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IN THE COURT OF COMMON PLEAS
FIFTEENTH JUDICIAL CIRCUIT
STATE OF SOUTH CAROLINA
COUNTY OF HORRY

JENNIFER SPIVEY FOLEY, as
Personal Representative of
The Estate of SCOTT RYAN
SPIVEY,

Plaintiff,

vs.

Case Number
2024-CP-26-03798

CHARLES WELDON BOYD and
KENNETH WILLIAMS,

Defendants.

VIDEORECORDED DEPOSITION UPON ORAL EXAMINATION OF
ROBERT C. MAHER, PhD, PE

BE IT REMEMBERED, that the videorecorded
deposition upon oral examination of ROBERT C. MAHER,
PhD, PE, appearing at the instance of the plaintiff,
was taken at 608 Cobleigh Hall, Montana State
University, Bozeman, Montana, on Monday,
September 8th, 2025, beginning at the hour of 1:00
p.m., pursuant to the South Carolina Rules of Civil
Procedure, before Deborah L. Fabritz, Court Reporter
- Notary Public.

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APPEARANCES

ATTORNEY APPEARING ON BEHALF OF THE
PLAINTIFF, JENNIFER SPIVEY FOLEY, as Personal
Representative of the Estate of SCOTT RYAN
SPIVEY:

Mr. Mark B. Tinsley, Esq.
Gooding and Gooding, PA
265 Barnwell Highway
Allendale, SC 29810

and

ATTORNEY APPEARING ON BEHALF OF THE
DEFENDANT, CHARLES WELDON BOYD:

Mr. Kenneth R. Moss, Esq.
Wright Worley Pope Ekster & Moss, PLLC
200 S. Lewis Street
Tabor City, SC 28463

and

ATTORNEYS APPEARING ON BEHALF OF THE
DEFENDANT, KENNETH WILLIAMS:

Mr. M. O'Bryan Martin, Esq. and
Mr. L. Morgan Martin, Esq. (via Zoom)
Law Offices of L. Morgan Martin, PA
1121 Third Avenue
Conway, SC 29526

Robert C. Maher, PhD, PE

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Mr. Robert E. Lee, Esq. (via Zoom)
Robert E. Lee, LLC
PO Box 1096
Marion, SC 29571

ALSO PRESENT:

Bridger Arthun, videographer



Robert C. Maher, PhD, PE

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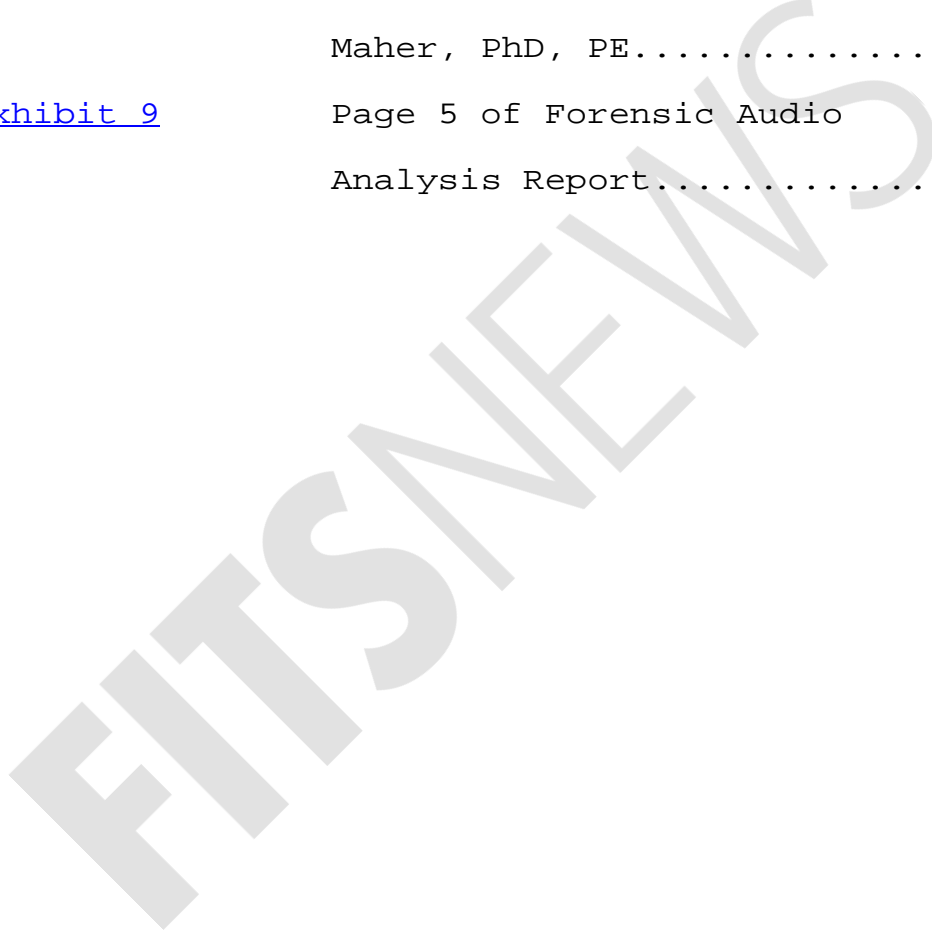
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Robert C. Maher, PhD, PE

1 Whereupon, the following proceedings were had
2 and testimony taken, to-wit:

3 * * * * *

4 THE VIDEOGRAPHER: This is the
5 videorecorded and videoconferenced deposition of
6 Robert C. Maher, PhD, PE, taken in the Court of
7 Common Pleas, 15th Judicial Circuit, State of South
8 Carolina, County of Horry. Case number
9 2024-CP-26-03798. Jennifer Spivey Foley, as personal
10 representative of the estate of Scott Ryan Spivey,
11 versus Charles Weldon Boyd and Kenneth Williams.

12 Today is September 8th, 2025. The time is
13 12:55 p.m. Mountain time. We are present with the
14 witness at 608 Cobleigh Hall, Montana State
15 University, Bozeman, Montana 59717.

16 The court reporter is Deb Fabritz, and the
17 video operator is Bridger Arthun of Fisher Court
18 Reporting. The deposition is being taken pursuant to
19 notice.

20 I would now ask the attorneys to identify
21 themselves, who they represent, and whoever else is
22 present. For those attending remotely, please note
23 from where you are appearing.

24 MR. TINSLEY: This is Mark Tinsley, and I
25 represent the plaintiff, the Spivey family.

Robert C. Maher, PhD, PE

1 MR. MARTIN: This is O'Bryan Martin. I
2 represent the defendant, Kenneth Bradley Williams.

3 MR. MOSS: This is Kenneth Moss. I
4 represent Charles William Boyd.

5 THE VIDEOGRAPHER: Okay.

6 MR. LEE: Robert Lee. I represent with
7 Mr. Martin, the same defendant.

8 THE VIDEOGRAPHER: With that, the court
9 reporter will now administer the oath.

10 ROBERT C. MAHER, PhD, PE,
11 called as a witness, having been first duly sworn,
12 was examined and testified as follows:

13 EXAMINATION

14 BY MR. TINSLEY:

15 Q. Good afternoon, Dr. Maher.

16 A. Good afternoon.

17 Q. Would you tell the court what it is that
18 you do for a living?

19 A. I'm employed as a professor of electrical
20 and computer engineering at Montana State University.

21 Q. And how long have you been employed here?

22 A. I've been at this university since 2002,
23 so I'm starting my 24th year.

24 Q. And -- and for the jury's benefit or the
25 court's benefit, where are we today?

Robert C. Maher, PhD, PE

1 A. We're in Bozeman, Montana, on the campus
2 of the university.

3 Q. And tell us what that means. What is it
4 that you teach?

5 A. The field of electrical engineering is a
6 well-known specialty that deals with anything that
7 has electricity involved in it. So that could be
8 electrical power systems. Could be computers. Could
9 be mobile phones. My particular specialty area is
10 audio engineering, which is using electronics to
11 record and process and interpret audio.

12 Q. Okay. And if you could, give us a rundown
13 of your educational background beginning with
14 college.

15 A. I went to college as an undergraduate at
16 Washington University in St. Louis. Graduated there
17 with a bachelor's degree in electrical engineering in
18 1984. Then I pursued a master's degree in electrical
19 engineering from the University of Wisconsin-Madison
20 in 1985 and then earned a PhD in electrical
21 engineering from the University of Illinois,
22 Urbana-Champaign in 1989.

23 Q. Do you have any private or -- obviously
24 you're here today in a case in South Carolina. But
25 do you do private or consulting business work in this

1 area?

2 A. Yes. So I -- in addition to my
3 responsibilities to the university, I also in my
4 spare time and weekends and evenings do consulting
5 work in my areas of specialty.

6 Q. You were asked by me to analyze a couple
7 of audio recordings. Correct?

8 A. That's correct.

9 Q. And is that the kind of thing you do in --
10 not -- in your professional endeavors, not just in
11 the educational perspective but also for third
12 parties?

13 A. Yes. So my consulting practice, which is
14 the auspices for -- under which I'm here today, deals
15 with interpreting audio forensic analysis of audio
16 recordings and videos and other evidence of that
17 type. I also teach this subject in the university.
18 So I have students who are studying the principles of
19 audio engineering, digital signal processing, and
20 basic audio forensic analysis. But I'm appearing
21 here, doing this work that I do in my private
22 practice.

23 Q. And what is the name of that practice?

24 A. Simply it's my name, just a sole
25 proprietorship.

1 Q. Okay. And obviously you're being paid for
2 your time?

3 A. Yes. That's --

4 Q. How much are you being paid?

5 A. My agreement is an hourly fee of \$250 an
6 hour.

7 Q. Okay. Have you offered sort of expert
8 witness consulting work in the past?

9 A. Yes.

10 Q. Have you been qualified as an expert in --
11 in court matters?

12 A. Yes. I've had courtroom testimony and
13 depositions conducted in several states.

14 Q. And in what area of expertise were you
15 qualified as an expert to give expert opinion?

16 A. In audio forensic analysis.

17 Q. Have you -- and is that the area or the
18 field of study in which you intend to offer opinions
19 today?

20 A. Yes, it is.

21 Q. Okay. And have you written -- I know
22 Mr. Moss has got a stack of your papers, but so have
23 you written any materials that are peer-reviewed
24 materials on this subject?

25 A. Yes. As part of my professional career

1 for 30 or 40 years now, I've published papers, which
2 means scholarly works that are reviewed by peer
3 scientists and then published in journals, meaning
4 that they're read by people with similar background
5 and interests.

6 I also give presentations at professional
7 meetings. I've been invited to do that for a variety
8 of organizations as well as submitted publications
9 for that purpose, and I have written a textbook about
10 audio forensic analysis that has been published and
11 reviewed for this particular area of my expertise.

12 Q. When was that first published?

13 A. The date? 2018.

14 Q. And are you a member of any of those
15 professional societies or organizations that you
16 referenced maybe you have written some of these
17 papers for?

18 A. Yes. I'm a member of IEEE, which is the
19 electrical engineering international professional
20 organization. I'm a fellow of the Audio Engineering
21 Society, which is a specialty field of -- of audio
22 engineers. I'm a member of the Acoustical Society of
23 America and the American Academy of Forensic Science
24 and also the American -- the engineering education,
25 American Society for Engineering Education, ASEE.

1 Sorry.

2 Q. And -- and you're a licensed professional
3 engineer in the state of Montana?

4 A. Yes. I have a professional engineer's
5 license in this state.

6 Q. How long have you held that?

7 A. I could look up the exact date. I think
8 it's since 2007, 2008, something like that.

9 Q. Okay.

10 MR. TINSLEY: At this time I would offer
11 Dr. Maher as an expert in the area of audio digital
12 signal processing and audio forensics.

13 THE WITNESS: Okay.

14 BY MR. TINSLEY:

15 Q. Okay. So you touched on it already that
16 you were sent some recordings by me. Can you tell us
17 what you received? Let's just start with what you
18 have.

19 A. Yes. So my recollection is you contacted
20 me via e-mail, and you provided three audio
21 recordings. So these were in -- in digital form, and
22 I have a report that describes the details of those
23 if you would like me to refer to the exact file names
24 and so forth.

25 Q. So -- and if nobody has any objection, we

1 can -- let's -- let's identify them from your report
2 so that we're all on the same page.

3 There is -- there are three -- on page 3
4 of your report, there are three recordings noted.
5 The first one is a long -- starts with O underscore
6 P.

7 Okay. And that is -- that is the 911 --
8 you refer to that as the 911 call center recording.
9 Is that fair?

10 A. Yes. My interpretation of that recording
11 was it appears to be a recording made at the 911
12 emergency dispatch center. So it seems to be on the
13 site of the 911 operator. And then we can hear
14 voices on a telephone channel.

15 Q. Okay. The next one, at least that you
16 have got there, it's the file that begins with 911
17 underscore 1, and -- and that is what you refer to in
18 your report as the mobile phone recording of that 911
19 call. Is that correct?

20 A. Yes. My interpretation was that was a
21 recording made at the calling end of the
22 conversation, and it has utterances that appear to be
23 in a vehicle and also the voice of the 911
24 dispatcher.

25 Q. And for purposes of your analysis that

1 we're going to talk about, I think I represented to
2 you that that was a recording made by Weldon Boyd's
3 phone. Did you assume that to be true?

4 A. That was my assumption that this was a
5 recording that was made at the time of the incident.

6 Q. Then the third recording is something
7 referenced new recording, which is a portion of the
8 mobile phone recording but slowed down. Did you use
9 that at all?

10 A. I listened to it just out of curiosity,
11 but because you had informed me that that was a
12 processed recording that you had obtained, I did not
13 refer to that recording in what I -- in the work I
14 did.

15 Q. Okay. Help us understand your rationale
16 in why you weren't interested in that recording?

17 A. Well, the principles of forensic audio
18 analysis would be to rely totally on the audio
19 information that's presented from the actual scene.
20 Other information about the incident and modified
21 audio may be interesting, but I avoid that because
22 that might tend to bias my thinking or give me an
23 indication of some particular aspect of the recording
24 that I would not have come to on my own using the
25 principles of audio forensic analysis.

1 Q. Okay. And did the new recording, the
2 portion that was altered, did it affect your
3 decisions, opinions, conclusions that you're going to
4 give us?

5 A. No. I did not rely on that at all.

6 Q. All right. The 911 call, this is from the
7 call center call. Are there certain limitations in
8 terms of the way those recordings are made as far as
9 what is captured in the recording?

10 A. Yes. So the 911 call center, because they
11 have lots and lots of recordings to make, they --
12 they generally tend to use a relatively narrow band
13 width, meaning the quality of the recording is
14 sufficient for speech intelligibility, but generally
15 they don't make it high fidelity.

16 So, for instance, that recording was
17 sampled at 8,000 digital samples per second, which is
18 adequate for voice communication, but it would be
19 much lower than a high fidelity recording that might
20 be at 44,100 samples per second. That would be like
21 a compact disc quality or 48,000 samples per second.
22 So it's only 8,000 samples per second. So it is
23 somewhat lower quality. I found the speech to be
24 very intelligible in that recording, so there didn't
25 seem to be a limitation.

1 The other aspect of the limitation is that
2 the 911 call center is communicating with a caller
3 over the telephone network. And the digital
4 telephone network like from a cell phone -- modern
5 cell phone uses a speech encoding algorithm in the
6 phone. So in other words --

7 Q. So -- yeah. I'm sorry. What does that
8 mean?

9 A. So that means that the phone is trying to
10 extract information that is useful to interpret
11 speech. So the speech sounds that we have, the vowel
12 sounds, the fricatives and so forth are trying to be
13 conveyed. So generally, that telephone channel has
14 difficulty if sounds are presented that are not
15 speech-like. So if there is a bang or a --

16 Q. Gunshot?

17 A. -- or a gunshot, for instance, typically
18 the speech encoding algorithm does not recognize
19 those sounds as being speech, and so they're often
20 not included in the information conveyed to the call
21 center.

22 Q. Okay. Now, in your report you outline, --
23 and I'm going to call them limitations. If you don't
24 like that word, we can -- you can use something else.
25 In terms of the cell phone recording, were there

1 certain limitations in -- in terms of how cell phones
2 record, what format that file is in in terms of
3 analyzing the audio of that call?

4 A. So the cell phone recording that was
5 provided here is a -- a wider band recording, and by
6 that, I mean it has more samples -- digital samples,
7 per second. So the call center recording I mentioned
8 was 8,000 samples per second. The recording of the
9 mobile phone was done at 44,100 samples per second,
10 so we have a --

11 Q. Closer to your compact disc example?

12 A. Correct. However, the mobile phone
13 recording is encoded in what's known as MP3, MP3,
14 which is MPEG-1, layer 3, which is a particular
15 perceptual encoding algorithm that is pretty commonly
16 used in audio recording.

17 What it does is it tries -- the algorithm
18 -- the software that is performing that encoding
19 tries to determine what sounds in the recording would
20 be perceived by a human listener and tries to
21 maintain those. And other parts of the recording
22 that wouldn't be perceived by a human listener, it
23 leaves out. So we end up with a recording that to a
24 human listener will sound very much like the original
25 recording, but we have to be concerned in the

1 forensic analysis because it -- it has a data
2 reduction that has taken place during that process.

3 Q. And -- and what does that mean?

4 A. It means that instead of having every
5 single detail of the audio waveform that was
6 presented to the microphone of the recording device,
7 some of the information will be -- will be left out
8 or will be distorted slightly. But the purpose of
9 the algorithm is to do that in such a way that we can
10 have smaller digital files. We don't need to store
11 as many digital bits but still have it sound to a
12 human listener the same as the original.

13 Q. And from a more dumb down, which is the
14 only way in which I understand it, is the distortion
15 or -- or that limitation a function of the
16 information overloading the speaker, or is that a
17 different issue?

18 A. It has to do with the way the human
19 hearing system works and how human perception works.
20 There's a phenomenon known as masking, and that
21 technical term masking means that when we listen to a
22 complicated sound -- let's say it was a musical piece
23 with lots of different instruments playing -- our ear
24 and brain are only able to detect a certain level of
25 the information that is being presented. And so some

1 of the noisy portions of the signal or some of the
2 portions of the spectrum, the frequency range that
3 are relatively quiet, a human may not be able to
4 perceive those.

5 So the -- the perceptual encoding
6 algorithm is intended to try to mimic the way a human
7 would hear the sound and only encode the portions
8 that are of interest. So a -- a typical CD-quality
9 recording would have over a million bits of
10 information per second in that storage. An MP3 file
11 typically would maybe only be 100,000 bits per
12 second. So it may be compressed by a factor of -- of
13 ten or something like that.

14 Q. Okay. Ultimately, does that limitation
15 affect the opinions you're going to give us or your
16 conclusions that you're going to give us today?

17 A. In the case of the -- the timing
18 information and in the case of the interpretation of
19 the intelligibility of the sound, it really doesn't
20 have any -- any impact.

21 Q. Okay. And now, the two recordings, your
22 -- your report indicates the 911 call center is 10
23 minutes, 17.28 seconds. Did you listen to all of it?

24 A. Yes.

25 Q. And the mobile phone recording you

1 indicate was 8 minutes, 22.804 seconds. Did you
2 listen to all of it?

