to them as it does any other system.

Q Why are you so concerned about not taking a clear position on your view of open source software?

A It's not a clear -- it's not an argument with a clear winner.

Q Let's just move on then. 6.7, my last question about this document. Is it your opinion that or, rather, do you have an opinion about whether the internal validation at the Michigan State Police complied with 6.7.1? And, again, as with the previous questions if you don't want to offer an opinion that's fine, I can move on.

A I don't, I don't know. I haven't spent the time comparing those two documents, comparing the FSR guidance with the internal validation standard. Excuse me, the internal validation document, not standard.

Q Now, a lot of this issue comes down to stylistic preferences for coding, right, your review of the code, your

criticisms, it's about style, not necessarily about substance, right?

A I disagree with that.

Q Why do you disagree?

A The documentation I would not consider to be style, documentation and examinations of how extensive testing is. A lot of the concerns that I have are frustrations with things that STRmix appears not to have done are frustrations, substantive frustrations that I have with the field that they haven't defined them. Just as a couple times I said the language in this draft guidance needs to be tightened up in order to be meaningful at all. Concerns that I have that, substantive concerns about defining the sufficiency, how much testing, what types of testing need to be conducted, how are they conducted, who are they conducted by, when and where they are conducted. These are concerns that I have that I think are not at all stylistic. Certainly there could be a flare.

Q Many of your concerns are with the discipline, the field, is that right?

A Yeah, many of them are, yeah.

Q And that field is governed by SWGDAM and ISFG, some of the other entities the Court has heard testimony about, but you agree that those bodies haven't adopted your view of how these software programs should be coded, right?

A I don't know that governed by. It might give the

impression that they are mandatory, that they set those regulations, that they have power to enforce them.

Q Well, let's forget about the governed by then. You agree that SWGDAM and ISFG have not adopted your view, correct?

A Correct. I would agree that they are authorities in the field, certainly not the final.

Q You're not a member of either of those bodies, right?

A That is correct.

Q Now, you reviewed the code twice you testified to and you produced a report in each case, right?

A I did.

Q We have only looked at one of those reports. I think it's the one you produced for this case, and I don't need to go through them in detail, though, I do have a few questions about them. First I want to ask you about your opinion on the differences between version 2.3.07 that you reviewed for this case, and version 1.8 that you reviewed previously. Do you think 2.3.07 is an improvement on 1.08?

A I can't discuss 1.08.

Q Well, I believe you can under the Court's protective order. Your report in 1.08 was produced in this case so I'm quite confident you can discuss 1.08.

A I haven't gotten any notice from ESR that they are waiving their interest in the nondisclosure agreement.

Q Well, the Court entered the protective order, and then ESR

produced your report in 1.08 to me. So I would ask that the Court on the basis of the protective order direct the witness to answer the question. I have the report. I can show it to him.

THE COURT: I need to look at the protective order.

MS. KLOET: Your Honor, before the Court makes a ruling on this particular request, if there is a request, I just want to express I don't believe Mr. Adams is trying to be difficult. I understand that he's been threatened in the past with litigation from ESR, so to -- through cease and desist letters and the like -- to the extent to which ESR consents to his testimony vis-a-vis the protective order I think he is comfortable doing so.

THE COURT: Well, I'm not, I don't know who has threatened him with litigation. But I'm certainly not going to compel him to answer something that he feels he is precluded from doing so.

MR. PRESANT: Your Honor, I have a copy of the order if you would like to review it.

THE COURT: I would like to look at it.

THE LAW CLERK: What docket number is it?

MR. PRESANT: It's docket number 70 entered on May 11th.

THE COURT: My docket sheet doesn't go that high.

THE LAW CLERK: I've got it here and I can probably

print it.

THE COURT: Well, it says in paragraph 1 that, The Adams 1.08 STRmix report and any Adams 2.3.07 STRmix report are to be used by the defendant and his counsel solely for the preparation of their defense. No disclosure of those two discovery materials is authorized except as necessary for the preparation of the defense, and such determination of necessity is to be made by counsel for the defendant, not by the defendant himself.

Disclosure of the discovery materials for purposes related to defense is permitted to members of the defense team, experts or consultants, and the Court.

All parties will take reasonable steps necessary to ensure that the discovery materials are not improperly disclosed.