3 A. I did.

4 Q. Were you given any direction in terms of
5 what portions of those ten-minute and eight-minute
6 calls to focus on?

7 A. Yes. So after I had received the files
8 from you and did an initial interpretation and then
9 spoke with you about -- I believe on the phone about
10 what your needs would be and what I would be able to
11 interpret from these recordings, then you asked me
12 two specific forensic questions that -- that I could
13 address.

14 Q. All right. And -- and if you will, let's
15 talk about the two questions that -- that you
16 addressed.

17 A. So I've listed them here on the report on
18 page 6.

19 Q. I'll tell you what, just for the record,
20 we'll mark your report as Exhibit --

21 THE REPORTER: 1.

22 MR. TINSLEY: I know it's going to get
23 confusing. I'm going to mark it as the last exhibit
24 for the record, and then -- so when we get to the
25 end, once I've marked the figures and -- and things,

1 I'll mark that as the last exhibit.

2 BY MR. TINSLEY:

3 Q. But go ahead. I'm sorry.

4 A. So the -- the two questions I have -- I
5 have listed here in the report and -- would you like
6 me to read them or --

7 Q. Yeah. I mean, you can just -- the first,
8 I had asked -- I had asked you whether you could
9 discern or tell whether there were gunshots prior to
10 what we refer to as the first audible gunshot in the
11 recording.

12 A. Yeah. So both of the questions pertain to
13 what I refer to as the mobile phone recording, so
14 this was the MP3 file that appeared to be recorded
15 during the incident from the -- the vehicle that was
16 involved, where the call came from.

17 Q. All right.

18 A. And the first question had to do with
19 whether there were any gunshots audible in that
20 recording prior to the first obvious gunshot at 3
21 minutes, 33 seconds, FET or file elapse time. So
22 from the beginning of that recording at 3 minutes and
23 33 seconds, there is what I consider to be a very
24 obvious first gunshot.

25 And so your question was whether there

1 were any gunshots audible in the recording prior to
2 that time.

3 Q. Okay. And so tell us what you did to
4 analyze the audio to come to a conclusion?

5 A. So the -- the principles of forensic audio
6 analysis involve three general steps. The first step
7 I refer to as critical listening, and that is just
8 like it sounds. It means without any distractions,
9 simply listening with my ears very carefully to the
10 recording. And that often involves several different
11 passes through the recording, one time typically
12 listening for the -- the obvious -- what I would call
13 foreground sounds, like speech utterances or loud
14 sounds. Another pass through, listening very
15 carefully for what you might call background sounds.
16 So these would be sounds that would be not the main
17 conversation but in the background. So that's the
18 first thing, is critical listening.

19 The second step is referred to as waveform
20 analysis. And what this means is using a software
21 tool to visually to look at the waveform of the
22 recording. And by waveform, I mean when the
23 acoustical pressure of sounds reaches the microphone,
24 the microphone creates an electrical signal that is
25 an analog signal that is an analogy to the pressure

1 disturbance in the air of the sound. And so that
2 produces a graph. So it has an amplitude of Y axis
3 and then time on the horizontal axis. And by
4 visually looking at that waveform, that provides a
5 way of detecting when there are changes in the
6 signal, how loud different sounds are proportionally,
7 and other metrics like that.

8 And then the third technique required in
9 audio forensic analysis is referred to as
10 spectrographic analysis, and that's looking at the --
11 the spectrum -- the frequency spectrum of the audio
12 information. And the spectrogram is a special graph
13 that has frequency on the vertical axis, or the Y
14 axis, time on the horizontal axis, and then uses
15 typically color or intensity of the brightness of the
16 pixels to indicate the amount of sound energy at a
17 particular frequency at a particular point in time.

18 So the spectrogram is a well-known
19 technique in electrical engineering that uses the
20 short time fourier transform to display the frequency
21 content of the signal.

22 Q. So I'm going to mark as Plaintiff's
23 [Exhibit 1](#) the Figure 1 from your report and ask you
24 -- you just explained to us about the waveform
25 analysis and the spectrographic analysis.

1 (Whereupon, [Exhibit 1](#) was
2 marked for identification.)

3 BY MR. TINSLEY:

4 Q. And does that demonstrate or illustrate
5 what you were talking about?

6 A. Yes. So Figure 1 has two of these
7 representations together, the --

8 Q. Will it be useful for you to point to the
9 figure?

10 A. Sure.

11 Q. Let me -- let us get the camera fixed
12 right here.

13 A. Am I okay standing here?

14 Q. Yes, sir.

15 MR. TINSLEY: Could you just zoom in just
16 a smidge?

17 BY MR. TINSLEY:

18 Q. Okay.

19 A. Okay. So this is Figure 1 from the
20 report. The upper portion of this picture that is
21 white indication on a dark background, that's what
22 I'm referring to as the waveform analysis. So time
23 is running along here. This is roughly 30 seconds or
24 so from time 3:33 to 3:58 across horizontally. And
25 the vertical dimension of the waveform plot is

1 indicating how loud or how significant that sound
2 energy was at that particular point in time. So this
3 particular span has audible gunshots in it, and those
4 can be seen as these vertical impulsive indications
5 in -- in the recording.

6 Q. So -- so ultimately -- and we're going to
7 talk about the -- we've said audible clearly,
8 discernible. Is it your opinion that all of these
9 gunshots were fired within -- assuming the cell phone
10 is within William Boyd's vehicle, within that
11 vehicle, the ones that you have here illustrated in
12 Figure 1?

13 A. Yes. So, again, based on the critical
14 listening, so listening to this very carefully, based
15 on the waveform analysis observing the occurrence of
16 these impulsive indications that correspond to those
17 loud reports, and then also the lower portion of this
18 figure which is the spectrogram that I mentioned,
19 which is showing low frequencies to high frequencies
20 vertically. And then horizontally it's the same time
21 span as the waveform.

22 What we can see is when we have a very
23 impulsive or sudden onset of a signal in the
24 waveform, that corresponds to a vertical bright
25 indication in the spectrogram, because an abrupt

1 sound like that has energy at all different
2 frequencies but it's very short in time. So we get a
3 vertical indication in the -- in the spectrogram.

4 So your question about these 29 impulsive
5 sounds I've attributed to the gunshots in this, all
6 of them have very similar amplitude. They sound very
7 similar, and the spectrographic analysis of each of
8 them is very similar. And so my assumption was all
9 of those 29 sounds would have been from firearms in
10 the vehicle where the recording was made.

11 Q. When you say similar amplitude, does that
12 -- does that relate somehow to volume?

13 A. Yes. So when I say amplitude, I mean the
14 indication of the sound pressure. So that would be
15 the loudness --

16 Q. Okay.

17 A. -- of the sound.

18 Q. Okay. And -- and ultimately, you identify
19 in the entire gunshot sequence, if -- another phrase,
20 but 29 clearly discernible gunshots?

21 A. Yes. So in this figure I manually added
22 arrows and numbers. I added these by hand, the
23 indications of where I hear and see in the different
24 segments that there is an impulsive sound that I'm
25 attributing to the gunshots. And if I count all

1 those up in this span from 3:33 to 3:58, I count 29
2 of those.

3 Q. Okay. If you want to sit back down.

4 So let me ask you some questions just in
5 terms of the way that the energy or the gunshots
6 would be recorded. So if we assume a gun is fired
7 from a static position, it's not really changed in
8 orientation as it relates to the microphone, would
9 you expect to see similar waveforms and spectrograms
10 of those shots with one gun? Does that make sense?

11 A. I think so. So yes. If there is a single
12 firearm with same ammunition loaded and not -- no
13 particular change in the acoustical surroundings,
14 which would mean the gun was pointed in the same
15 direction, the microphone was not moving or changing,
16 there are no other changes like that, then from one
17 shot to the next, there will be some differences.
18 You know, the exact amount of gun powder in the
19 casing and the -- the casings crimp strength and a
20 variety of things, there will somebody differences
21 between that. But all in all, we would expect that
22 the sound would be very similar in amplitude that I
23 mentioned and spectrum and listening to it with
24 critical listening.

25 Q. And if we had -- let's say we had two guns

1 that were substantially the same, I mean, you know,
2 maybe they're different colors. Maybe they're
3 slightly different ammunition but the same caliber.
4 If they were substantially the same as we could get
5 to go -- so I'm just -- this is hypothetically -- and
6 they are different distances from the microphone,
7 would you expect to see different waveforms and
8 spectrographic analysis or spectrograms in terms of
9 how those sounds would be captured?

10 A. The -- the general answer would be -- they
11 would be similar in amplitude because the parameters
12 are similar, but if they're in different locations, I
13 would expect there would be some discernible
14 difference between the report of those different
15 firearms.

16 Q. Let me ask it a different way. So if --
17 if we have -- let's say we just have a cell phone,
18 for instance, and it's on the console and I shoot
19 straight ahead through the driver's windshield, and
20 then I turn 90 degrees and I shoot out the window.
21 Would -- would those be recorded the same or would
22 they appear differently?

23 A. I -- I would expect there would be a
24 difference discernible in that circumstance. The
25 sound emanating from the barrel of the gun is

1 directional. So it matters what direction the gun is
2 pointing. It's not so directional that we would
3 expect there to be a huge difference, but there is --
4 there would possibly be a difference in that
5 situation.

6 MR. MOSS: Could you tell us what that
7 sound is?

8 THE WITNESS: I don't hear anything. I'm
9 kidding. They're obviously doing some work on the
10 building. I'm sorry about that.

11 BY MR. TINSLEY:

12 Q. Yeah. That's okay. Timing was -- is
13 impeccable. All right. So --

14 MR. TINSLEY: How well can you hear him?

15 THE VIDEOGRAPHER: It's loud. You can
16 really hear that. Should I go off for a second?

17 MR. TINSLEY: Yeah. Let's go off for a
18 second.

19 THE VIDEOGRAPHER: We'll go off the
20 record. The time is 1:26 p.m. Mountain time.

21 (Whereupon, a break was then
22 taken.)

23 THE VIDEOGRAPHER: We are back on the
24 record. The time is 1:28 p.m.

25 BY MR. TINSLEY:

1 Q. All right. So, Doctor, we've got some
2 construction going on that we're probably not going
3 to be able to avoid, so we'll try to talk loud maybe
4 a little quicker. I have marked as -- as Exhibit 2
5 Figure 2 to your report.

6 (Whereupon, Exhibit 2 was
7 marked for identification.)

8 BY MR. TINSLEY:

9 Q. So the first step that you mentioned to us
10 in terms of the way that you would conduct this
11 analysis was the critical listening. Does Figure 2
12 illustrate some of the things that you noted when you
13 were performing that step?

14 A. Yes. So the figure has indications that I
15 added of my interpretation of -- of the utterances
16 during this segment prior to the first obvious
17 audible gunshot. So this section that's shown in the
18 figure is from about 3 minutes, 19 seconds to 3
19 minutes, 34 seconds, where the first audible gunshot
20 was at about 3:33.9, I think. So that's visible over
21 on the far right of this figure is where that first
22 clearly audible gunshot is. And so this is the
23 segment of, you know, 15 seconds or so prior to that
24 first audible gunshot.

25 Q. And so just so the court understands, what

1 is represented as the first audible gunshot in
2 [Exhibit 2](#) corresponds with what you've identified as
3 number one gunshot in [Exhibit 1](#)?

4 A. That's right, yes.

5 Q. And -- and -- and this is the area where
6 you primarily focus to see if there was a gunshot
7 before the first audible gunshot?

8 A. Yes. So in the body of the forensic
9 question was whether there are any gunshots audible
10 in the mobile phone recording prior to that first
11 obvious gunshot. So this is an example of a portion
12 of the recording just prior to that first obvious
13 shot.

14 Q. Okay. And are there any indications to a
15 reasonable degree of engineering certainty of a
16 gunshot within the section of the audio recording
17 that's illustrated here in [Exhibit 2](#)?

18 A. No. So a combination of the critical
19 listening I mentioned, looking at the waveform
20 analysis here and also the spectrogram, I -- I did
21 not find any evidence that there was a gunshot prior
22 to that first audible gunshot in the sequence.

23 Q. When you consulted in other cases, I mean,
24 are those generally criminal cases?

25 A. Often, yes. Uh-huh.

1 Q. And what sorts of issues are you
2 addressing in those kinds of cases, the ones you've
3 testified in or given opinions in?

4 A. Well, the work that I've been doing for
5 the last 10 or 15 years has often focused on gunshot
6 sounds, and so that's a particular area that there
7 may be a question of who shot first if there's an
8 exchange or apparent exchange of gunfire. There
9 might be a question about the timing or how long the
10 time elapsed between one event or maybe one utterance
11 and some other portion of that signal. And
12 occasionally there's a question about if there are
13 multiple shots, what is the likely firearm type or
14 characteristic of -- of the gun.

15 Q. Okay. And when you're performing the
16 critical listening, I mean, you're paying attention
17 -- or are you also paying attention to what the
18 people recording are saying or doing?

19 A. Yes. Although that wasn't brought up as a
20 part of the audio forensic question, it was helpful
21 to me to do that to understand and be able to talk
22 about where or when or what order in which different
23 things happened.

24 Q. And then in [Exhibit 2](#) you actually typed
25 in some of the words that you discern from the audio

1 recording. Correct?

2 A. Yes. This is my subjective interpretation
3 of what was stated as a reference at the different
4 points in that recording.

5 Q. And what you have -- I mean, you -- you
6 can hear Weldon Boyd identify himself at the
7 beginning of the recording, but as far as identifying
8 Bradley Williams, did you assume that there were two
9 speakers on that or two people in that car; one was
10 Weldon Boyd and one was Bradley Williams?

11 A. Yes. And I'm -- there's no way I knew
12 that from the recording itself, so I believe you told
13 me the names or somehow referred to the -- the two
14 parties that were believed to be in the recording,
15 and that's the information I've used here.

16 Q. But as far as specific -- like this dude's
17 got a gun, I didn't tell you that's Weldon Boyd or,
18 hey, back up, Weldon. I didn't -- I mean, we didn't
19 have that kind of conversation.

20 A. I don't recall we ever talked that way.

21 Q. Does -- what you have indicated in Exhibit
22 2 in terms of what you have attributed each of the
23 defendants saying, does that fairly and accurately
24 depict what you heard them say in those recordings?

25 A. Yes. Again, that's my subjective

1 interpretation, so --

2 Q. And is there any indication in this
3 section of the audio recording that the cell phone
4 changes its location, meaning that it goes from --
5 from somebody's ear to the floorboard or that it
6 seems to have moved in any way?

7 A. I think probably what you're asking is
8 there some acoustical change that occurred during
9 this interval.

10 Q. Well, if --

11 A. Because I don't know exactly how this
12 recording was made. I don't know if it was a
13 microphone in the phone or if it was a separate
14 microphone of some kind or, you know, a headset. I
15 don't know precisely what type of device made this
16 recording. But to answer your question, no. I don't
17 see any change in the acoustical aspect here that
18 would indicate to me that there had been a change in
19 position of the microphone.

20 Q. Yeah. So in my earlier example I asked
21 you if there was a change in the position of the
22 orientation of the gun to the microphone you would
23 expect to see something like that, but if we move the
24 microphone, it would achieve the same thing.
25 Correct?

1 A. Yes. Yes. You would expect there would
2 be some indication in the recording that the
3 microphone position had changed.

4 Q. And if the phone were, say, a normal
5 talking position to being suddenly dropped on the
6 floor, in the seat, dropped anywhere, would you
7 expect there to be some indication either in the
8 waveform or the spectrogram?

9 A. Yes. I would expect that that would be
10 noticeable in the recording.

11 Q. And to a reasonable degree of engineering
12 certainty, is that indicated like a cell phone being
13 dropped, for instance -- that was a lot louder than
14 maybe it would have been. But is there any
15 indication of that?

16 A. No. I did not come to that conclusion
17 about any other recording.

18 Q. Okay. Ultimately, you have some opinions
19 about the 29 audible shots, do you not, in terms of
20 most probably which weapon fired or how many weapons
21 were firing those shots?

22 A. Yes. Again, based on the forensic
23 questions that you asked me, one was this whether
24 there were sounds of gunshots prior to the first
25 obvious audible gunshot, and my conclusion was I

1 couldn't detect any in that time interval in the
2 recording.

3 And the second question you asked me would
4 be whether there would be gunshots referred to in the
5 background that could be from outside the cabin of
6 the vehicle in which the mobile phone recording was
7 made.

8 So as I was addressing that, I was trying
9 to interpret whether the 29 clearly audible shots, if
10 there were any differences or any changes or any
11 significant effects that would lead me to the
12 conclusion that those came from outside the cabin of
13 the vehicle where the recording was made. And so to
14 answer your question, no. I did not find any
15 indication that any of those 29 shots were from a
16 location other than inside the vehicle.

17 Q. All right. Ultimately, you not only
18 record the amplitude of the shots. We -- we know
19 where they are in relation to the entire recording,
20 and each other. Fair?

21 A. Yes.

22 Q. All right. And did you form any opinions
23 as it related to which or how many weapons had fired
24 the various 29 shots?

25 A. The result that I had and that I give in

1 my report is that the first 17 shots -- first 17
2 shots -- audible shots in the recording are
3 sufficiently similar in amplitude, in my critical
4 listening, and in the spectrographic analysis and the
5 pacing that I would come to the conclusion that all
6 17 of those shots likely came from a single firearm.

7 Q. All right.

8 A. The only question was between shot seven
9 and eight in the -- the sequence. The time
10 difference between seven and eight is so short that
11 that is irregular. That didn't seem to be likely to
12 have been a single semiautomatic gun making those two
13 sounds so close together.

14 Q. All right. If we can, I would like for
15 you to sort of briefly walk us through the -- the --
16 your comparison of the amplitude of the 17 shots and
17 then talk about the waveform analysis of why you've
18 come to the conclusion that those first 17 shots are
19 most probably from the same weapon.

20 A. Would you like me to start with this
21 figure?

22 Q. Yeah. For the record, I'm going to mark
23 that as Plaintiff's [Exhibit Number 3](#), which is Figure
24 3 from your -- your report.

25 (Whereupon, [Exhibit 3](#) was

1 marked for identification.)

2 THE WITNESS: So this figure horizontally
3 is showing time, minutes and seconds, horizontally
4 here. The vertical scale on this is the amplitude or
5 the -- how loud the sound was, and I've indicated
6 with numbers the same sequence that was applied to
7 the earlier figures. So this 1 through 17 is the
8 same 1 through 17 that would have been on --

9 BY MR. TINSLEY:

10 Q. [Exhibit 1](#)?

11 A. -- the Figure 1. That's right.

12 The difference of what we're looking at
13 here than what the prior plots were is that this is
14 looking at -- at what is referred to as the amplitude
15 envelope, and RMS is an abbreviation for root mean
16 square, which means we take the original waveform, we
17 mathematically square it, so we multiple each sample
18 times itself, which gives us a squared and purely
19 positive result. We take the mean or the average
20 over a short interval, and then we take the square
21 root of the result.

22 So this is a mathematical computation.
23 It's not a -- something I invented. This is a
24 standard way to look at this type of a waveform to
25 get the -- the comparison. So we end up with --

1 instead of the pressure fluctuation which is very
2 rapid during this interval, we're looking kind of at
3 the overall envelope or the -- the sound level during
4 this interval.

5 So each of these spike-like features would
6 correspond to the bang sound or the muzzle blast of a
7 -- of the firearm. So we can see them pretty easily
8 here. They vary a little bit in amplitude. They're
9 not all exactly the same, but they're largely in very
10 much the same realm over this interval.

11 Horizontally we can measure the timing or
12 the time interval between each of the -- each of the
13 reports. And as I mentioned, the one that was --
14 that I can't really explain is between seven and
15 eight that I've identified here. These occurred
16 very, very close together in time.

17 And my experience with pulling a trigger
18 of a semiautomatic gun would be I don't think it's
19 possible to give two pulls and have a mechanical
20 mechanism produce those two so close together. So I
21 don't have an explanation for that. I -- I guess
22 it's possible one of the -- just conjecture.

23 Q. Sure.

24 A. One of the sounds could be a bullet
25 impacting, you know, the front of the car, or it

1 could be a -- some kind of misfire from that gun, or
2 it could be a second firearm took that shot right
3 about the same time as this one. I don't have a good
4 way of knowing which was which.

5 Q. With the variance in the amplitude -- we
6 can go and look at the windshield and there are
7 various bullet holes. They're not -- so the firearm
8 is not completely static. Can that explain part of
9 the variance that we're seeing there?

10 A. Yes. I have done research on -- for a
11 given box of ammunition how much variability there
12 might be from one cartridge to another, for instance.
13 And as you mentioned, it's -- the trajectory is
14 varying. So these are -- are not unexpected within
15 the circumstances that I understand for this
16 recording being made.

17 Q. And -- and to your point about seven and
18 eight -- shots seven and eight and not being able to
19 -- to say precisely or exactly, the way engineers
20 like to -- to be, but it's your opinion more probable
21 than not based on the analysis -- and we're going to
22 get to the waveform next -- that those first 17 most
23 probably came from the same weapon?

24 A. Yes. There's nothing about these with
25 this caveat about seven and eight that I can see

1 clearly that I could attribute one or more of these
2 sounds to a different firearm.

3 Q. All right. And -- and would it be helpful
4 to go to [Exhibit 4](#), which is Figure 4 from your
5 report now?

6 (Whereupon, [Exhibit 4](#) was
7 marked for identification.)

8 BY MR. TINSLEY:

9 Q. So this is -- this is Figure 4, what we're
10 marking as [Exhibit 4](#). Tell us what we're seeing
11 here.

12 A. So what I have done here is used the time
13 waveform. So this is the signal that was recorded
14 from the microphone and then run through the
15 perceptual coder, the MP3 coder, and then this is
16 being reconstructed from that.

17 This undulation that we're seeing here
18 corresponds to shot one that I identified, shot two,
19 shot three, and so forth. And there are 17 of these,
20 indicating those 17 individual shots. So I put them
21 here as what you might call a lineup so we could
22 visually compare what the waveforms look like for
23 each of those audible shots.

24 Q. So -- and just so it's clear, if we -- if
25 we could go back -- and I'm not saying -- I mean, but

1 if you go back and you look at [Exhibit 1](#), in the top
2 portion of that was the -- what you called the
3 pressure up and down and the -- the waveform. This
4 is a more focused version of -- of each one of those
5 17 points. Is that fair?

6 A. Yes. So this, if you will, is a zoom. So
7 we're -- instead of looking at 30 seconds, we're now
8 down looking at a few hundred milliseconds.

9 Q. Okay.

10 A. A few thousandths of a second. So we've
11 zoomed in on just what's happening around the time of
12 one of the shots. So all of these reports are in
13 that Figure 1. It's just that we've zoomed out so
14 all we see is a little blip. So this is looking at
15 more detail at each of those sounds.

16 Q. And there on the left-hand column towards
17 the bottom, that's where you see two and then one
18 carries over. Is that shots seven and eight?

19 A. So one, two, three, four, five, six --
20 yes. So this is what I identified as shot seven, and
21 that's the start of shot eight, which then I've
22 repeated the whole thing right here. So those are
23 the seven and eight.

24 What I take from this is listening to
25 them, I'm not with critical listening able to

1 distinguish anything about these shots that allows me
2 to -- to make a statement that I think that's a
3 different firearm. So these are similar enough, and
4 you can see visually when we compare them that --
5 that to our eye, to our ear, and the spectrogram as
6 well, there's nothing really different about these
7 that would allow me to say that's a different
8 firearm.

9 Q. And it's -- and it's possible that a
10 firearm can fire that fast, but you called it a
11 misfire or -- or malfunction of the firearm.

12 A. So my expertise is the acoustics, and so
13 somebody who knows about the particular firearm
14 believed to have made this sound might be able to
15 give you a mechanical --

16 Q. Sure.

17 A. -- reason for that. That's -- that's
18 outside my area of expertise.

19 Q. Okay. And -- and then -- I mean, at least
20 in my mind it makes sense to -- if we were going to
21 compare -- and I know I'm jumping ahead. Are you
22 able to look at the -- the waveform that's expressed
23 among those 17 -- and I think you just said it -- to
24 a reasonable degree of engineering certainty, it
25 appears these are all from the same firearm, same

1 general orientation, with the microphone or the cell
2 phone, whatever it is, being in a fairly static
3 position?

4 A. Yes. So to critical listening, to my
5 waveform observations, and then to the spectrographic
6 analysis, so using the techniques of audio forensics,
7 I don't have anything here that I'm able to
8 scientifically say would lead me to a conclusion that
9 -- that these were different guns.

10 Q. Okay. And -- and I'm going to -- I'm
11 going to just sort of spoiler alert. But -- but when
12 we look at the waveform for the next 12 shots, do you
13 have an opinion to a reasonable degree of engineering
14 certainty that the waveform that's expressed in these
15 next shots came from a different firearm?

16 A. So using the similar approach of critical
17 listening, the waveform analysis, and the
18 spectrographic analysis, after this 17 shots, there
19 are additional shots, 12 more, up to 29, and those
20 other shots have distinguishing features that would
21 lead me to the conclusion that those likely came from
22 a different firearm.

23 Q. Okay.

24 A. Do you want to look at those?

25 Q. Sure. I want to look at those. Tell me

1 the best way to do that.

2 A. Okay. So now I'm from the report showing
3 Figure 7, and Figure 7 is for shots 18, 19, 20, and
4 so forth, after the first one. And so, again, I'm
5 showing a lineup of comparing the different waveforms
6 zoomed in for each of those shots.

7 Listening to those shots, my critical
8 listening indicated that they appear to be at a more
9 rapid cadence. By that I mean the time interval
10 between the shots is faster than in the first shots,
11 and I've got a table also that shows the measure of
12 timing information there. So that was one thing I
13 noticed.

14 The other is these have a slightly
15 different sound quality to them. And looking at the
16 waveforms here, what I am noticing is that the onset
17 of these shot sounds, there is something -- I guess I
18 might call a W. There's a waveform indication that
19 has a particular distinctive shape that we can see in
20 these successive gunshot sounds.

21 Q. And just for the record you're pointing at
22 shot 18 and 19 when you were indicating there.

23 Correct?

24 A. Yes.

25 Q. Okay.

1 A. And the details of those waveforms and to
2 my ear sounds different and looks different in the
3 waveform than the earlier shots that had been
4 identified 1 through 17.

5 Q. Okay.

6 A. So that would indicate to me that I'm
7 discerning something that's different about this
8 portion of the shots, and I think in -- the question
9 would be what might account for these differences,
10 and there's a variety of things. It could be
11 different ammunition. It could be a different
12 firearm. It could be the orientation entirely
13 changed for a gun.

14 Based on the circumstances and the timing
15 here and the fact that these have this different
16 characteristic, my sense was that these 12 shots were
17 from a different gun than from the first 17.

18 Q. Okay. And -- and are somewhere between
19 the end of this first 17 and -- and somewhere during
20 this time period, shots 18 through 29, do you also
21 detect reloading sounds?

22 A. I think as I mentioned in the report, in
23 addition to the loud obvious gunshots, there's a
24 variety of other background sounds that I cannot
25 identify for certain what they are.

1 Q. Okay. Okay.

2 A. But they could conceivably be spent
3 cartridge ejection or debris falling from a broken
4 window. There's a variety of things that it could
5 be. But these were interpretation of the gunshot
6 sounds.

7 Q. Fair enough. Why don't we talk about that
8 now. You're welcome to have a seat.

9 A. Okay. Which -- the --

10 Q. So sort of the second question that I
11 asked you. So the first question was to a reasonable
12 degree of engineering certainty in the field of audio
13 forensics analysis, were there audible gunshots or
14 were there any gunshots prior to the first audible
15 gunshots, and you've told us what your opinion is on
16 that.

17 Then the second one was whether or not
18 there were any gunshots from outside the vehicle that
19 were captured by the microphone. Now I've changed it
20 from the way you represented it in your report, but
21 tell us whether you found things that could -- and
22 maybe if we make certain assumptions, like if there
23 was, in fact, another weapon being fired, are you
24 able to find artifacts or graphical representations
25 of those noises or sounds?

1 BY MR. TINSLEY:

2 Q. I'm sorry. I just wanted to clear that.
3 So I interrupted you. Tell us -- tell us what you
4 did with respect to trying to see whether or not the
5 microphone recorded any other gunshots?

6 A. So I think I mentioned earlier that the
7 process of critical listening usually involves
8 several passes. By that I mean listening to the
9 recording several times, one of the times
10 deliberately listening for the obvious -- what I
11 refer to as foreground sounds, which would include
12 the utterances of the participants and very clearly
13 audible gunshots, and then another listen which is
14 trying to pay attention to the background sounds or
15 the subtle maybe voices or other types of sounds that
16 would be not so prominent. And so it takes a little
17 bit of concentration to try to separate in my mind
18 what I'm hearing as the background and what's the
19 foreground.

20 And then looking at the waveform analysis,
21 similar type of thing would be -- would be done. So
22 when I originally listened to the recording and
23 identified the clearly audible gunshots, I was not
24 listening and did not come to the conclusion that
25 there were any other gunshot sounds in the recording.

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1 Then when I got your second audio forensic
2 question, I went back through to try to see could
3 there possibly be any subtle sounds in the recording
4 that I might have missed in the first pass that I
5 could say, well, these are -- are gunshots based on
6 the critical listening, the waveform analysis, and
7 the spectrographic analysis. Ultimately, I was not
8 able to be confident that there were any other
9 audible recordings.

10 However, to address your question -- and
11 I've indicated in -- in Figure 8 here, there were
12 several sounds between the very loud audible shots
13 that have a spectral characteristic, meaning
14 low-frequency energy and an impulsive nature that I
15 can't identify as being inside the vehicle where the
16 shots were fired. And so that was my response, which
17 is there's a possibility that as I've indicated here
18 with the yellow arrows there were additional sounds
19 that might be attributed to gunshots from outside the
20 vehicle.

21 Q. So if we assume that Scott Spivey fired
22 his weapon from inside of his vehicle somewhere
23 during this point in time of the entire exchange, do
24 you have an opinion -- because what I hear you saying
25 is, is that I can't identify these points as gunshots

1 in and of themselves, but there are things here that
2 I also can't explain that could be gunshots. Fair?

3 A. Yes. I think that's the correct way to
4 put it.

5 Q. Okay.

6 A. So I'm not in a position to be able to say
7 -- you know, I don't -- I was not at the scene, I
8 don't know the circumstances. So from your
9 explanation, the other vehicle that was at the scene
10 was 30 or 40 yards away, I think was the description.
11 There was a statement that -- that it's possible that
12 -- and maybe there's physical evidence that I would
13 not know from the acoustics that shots were fired
14 from inside that vehicle and so at that distance
15 inside the vehicle to inside this vehicle, these
16 types of reports would not surprise me as being the
17 sound of gunshots.

18 Q. All right. And -- and just so -- so the
19 judge or whoever is looking at this is --
20 understands, what you're saying is you don't know
21 about the things other than what is captured on this
22 audio, like for instance, that you can hear three
23 different speakers. You -- you hear these 29 clearly
24 discernible shots. You hear other noises that are
25 captured. But you don't know whether or not Scott

1 Spivey fired his weapon from this recording, but if
2 we assume he fired his weapon from his car, do you
3 have an opinion to a reasonable degree of certainty
4 that -- that these points that you've noted in Figure
5 8, which is [Exhibit 6](#), with the yellow arrows are
6 most probably those gunshots?

7 A. I don't know if I would say most probably.
8 They could be accounted for as this distant firearm
9 inside the cabin of another vehicle.

10 Q. Okay. So assuming -- assuming that
11 things --

12 A. So that would actually require information
13 I don't have.

14 Q. Okay. But assuming the information that
15 the -- that the weapon was fired that -- during that
16 period of time, those points would indicate -- could
17 indicate those gunshots. Is that --

18 A. Yes.

19 Q. All right. And the way that the gunshot
20 itself moves, if the gun were outside of the vehicle,
21 pointed at the -- the microphone, the cell phone,
22 would you expect the gunshot to be louder, of greater
23 amplitude than if it were inside the vehicle and
24 pointed in various different directions?

25 A. Yes. With all of the hypothetical

1 description you're describing to me, yes. I would
2 expect that if the firearm was discharged out in the
3 open versus inside a vehicle, that there would be a
4 difference in the amplitude.

5 Q. Okay. And then [Exhibit 7](#), which is your
6 Figure 9, the spoken words that you've attributed to
7 Boyd and Williams in -- in this Figure 9, which I'm
8 marking as [Exhibit 7](#), do they fairly and accurately
9 depict what is captured on the recording?

10 A. Yes. So these transcriptions again are my
11 subjective interpretation about what is being said at
12 those points. The identification of Boyd and
13 Williams again is based on you telling me who the
14 individuals are believed to be. There's no way I can
15 know that from the -- the recording itself.

16 Q. Sure.

17 A. But those are to the best of my listening
18 subjectively what the utterances were.

(Whereupon, [Exhibit 7](#) was
marked for identification.)

21 BY MR. TINSLEY:

22 Q. Okay. And so in summary, do you have an
23 opinion to a reasonable degree of engineering
24 certainty that there are no gunshots recorded by
25 either -- we really just talked about the -- the cell

1 phone audio, but by either the 911 recording or the
2 cell phone recording prior to what we call the first
3 audible shot, that number one shot?

4 A. That's correct.

5 Q. All right. And if we assume that Scott
6 Spivey fired his weapon at some point, do you have an
7 opinion that more likely than not those yellow arrows
8 indicated in [Exhibit 6](#), which is Figure 8, could be
9 explained by those gunshots?

10 A. Yes. That's the way I've described it.

11 Q. And that would be your opinion?

12 A. That's correct.

13 Q. And if Scott Spivey's weapon were closer
14 to the cell phone, pointed at the cell phone, it
15 would be louder than if it were inside of his truck
16 or pointed some other direction?

17 A. Yeah. So, again, from my experience with
18 firearms, that that would be the case. I don't know,
19 again, the specific firearms here or -- or the
20 circumstances. But yes. I would expect if there
21 were a firearm closer to the microphone out in the
22 open, it would be louder than if it were being fired
23 from inside a vehicle.

24 Q. Sure. But if -- if, say, Weldon Boyd -- I
25 mean, if Weldon Boyd's gun is pointed at the

1 microphone versus the opposite direction of the
2 microphone, would one be recorded louder than the
3 other in terms of amplitude in the spectrogram or the
4 waveform?

5 A. I would expect that, yes.

6 Q. Okay.

7 MR. TINSLEY: All right. I think those
8 are all the questions I have for you. Thank you.

9 Oh, I'm going to mark -- can we mark that
10 copy there that you have?

11 THE WITNESS: Sure.

12 MR. TINSLEY: That will be [Exhibit 8](#).

13 (Whereupon, [Exhibit 8](#) was
14 marked for identification.)

15 MR. MARTIN: I'm going to have to go back
16 through this and make sure these are marked right.

17 MR. MOSS: Sure.

18 THE WITNESS: And what I have there is I
19 simply took the report I e-mailed to you and printed
20 it out, so --

21 MR. TINSLEY: I did, too, but I wrote all
22 over mine. I'll give it back to you while Mr. Moss
23 asks his questions.

24 THE WITNESS: So I -- I -- the intent is
25 this is identical to what you would have had already.

1 There's nothing -- nothing new here.

2 THE VIDEOGRAPHER: Shall we go off the
3 record?

4 MR. MOSS: Yeah, let's do.

5 THE VIDEOGRAPHER: Okay. We'll go off the
6 record. The time is 2:04 p.m. Mountain time.

7 (Whereupon, a break was then
8 taken.)

9 THE VIDEOGRAPHER: We are back on the
10 record. The time is 2:10 p.m. Mountain time.

11 EXAMINATION

12 BY MR. MOSS:

13 Q. Dr. Maher, is that right?

14 A. Maher.

15 Q. Maher. I'm Kenneth Moss, and I represent
16 Charles Weldon Bailey -- Boyd in this case -- Charles
17 Weldon Boyd in this case. And I didn't get a chance
18 to take what we call a discovery deposition, so I'm
19 going to ask you a few questions, a little bit about
20 your background to try to understand more about the
21 foundation for the opinions you've expressed. But --
22 so I'm going to dive into some of that.

23 But before I do, I want to make sure I
24 understand. You -- you kind of referred to this in
25 some of your testimony. Your opinions are based

1 solely on the acoustics of -- contained in the files
2 that you examined. Is that right?

3 A. Yes.

4 Q. Okay. And you had a small amount of
5 information given to you by Attorney Tinsley in the
6 e-mails, but primarily it was acoustics. Right?

7 A. That's correct.

8 Q. And so you would agree with me, would you
9 not, that your opinions would have to yield to any
10 physical evidence or credible eyewitness testimony or
11 credible earwitness testimony that was actually at
12 the scene. Right?

13 MR. TINSLEY: Object to the form.

14 THE WITNESS: The -- yes. So the
15 information beyond what I'm able to discern from the
16 recordings informed by the basic circumstantial
17 description of Mr. Tinsley, would be other evidence
18 that I don't have available.

19 BY MR. MOSS:

20 Q. Okay. And there will be some examples of
21 that that I'll talk to you about in a minute with
22 respect to your opinions.

23 So I believe the three files that you
24 testified about and identified by name -- and we
25 actually had it up on the screen, your testimony in

1 response to Attorney Tinsley's questions, were those
2 three files that were forwarded to you by Attorney
3 Tinsley. Is that right?

4 A. That's correct.

5 Q. Okay. And did you examine any other
6 information relevant to the circumstances that bring
7 us here today besides those three files?

8 A. As I mentioned, I had some communication
9 with Mr. Tinsley via e-mail and telephone but no
10 other files or evidentiary information, no
11 photographs, nothing like that.

12 Q. In one of those e-mails, Attorney Tinsley,
13 I think, suggested to you what some eyewitness
14 testimony was, but you didn't actually hear that
15 eyewitness testimony in the recording, did you?

16 A. I was not asked to do any comparison like
17 that and I don't recall that.

18 Q. Okay. Do you recall that Attorney Tinsley
19 suggested to you what one eyewitness said?

20 A. I don't remember that, no.

21 Q. Okay. Would that have been part of your
22 analysis at all?

23 A. No.

24 Q. Okay. And if you had listened to an
25 eyewitness testimony or recording or read an

1 eyewitness report, you would have included that in
2 your report, would you not?