Well, I think you need to, you need to proceed carefully. Paragraph 5 says, "This Order does not permit the disclosure of any trade secrets relating to STRmix other than as set forth in the Order and specifically it does not permit the disclosure of the STRmix source code or portions thereof, or accompanying materials provided by ESR in connection with Mr. Adams's review, except to the extent necessary to report, to produce a report on 2.3.07, and to testify regarding his review, in this case only. This Order does not abrogate the obligations of any nondisclosure agreement that Mr. Adams has

entered into with respect to review of the code.

Tell me where you're going with your questioning, Mr. Presant, with regard to 1.08.

MR. PRESANT: The only point I want to make with respect to 1.08 is I want to get his assessment of whether the newer code is an improvement upon 1.08, then I want to compare his qualitative baseline conclusions in each of those reports. And the government is relying in part on the parts of paragraph 5 that make clear he's bound by those agreements but except to the extent that it restricts his ability to testify regarding his review of STRmix's source code, or STRmix's code again in this case only. I was the primary drafter of this document, though it was filed or it was entered after a joint motion was filed and Ms. Kloet reviewed it. And I'll represent to Your Honor that the way this document came to be is we wanted to make sure Mr. Adams's testimony was not restricted in any way in this case, and so I presented this document to ESR's attorneys to make sure they would be fine with the disclosure of the earlier report so that he could ask, he could be asked questions about it. And they are not parties to this case so would not have been appropriate for them to move in this court for a protective order, but as an officer of the court I can tell you that they have reviewed this document and approved it before Ms. Kloet and I jointly moved for the Court to enter it.

THE COURT: Here's what I think based on my reading of

this document. I think he can properly within the bounds of the agreement answer the question whether 2.3.07 is an improvement or whatever other word you used on 1.08, but I'm not totally confident that you can do a point by point comparison of the two.

MR. PRESANT: I'm not going to go point by point. I'm only going to ask about the conclusion from 1.08, otherwise I'm going to review some issues about 2.3.07.

THE COURT: Let's give it a start and we will see where we go. But I do think your first question can be properly answered within the bounds of the agreement.

MR. PRESANT: Thank you, Your Honor.

BY MR. PRESANT:

Q So Mr. Adams, I'll ask you again, qualitatively based on your review of 1.08 and 2.3.07, do you have an opinion on whether 2.3.07 is an improvement upon 1.08?

A Can I ask Your Honor something?

THE COURT: Sure.

THE WITNESS: In the nondisclosure agreements I'm required to ask for all reasonable measures to make sure that I don't disclose anything if I'm compelled to to people who aren't privy to that information. So these are nondisclosure agreements that are separate from subpoenas or court orders that I signed personally with ESR; that if I am directed to share any trade secrets or protected information, I'm to ask

for all appropriate reasonable precautions.

THE COURT: Well, that first question I don't think implicates any of that. Because he is not asking you for any specific information about either of the two versions of the software. He's just asking you is one better than the other in your opinion.

THE WITNESS: Respectfully, my opinion could only be arrived at by reviewing protected information.

THE COURT: I get that. But you're not disclosing any of it. With the answer to that question, you're not disclosing any information that you have that other people can't have under the agreement. Okay? You see what the distinction is?

THE WITNESS: I don't. Unfortunately, I feel uncomfortable. I'm not a lawyer. My lawyer hasn't reviewed the agreements in this context. Certainly the nondisclosure agreement for this case, but there is a separate nondisclosure agreement that we arrived at two and a half years ago for the other review.

THE COURT: In answering Mr. Presant's fundamental question, is the development of 2.3.07 an improvement on 108, you're not disclosing anything except your opinion. There's no -- it's a, far as I'm concerned, and I don't, I don't think I'm totally out of bounds, as far as I'm concerned there is no disclosure of anything there, except for your opinion.

THE WITNESS: I have been threatened by ESR for

sharing no opinions.

THE COURT: Well, you know I certainly can't force you to answer. I'm not going to hold you in contempt for failing to answer but I do think that you are being overly cautious because I don't think there is, there would be any grounds on which they could justifiably claim that you had made a disclosure in violation of a nondisclosure agreement by simply stating your opinion.

THE WITNESS: I am not trying to be difficult.

THE COURT: I'm sure you're not. I'm sure you're not. But I also think that you are being overcautious under the circumstances.