3 A. Yes. If I was asked to interpret some
4 other audio evidence, that have would been in my
5 report.

6 Q. Well, I don't mean to ask interpret it.
7 But if you relied on it in any way in connection with
8 your analysis, you would have said I relied on this.
9 Right?

10 A. That's correct.

11 Q. In your report?

12 A. Yes.

13 Q. So earlier you were asked questions about
14 offering opinions within a reasonable degree of
15 certainty, and in one place I think it was said
16 reasonable degree of engineering certainty. In one
17 place you wrote a reasonable degree of scientific
18 certainty. They are different terms. Okay?

19 But do you have an understanding that --
20 that they're different meanings?

21 MR. TINSLEY: Object to the form.

22 THE WITNESS: So not being an attorney, I
23 -- I'm not contemplating that I was trying to use
24 different terminology for different meanings. So in
25 my mind the statement about reasonable degree of

1 scientific certainty would be applicable to all of
2 the information in the report.

3 BY MR. MOSS:

4 Q. Well, and the reason I ask this question
5 is it took me a lot of years of doing this to figure
6 out, but everybody -- when they heard the words
7 "reasonable degree of certainty," whether it's
8 medical certainty or engineering certainty or
9 scientific certainty, that term doesn't mean the same
10 to everybody who hears it.

11 So I want to explore what your
12 understanding of what that means. What does it mean
13 to say something -- an opinion is within a reasonable
14 degree of scientific certainty, within your field?

15 A. Yes. So within my field, the normal way
16 that discourse about recordings would be done in a
17 scholarly manner would involve writing a paper and
18 then having it reviewed by peers, so not by people
19 off the street, but by people who also work in the
20 same field. And so those people would have what you
21 might think of as an informed opinion about the
22 content of the paper or the information. And so in
23 that case, I would say that this conclusion had been
24 peer reviewed.

25 Now, in the case of the report I prepared

1 in this case, like most reports like this, they're
2 confidential and there is no direct opportunity when
3 preparing the report to have that peer review being
4 done. So instead, what I'm saying is that using the
5 scientific principles that I've been trained to use
6 and have demonstrated I know how to use and that I
7 teach my students to use, I'm using those principles,
8 and that's where I come to the conclusion that this
9 is to a reasonable degree of scientific certainty in
10 the field of audio forensic analysis.

11 Q. I understood everything you said, and I
12 appreciate it, but it's not exactly responsive to my
13 question. What -- what -- what do you understand a
14 reasonable degree of scientific certainty to be in
15 the field of forensic analysis means? Let's say if
16 you put it on a probability scale.

17 MR. TINSLEY: Object to form.

18 THE WITNESS: So it means that the
19 techniques that were used in performing the analysis
20 and coming to the conclusions that are stated are
21 well defined, that they're established in the field.
22 Other people besides me use them. I'm not using
23 proprietary methods or anything. These are very well
24 known.

25 And so based on that conclusion, I will

1 have -- I would not say that it's necessarily beyond
2 a reasonable doubt if you're thinking of that level
3 of certainty. But certainly I would say that I
4 consider these to be at a higher standard than just
5 more likely than not.

6 BY MR. MOSS:

7 Q. That's precisely what I was getting at.
8 And I would suggest to you that that's exactly a
9 more-likely-than-not standard by someone who is
10 educated in the field. But you've not heard that
11 before?

12 A. That wouldn't be part of my training as an
13 engineer.

14 Q. Okay. Now, you -- you've obviously have
15 written a lot of articles, and I've read many of
16 them. You see I've got a stack here on the table.
17 And they're quite impressive, I'll acknowledge that,
18 but what I read in a lot of those analysis was far
19 more thorough than what I have seen in the report
20 here.

21 In those labs, if you will, of scenarios
22 where you were analyzing many of those things, you
23 had more sophisticated equipment. Is that fair?

24 A. You're probably referring to the -- the
25 scientific experiments that I've done on gunshot

1 characterization?

2 Q. Correct. Correct.

3 A. Yes.

4 Q. Where you had -- you had very
5 sophisticated microphones and sound pressure meters,
6 and you had them set up in a way to --

7 THE REPORTER: I'm sorry. Sophisticated
8 microphones and sound pressure --

9 MR. MOSS: Sound pressure gauges.

10 THE REPORTER: Gauges. I'm sorry.

11 BY MR. MOSS:

12 Q. -- so you could set them up in varying
13 asmet is from your muzzle of a gun that was being
14 shot, and you could determine a lot of engineering
15 information from that sophisticated recording
16 equipment. Is that right?

17 A. Yes.

18 Q. And you couldn't do that kind of analysis
19 in our fact pattern. Would that -- is that fair?

20 A. Correct.

21 Q. You didn't have the tools to do it with.
22 I mean, you didn't have the -- we're over 2,000 miles
23 away of an incident that happened on September of
24 2023 that you didn't witness or see, and you haven't
25 talked to any witnesses. So you're limited in what

1 you could look at. Right?

2 MR. TINSLEY: Object to the form.

3 BY MR. MOSS:

4 Q. Is that right?

5 A. Yes. As I explained, I received the
6 recordings and a little bit of background
7 information, but certainly it's not a scientific --
8 what you might call laboratory experiment, although
9 we do that outdoors like you read in the papers.

10 Q. So obviously acoustical engineering is a
11 pretty recognized field internationally. You've
12 written papers that are published in international
13 journals, and you have written some papers about
14 gunshots in international journals. Right?

15 A. Yes.

16 Q. But what I couldn't find, Doctor, was any
17 published standards for the world of analyzing
18 gunshots by an acoustical engineer. And are you
19 aware of any IEEE standards or any perhaps ASTM
20 standards or other professional society standards
21 that have been adopted for how to go about analyzing
22 gunshot sounds?

23 A. I'm not aware of any standards of that
24 character.

25 Q. Well, with any engineering problems, there

1 are standards that have been adopted by volunteer
2 organizations that professionals participate in, such
3 as IEEE or other engineering societies. Is that
4 fair?

5 A. Yes.

6 Q. And -- and -- and that's because those
7 fields have been further developed. Is that right?

8 A. Yes. Certainly that would be the reason,
9 yeah.

10 Q. And if I were to suggest to you that based
11 upon all that I read, you seem to have been the
12 pioneer in this field. Would you feel that would be
13 an appropriate suggestion? I saw three or four names
14 that kept appearing.

15 A. Yes. This is a -- an area that I
16 originally became involved in and interested in
17 because I was not able to find published work. The
18 explanation I received at the time was that much of
19 the work was -- had been done over the years by the
20 Department of Defense or defense contractors and was
21 not published for that reason.

22 So that is where I sought funding from the
23 National Institute of Justice, U.S. Department of
24 Justice, to start performing the scientific work
25 that's reported in these papers. And so they funded

1 that work. And so in that sense, making available
2 the scientific work we've done, I guess that would be
3 -- you could consider that pioneering, at least as
4 far as the open literature goes.

5 Q. That's the best word I could come up with.
6 But, again, there are no standards. What about for
7 the laboratory analysis or equipment? Do you have to
8 have -- well, let me rephrase that.

9 For some of your work in acoustical
10 engineering, you have to have accredited
11 laboratories, do you not?

12 A. In the forensic fields, yes. Generally
13 there would be some accreditation if it was a
14 chemical analysis, let's say, or something like that.

15 In the acoustical field there are
16 standards and calibration standards that are
17 available, and that would apply -- for instance, in
18 the test recordings that we made, there's a -- a
19 calibrator that's used on the microphones to record
20 and identify their sensitivity to sound.

21 Q. Okay.

22 A. That clearly in the case of a recording
23 like in this case being presented to me, I don't have
24 access to that knowledge or -- or calibration of the
25 recording device.

1 Q. And it's reasonable that you wouldn't know
2 how to -- I noticed the scales that you had in many
3 of these graphs that we'll talk about in just a
4 minute were a linear scale, whereas in your papers
5 you wrote you used that -- a unit of measure of
6 Pascal or algorithmically modified unit of measure
7 for decibels. Is that right?

8 A. Yes. There's a variety of ways to --

9 Q. You couldn't do that here because you
10 didn't have the information. Is that fair?

11 A. I don't have a way of -- of doing -- as I
12 used the term calibration, which would indicate what
13 the sound pressure was corresponding to one of the
14 amplitudes in the recording, because there's no way
15 for me to measure that.

16 Q. So your linear scale was just a -- a
17 visible comparison to the atmospheric pressure.
18 Right?

19 A. Yes.

20 Q. Okay. So --

21 THE REPORTER: Did you say linear?

22 MR. MOSS: Linear.

23 BY MR. MOSS:

24 Q. -- as a practical matter, would it be fair
25 to say you didn't have the information sufficient to

1 analyze this problem like you did many of the
2 problems in the labs for the papers you wrote? Is
3 that fair?

4 MR. TINSLEY: Object to the form.

5 THE WITNESS: Yes. So in a forensic case
6 like this with consumer recording devices and unknown
7 circumstances, I don't know that I've ever
8 encountered a situation that would have laboratory
9 quality audio recordings. That would be a very
10 unusual circumstance.

11 BY MR. MOSS:

12 Q. But you have had circumstances, in fact
13 you wrote a paper on one, where you had multiple
14 firearms on the city street where you were trying to
15 you analyze them from a residential surveillance
16 camera. Is that correct?

17 A. For example, yes.

18 Q. And in that -- in that case you -- you --
19 you knew more about the topography or the surrounding
20 circumstances of the audio because you knew there
21 were buildings in play?

22 A. Yes.

23 Q. And in -- in that scenario you knew about
24 reflections from the buildings. In fact, that's how
25 you went about identifying one of the gunshots is by

1 reflection from a nearby building. Is that right?

2 A. Yes. That was the conclusion. I believe
3 I remember the case you are referring to.

4 Q. And I think the actual name of the article
5 ended in "who shot first." Is that right?

6 A. Yes.

7 Q. So there you actually had more relevant
8 circumstances or information to the scenario than you
9 had in this particular project. Is that fair?

10 A. Yes. My recollection of the case you're
11 referring to there were several concurrent audio
12 recordings of the incident from different locations,
13 so home surveillance system with microphones on
14 different sides of the home that all captured the
15 recording from different locations.

16 Q. I don't think we're talking about the same
17 paper. The one that I'm referring to -- and let me
18 -- let me back up for a minute.

19 There are papers where you had tried to
20 talk about how to synchronize multiple microphones if
21 an incident was recorded on different types of
22 microphones and -- and worn by different people and
23 located different places. I saw the paper written on
24 that. And synchronization of microphones was one of
25 the issues you were trying to wrestle with. Is that

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1 right?

2 MR. TINSLEY: Object to form.

3 THE WITNESS: Yes.

4 BY MR. MOSS:

5 Q. But on the example that I'm talking about
6 on who shot first, my -- my belief is that you had
7 one microphone from the residential surveillance
8 camera, and I would be happy to find the article.

9 A. Yeah. I think that for the purposes of
10 the paper, I was describing the microphone located on
11 the front of the residence, which was essentially
12 facing the scene where these individuals exchanged
13 gunfire. And so in that case I knew precisely where
14 the microphone was located.

15 There were various evidence about where
16 the individuals were located, and I knew the location
17 of various buildings on the street and things like
18 that. So it was --

19 Q. And so that -- that --

20 A. -- a more sophisticated analysis.

21 Q. I'm sorry. I didn't mean to interrupt
22 you. Are you finished?

23 A. Yes.

24 Q. Okay. So those physical characteristics
25 of the incident scene are important to an analysis

1 for completeness. Is that fair?

2 MR. TINSLEY: Object to the form.

3 THE WITNESS: I would say yes. If there's
4 knowledge about additional aspects of the
5 circumstances of the recording, that can be helpful,
6 yes.

7 BY MR. MOSS:

8 Q. So would it be fair to say the more
9 information you have, the more informed your decision
10 can be? Is that right?

11 A. I would say that's generally true, yes.

12 Q. So I want to talk to you about some of the
13 aspects of this particular incident that brings us
14 here today to explore what other factors might have
15 been considered but weren't.

16 For example, what do you know about the
17 location of this shooting in general, where it
18 occurred?

19 A. I believe the address or the cross street
20 location was uttered in the 911 call. So the
21 individuals in the recording say they're on a
22 particular road.

23 Q. Camp Swamp Road, do you recall that?

24 A. Camp Swamp Road.

25 Q. And do you know anything about where that

1 is?

2 A. I know it's in South Carolina. I did do a
3 quick Google Map search to kind of position myself.
4 I'm not familiar with that -- with your -- with your
5 part of the country so much and saw that it was close
6 to the North Carolina border, I believe. So I did
7 that.

8 And then I heard from Mr. Tinsley that
9 there were these two vehicles, and at the time of the
10 gunfire, they were stated to be 30 or 40 yards apart.
11 So I guess I pictured in my mind that they were on a
12 street facing each other, more or less. So I think
13 that's kind of the extent to which I had a sense of
14 the scene.

15 Q. Okay. Anything about buildings or
16 topography or trees or anything like that that you
17 know about?

18 A. No.

19 Q. What do you know about specific weapons
20 that were used in the shooting of the incident that
21 brings us here today?

22 A. There was no information I could determine
23 from the audio recordings, but I believe Mr. Tinsley
24 indicated that the firearms in the cabin of the
25 vehicle were some sort of 9-millimeter semiautomatic

1 handgun. And I don't know anything or recall
2 anything about the other firearm that's been
3 mentioned, other than I think that also was a
4 handgun.

5 Q. And that matters for your forensic
6 analysis because the type of handgun -- or the type
7 of gun that was shot in determining some
8 circumstances, are the kinds of characteristics you
9 look for in sound bites. Right?

10 MR. TINSLEY: Object to form.

11 THE WITNESS: Yes. That could be a
12 factor, yes.

13 BY MR. MOSS:

14 Q. And what about the vehicles that were
15 involved? What do you know about the type of
16 vehicles that were involved in this particular
17 incident that brings us here today?

18 A. Nothing particular about the make or model
19 of the vehicles. So I was believing that these were
20 trucks just based on kind of the type of description,
21 but I did not use that in the analysis.

22 Q. Okay. But would it be fair to say
23 different vehicles with different trim packages or
24 different feature packages might have different --

25 THE REPORTER: I'm sorry. I'm really

1 having a hard time understanding what you're saying
2 with that noise.

3 MR. MOSS: I understand.

4 THE REPORTER: So if you could start
5 again, that question. But if you have different
6 vehicles --

7 MR. MOSS: It would be fair to say --
8 well, I've got to start over. Because I'm not going
9 to be able to phrase it exactly the same way.

10 THE REPORTER: That's fine. Sure.

11 BY MR. MOSS:

12 Q. Would it be fair to say that different
13 trim packages and different features on vehicles
14 might receive acoustical information or sound waves
15 differently? Is that fair?

16 A. Yes. The interior of the vehicle, which
17 appeared to me is where this recording was made, the
18 details of the vehicle would -- would have some
19 effect on the acoustics.

20 Q. Whether they were sealed with all windows
21 up or whether windows were down, that would have an
22 effect on acoustics. Is that right?

23 A. Yes.

24 Q. In fact, you wrote a paper where you
25 compared a handgun being fired from -- perpendicular

1 to a driver's window in both a configuration with the
2 window down and a configuration with the window up.

3 Is that right?

4 A. Yes.

5 Q. So it matters?

6 A. Yes.

7 Q. And so some vehicles are insulated against
8 sound -- exterior sound better than others. Is that
9 right?

10 A. Yes.

11 Q. Now you don't know who Mr. Spivey is or
12 was. You don't know anything about Mr. Spivey, do
13 you?

14 A. No.

15 Q. And the vehicle he was driving is unknown
16 to you. Is that fair?

17 A. That's correct.

18 Q. Okay. And my client is Mr. Boyd. You
19 don't know Mr. Boyd, do you?

20 A. No.

21 Q. Have you read anything about Mr. Boyd?

22 A. No. I believe I looked up the name to
23 verify spelling of Weldon, which I believe is your
24 client's first name.

25 Q. That's correct. Well, that's his middle

1 name, but he goes by Weldon.

2 THE REPORTER: I'm sorry. What was
3 your --

4 MR. MOSS: That's his middle name but he
5 does go by Weldon.

6 THE REPORTER: Okay. Thank you.

7 BY MR. MOSS:

8 Q. So do you know who was driving with
9 respect to the vehicles?

10 A. No. I assumed that Mr. Boyd was driving
11 the vehicle in which the recording was made.

12 Q. Okay. So the shooting scene itself in
13 terms of how the parties involved were positioned
14 with respect to each other, what do you know about
15 that?

16 A. Other than this spacing of the vehicles 30
17 to 40 yards and the interpretation of the utterances
18 where it appears that Mr. Boyd could see the other
19 vehicle and the other individual, there's various
20 comments about that posture. So I know that, but
21 I've not seen any photographs or diagrams of the
22 crime scene or anything like that.

23 Q. So that -- that spacing of 30 to 40 yards
24 you mentioned a couple of times today, that's
25 different than the 20 meters that you referred to in

1 your report at one time. Is that correct?

2 A. Can I refer to my report?

3 Q. Please. Please. In fact, I have seen two
4 numbers, and I --

5 A. Well, I'm seeing on the last paragraph on
6 page 12 of my report, I refer to it is plausible that
7 those reports could be attributed to a firearm being
8 discharged from inside the cabin of another vehicle
9 located, quote, 30 to 40 yards away, unquote.

10 Q. I do see that as well.

11 A. Yeah.

12 Q. I recall somewhere reading about 20
13 meters. It could have been in your e-mails if not in
14 your report. As you sit here today, you don't know,
15 do you, the physical characteristics --

16 A. No. If -- if -- if somewhere in -- in the
17 report here I referred to 20 meters, I think maybe
18 that was just a starting point for the discussion,
19 but the particular quote I remember from -- from Mr.
20 Tinsley was 30 to 40 yards away. And I seem to
21 recollect that in the dialogue between the 911
22 dispatcher and Mr. Boyd, there was also mention of
23 that -- that distance.

24 Q. So --

25 A. But I don't have that in the report.

1 Q. Now, the distances between these vehicles
2 could matter to an analysis such as yours, couldn't
3 it?

4 A. Yes.

5 MR. TINSLEY: Object to the form.

6 BY MR. MOSS:

7 Q. Okay. And so -- but I didn't read in your
8 report anywhere that you actually factored the
9 distance in any of your calculations.

10 A. That's correct. As you saw from the
11 report, the audio forensic question had to do with
12 audibility of additional gunshots beyond the clearly
13 audible 29 that were in the recording.

14 Q. Okay.

15 A. So I was not performing an experiment
16 there. I was addressing that particular question.

17 Q. And you weren't addressing it with
18 mathematical precision such that the distance would
19 have been that relevant, whether it was 20 meters or
20 30 to 40 yards or what it actually was, which is
21 neither of those?

22 MR. TINSLEY: Object to form.

23 THE WITNESS: So again, I was using
24 information that I had available. I have no idea if
25 there were additional gunshots. Because all I am

1 doing is based on what I can discern from the audio
2 recordings. Clearly, for other parts of your case
3 you'll have physical evidence and other -- other
4 things.

5 BY MR. MOSS:

6 Q. So please confirm to us what you know
7 about the recording device or devices from which this
8 audio channel was last recorded or upon which it was
9 recorded?

10 A. So I've not received information
11 specifically about the model number of the device or
12 the type of software that was used to make the
13 recording. So as I say in the report, I'm assuming
14 that the reliability of that device was sufficient to
15 record the utterances and the sounds that were
16 present when the recording was made.

17 Q. Okay. But you know it ended up being
18 recorded into an MP3 file?

19 A. That's what I received. Whether that was
20 the original file, again, I don't have any way of
21 knowing that for certain. But I'm working on the
22 assumption this is the best available recording or
23 example of the recording.

24 Q. Indeed you stated that in your report that
25 you're working under that assumption, and it was the

1 best available. Is that right?

2 A. Right.

3 Q. So are you familiar that some vehicles
4 have noise cancellation technology in their building?

5 MR. TINSLEY: Object to the form.

6 THE WITNESS: Do you mean an active noise
7 cancellation or --

8 BY MR. MOSS:

9 Q. Whether active or passive, some vehicles
10 have noise cancellation technology built into the
11 vehicles. Right?

12 A. Yes.

13 Q. And passive might be something like
14 insulation or particular shapes of windshields or
15 body panels. Is that fair?

16 A. Yes.

17 Q. And active might mean electronic
18 sophisticated reactionary-type technology that would
19 interpret signals and try to produce negating sound
20 waves to cancel them. Is that right?

21 A. Yes.

22 Q. Those things work rather quickly but
23 probably not quick enough for the initial impulse to
24 a gunshot. Is that right?

25 A. To my knowledge, that -- that would be

1 very difficult to do, to have an adaptive algorithm
2 that would act that quickly.

3 Q. For a singular gunshot?

4 A. Yes.

5 Q. But it would be fair to say, though, when
6 you have a succession of gunshots that were maybe a
7 couple of milliseconds apart like you suggested in
8 this table these were, you could have an interactive
9 interplay or some reactionary interplay with noise
10 cancellation equipment that was active. Is that
11 right?

12 A. Yes.

13 Q. And you don't know if that happened here
14 or not, do you?

15 A. I don't know. What I can say is that when
16 I encountered an automatic gain control or some other
17 type of adaptive algorithm, usually there's evidence
18 of that in the recording. It's possible to see that
19 -- the reaction time of that -- those electronics to
20 make those changes.

21 Q. Indeed, I read your paper where you
22 actually analyzed that automatic gain control feature
23 of an electronic digital portable recorder. In that
24 particular document you -- you talk about how the
25 waveform checks would change with automatic gain

1 control. Is that right?

2 A. Yes.

3 Q. Would it be fair to say that for one
4 impulse, for one gunshot, probably that technology
5 would not have time to react sufficiently or quickly
6 to make a difference. Right?

7 A. Yes.

8 Q. But when you have a barrage of shots,
9 whether it's 29 or whether it's 17 or whether it's
10 24, these electronic devices are doing something. Is
11 that fair?

12 A. If such a device is presented with a very,
13 very loud sound, often it will react to that sound,
14 and that reaction usually has what would be called a
15 release time, so some period of time after which it
16 will resume its original configuration.

17 Q. And you -- you could analyze that if you
18 knew what was in play, couldn't you, if you knew what
19 equipment was there, because you have analyzed
20 similar devices with a digital handheld recorder? Is
21 that right?

22 A. Yes.

23 THE REPORTER: With a digital what?

24 MR. MOSS: Digital handheld recorder.

25 THE REPORTER: Handheld.

1 THE WITNESS: Yes.

2 BY MR. MOSS:

3 Q. But here you just didn't know?

4 A. That's correct.

5 Q. Okay. So let's talk about the digital
6 audio perception compression MP3 algorithm. They're
7 not all the same, are they, in terms of bit rate?

8 A. The standard that MPEG, moving picture
9 experts group standard, specifies a variety of
10 perimeters that could be used during that data
11 compression step that's used to make the MP3 file.
12 So from one recording to another, there could be
13 differences in the bit rate.

14 Q. From one -- one device to another there
15 could be differences in the bit rate. Right?

16 A. Conceivably, yes.

17 Q. And the higher the bit rate, the better
18 the sound quality on the resultant product. Is that
19 right?

20 A. Generally, that's true, yes.

21 Q. And so not only do we have to consider
22 there could be a bit rate in the recording device,
23 the -- the application software that's being utilized
24 has to interpret that bit rate. Right? And you
25 could throttle, if you will, the bit rate?

1 A. The decoder in playing back the recording
2 is standardized, and that is essentially identical on
3 any different playback device, but the encoder --

4 Q. The encoder --

5 A. -- that's creating the file could differ
6 from one implementation to another.

7 Q. And even if you had a very sophisticated
8 microphone, if you're encoding equipment, you're
9 encoding algorithm or encoding software is limited in
10 bit rate, then you're stick with that limitation.
11 Right?

12 A. Yes.

13 Q. So we don't know any of that information
14 with respect to this project, do we?

15 A. I don't know, no.

16 Q. Okay.

17 A. Presumably the device that made the
18 recording can be discovered and -- and those
19 determinations can be made, but that was not
20 information that was provided to me.

21 Q. And you didn't ask for the information
22 either, did you?

23 A. No.

24 Q. Okay. And so I believe you referred to
25 the MP3 algorithm that was being utilized as a very

1 lossy and -- very lossy technology. Is that right?

2 A. Yes. Very is hard to -- yes. It's a
3 lossy algorithm deliberately.

4 Q. I know that's the word because I read the
5 word lossy.

6 So quite a lot of what otherwise might be
7 usable data is just discarded. Is that right?

8 A. Yes. It's a little more complicated than
9 just discarded, but yes. It's -- it's no longer
10 present in the -- in the file.

11 Q. And not retrievable?

12 A. Correct.

13 Q. Okay. So in fact, you wrote to Attorney
14 Tinsley, and you told him as much when you said
15 having it be perceptually compressed is not desirable
16 to any kind of forensic analysis. Do you recall
17 writing that?

18 A. Yes.

19 Q. And -- and as we sit here, you know that
20 to be a true statement. Right?

21 A. Yes.

22 Q. It's not desirable.

23 A. Yes.

24 Q. So earlier you talked about what MP3
25 loses, and some -- some publications will state that

1 you lose as much as 90 percent of your data. And you
2 didn't say that, but you said that you might have a
3 million samples per second and MP3 might record just
4 100,000 or so, and that's -- that's 90 percent of
5 your data that's being discarded, isn't it?

6 A. That's correct.

7 Q. So that is -- whether it's debated in
8 trade articles or not, it is fair to say that as much
9 as 90 percent of data can be discard in MP3 encoding.
10 Is that right?

11 A. Yes.

12 Q. Never to be recovered?

13 A. That's correct.

14 Q. Okay. And the MP3 technology relies --
15 relies on something called psychoacoustics
16 principles. Do you know what that is?

17 A. Yes.

18 Q. Can you explain that?

19 A. The way I mentioned it in my earlier
20 testimony is it has to do with what a human being can
21 perceive. And so the term psychoacoustics,
22 psycho means brain or a human. So a psychoacoustical
23 analysis is to determine what a human being can
24 perceive in a recording. And humans are very good at
25 certain tasks and not very good at other tasks. And

1 so the engineering of MP3 and similar technology is
2 to take advantage of the strengths and weaknesses of
3 a human being listening to the recording.

4 Q. And as a practical matter without that
5 type of technology, we couldn't accommodate the file
6 sizes that may be required to maintain all of this
7 available information in a sound wave that we really
8 can't interpret anyway. Is that fair?

9 A. That's exactly the -- the engineering
10 principle that's -- that is being used all the time
11 nowadays in these recordings.

12 Q. But this information that's being
13 discarded, it -- it -- it's -- it's -- it masks or it
14 discards information that the algorithm believes that
15 we can't interpret anyway. Right?

16 A. Right.

17 Q. But it also can discard sounds that are
18 masked by louder sounds, can't it?

19 A. That's correct.

20 Q. Okay. So for example, the gunshot being
21 in a remote vehicle could be discarded or masked
22 because you have a louder sound right here in the cab
23 of this truck. Right?

24 A. That's conceivable, yes.

25 Q. Okay. So let me ask you. When you --

1 when you undertook your -- your three analysis, one
2 being critical listening, did you alter
3 electronically in any way the file? Did you listen
4 to it by slowing it temporally or maybe lowering the
5 decibel volume of it? Did you do anything to alter
6 it as you critically listened to it?

7 A. I often will change the volume level, so I
8 changed the amplitude, how loud the sound is. So if
9 there's a segment of the recording that is relatively
10 quiet, I might play it back just that segment and
11 make it a little louder to try to see if I'm hearing
12 what I thought I heard at another level. So I will
13 do that sort of adjustment to the -- the sound during
14 the critical listening.

15 Q. And there's nothing -- from an engineering
16 standpoint there's nothing inappropriate about doing
17 that, is there? You're simply trying to scale the
18 file you're listening to so that the receiving ear
19 can interpret it better. Is that right?

20 A. That's correct.

21 Q. Okay. And so, for example, the file that
22 you chose not to utilize that had been altered with
23 respect to slowing it down or temporally altered it,
24 you didn't choose not to use it because that was an
25 inappropriate thing to do to listen to it critically.

1 You discarded it because you didn't know exactly what
2 alteration was applied. Is that right?

3 A. Primarily that was it, and then also I try
4 to be real careful that if there is a -- if I'm
5 getting the sense that I'm being asked to hear a
6 particular thing, that supposition or the suggestion
7 of "listen for this," it's very hard to ignore those
8 types of things. And so what I didn't want to have
9 happen was a bias where I would be anticipating what
10 I'm hearing, and then that would potentially affect
11 that critical listening step.

12 It obviously wouldn't change the waveform
13 and the -- the spectrogram, but the perceptual aspect
14 could potentially be affected. So that's the reason
15 I would -- did not listen in this case. Generally
16 don't want to do that kind of a thing, unless again
17 it's part of a forensic analysis that would be asked
18 for.

19 Q. You could appreciate it if we attorneys,
20 when we hire experts, we want them to offer opinions
21 helpful to our case. And in many circumstances the
22 more information we provide the expert, the better
23 informed they can give us an opinion.

24 And so what you're suggesting is kind of
25 the opposite, that you want less. Less is more in

1 your scenario. Right?

2 A. And I described this in my book. The --
3 one of the concerns in forensic science is that
4 unintended bias. And when I'm doing an audio
5 forensic analysis, I'm not part of the investigating
6 team, trying to explain all the details of the crime
7 scene and what happened and what the motivations are
8 and so on. I'm only interpreting the audio portion
9 of this. So I'm not an advocate for you or for
10 Mr. Tinsley about the circumstances.

11 What I'm trying to do is explain what can
12 be discerned from the audio recording and what
13 cannot, and then I would expect -- and I know you are
14 diligent advocates, so you are collecting other
15 evidence from witnesses and -- and gunshots and
16 things like that. But my role is not to interview
17 witnesses and do those things. That is not what I
18 was hired to do.

19 Q. So the scope then of your opinions were
20 two in your written report. There were a few more
21 offered today. But in your report you underlined two
22 opinions that you offered, and you actually offered
23 them within a reasonable degree of scientific
24 certainty in the field of forensic audio acoustics,
25 as I recall, which is a little bit different than in

1 your report in the underlined section in the
2 conclusions and -- and the questions that were framed
3 at the beginning when you suggested what Attorney
4 Tinsley asked you.

5 But those are really the only two opinions
6 you're offering in your report -- is that right --
7 within a reasonable degree of scientific certainty,
8 whatever that means?

9 A. Yes. There's -- I would tell you there's
10 nothing else in the report that would not meet that
11 same sense that I have. There's nothing in there,
12 but you do see several other places in the report
13 where I indicate information that I just don't know
14 what I can make of that. I, you know, use that
15 example of shot seven and eight. I can't explain why
16 that sound is there. I can explain that the sound is
17 there.

18 Q. But you -- you're not offering source
19 localization. You don't know where the sources were
20 vis-a-vis the microphone. Is that right?

21 A. That's right.

22 Q. You don't know what the asmet is between
23 various firearms and the microphone?

24 A. That's correct.

25 Q. And you don't know to a certainty whether

1 or not the microphone moved or not during the upset,
2 do you?

3 MR. TINSLEY: Object to form.

4 THE WITNESS: Yeah. I don't have
5 certainty about that.

6 BY MR. MOSS:

7 Q. So earlier you testified that you had no
8 basis to believe it did move. I want to make sure I
9 word that correctly because I don't want to put words
10 in your mouth.

11 But do you remember being asked by
12 Attorney Tinsley if you forensically could determine
13 if there was any movement of the microphone?

14 A. Yes.

15 Q. The answer was you don't know?

16 MR. TINSLEY: Object to the form.

17 THE WITNESS: I -- I believe the question
18 and the way I interpreted the question was whether I
19 had evidence that the microphone moved during a
20 particular portion of the recording. And the answer
21 to that question, what I would be looking for in the
22 recording was some change in the acoustical
23 properties. The sound of the voices was quieter or
24 more muffled, for instance, or there was a clattering
25 sound that could be a microphone being dropped or

1 something like that. So all I could say was I did
2 not notice or come to any consensus that there would
3 have been any movement of the microphone during that
4 part of the recording.

5 Q. But that doesn't mean there wasn't
6 movement of the microphone. Is that fair?

7 A. That's correct. I'm saying what I could
8 determine from the audio.

9 Q. And the muzzle of the microphone distance,
10 if there was a change in that, you wouldn't know to a
11 certainty, would you?

12 A. No.

13 MR. TINSLEY: Object to form.

14 BY MR. MOSS:

15 Q. Okay. Or who fired first in this case,
16 you really didn't know it from the audio that you
17 have analyzed, would you?

18 MR. TINSLEY: Object to the form.

19 THE WITNESS: That's correct.

20 BY MR. MOSS:

21 Q. Okay. And you're not offering any opinion
22 here that any particular transient waveform was
23 definitively a shot fired outside the vehicle. Is
24 that correct?

25 A. Yes. As I explained in my report, I -- I

1 am not able to give that level of certainty about
2 anything but the -- the 29 clearly discernible
3 gunshot sounds.

4 Q. Okay. And you would defer, then, to
5 investigating law enforcement officials about
6 physical characteristics like trajectory, gunshot
7 residue, for example, physical scene evidence, any
8 kind of reconstructive process, you would have to
9 defer to those investigations. Right?

10 MR. TINSLEY: Object to form.

11 THE WITNESS: Well, it's not relevant to
12 the analysis I did.

13 BY MR. MOSS:

14 Q. Fair enough. Fair enough.

15 So any testing by you of any similar
16 recording devices to what was -- what was utilized by
17 my client to record the audio that you listened to?

18 A. No.

19 Q. Okay. As a practical matter, do you even
20 know what type of device my client was utilizing?

21 A. I do not.

22 Q. Do you know what type of software he was
23 utilizing to -- to encode or record that MP3 file?

24 A. Yeah. I don't know that.

25 Q. And, again, you said you don't know for

1 sure it was an MP3 file, but I want to represent to
2 you it was being recorded and encoded into an MP3
3 file.

4 But you wouldn't know that if I didn't
5 tell you that with certainty. Is that right?

6 A. That's right. So I was not asked to
7 determine authenticity of these files. My assumption
8 going in was that both parties have agreed this is
9 the -- the evidence.

10 Q. Okay. Now, it would be fair to say that a
11 microphone diaphragm might be pushed beyond its
12 limits when it receives an impulsive wave like a
13 gunshot. Right?

14 A. Yes.

15 Q. But you expect, don't you, for most of
16 these devices that are designed for human -- human
17 utilization that that microphone would be -- it would
18 exceed its -- the limits of its capabilities?

19 A. Often that is the case, yes.

20 Q. Okay. And that's an example of why you
21 use those very sophisticated microphones in your lab
22 in preparation of writing a paper. Is that right?

23 A. That's right.

24 Q. And even those are exceeding --

25 THE REPORTER: Even those are --

1 BY MR. MOSS:

2 Q. Even those sophisticated microphones are
3 pushed to their limits or beyond in your -- when
4 you're labbing a particular scenario for a paper you
5 want to write?

6 A. Yes. There has to be care done to avoid
7 those circumstances.

8 Q. And in addition to the software -- I mean,
9 in addition to the microphone exceeding its limits,
10 mechanical limits, if you will, software can be --
11 the limits of software encoding algorithms can be
12 exceeding as well. Right?

13 A. Yes.

14 Q. So we call that clipping, don't we?

15 A. Amplitude exceedance like in a microphone
16 when there's a loud sound, yes. The term is often
17 used clipping, meaning that the signal can't be
18 represented above that clip level that would indicate
19 that we've reached the maximum.

20 Q. So if you're at a clip level, a sound -- a
21 sound pressure that's higher, in other words, a sound
22 that's louder than the clip level, isn't measured, is
23 it?

24 A. Generally, no. So we -- we will not know
25 how much higher it went because all we did is that it

1 exceeded the clip level.

2 Q. And when you -- when you prepare a root
3 mean square drawing like you have graphically
4 prepared in one of your figures, you're not actually
5 depicting what the actual sound pressure was. You're
6 -- you're basically getting a working average, if you
7 will. Is that fair to say?

8 A. Yes. So the -- the waveform picture and
9 the spectrogram, the spectrogram is the orange
10 colored portion of these figures that's showing the
11 frequency distribution. When we look at the RMS or
12 the average envelope, we're not looking any longer at
13 that frequency distribution. It's being averaged
14 together to get the envelope.

15 Q. And indeed in Plaintiff's 3, this is all
16 average calculations. Right?

17 A. That's right.

18 Q. You talked about a root mean square
19 analysis?

20 A. Right.

21 Q. And so when you're averaging for a diagram
22 like this, you're not -- you're -- you're deviating
23 or getting away from actual measurements of actual
24 sound pressure. Is that fair?

25 A. Yes. So the actual measurements of sound

1 pressure are another figure. So it's included in the
2 report, but for explanation purposes, the RMS is a
3 convenient and customary way to look at that.

4 Q. But if you're comparing amplitudes in the
5 RMS diagram and you're suggesting that maybe one gun
6 fired an impulsive sound wave or a shot that created
7 an impulsive sound wave in this amplitude and another
8 gun fired it for another impulsive sound wave that's
9 depicted as an amplitude, you're really getting away
10 from the raw data, aren't you, because you're using
11 an average?

12 A. Yes. But, again, the technique involves
13 several steps, not just that one. So I'm not making
14 a statement based solely on the average. I've got a
15 critical listening step. I'm looking at the time
16 waveforms, which I guess you could say the average
17 was certainly related to that, and then I look at the
18 spectrogram so that the assessment is done based on
19 all of those aspects of observation, not just -- not
20 just the average or not just the spectrogram.

21 Q. You're familiar with what a dialogue
22 isolator is. Is that correct?

23 A. Dialogue isolator?

24 Q. Dialogue isolator.

25 A. Maybe you better inform me what that is.

1 Q. Well, a device designed to interpret human
2 speech and mask out other noises.

3 A. Okay. Yes.

4 Q. Are you familiar with that?

5 A. Yes.

6 Q. You don't know if one was utilized in the
7 device or equipment that my client was utilizing, the
8 phone in which these audios were recorded, do you?

9 A. I don't know that.

10 Q. And I should say upon which one of these
11 audios you analyzed was recorded, because the other
12 was recorded by the 911 call center. Is that your
13 understanding?