MR. PRESANT: I'm sorry, Defense Exhibit D has already been entered into evidence, correct?

THE COURT: Yes.

MR. PRESANT: And that's your report from the code review in this case.

THE WITNESS: Could I turn to it to confirm that?

BY MR. PRESANT:

Q Please.

A My code review in this case.

Q Can we bring it up? I have it marked also if it would be easier.

A Yes, that's my statement in this case.

Q And you don't have any concerns about the fact that that

was disclosed here?
A Not at all.
Q Let's go to your conclusion. Your conclusion in this report was that STRmix should not be relied upon, is that right?
A I'll accept that at least as a paraphrasing.
Q I think I found that language in here somewhere.
A It might.
Q Is that your opinion in this case, STRmix shouldn't be relied upon?
A Yeah, until additional methods of software quality assurance have been undertaken.
Q And your opinion in the 1.08 report was that STRmix should be questioned, is that right?
A Honestly I can't discuss it.
Q So we would have to introduce your report into evidence to get that before the Court, is that right?
A I don't know the legal procedures for that.
Q Well, hypothetically, if that were your opinion that it should be questioned, and now you're saying it should not be relied upon, this later version that's undergone additional developmental work, does that make sense to you that you would take a more aggressive position even after the software had been developed further?
A If a version of software has gone from should be questioned

and then later in its development it should not be relied upon, is that your question? Is that an odd position to take?

Q Well, well, you know, I think I made the point so I'm just going to move on in the interest of time.

Let me ask you this. Is getting source code important for you to do a full review, that's something you care about, getting the source code, right?

THE WITNESS: Generally.

BY MR. PRESANT:

Q Can we go to page 16 of the report, please? You were granted access to the source code in this case, correct?

A Yes.

Q And yet you write, if we can zoom in on this area, "This review should not be considered comprehensive or complete." Right?

A Correct.

Q You were given what you wanted in this case, access to the source code; why didn't you do a comprehensive or a complete review?

A It's estimated that software testing or more generally verification and validation processes during software development should take somewhere between ten and maybe, excuse me, around 35 or 40 percent of the total budget. I was given 20 hours to inspect a program that's developed over the course of the past seven years.

Q Okay. You were given 20 hours by whom, defense counsel, correct?
A 20 hours was the agreed upon amount.
Q Agreed upon by whom?
A Between all parties in the discussion, ESR, the place where we took the inspection, me, defense.
Q Well, at one point ESR offered you 36 hours, 36 hours that were requested by defense counsel, correct?
A Yeah, I believe that was discussed at some point.
Q Okay. So ESR said we will make the source code available, how long do you want it for, defense counsel said how about give us a quote for 36 hours, right?
A That sounds right, yes.
Q But you only used 20 of them, right?
A A little over 20.
Q A little over 20 then you produced this not comprehensive or complete report, correct?
A Correct.
Q This isn't the first time that you've been given access to source code but haven't actually spent the time looking at it, is that right?
A I don't follow.
Q Do you recall your testimony in the Simmer case?
A The Simmer case. Out of Nebraska?
Q I believe so, yeah, do you recall that?

A Yes.
Q Do you recall being asked, now you're aware that was a TrueAllele case, right?
A It was a hearing in the trial itself.
Q But it involved TrueAllele, not STRmix.
A Correct.
Q And you were asked, Now you're aware that TrueAllele Cyber Genetics says, "Okay, you can look at our source code. You're aware of that now, correct?" And you answered, "I'm aware of the offer. Question. But yet you haven't looked at that source code yet. Answer. Correct. Question. So you've been asking for something. I want to see this. I want to see it. And now you can see it and you're not looking at it. Correct? Answer. I've been asking for it for three years and I have had the opportunity for five months. Question. And haven't taken that opportunity in the past five months. Answer. Not yet." Do you recall that testimony from the Simmer case?
A It sounds familiar.
Q Okay. Would you like to see the transcript of it?
A No.
Q All right. Do you remember the Washington case that I asked you about earlier?
A This is the Washington case out of Pennsylvania?
Q Correct, the defendant is Washington, you testified in Pennsylvania. That's the case. Was there a similar situation

there where you didn't actually run the review on the materials you had been given?