14 A. That's right.

15 Q. Okay. So the dialogue isolator, by
16 whatever terminology that you would call a device
17 like I've described, could alter the information
18 that's being encoded. Is that right?

19 A. Yes. And I did mention that a cell phone
20 telephone call where the phone is in telephony mode
21 will often have a speech coding algorithm built in
22 which would have that property of trying to encode
23 only dialogue and not the background sounds. So that
24 -- I'm not familiar with a true dialogue isolator,
25 but I think the function would be the same.

1 Q. So it's -- basically electronics could be
2 by design masking out sounds that are not human
3 speech?

4 A. Yes. That could be a goal, yeah.

5 Q. Okay. And it could have been in play or
6 an integral part of my client's equipment, couldn't
7 it?

8 A. Yes. I don't know. But such things
9 exist, yes.

10 Q. So -- and phones have become pretty
11 sophisticated, haven't they, with these type of
12 features, telephones -- or cell phones?

13 A. Yes.

14 Q. Now, you don't have any personal knowledge
15 of where the actual recording device -- and I'm going
16 to submit to you it was a phone as opposed to a
17 digital recorder or a telephone, a cell phone. You
18 don't have any idea where it was in the cab of this
19 truck, do you?

20 A. No.

21 Q. Okay. And you don't know who was holding
22 it or where it -- where it was -- or whether or not
23 it was moved. We talked about that.

24 A. Yes. I didn't have any observation from
25 the audio recordings that -- and when you say phone,

1 I would be thinking more in terms of where the
2 microphone is located. So a microphone could be
3 integral to the phone.

4 As you mentioned about modern telephones,
5 they often have more than one microphone involved. I
6 don't know the configuration of this particular
7 device. It is conceivable that there was an earpiece
8 with an integral microphone in it. It could have
9 been on a microphone located on the dashboard of the
10 vehicle. So I don't know.

11 Q. It could have been a looped-in connection
12 to an in-car microphone. Is that fair?

13 A. Yes. I don't know that.

14 Q. So -- and all these are variables that
15 could affect your analysis, are they not?

16 MR. TINSLEY: Object to the form.

17 THE WITNESS: I don't think they would
18 affect my analysis, but they certainly would affect
19 the recording.

20 BY MR. MOSS:

21 Q. Because they -- latency can occur when you
22 have a remote microphone. Is that fair?

23 A. And when you say latency, are you
24 referring to the speed of sound latency or the
25 latency of the -- the wireless connection or --

1 Q. Well, both. I'm talking about the time it
2 takes between an actual impulse being received by a
3 microphone and it being encoded by a software that's
4 going to encode it into an MP3 file. There's latency
5 there. Right?

6 A. Yes, there is. Yes.

7 Q. And that latency is dependent upon many
8 things, including whether or not you have a
9 microphone that's integrated into a device or whether
10 you have a remote microphone that's wireless or a
11 remote microphone that's wired. Right?

12 A. Yes. Although I would expect during a
13 continuous recording that latency wouldn't be
14 varying. It would be whatever it is for the
15 particular communication channel that had been
16 established.

17 Q. When you're -- when you're diving down
18 into microseconds like you refer to in your graphs,
19 latency could be a -- it could be a factor, couldn't
20 it?

21 A. If -- if it was changing, yes. It could
22 be a factor. I'm not aware of an explanation of why
23 the latency would change.

24 Q. Well, it could change if the microphone
25 was moved, wouldn't it --

1 A. Yes. So I, again, would be expecting
2 there would be some artifact in the audio that would
3 indicate some change of that sort.

4 Q. So from your analysis, all you know is you
5 didn't detect it?

6 A. That's right.

7 Q. Okay. And so there are some
8 characteristics I read about in your numerous
9 articles that I didn't see referenced in the report
10 that you drafted for this case. I want to talk to
11 you about them.

12 Can you tell us what reverberation is?

13 A. So reverberation in the context of audio
14 engineering refers to the sound that is emanated from
15 some source and now is being reflected off different
16 surfaces in the vicinity of the recording. And so
17 the microphone or your ear is picking up not only the
18 direct sound from the source but also those
19 reflections off the various surfaces in the vicinity.

20 Q. And reverberation and echo is similar but
21 not exactly the same thing, are they?

22 A. That's correct. So when we say echo,
23 usually we mean a very distinct reflection, and so --

24 Q. Like a one-off reflection?

25 A. Yes. And so reverberation often is

1 referring to multiple order echoes, meaning that the
2 sound reflected off one surface and then off the
3 floor and off the ceiling and the wall before
4 arriving at the microphone or your ear. So there --
5 reverberation tends to be an overall wash of sound,
6 not distinct echoes.

7 Q. And if you're in an enclosed environment,
8 for example the cabin of a vehicle with windows
9 closed up, reverberation is very much a factor of the
10 sound analysis overall, is it not?

11 MR. TINSLEY: Object to the form.

12 THE WITNESS: It -- it -- it can be. So
13 the interior of the vehicle does have an acoustical
14 reverberation. It's generally very short because the
15 reverberation time of how long the sound lingers is
16 dependent on the absorption and then inversely
17 proportional to the volume or cubic meters of -- of
18 the cabin. So it is present, but inside a typical
19 vehicle it's -- it's not an extremely lengthy effect.

20 Q. Sometimes people ask you to deploy devices
21 to make it a lengthy effect, don't they, because they
22 want -- they want that effect? Musicians do that
23 sometimes, for example, don't they?

24 A. Yes. There are ways to simulate or make
25 an artificial reverberation. That's true.

1 Q. Right. And I'm not suggesting any of
2 that's in play here, but the fact is there would have
3 been reverberation inside this vehicle cabin if the
4 gunshot was fired, and we had this impulsive sound
5 wave that would have reflected off many of the
6 surfaces in the vehicle's cabin. Right?

7 A. That's correct.

8 Q. And you said it's not very long. What
9 does that mean exactly? Because we're looking --
10 we're looking into the microseconds with some of your
11 analysis, so certainly it would last more than
12 microseconds, wouldn't it?

13 A. Yes. It would depend on the geometry and
14 the absorbing materials inside the cabin of the
15 vehicle, and we could compute an estimate of that. I
16 didn't in this case.

17 Q. But when we're looking at an overall sound
18 pressure on an RMS scale like you referred to in your
19 -- some of your figures, we have to assume, don't we,
20 that not only the impulsive sound wave of the firearm
21 being fired but also reverberations included in the
22 impulsive sound wave as you graphically depicted in
23 an RMS. Right?

24 MR. TINSLEY: Object to the form.

25 THE WITNESS: Yes.

1 BY MR. MOSS:

2 Q. And it would also be included in the
3 spectrogram, wouldn't it?

4 A. Yes.

5 Q. And so it's -- it's -- it -- you really
6 can't distinguish a shockwave and a muzzle blast and
7 whether or not there was any ballistic sound from the
8 reverberation in the spectrogram, can you?

9 A. No. Not especially when we've got
10 reflecting surfaces very close to the presumed sound
11 source. So if the firearm is inside the cabin of the
12 vehicle, those reflections or reverberation happens
13 very quickly, which would be different if this were,
14 you know, a big concert hall or something where it
15 takes time for sound to travel all the way to a wall
16 and reflect back.

17 Q. So when we're looking at these amplitudes
18 that are -- appear to be clipping the device that's
19 encoding them, it's not only including the impulsive
20 sound wave from the shot, it's including these other
21 sound characteristics. Is that fair?

22 A. Yes.

23 Q. And -- and this MP3 technology by design
24 is discarding a lot of that. Is that fair?

25 A. Well, it's attempting to discard the

1 portions that would not be perceptually relevant,
2 meaning that a human being wouldn't know whether
3 those were included or not.

4 Q. And we have no way of knowing what was
5 discarded and what was not discarded by the
6 employment of this MP3 technology in this analysis,
7 do we?

8 A. No, we don't.

9 Q. Okay. Now, I want to take a look at your
10 figures for a moment. On Figure 1, which was this
11 drawing, if you would, the first drawing -- I think
12 it's -- you can find it in your report.

13 Do you -- do you have it, Figure 1?

14 A. Yes.

15 Q. On the right-hand side you've got a scale,
16 but I can't read it on my copy. Is that -- is that
17 in decibels or is that in some other kind of unit?

18 A. So there are two different things here.
19 There's the waveform --

20 Q. I'm referring to the -- I'm sorry. I
21 interrupted -- the waveform. I don't want to --

22 A. Yeah. White on black.

23 Q. Yeah.

24 A. So the depiction on the graph is a linear
25 depiction and it has a scale -- this particular

1 software is representing it as decibels. So we have
2 a -- you can see that the indicator marks, the -- the
3 tick marks, horizontal marks in there are not
4 uniformly spaced. So they have chosen to show them
5 as a logarithmic representation, but the waveform
6 itself is -- is linearly represented here.

7 Q. And the scale itself is not -- it's for
8 reference, but it's -- it's -- it's not necessarily
9 an indication by you or an opinion by you that these
10 are the exact decibel readings that we would have
11 received had we been present on-site with a decibel
12 meter. Is that right?

13 A. Well, we have to be careful because the
14 use of decibel in this case is not sound pressure
15 level, which would be the customary use of dB. This
16 dB is with respect to a full scale digital
17 representation, so the numbers that we're seeing in
18 here are how many dB down from the -- the peak level
19 is. So we can't interpret these decibel references
20 in terms of sound pressure levels.

21 Q. So here the scale was just for relative
22 indexing or relative comparison?

23 A. That's right.

24 Q. Whereas in many of the labs that you've
25 conducted and written papers about, you actually had

1 actual decibel readings. Is that right?

2 A. Yes. So in that case, as I -- I
3 mentioned, the scientific approach, we would
4 calibrate the microphone so we know for a given
5 indication that we would plot what sound pressure
6 fluctuation in Pascal was present. And then, again,
7 it's customary in acoustics to represent -- rather
8 than Pascal is to represent that as dB sound pressure
9 level.

10 Q. It's interesting that you use that
11 phaseology in that scenario in the scientific
12 approach, but what you've done here is not exactly a
13 scientific approach. Right?

14 MR. TINSLEY: Object to the form.

15 THE WITNESS: Well, it's a scientific
16 approach, but I don't have access to the calibration.

17 BY MR. MOSS:

18 Q. Okay. So I want to talk to you about the
19 documents you've gotten. When you got the files, you
20 said you did a bit-for-bit comparison. Explain that.

21 A. Oh, when -- the files I received, I think
22 I received in e-mail. Mr. Tinsley e-mailed them as
23 attachments. So generally, those attachments are
24 very reliably transported, but I wanted to make sure
25 that there was no indication that there had been any

1 -- any bit errors attributable to the e-mail process.

2 Q. And that's a pretty standard process in
3 your field for trying to verify the integrity of
4 data, isn't it?

5 A. Yes.

6 Q. But there are other -- other ways to do
7 that; for example, like electronic network frequency
8 checking. You didn't do any of that, did you?

9 A. So electrical network frequency or ENF
10 testing is sometimes used in audio forensics, but it
11 wasn't a relevant thing here. The principle there is
12 that if you have electrical power lines around, like
13 we do in the building here, the current going through
14 those wires creates an alternating magnetic field and
15 that can in some circumstances get picked up in an
16 audio recording.

17 And because the grid -- and I know you're
18 a power engineer, so the grid frequency, the rate at
19 which all the rotating generators are operating,
20 fluctuates up and down a little bit as the load
21 changes. And so at any given time in the day, it may
22 not be exactly 60.0 cycles per second. It may be a
23 little higher or a little lower.

24 So it is possible from a recording to try
25 to extract that hum or that result and then compare

1 it if it's known what the actual network frequency
2 was at that time and try to do authenticity to make
3 sure the recording was made at the time that was
4 indicated. So in this case that wasn't something I
5 was asked to consider.

6 Q. Okay. And that -- you would employ
7 something akin to noise cancellation to create a
8 negative signal to offset it if it were present. Is
9 that fair, if you had ENF?

10 A. The use of ENF, if I were doing it, would
11 be to extract that varying line, power line
12 frequency, and then I would have to try to find
13 somebody who had maintained a database of those
14 readings and then compare it and -- and make sure
15 that if this recording took place at a certain time
16 in a certain place in a grid, that I could then
17 verify that it matched the known deviations of the
18 power line frequency. In this case, since there was
19 a 911 recording and -- and it didn't sound like there
20 was a dispute about the authenticity here, I'm
21 assuming that's why Mr. Tinsley didn't ask me to do
22 that.

23 Q. Well, I'm going to jump ahead a little bit
24 and talk to you about some other things. There's no
25 differentiation in your analysis between the initial

1 impulse and these other acoustical effects we talked
2 about. Is that fair?

3 MR. TINSLEY: Object to form.

4 BY MR. MOSS:

5 Q. Like reverberation, like echo, like --
6 there were other effects of acoustical sound waves
7 phenomena that -- that are all just kind of rolled
8 up and not dissected or analyzed in your -- in your
9 analysis here. Is that right?

10 MR. TINSLEY: Object to the form.

11 THE WITNESS: Yeah. I think the answer to
12 that is yes. I was looking primarily at the onset of
13 these sounds, because that's what I would expect from
14 a gunshot report.

15 BY MR. MOSS:

16 Q. Earlier you talked about a low-frequency
17 sound, and you talked about plausibility. Okay? You
18 said plausibly these could be shots from a remote gun
19 outside of the cabin at some distance away. And --
20 and I want to make sure I understand what that term
21 "plausible" means when you use it in your report.

22 A. So what was posed to me was, could there
23 be any indications in this recording that shots
24 occurred outside the cab, and you can see the way
25 that that forensic question was posed. So by

1 plausible, I meant that I cannot take this recording
2 and say the way I can with the other gunshots, that
3 I'm certain those are gunshots. I can't say that I'm
4 certain that these are there.

5 But in a hypothetical situation that
6 Mr. Tinsley posed that these -- that there were
7 additional shots, those reports or those indications
8 that I can hear from critical listening and see in
9 the waveform and pick out in the spectrogram could be
10 attributable. So that's what I meant by plausible.

11 Q. I mean, I wanted to make sure I was right
12 on that sort of the definition of the word plausible
13 was, and I would submit to you that it seemed that it
14 is, from one dictionary anyway, seeming likely to be
15 true or able to be believed.

16 A. Yes.

17 Q. Is that your understanding of the
18 definition of plausible?

19 A. I think I'm using it in the latter
20 definition.

21 Q. Able to be believed?

22 A. Yes.

23 Q. Okay. So I just want to make sure when I
24 hear it I understand what you're saying.

25 Okay. The -- the -- the telltale signs of
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1 a gunshot or a weapon that you wrote about in some of
2 your papers, we don't have an analysis here in this
3 project to tell us any of those things, do we?

4 MR. TINSLEY: Object to the form.

5 BY MR. MOSS:

6 Q. In other words, to try to identify one gun
7 versus another gun?

8 A. Your use of the term "telltale," I think
9 what I would -- if I were using that term, I would
10 ordinarily be thinking about subtle details that
11 might indicate difference from one firearm to
12 another.

13 Q. Exactly. And you did use that term in a
14 paper you wrote. Is that right?

15 A. Yes.

16 Q. You did use that term. And that's exactly
17 what I'm referring to. You analyzed a number of
18 firearms made. I think you had six in your article,
19 and you were looking for not only the sound wave
20 components after a gunshot, whether it was the
21 initial impulse or shockwave or whatever, whether it
22 was a muzzle blast or whether it was some ballistic
23 component or whether it was a mechanical component
24 from the action of the firearm or maybe the ejection
25 or pumping of a shotgun, these are all telltale signs

1 you described. Is that correct?

2 A. That's correct.

3 Q. None of that was in play in your analysis
4 here. Right?

5 A. Not -- there was no question asking
6 specifically about that. I think in the report I do
7 mention that there are other sounds besides the
8 gunshots that I cannot determine what they might be.
9 But having knowledge of the telltale sounds, like an
10 ejected spent cartridge inside the cabin of a
11 vehicle, it's -- again, I'll use my term plausible
12 that that would make a clink if it hit the dashboard
13 or -- or something like that. So there are other
14 clicks and pops and -- and sounds in the background
15 that again to me could be attributable to those
16 telltale types of sounds.

17 Q. And I realize that in your written report
18 you didn't refer to telltale signs with a particular
19 firearm, but you did touch on opinions that suggested
20 that you believed the first 17 shots likely came from
21 one firearm. Is that right?

22 A. That's right.

23 Q. And so these telltale signs that you
24 suggested in your paper could have been one method of
25 which you could have found that information to be

1 likely. Is that right?

2 A. Conceivably, yes.

3 Q. But they weren't in this -- in this
4 project they were not. Is that right?

5 A. That's right.

6 Q. Because you don't know what kind of
7 weapons they were using?

8 A. That's right.

9 Q. Okay. So those of us seeking to rely on
10 your opinion need to understand that your -- your
11 opinions are limited to the information that you had.
12 Is that fair?

13 A. That's right.

14 Q. It could have been more thorough, but it
15 wasn't more thorough in terms of analyzing telltale
16 signs or analyzing reverberation or echo or latency.
17 It could have been -- you could have done those
18 things, but you didn't do those things. Right?

19 A. Yes. I was responding to the specific
20 forensic questions I was asked.

21 Q. Okay. In your analysis did you utilize
22 any automated detection algorithm to say, hey, that's
23 a gunshot?

24 A. No.

25 Q. So your -- your detection of a gunshot was

1 from your critical listening and from your visible
2 depiction in the spectrogram and the amplitude graph.
3 Is that right?

4 A. That's right.

5 Q. But there are algorithms to identify
6 gunshots in your report, software algorithms?

7 A. Yes.

8 Q. Okay. Do you recall when you analyzed the
9 digital voice recorder that you could have -- that
10 you found that you could have a time smearing of up
11 to 25 milliseconds?

12 A. I would have to -- it's been awhile since
13 I wrote that paper, but I'll -- yes. There's -- can
14 be time delay associated with the coding and those
15 type devices.

16 Q. And so when you're looking at time delay
17 in coding devices -- and you're welcome -- I've got
18 the paper if you would like to see it, but I'm --
19 I'll represent to you at least for that Olympus
20 report that you analyzed, it was as much as 25
21 milliseconds.

22 A. Yes. I probably should refer to that
23 paper, and not go on my memory.

24 Q. Sure.

25 A. If you would like me to look at it, I'll

1 be happy to.

2 Q. Well, you're welcome to look at it, but I
3 don't -- I don't have to have you look at it for my
4 next question, but I don't want you to think that I
5 won't show it to you.

6 The point is, there could be time smears,
7 you call it. Is that right? I have a paper entitled
8 "Gunshot Recordings from Digital Voice Recorders."

9 THE REPORTER: I'm sorry. You need to
10 speak up.

11 BY MR. MOSS:

12 Q. I have a paper entitled "Gunshot
13 Recordings from Digital Voice Recorders." I only
14 have one copy right here. Let me try and find
15 another copy because I've highlighted this one.
16 Mr. Tinsley might not want you to have that one.

17 MR. TINSLEY: I don't care.

18 BY MR. MOSS:

19 Q. I'll hand you my copy. I'll hand you my
20 copy, and I'll suggest to you that --

21 A. Okay. I can look it up if you want.

22 Q. -- page 3 of the article. You can
23 disregard my highlighting.

24 A. Okay.

25 Q. Do you recognize the article?

1 A. Yes. So this is from an audio engineering
2 conference in London in 2014, so 11 -- 11 years ago.
3 And you said page 3?

4 Q. Page 3, up in the left-hand side. I think
5 in that particular device, you're suggesting that
6 there was a time smear component that you were -- it
7 was also automatic gain control that you were
8 referring to, but the timing is what I'm referring to
9 now.

10 A. Okay. So the circumstances here is in --
11 on page 2 of this. In Figure 1 I'm showing a
12 recording we made of a Glock 19, 9-millimeter
13 handgun, and this recording was made. And the term I
14 use here is anechoic. So you've mentioned
15 reverberation and echoes and things like that. So an
16 anechoic means no echo recording. So in order to
17 obtain a recording like this, it has to be recorded
18 in a very special circumstance that there are no
19 reflections of sound.

20 Q. Wide open places?

21 A. Yeah. So you get just the -- the muzzle
22 blast of the gun and none of the reflections. And as
23 is typical for these firearms, the actual muzzle
24 blast of the gun without the reflections only lasts
25 about two milliseconds. It is just (indicating).

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1 And, in fact, we often have -- earwitnesses, people
2 will say it didn't sound like a gun. All I heard was
3 pop, pop, pop, pop, pop. And it's like, well, that's
4 what a real gun sounds like that isn't in a movie or
5 something like that. So it's an extremely short
6 report.

7 So in this paper what I was comparing is
8 the known sound of an anechoic recording of that
9 Glock 19 handgun to a real recording that was made
10 with this memo recorder. And I think the
11 circumstance here was -- yeah. The recorder is
12 placed three meters from the handgun, nine degrees
13 off axis from the muzzle. And so we end up with a
14 recording, and it has that initial two- or
15 three-millisecond pop of the gun and then this
16 additional material, which I think was ultimately
17 your question, which is that it smeared out or has
18 this additional energy that's present that's beyond
19 that initial onset of the -- of the firearm.

20 Q. And -- and that's analogous to the
21 additional energy that's showing up in Figure 1,
22 isn't it --

23 A. Yes.

24 Q. -- in the amplitude graph?

25 A. Yes.

1 Q. Then these devices -- my question was
2 about a -- a time smear, and you got a little bit off
3 topic in your explanation. But at least in that
4 electronic device, you suggested on the third page
5 that there could be as much as a 25-millisecond time
6 smear, which is a deviation between actual time and
7 the time it was encoded. Is that fair?

8 A. Well, what I'm referring to here is that
9 the MP3 encoder -- we've been talking about this
10 perceptual coder, and the way it operates is it uses
11 what's called a frame. So we're taking the original
12 audio recorder, and we're breaking it up into short
13 pieces.

14 And my statement here is that some of
15 those pieces are 25 milliseconds long. So the
16 encoder is looking at a 25 millisecond, a little
17 snapshot, if you will, of the signal and then making
18 its decision about audibility and what to include in
19 the encoder file. Okay? So that's the framing of
20 the encoder.

21 And what I end up with then is the
22 conclusion later here where it appears to be spread
23 over a five- to ten-millisecond span. So that's the
24 point at which the timing would come in, is that
25 five- to ten-millisecond spread. So instead of

1 getting a single two -- two-millisecond impulse that
2 we get from the Glock, we're getting something that's
3 stretched out in time by five or ten milliseconds.

4 Q. So it's a distortion to the actual sound
5 wave -- is that right -- because of the encoder
6 technology?

7 A. Yes.

8 Q. That was the point of the paper. Right?

9 A. Yes. And so as I mentioned in the report
10 and I probably mentioned to Mr. Tinsley, it's not
11 ideal to have an MP3 audio recording. It would be
12 better to have a higher quality uncompressed audio
13 recording. But I didn't get to make that choice,
14 so --

15 Q. Well, I understand and I'm not -- I'm not
16 being critical. In fact, I enjoyed reading your
17 paper.

18 But the -- the -- the cautionary language
19 here is you got to be careful when you rely upon
20 these type of recordings because you're not seeing
21 necessarily what actually occurred. Is that fair?

22 MR. TINSLEY: Object to form.

23 BY MR. MOSS:

24 Q. Depending on what your analysis parameters
25 are?

1 A. Yes. You have uncertainty due to that
2 aspect of the recording you identified correctly
3 there.

4 Q. Now, when you took the sound graph,
5 amplitude graph, and you -- I believe you -- maybe in
6 not exactly these words, but I believe you manually
7 excised your interpretation of one shot from the next
8 in your Figure 4. Is that right?

9 A. Yes.

10 Q. So you took the graphical information, and
11 you decided where one gunshot ended and one began.
12 Is that right?

13 A. I was identifying where they began, and
14 then I chose a time interval long enough to encompass
15 visually what appeared to be all of the report of
16 that particular shot.

17 Q. So it would be fair to say there's some
18 marginal error in your interpretation of the
19 graphical depiction of the sound waves that you
20 undertook? Is that right?

21 MR. TINSLEY: Object to the form.

22 BY MR. MOSS:

23 Q. We're talking about microseconds, would it
24 be fair to say, with some margin of error? Right?

25 MR. TINSLEY: Object to the form.

1 THE WITNESS: I didn't do any comparisons
2 at the microsecond level, so --

3 BY MR. MOSS:

4 Q. I thought I understood your testimony was
5 you zoomed in very closely on these things down to
6 the -- what was your scale because it's not on here?

7 A. Yeah. So each of the shots in that
8 recording, I would have to look a -- back at the
9 original to see what that rough duration is. It's
10 analogous to that figure that you were looking at in
11 the -- the prior paper.

12 Q. Okay.

13 A. So I'm -- I'm thinking it's maybe the
14 total duration of that is -- well, I shouldn't guess,
15 but it's 50 -- 50 to 100 milliseconds.

16 Q. Okay. So if there's a 50- to
17 100-millisecond margin of error, would --

18 A. No. It's not a margin of error. That's
19 the duration of that picture of the waveform. I'm
20 identifying the first sample of that waveform, and
21 that's -- in this case we had a
22 44,100-sample-per-second sampling rate. So it's
23 limited by the sampling rate about how much it can --
24 can pick that up.

25 But each of those recordings is many,

1 many, many samples. That's all of that --

2 Q. Correct.

3 A. -- in the figure you showed me, all of
4 those details.

5 Q. But where you got stumped between shot
6 seven and eight was only approximately 64
7 milliseconds. Right?

8 A. Yeah.

9 Q. That was the question that I've been
10 pondering. So that's -- we're certainly within the
11 margin of the 64 milliseconds in this interpretative
12 data. Is that right?

13 MR. TINSLEY: Object to form.

14 THE WITNESS: Well, yes. We can see -- in
15 that picture you can pick out visually and -- and
16 even audibly, you can hear the difference at that
17 level.

18 BY MR. MOSS:

19 Q. Okay. I want to talk to you about this
20 suggestion of what might have been plausible
21 impulses, maybe from a firearm fired some distance
22 away outside the truck. And I would like you to look
23 at your report on page 12 if you would.

24 Are you there?

25 A. Uh-huh.

1 Q. That's Figure 8. I think it's one of the
2 exhibits that Mr. Tinsley had marked.

3 MR. TINSLEY: I think it was 13 -- or 12
4 is Figure 7.

5 Mr. MOSS: you're right. 13 is Figure 8.
6 Thank you, Mark.

7 BY MR. MOSS:

8 Q. Plaintiff's [Exhibit Number 6](#), can you take
9 a look at that? You identified three of these
10 low-frequency impulses that you said plausibly could
11 be a shot taken from a firearm that was outside the
12 cab of the vehicle where the microphone was. Is that
13 right?

14 A. That's right.

15 Q. Okay. And -- and you talked about what
16 plausible was. It could be believed, but you're not
17 -- you're not suggesting with any kind of certainty
18 that that was a gunshot. Fair?

19 A. That's fair.

20 Q. What struck me about the report and your
21 depiction is you prepared three of these. Right?

22 And one was between the impulse that you
23 labeled 18, which would have been analogous to the
24 18th shot that you detected that you thought was a
25 shot for certain. Right?

1 And shot 17. Is that right?

2 A. That's right.

3 Q. And then one was between shots 25 and 26?

4 A. Yes.

5 Q. And one was -- one was between 26 and 27.
6 Is that right?

7 A. Yes.

8 Q. So in your report is there any particular
9 reason why you chose this time span to expand the
10 spectrogram and the sound wave graph to just only
11 this period of time?

12 A. Well, the question had been about whether
13 there are sounds in the background that would
14 correspond to gunshots from outside of the cabin of
15 the vehicle. So what I did during the entire span --
16 relevant span of the recording, which is what was
17 shown in Figure 1, so between shots 1 and 29
18 basically, was to use my critical listening, to look
19 at the waveform, and then to look at the spectrogram
20 to try to discern is there any background sound in
21 that span that I could interpret as being -- whatever
22 the comment was -- the sound of a gunshot from
23 outside the cab of the vehicle in which the mobile
24 phone recording was made.

25 So to do that task, I'm listening very

1 carefully again, not trying to hear the foreground
2 sounds, which are obvious, but listen for those
3 background sounds. And the only place that I had a
4 perception of something that -- to my ear and to my
5 eye would possibly correspond to a gunshot outside of
6 the vehicle is this span that's indicated there.

7 Q. So you -- in your report on page 12, you
8 had some low -- and I'll be happy to publish it and
9 you tell me if I got it right, but you're welcome to
10 look at this paragraph.

11 It says "Finally, I discern several
12 impulsive audible sounds that have a low-frequency
13 emphasis that could possibly be attributed to a
14 firearm discharged from some distance away from the
15 vehicle in which the recording is made." Is that
16 right?

17 A. Uh-huh. Yes.

18 Q. And that's what we're talking about here.
19 That's the -- that's the plausibility word you used?

20 A. Yes.

21 Q. I want to ask you about this statement.
22 First and foremost, how many are the several that you
23 referred to?

24 A. Well, I've identified specifically three
25 that I circled the spectral response and indicated

1 with the arrows and then I have a couple sounds
2 around slightly before and slightly after shot 20
3 that I've indicated with question marks in that
4 figure, and that's again because trying to separate
5 this background sound I'm listening for from the
6 foreground loud sound of the recording, I was not
7 confident that I was going to be able to do that with
8 any great success, so --

9 Q. When you were listening critically, were
10 you listening in realtime speed or did you slow it
11 down for your critical listening?

12 A. I was listening in realtime speed, but I
13 listened to different lengths of the recording.

14 Q. So realtime speed but you turned the
15 volume down, though. Right?

16 A. Yes.

17 Q. So you were listening in realtime speed,
18 and you detected these three that you graphed, but
19 you said in your report there were several. You
20 didn't say there were three. Is that fair?

21 MR. TINSLEY: Object to the form.

22 THE WITNESS: Yes. I don't think I was
23 trying to be deliberately confusing there. I have
24 three specific ones that are identified and then
25 those question marks to indicate while there's other

1 information there, that I was not able to tease out
2 because of the overlap with the foreground sounds.

3 BY MR. MOSS:

4 Q. Well, let's talk about the -- the visual
5 indication of these low-frequency impulse that --
6 that plausibly could be another gunshot. What about
7 the -- the amplitude graph or what about the
8 spectrogram visually indicates to you that these
9 plausibly could be another gunshot -- another gun
10 from a distance outside the cab of the truck where
11 the recording device was?

12 A. So what I would be looking for there is my
13 expectation that I would want to discern the
14 characteristics of a firearm muzzle blast. And those
15 characteristics are very short duration, a high
16 amplitude in frequency extent. And their --
17 depending on the position and distance, what high
18 amplitude and what those other differences are is
19 going to vary somewhat. But that's what I was
20 looking for in this recording and listening for,
21 would be a sonic report that to my ear and to my eye
22 and to the spectrogram would have those expected
23 characteristics of a -- of a gunshot.

24 Q. So we get a bright vertical line on the
25 spectrogram that indicates broad frequency, right, a

1 lot of energy across the frequency band?

2 A. That's right.

3 Q. And we get a very short impulsive
4 amplitude on the visual -- the black and white
5 diagram -- right, the amplitude graph?

6 A. Yes.

7 Q. And you picked up these three visually as
8 being plausibly a gun from -- fired from another
9 vehicle?

10 A. Well, I -- I listened to them. I observed
11 that there was an indication in the time waveform,
12 and then I observed that the spectrogram had this
13 energy going right down to low frequency as more of a
14 thump kind of a sound. And all of those attributes
15 together led me to that discernment that these are
16 plausible as distant gunshots.

17 Q. You -- you -- you mentioned low frequency
18 a couple of times. Again, you said low frequency in
19 the sentence of your report that I read. What
20 frequency are you talking about in terms of hertz?

21 A. So the -- when I say low frequency, I'm
22 thinking things down in the range -- the low perhaps
23 200 hertz. So I would be saying from zero to maybe
24 100 hertz, that's what I would consider low
25 frequency.

1 Q. And how high -- how high does your
2 low-frequency threshold go? For example, 1,000
3 hertz, could that be considered low frequency --

4 A. I would start to consider that to be high
5 frequency. So for me it's -- it's in that 100 to 200
6 hertz range, would be what I would consider low
7 frequency in this context.

8 Q. Okay. So on the amplitude graph, which is
9 the black-and-white drawing there in Figure 8, you
10 see what looks like a nodule or a node on the graph?
11 It's very low amplitude. Right? At the -- at the
12 three locations that you indicate could have been
13 impulsive --

14 A. Yes. On this scale they -- they are much,
15 much quieter than the louder gunshot reports.

16 Q. And -- and -- and if they were indeed a
17 firearm fired from outside of the sealed, enclosed
18 vehicle, you would expect them to be much lower in
19 amplitude. Right?

20 A. That's right.

21 Q. So if you could turn back to Figure 1, do
22 you have that in front of you?

23 A. Yes.

24 Q. Will you get it in front of you? This is
25 the same -- or the data that's in Figure 8 was taken

1 from the same amplitude graph that you depict in
2 Figure 1 except it's zoomed, if you will. Is that
3 right?

4 A. That's right.

5 Q. And Figure 8 is -- is a snapshot in time
6 of the discontinuum in Figure 1. Is that right?

7 A. That's right.

8 Q. Same thing for the spectrogram, it's the
9 same data, but it's a -- it's a time snap or a
10 zoomed-in portion of the spectrograph in Figure 1.
11 Is that right?

12 A. Yes.

13 Q. When I looked at Figure 1, Doctor, I saw
14 numerous other of these low amplitude nodules with a
15 corresponding bright vertical line or a brighter
16 vertical line that you didn't reference that's
17 plausibly a -- a sound wave that could have come from
18 a gunshot from a far away gun outside of the vehicle
19 cabin.

20 But there are some here, aren't there?
21 There are others besides three, aren't there?

22 A. Well, again, the techniques of audio
23 forensic analysis are not looking at a picture like
24 this and making a decision. So I'm combining
25 critical listening, to looking very carefully at the

1 waveform and then looking at the spectrogram. So
2 it's the combination of those things that would lead
3 to a conclusion. So there are a variety of impulsive
4 sounds in this recording, which when listening to
5 them sound to me like they are a plink sort of sound,
6 which I might think, well, that is more likely a
7 spent cartridge casing hitting the dashboard or a
8 piece of glass falling or -- or some other sound like
9 that but don't to my ear and eye and then on the
10 spectrogram have the characteristics of those of a
11 gunshot sound.

12 So, for instance, when you're looking at
13 Figure 8, I've got an identification of a possible
14 gunshot, the one on the right in that figure. And
15 just to the left of that one there's a louder sound
16 that has a -- based on the visual comparison, would
17 be very similar, but you can see it doesn't have the
18 low-frequency characteristic. And when listening to
19 that, again, it's -- it's more of a -- a plink sort
20 of sound, a high-frequency emphasis, where the
21 gunshot sounds would have more of a -- a
22 low-frequency thump sort of emphasis.

23 So that's just one example of things that
24 we don't want to try to make a conclusion based on
25 just one of the observations. We want to combine the

1 different analysis techniques.

2 Q. And so obviously you would agree with me
3 that I can -- I can look at the same spectrogram that
4 you looked at. I can look at the same amplitude
5 graph that you can look at, but I cannot critically
6 listen to the same sounds you critically listened to
7 and necessarily draw the same conclusion. Is that
8 fair?

9 MR. TINSLEY: Object to the form.

10 THE WITNESS: Just like I said with my
11 indication of what the -- the subjective
12 transcription is, I can't say my ears are somehow
13 better than yours. So I -- I -- I'm saying this
14 subjectively is what I'm hearing, and that's what I'm
15 reporting.

16 BY MR. MOSS:

17 Q. And it is subjective?

18 MR. TINSLEY: Object to form.

19 THE WITNESS: In the case of something
20 like a transcript or in the case of combining these
21 different effects, it's as presented here using those
22 techniques.

23 BY MR. MOSS:

24 Q. Let me show you a page out of my report
25 that I'm looking on. It's page 5. I'll show it to

1 you. I've circled other of these low amplitude yet
2 impulsive characteristics on the amplitude graph.
3 And they have corresponding bright or brighter to the
4 background amplitude vertical lines in the
5 spectrogram.

6 Can you take a look at that for me please,
7 the ones I've circled?

8 A. So, again, it would not be an audio
9 forensic analysis simply to circle stuff on a graph.

10 Q. Agreed. Agreed.

11 A. It would not be considered an appropriate
12 scientific approach.

13 Q. But do you see what I'm talking about?

14 A. Well, I see that you circled some things
15 on the graph, but it's not a scientific approach.

16 Q. Well --

17 A. If you were my student, I wouldn't accept
18 that as evidence of anything.

19 Q. Well, I'm not your student, but I am a
20 lawyer asking you questions. Will you hold the
21 document, please. In every scenario that I've
22 circled, isn't there a corresponding brighter
23 vertical line in the spectrogram?

24 A. Looks like those are impulsive sounds,
25 yes.

1 Q. They're impulsive sounds of some kind?

2 A. Yes.

3 Q. And from the spectrogram we know they're
4 broad in frequency range. Is that right?

5 A. Yes.

6 Q. Which is what a gunshot is, right, broad
7 frequency range?

8 A. Well, the thing that's incorrect is that
9 you're asserting that those could only be shotgun
10 sounds.

11 Q. No. I'm not -- I'm not --

12 A. They could be a clink. They could be a
13 click. They could be any number of things.

14 Q. I'm not asserting --

15 A. So you're not asking me to do a task that
16 is reasonable for me to do.

17 Q. I'm not asserting to you they're gunshot
18 sounds, but I do have a question. Would you count
19 the numbers -- the number that I've circled?

20 A. Well, it's your report. You can count
21 them.

22 Q. Well, there's 11 I'll submit to you.

23 A. Okay.

24 Q. Do you know how many expended bullet
25 casings were found in Mr. Spivey's truck?

1 A. No.

2 Q. Well, coincidentally there were 10 found,
3 plus there was additional 1 found when the truck was
4 taken home by his family, so 11?

5 A. So is that an audio forensic question that
6 you're posing to me? Is it a question that could be
7 answered from audio forensic evidence?

8 Q. My question is, if there were 11 expended
9 bullet casings that we know from the physical
10 evidence which you wouldn't have, I'm going to ask
11 you to accept that as a fact.