A Well, that's different. The source code at that time was not available. I believe that policy change, to the best of my memory, that policy change in the Cyber Genetics organization occurred late summer, early fall last year in the Washington case, so there was no source code offered to me.

Q Was the software offered to you to be able to work with?

A A portion of the software. TrueAllele is a different architecture perhaps than STRmix. STRmix is a desktop program that can be run on a desktop computer. TrueAllele is a client server architecture, so it has a client program that allows you to input data. So that's what was offered to me, not the entire deconvolution, LR calculation; the whole set of TrueAllele programs were not offered to me.

Q But you didn't run the data in that case either, based on what was offered to you, correct?

A I did not.

Q So it's a bit of a theme, you get access to materials but you don't spend the time to actually go through them to figure out whether it works properly or not.

A I can't answer all of those questions with the levels of access that I've been given.

Q You have testified here today that you were never offered access to Github, right?

A Right.
Q Did you ask for access to Github?
A I asked for assess to the validation materials.
Q When you saw what had arrived, did you say, hey, I would like to see a few more things, can you get me these other things? Did you ever ask them?
A Well --
Q That's a yes or no. Did you ask them for additional information after you saw that there wasn't everything there that you would have liked to see?
A No.
Q Okay. Your report also repeatedly says that several things are unclear. Is that correct?
A In this case?
Q Yeah, the report in this case.
A Yes, sir.
Q And is it possible that several items weren't clear to you because either your lack of training and experience or the fact that you didn't spend the time to actually figure out what the answers to those questions were?
A I think some things that are not clear could be learned in time, yes, with more exposure to the materials.
Q Now, you testified to Ms. Kloet regarding the location of bugs, the identification of bugs in software generally and in STRmix in particular, correct?

A I did.
Q And my question for you is debugging common as software is continuously developed over time, new versions of software are rolled out?
A Is debugging --
Q Yeah, is debugging a common feature of ongoing software development?
A This is a pedantic point, but debugging is a term of art that I'm not sure applies here. It's a tool.
Q I'm not a computer scientist so maybe I'm using it incorrectly. What I'm trying to figure out is is it common as new versions of software are released, complicated software, that those versions are sometimes released because little problems are identified and you need to fix them and that's why you push out a new version of software? Is that fair?
A There's patches and upgrades, yes, that's common.
Q Now, for the various errors or criticisms that you said you found in STRmix, did you attempt to figure out whether or not those actually had a material impact on the operation of the software in this case?
A No.
Q Have you testified before that that's something your lab does, actually run the software to figure out what the answer is?
A What software?

Q Well, whatever software you're looking at in a particular case, that that's something you do, you get the software, you get the data and you look at it to see if it was done correctly in that case; is that a service offered by your firm?

A I think that's a very broad question. We have software that laboratories use. We use that regularly in reviews. We have not used STRmix to come up with alternative likelihood ratios if that's what you're asking.

Q Do you actually run the program, STRmix, that's my question?

A I have before. I have not in case work.

Q And why didn't you try to figure out in this case if any of these stylistic criticisms you had actually made a difference to the bottom line?

A That wasn't the goal, the main goal of my inspection.

Q That wasn't the scope of work provided to you by defense counsel?

A I'm sorry?

Q That wasn't what you were asked to do.

A I'm not sure if we were asked to do that and given that was our primary charge. We certainly had conversations about what I ended up doing.

Q Okay. So I'm trying to move along, Your Honor. You've testified previously that the most variants you would expect to see in multiple runs of STRmix is one order of magnitude?

A On the same set of input data with no other parameters changed.
Q Right. You run it again, the Monte Carlo engine might produce something that's off by one quarter magnitude, correct?
A Yes.
Q And you still agree with that as you sit here today?
A Generally.
Q You agree and you've testified previously that internal validation is an appropriate thing to do to test software, right?
A Yeah.
Q Do you agree that of the probabilistic genotyping software you've reviewed, not just STRmix, but all other probabilistic genotyping software, STRmix probably comes closest to meeting the IEEE standards?
A Yes, I would.
Q Let me briefly ask you about a couple of these exhibits that Ms. Kloet introduced. Do you have PP in front of you?
A Yes. Is that the Benschop article?
Q It is, yes. You do have it in front of you?
A Yes, sir.
Q Was STRmix the software model used in generating this article?
A No.
Q What model was used?

A This was the probabilistic genotyping program itself. I believe this was LRmix.

Q Right. That's what says in the abstract, LRmix, if we zoomed in here.

A Yes, sir.

Q Okay. And the conclusions of the paper then are based on the model; if STRmix were studied, the conclusions in the paper might be different, right?

A It's possible.

Q Now, can we go to page 95 of the paper which is the fourth page of the paper? And look at this area down here in the bottom left-hand corner. Do you see the portion where it says, "In most instances, the likelihood ratios were equal or larger for hypotheses that used the true number and not an incorrect number of contributors."

A I see that.

Q I read that accurately?

A Yes.

Q Do you think that statement is consistent with the idea that a wrong number of contributors leads to a conservative result?

A Not universally, but this is, this starts with "in most instances," that's a generalization for the majority of the cases.

Q In most instances, right, that's all I'm saying. It's

consistent with that in most instances, right?
A That's what it says, yes.
Q Now, can we bring up Defense Exhibit AA which you were asked about? Finding 4. It seemed like you said you were confident that miscode 3 affected this version; it was less clear whether these other ones did, but 4 might have in your opinion based on your review of this document. Right?
A Could I rephrase that?
Q Sure.
A It's been mentioned by witnesses other than me that 3 applies to the version and could potentially affect results in this case. It seems like the consensus is that it doesn't really. The other --
Q Are you talking about 3 or 4?
A 3.
Q Okay.
A 4.
Q I only want to look at 4. I know other witnesses testified about 3. I think you're the only witness who thought 4 might have an impact on this version. I just want to highlight for you that the conclusion of the study of 4 was that there was no detectable effect on the likelihood ratio in the profiles tested, right?
A Where is the conclusion?
THE COURT: On the right-hand side.

THE WITNESS: Okay.

MR. PRESANT: I read that accurately?

THE WITNESS: Yes, you did.

MR. PRESANT: Okay. Ms. Kloet asked you about the confusion about the Markov Chain Monte Carlo issue that has gone back and forth in these battling reports. You said you were educating yourself on whether or not you were right about that, right?

THE WITNESS: Did I?

BY MR. PRESANT:

Q Never mind. I'll move on. I'm almost done here. You testified about how Niche Vision is currently being used to code, right?

A They were referenced in the change request.

Q And you thought their portions of the code were quote "tidy, well maintained," close quote, right?

A The ones attributed to those two gentlemen.

Q But yet there's still been bugs or issues found with that professional, professionally developed code, right?

A The disclosure is not that descriptive of which portions, who was ultimately responsible for those.

Q So even professional coders sometimes create bugs that then need to be worked out in later versions. I mean do you disagree with that general idea?

A Professional coders are not immune to making mistakes.

Q All right. Last set of questions. Your firm has its own software, right?
A We do.
Q Is that software called Genophiler?
A One of them.
Q I just want to ask you about Genophiler. Can we bring up Government's Exhibit 24? It's in the other book in front of you but we will put it on the screen. Do you recognize Exhibit 24?
A It's our website.
Q And this is specifically the page on Genophiler public validation, right?
A Yes, sir.
MR. PRESANT: Your Honor, the government moves to admit 24.
THE COURT: Ms. Kloet.
MS. KLOET: I have no objection.
THE COURT: It's admitted.
MR. PRESANT: Can we go to the next page, please? Actually the page after that, I'm sorry. No, the page before. It's right above results here. Thank you. Do you see this journal article referenced on the validation of Genophiler?
THE WITNESS: I do.
BY MR. PRESANT:
Q And is D. Krane, Daniel Krane is your boss at FBS?

A Dan Krane, yes.
Q I'm sorry, Dan Krane. So he validated his own software, Genophiler, in this case, right, that's the result advertised on your website, correct?
A This, this is the publication for a paper on analytical thresholds.
Q Okay. Is the validation discussed anywhere like who actually did the validation on this website?
A It's likely to be a group consisting of those people. It was before my time.
Q Okay. So Professor Krane might have been the one who validated Genophiler, that sounds right to you?
A He would have been involved in the development. I don't know who conducted the validation.
Q You testified that independence in validation is extremely important: Financial, different person, different technical specifications, all this stuff about independence, right? But it seems like Genophiler wasn't independently validated. So my question for you is there one set of standards for software developed by other companies and a different set of standards for software developed by your company?
THE COURT: I think he testified that he didn't know who did the validation.
BY MR. PRESANT:
Q I'm sorry, give me a moment, Your Honor, please.

THE COURT: He just said that. The question, "So Professor Krane might have been the one who validated Genophiler." The answer was, "He would have been involved in the development. I don't know who conducted the validation."

MR. PRESANT: Let me ask you about your testimony in the Fair case. Do you remember testifying in that case about Genophiler?

THE WITNESS: It's come up before. I don't specifically in that case.

BY MR. PRESANT:

Q Do you recall being asked, "Question. So it's actually, so the people who validated it are the same ones that created it and they had access to the source code? Answer. Correct. Question. Do you know if the source code has been given to anyone else to validate it? Answer. I don't know." Do you recall that testimony?

A Correct. Yes.

Q So you acknowledge there that the same people who created the software were the ones who validated it, right?

A Right. I can't give you an author list of who conducted the validation. I'm sure Jason Gilder was involved, and it would be reasonable to expect that other people who developed the software were involved in its validation.

Q So my question for you is the independence requirements that you testified about aren't even applied by your very own

firm with respect to their software, is that right?

A That's going to be based on the significance of the software.

Q I'm not asking about the significance. I'm just talking about the application of the independence principle, not even followed with respect to Genophiler, right?

A I would not agree with that.

Q All right.

MR. PRESANT: Nothing further, Your Honor.

THE COURT: Just so everybody is aware, I'm going to give a brief opportunity to redirect and recross, not to exceed a total of ten minutes and then we are done.

MS. KLOET: Absolutely, Your Honor. I only have two brief topics.

REDIRECT EXAMINATION

BY MS. KLOET:

Q Ideally how long would a review of materials like you did for STRmix in this case, ideally how much time would you want?

A I think it could take weeks or months. As I said, it could be a significant portion of the original development budget and accordingly a review of these processes could take quite a while.

Q Is it your understanding that FBS, the company for which you work, they charge by the hour for your work?

A Yes, we do.

Q Is it your understanding that ESR charges by the hour?
A Yes.
Q Where did you take or where did you conduct your review?
A At a law office.
Q At a private law firm?
A Yes, sir. Ma'am.
Q Was anyone present during your review?
A Yes, I had a minder, I suppose.
Q When you say minder, was that someone from your company or from ESR or from another entity?
A From the law office.
Q Moving on to the next topic. If you can go to PP, Defense Exhibit PP this is the Benschop article. Have you reviewed -- have you reviewed any other research articles that address the issues that are addressed in this particular paper?
A Yeah. The effects of varying the number of contributors. There have been a number of publications involving those kinds of inspections.
Q And does that other research indicate that varying the number of contributors can affect a likelihood ratio potentially to the detriment of the defendant?
A Yes.

MS. KLOET: Thank you. That's all.

MR. PRESANT: Your Honor, I have no recross of this witness. The one issue I will raise with the Court, and I

really wish we had more time is just some of the new exhibits today, if we had more time I would like to show to Dr. Buckleton so he could explain their relevance if any for STRmix. And I would call him in rebuttal if we had additional time. But I'm not sure the Court or the witness's schedule permits to continuing this to tomorrow. So I just want to put that on the record for what it's worth.

THE COURT: Well, we don't have more time. You have taken up an entire two days. We have heard a lot of testimony. I think that with my opportunity to review my notes, and the rough of the transcript, I think I have heard enough to make a decision. I don't think we need rebuttal. And I'm not going to permit any.

We have a lot of material to digest. And what we are going to do, what you are going to do is provide me with supplemental briefing within some important limitations.

First of all, I want to make sure that everybody is in agreement with the requirements of Daubert. That is, are you both in agreement that Daubert requires the Court to examine the evidence in question and determine whether the method used to produce it was scientifically valid, and that the results are valid and relevant. So I'm asking both of you to put your either agreement or disagreement on the record that that's the fundamental duty of the Court under the Daubert decision.

MR. PRESANT: You want it on the record now or in the

supplemental briefing?

THE COURT: Right now.

MR. PRESANT: Your Honor, I believe that's correct. Daubert applied Rules 701 through 703 are interpreted and set forth some non exhaustive list of factors, four or five of those depending on which authority you look at, are considered usually discussed as the Daubert factors. Off the top of my head, it's whether the method has been subject to peer review and publication, whether the method is capable of being tested, whether the known error rate or the known potential error rate has been tested or could be tested, and then the Frye standard was incorporated too, general acceptance within the scientific community.

And so I think those factors all go to the way the Court has framed the issue. Whether -- I do think it's appropriate for the Court to examine the evidence that's been presented, the literature, and all the exhibits, and attachments to the briefs; I do think that's the role of the Court to examine that material in order to answer the Daubert question about whether the evidence should come in, and I think that goes to the validity issue as well. And of course relevance comes in both under the 700 series of federal rules, the expert rules, because the expert's testimony has to assist the trier of fact. This Court of course knows its gate keeping function under the relevance rules in the 400 series too.

So that's the government's view on those two questions if it's responsive. If it's not, I'm happy to address additional questions.

THE COURT: No, it is. Ms. Kloet.

MS. KLOET: Your Honor, if I understand the Court correctly, the two driving principles that are cited in Daubert that are found in the Federal Rules of Evidence are reliability and relevance. I think that's what the Court stated on the record today. We would agree with that and rely on the Daubert elements as set forth in the case itself.

THE COURT: Okay. And here's how it's going to go. We are going to have a defendant's brief which will be due within, in 48 days or 45 days, and that brief must articulate the specific grounds on which the defense objects to the admissibility of the evidence. I think that that has been a little fuzzy in this case. I think it has been a little bit of a moving target. And it's really important that you articulate specifically what the grounds are that you base your objections on.

Then I want you to tell me what testimony or evidence that has been produced in these last two days which supports your position on admissibility or inadmissibility, and why under the governing legal standards. And also, you know, to drop the other shoe, what the contrary evidence is.

Then within 45 days of the defendant's brief, the

government can respond. There's not going to be any reply allowed. Both briefs must identify the three most important documents that have been introduced here. There's really been a great deal of very technical, scientific documentation in this case, some of which I've read, much of which I have not. But it is not possible for either me or my law clerk to read all of it. And so I need for you to tell me, each of you to tell me what are the three most important supporting documents to your positions. And you're going to do all of this in 20 pages or less.

Are there any questions, comments, concerns? Kathie, have you got something else?

We do have a waiver of the speedy trial clock. Mr. Gissantaner, are you willing to extend your waiver until the briefing and opinion drafting in this case are concluded?

THE DEFENDANT: Am I understanding right when you say the 45 days, is my attorney, Ms. Kloet, takes 45 days to write her brief, and then he get 45 days to respond? So in total we talking 90 more days.

THE COURT: Well, but then I've got to read the briefs and write an opinion.

THE DEFENDANT: I'm cool with that.

THE COURT: Okay. Thank you. Anything else? Okay. Thank you all for your presentations. We are adjourned for the day.

THE LAW CLERK: All rise. Court is adjourned.

THE COURT: As we did yesterday, the clerk is going to read her list of the exhibits which she has that were admitted today and each of you should check your own list to determine whether she has the same ones that you have.

THE LAW CLERK: For the government, I have Exhibit 16, and Exhibit 24.

MR. PRESANT: That's correct.

THE LAW CLERK: Okay. For the defense I have Exhibit A, B, D as in David, E, L, P, Q, V as in Victor, then AA, LL, MM, and PP.

MS. KLOET: Double C admitted? We discussed that today.

THE LAW CLERK: I have that as yesterday.

MS. KLOET: I'm sorry. Okay. And you got PP listed.

THE LAW CLERK: Yes, PP.

THE COURT: Okay. Now we truly are adjourned.

(Proceedings concluded, 4:42 p.m.)

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REPORTER'S CERTIFICATE

I, Kathy J. Anderson, Official Court Reporter for the United States District Court for the Western District of Michigan, appointed pursuant to the provisions of Title 28, United States Code, Section 753, do hereby certify that the foregoing is a full, true and correct transcript of the proceedings had in the within entitled and numbered cause on the date hereinbefore set forth; and I do further certify that the foregoing transcript has been prepared by me or under my direction.

/s/ Kathy J. Anderson

Kathy J. Anderson, RPR, FCRR

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