12 We know there were 11 .45-caliber expended
13 shell casings or bullet casings, and we know that
14 there are 11 of these brighter vertical lines on the
15 --

16 A. Well, we don't know that. You as an
17 advocate have circled 11 things on here. I have no
18 idea what those are.

19 MR. TINSLEY: Can I see?

20 MR. MOSS: Sure, you can.

21 THE WITNESS: Yeah.

22 BY MR. MOSS:

23 Q. So my question -- I'll wait for a minute
24 -- a moment.

25 My question is simply this. Of these that

1 I circled, what about the spectrogram or the
2 amplitude graph would indicate to you the three that
3 you've described in Figure --

4 MR. TINSLEY: 8 was the one you were
5 asking about.

6 BY MR. MOSS:

7 Q. -- Figure 8? What about the three that
8 you described in Figure 8 make it plausible that
9 those could be gunshot sounds from a distant gun
10 outside the cabin where the recording device was and
11 these others could not plausibly be a gunshot?

12 A. So I've explained the -- the principles of
13 audio forensic analysis, which is using a combination
14 of critical listening, looking at the waveform at
15 different scales and so forth, and looking at the
16 spectrogram.

17 It appears what you have done is simply
18 circled some little white indications on the chart.
19 So you're asking a question that I'm not prepared to
20 answer because you're not using the techniques of
21 audio forensic analysis.

22 Q. Perhaps you --

23 A. If you found shell casings, I don't know
24 if those casings were attributable to this incident.
25 Maybe they had been in the vehicle before. I mean,

1 this is not expertise I have. So none of the
2 information you've given me is -- is posed as a
3 proper audio forensic question, so I'm not able to
4 really answer this.

5 Q. Doctor, I've asked you to accept this as
6 fact.

7 A. Well, I -- I can't accept this as fact.
8 You're asserting something I don't know.

9 Q. For the purposes of this question, I'm
10 asking you to accept this fact, that there were 11
11 spent .45-caliber shell casings found amongst
12 Mr. Spivey's --

13 A. Again, that's not an audio forensic
14 question. You're -- you're asking me a conclusion
15 with facts that are not relevant to my type of
16 analysis.

17 Q. Well, haven't you discussed earlier with
18 me that your audio forensic analysis would have to
19 yield to the physical evidence?

20 A. I've said that -- I didn't -- didn't say
21 yield. I said that that is another area of expertise
22 that presumably you're going to talk to another
23 expert about, not an audio forensic analysis expert.

24 Q. The purpose of my question I'm going to
25 ask you, I was very -- I wasn't asking you for a full

1 analysis from an audio forensic engineer. What I was
2 asking you --

3 A. That's what I'm here for, though.

4 Q. Well, right now you're here to answer my
5 question. I asked you to look at the amplitude graph
6 only and the spectrogram only. Okay.

7 A. Yes. But I -- again, that's not what I
8 would do as a scientist.

9 Q. Well, okay. Humor me and do it for the
10 purposes of this question. What is different about
11 the three that you've singled out for Figure 8 that
12 you said plausibly could be a gunshot and these other
13 nine that have similar characteristics in the
14 amplitude graph and in the spectrogram? And I am
15 asking you to confine your response only to amplitude
16 graph and the spectrogram.

17 MR. TINSLEY: Object to form.

18 THE WITNESS: Well, again, I -- I cannot
19 answer that because the training I have and expertise
20 I have involves audio forensic analysis. You're
21 asking for some sort of interpretation of -- of a
22 graph, and it's not something I'm trained to do.

23 BY MR. MOSS:

24 Q. Well, haven't we talked about your
25 interpretation of the spectrogram and amplitude graph

1 since we've been talking?

2 A. No. We've been talking about the
3 techniques of audio forensic analysis, which involve
4 critical listening, which involve waveform analysis,
5 and which involve spectrum analysis. And you're
6 saying now we're not going to do critical listening.
7 We're -- we're just going to use these other
8 techniques. And so that's not a scientific question
9 that you should be asking.

10 Q. There are three -- three components to
11 your analysis. One was the spectrographic analysis,
12 one was the waveform analysis, and one was critical
13 listening. Is that right?

14 A. That's right.

15 Q. In fact, you actually cited them in the
16 reverse order that I just stated.

17 A. Because ordinarily critical listening is
18 done first.

19 Q. And two of these I've posed a question
20 about and you can't answer it?

21 MR. TINSLEY: Object to form.

22 BY MR. MOSS:

23 Q. I posed a question expressly based on the
24 spectrographic analysis and the waveform analysis,
25 and I've submitted -- I've asked you to accept as

1 fact there were 11 shell casings of .45-caliber type
2 that were found in Mr. Spivey's vehicle and around
3 his vehicle. I've asked you to accept that as a fact.

4 And so you're telling me without the third
5 component of the analysis, you can't answer that
6 question. Is that -- is that fair?

7 A. That's fair.

8 MR. TINSLEY: Object to the form.

9 BY MR. MOSS:

10 Q. Okay. Would it be fair to say if you went
11 back and listened critically, that you might
12 interpret other components of these other nodes
13 differently than you did when you listened to them
14 before?

15 MR. TINSLEY: Object to the form.

16 THE WITNESS: Hypothetically, going back
17 through this, I'm confident that the procedure that I
18 used I would repeat now, you know, several months
19 later, and I am confident that the conclusions would
20 be the same.

21 BY MR. MOSS:

22 Q. Okay. Do you recall from Mr. Tinsley's
23 e-mails that he informed you there were 10
24 .45-caliber bullet casings found in and around
25 Mr. Spivey's truck?

1 A. I don't recall that, no.

2 Q. Okay. Will you accept my assertion to you
3 there was e-mail correspondence between you and
4 Mr. Tinsley that you provided to me?

5 A. Okay.

6 Q. Okay. Knowing that, does that change
7 anything about your unwillingness to answer the
8 question limited to the spectrogram and the wave
9 analysis?

10 MR. TINSLEY: Object to the form.

11 THE WITNESS: No. I -- I don't think I
12 talk about any, a count of shell casings in my
13 report. It's not relevant.

14 BY MR. MOSS:

15 Q. Okay. Well, you have -- you have stated
16 very clearly today that you -- in your report you
17 wrote it's likely that the first 17 of the impulsive
18 amplitudes that you saw that you said were gunshots
19 came from the same weapon, you assign that as a
20 likeliness, right, in your report expressly?

21 A. Yes.

22 Q. Today I think there was some suggestion it
23 might be more than likely. I want to be clear about
24 this.

25 Are you -- are you expressing with any

1 kind of scientific certainty in your analysis that
2 the first 17 shots were fired from one weapon?

3 A. The indications from the forensic
4 analysis, the critical listening, the waveform
5 analysis, and the spectrum analysis does not indicate
6 any distinction between those first 17 shots on that
7 basis.

8 Q. Okay.

9 A. So seeing no difference, my indication
10 would be based on that scientific approach, that
11 those 17 shots were likely from the same firearm.

12 Q. Would it change your opinion of that
13 indication if you were to learn that no weapon
14 involved in this whole scenario would hold 17 shots
15 in capacity?

16 MR. TINSLEY: Object to the form.

17 THE WITNESS: Again, I'm sure that would
18 be something that would be -- would be brought up.
19 I'm giving the statement based on the scientific
20 analysis of the acoustics.

21 BY MR. MOSS:

22 Q. Well, the scientific analysis can't
23 suggest there are 17 shots fired from the weapon when
24 it didn't have 17 bullets in it, can it?

25 A. Again, I don't know what the weapons were

1 involved in this case. I don't know there's a
2 limitation on the number of shots.

3 Q. Okay.

4 A. So I don't -- I'm not bringing in this
5 extraneous evidence to the acoustical analysis.

6 Q. So if this --

7 A. As an advocate, I'm sure you'll bring this
8 up.

9 Q. I have to.

10 A. Yeah.

11 Q. I mean, do you think it's reasonable for
12 me to bring up that a gun won't hold 17 bullets, yet
13 you're telling me that one gun fired 17 shots?

14 MR. TINSLEY: Object to the form.

15 THE WITNESS: Well, I don't know. Maybe
16 there was a reloading of ammunition. I don't know
17 that.

18 BY MR. MOSS:

19 Q. Did you hear it in your critical --

20 A. There's evidence of --

21 Q. A reloading?

22 A. -- other sounds in the background here
23 that I cannot attribute what they were for, as I've
24 explained in the report.

25 Q. Okay.

1 A. Isn't it possible that a magazine might
2 have been reloaded? I don't know. It's not
3 something I know from the acoustical analysis, but it
4 seems plausible.

5 Q. Within this time frame?

6 A. Well --

7 Q. Within five seconds while shooting is
8 going on?

9 A. With somebody who knows how to handle
10 firearms? I don't know. Again, this is not my area
11 of expertise.

12 Q. So you will not agree with me that your
13 analysis could be wrong if a gun won't hold as many
14 bullets as you suggested had been fired within a --
15 was it a three-second window?

16 MR. TINSLEY: Object to the form.

17 BY MR. MOSS:

18 Q. Six-second window? You would agree with
19 me, wouldn't you, that if -- if the testimony and the
20 evidence that's presented at trial was such that one
21 of the shooters only fired 14 rounds, it would not be
22 possible for the same gun to have fired 17 rounds.
23 Is that fair?

24 MR. TINSLEY: Object to the form.

25 THE WITNESS: I can say that based on the

1 acoustical analysis, other than this question about
2 the shots seven and eight, which seem very, very
3 close together in time, acoustically I can't
4 distinguish anything between these shots.

5 BY MR. MOSS:

6 Q. Very well. So the fact that you can't
7 distinguish acoustically doesn't mean that the first
8 17 rounds were fired by one gun, does it?

9 A. I believe my statement here is that they
10 are likely from the same firearm because I'm not able
11 to distinguish a difference between them.

12 Q. But in reality you don't know, do you --

13 MR. TINSLEY: Object to form.

14 BY MR. MOSS:

15 Q. -- that they were fired from the same gun?

16 A. I have not said that they were fired from
17 the same gun. I said that based on the fact that
18 there's no distinguishing acoustical features, it is
19 likely that they came from one firearm. That's the
20 exact statement in the report.

21 Q. That is the exact statement in your
22 report. But here today in the testimony elicited by
23 Mr. Tinsley, you seemed to indicate a little more
24 confidence in that statement than what you put in
25 your report. Do you stand by what is in your report?

1 A. Yes.

2 Q. Okay. As opposed to what was testified to
3 here today?

4 MR. TINSLEY: Object to form.

5 THE WITNESS: Well, I believe I've been
6 very consistent in my testimony here today, at least
7 that was the intention.

8 BY MR. MOSS:

9 Q. Okay. That was the intention. Okay.
10 Now, would it change your opinion or analysis in any
11 way if you learned that the two firearms that were
12 fired in the cab of the truck with the recording
13 device were identical in make and model and barrel
14 length?

15 A. Again, I don't have any way of knowing
16 that from the acoustics. I'm comparing the
17 acoustical reports of the sounds, and I've
18 distinguished that the sounds 1 through 17 have
19 acoustical features different than the remaining
20 sounds on the recording. And I've explained that
21 there's a variety of reasons why that could be.

22 Q. You have done that. You've been
23 consistent. But -- but my question was, would it
24 change your analysis or opinion on that particular
25 point if you could accept, because you have learned

1 that the two vehicles -- or the two weapons that were
2 fired in the cab of the vehicle that had this
3 recording device were identical in make and model and
4 barrel length?

5 A. Nothing in my acoustical analysis is based
6 on a particular firearm.

7 Q. Okay. Okay. You don't have enough data
8 in your acoustical analysis to compare any particular
9 firearm. Is that fair?

10 A. That's correct.

11 Q. Okay. The digital voice recorder that you
12 wrote about, do you think it's reasonable to assume
13 it's comparable to -- a microphone unit and the
14 encoding algorithm unit would be comparable in your
15 opinion or would be reasonable to assume it's
16 comparable to the microphone -- the integrated
17 microphone and the recording algorithm -- or coding
18 algorithm in a mobile phone?

19 A. The thing that I would expect is that I
20 believe that that paper about the digital voice
21 recorder was more than ten years ago, and probably
22 the device was even older than that. So technology
23 has improved considerably in the 10 or 15 years since
24 that -- that paper was written.

25 So I'm expecting that a more contemporary

1 mobile phone should -- you know, if that be what was
2 used, would probably have a higher quality audio
3 system than would be in a digital voice recorder from
4 a decade ago.

5 Q. But for the observation of the calendar,
6 you don't know, do you?

7 A. I don't know.

8 Q. Okay. In your paper you wrote it's
9 important for forensic examiners to understand the
10 strengths and weaknesses of the audio recording
11 systems used in mobile audio recorders. Is that
12 fair?

13 A. Yes.

14 Q. And that's -- that's -- you wrote it and
15 you agree with it. Right?

16 A. Yes.

17 Q. But you don't know the strengths and
18 weaknesses of the audio recorder used here because
19 you don't know anything about it. Right?

20 A. Well, I know that the quality of the
21 recording is sufficient to be able to determine these
22 various parameters, and I can understand the speech
23 and so forth. But as I believe I've noted in my
24 report, that it is an MP3 recording, and -- and so
25 there are limitations associated with that that are

1 well known.

2 Q. And you wrote in your report that there
3 were no distinctly identifiable audible gunshot
4 sounds other than your 29 obvious shots. You wrote
5 it in this report.

6 But if you -- if another audio forensic
7 examiner were to engage in the same three components
8 of critical listening, waveform analysis, and
9 spectrographic analysis and came to a different
10 conclusion about that, can you state necessarily
11 they're wrong, or do you think there might be some
12 subjective component about what they critically hear
13 and what you critically hear?

14 MR. TINSLEY: Object to the form.

15 THE WITNESS: It's conceivable that
16 different examiners would differ in their approach
17 and -- and maybe transcribe words differently or
18 something like that. So if they're using the
19 scientific principles that I describe in my book and
20 that I have used in this case, I would be pretty
21 confident that they would come to the same
22 conclusions.

23 BY MR. MOSS:

24 Q. Okay. Just to wrap up, I want to ask you
25 to concede with me a couple of things, if you will.

1 Will you concede with me that you cannot
2 identify with certainty in this case from what your
3 analysis is limited to which individual fired which
4 shots in this case?

5 MR. TINSLEY: Object to the form.

6 THE WITNESS: That's right.

7 BY MR. MOSS:

8 Q. Okay. From the audio alone, you just
9 can't do that. Is that fair?

10 A. Yes.

11 Q. Now, you have done that in other
12 circumstances where you've had more data to determine
13 -- you actually wrote a paper on where you tried to
14 determine who shot first. I think I got it right
15 here on the desk. Because you had more information.
16 Is that right?

17 A. Yes.

18 Q. Okay. And would you confirm with me you
19 were not given any other data than the audio
20 recordings that you referenced earlier, the three
21 that came from Attorney Tinsley?

22 A. That's correct.

23 Q. Okay. Can you confirm with me, will you,
24 that your analysis did not attempt to and certainly
25 does not and cannot establish the legality or

1 justification of any party's conduct in this case?

2 MR. TINSLEY: Object to the form.

3 THE WITNESS: Right. It does not.

4 BY MR. MOSS:

5 Q. Okay. Would you agree with me that your
6 work in this case -- your analysis in this case is
7 much less comprehensive than in numerous of the
8 situations that you wrote papers about --

9 MR. TINSLEY: Object to form.

10 BY MR. MOSS:

11 Q. -- where you had more information?

12 A. It probably wouldn't be the way I would
13 characterize it. When I do a scientific paper, which
14 I think if you're referring to my publications,
15 largely those are experiments where I'm in control of
16 the circumstances. I know the type of firearm. I
17 know the ammunition. I've calibrated the microphones
18 and so forth. Those are very special types of
19 situations. This is not one of those situations in
20 this case.

21 Q. Fair enough. Now, under our law in South
22 Carolina, do you understand that a witness who is
23 going to be qualified as an expert witness, must have
24 personal knowledge about the subject matter they're
25 testifying on. And while you have extensive personal

1 knowledge about audio forensic analysis, your ability
2 to analyze is limited to the information you have.
3 Is that fair?

4 MR. TINSLEY: Object to the form.

5 THE WITNESS: That's correct.

6 MR. MOSS: Okay. I think I'm through with
7 my questions, Doctor. I appreciate your time and
8 attention. Mr. Martin may have some.

9 MR. MARTIN: I do. Doctor --

10 THE VIDEOGRAPHER: Deb, can you hear him?

11 MR. MARTIN: Let me move and switch, get
12 nearer to the microphone.

13 Doctor, you've been going for some time
14 now, do you need a break?

15 THE WITNESS: Thanks for asking. I'm
16 doing good.

17 EXAMINATION

18 BY MR. O. MARTIN:

19 Q. All right. Doctor, as I said, we've been
20 -- we've been at it for some time. You've been asked
21 a lot by both of these other lawyers, and so a lot of
22 ground has already been covered. So I'm going to try
23 to be as brief as I can. Okay?

24 A. Well, I admire the professionalism of
25 everybody involved. It's been good.

1 Q. Well, thank you. And I think some of this
2 has been covered, but it just flows with my line of
3 questioning, so if it has, if you'll just -- just
4 answer it.

5 But prior to -- prior to receiving the
6 recordings, you didn't receive any background
7 information about this case before you conducted your
8 analysis, did you?

9 A. No.

10 Q. Did you do any independent research on
11 your own about any information or circumstances back
12 surrounding this case?

13 A. No.

14 Q. Okay. You did not review any physical
15 evidence in the case before conducting your analysis?

16 A. No.

17 Q. Since completing your analysis have you
18 either on your own or having been -- it having been
19 provided to you, reviewed any additional physical
20 evidence, any evidence whatsoever in this case?

21 A. No. All that has happened is I've seen
22 some headlines related to this case.

23 Q. Haven't we all?

24 A. Well --

25 Q. Okay. Just in general, how many hours per
156

1 day would you say on average do you dedicate to the
2 critical listening of audio for forensic purposes?

3 A. It really varies from day-to-day. My day
4 job as a professor I do in --

5 Q. Right.

6 A. -- a lot of things related to my teaching
7 and so forth. At any given session where I'm doing
8 critical listening, it would probably be maybe 30
9 minutes at a time, would be a good interval.

10 Q. Okay.

11 A. And in the course of this -- preparing
12 this particular report, I could look at my invoice
13 and see, but I -- I -- it was several hours of -- of
14 combination of the analysis that went into this.

15 Q. You said several hours. When you say
16 several hours, that's not several hours of critically
17 listening to the audio. That's a combination of all
18 of the techniques we've been talking about. Is that
19 right?

20 A. That's right.

21 Q. Okay. What exactly -- could you describe
22 your listening environment and the playback system
23 used for the analysis?

24 A. Yes. I typically do the critical
25 listening using a pair of -- I believe they're Denon

1 headphones, and I use a conventional personal
2 computer with a sound card in it. And some of the
3 listening I do is open air with loud speakers, but
4 mostly critical listening I'm doing with -- with
5 headphones.

6 Q. And some of this we talked about a little
7 bit, but I'm going to -- I'm going to buzz through it
8 real quick.

9 Were you aware that the recording was made
10 from inside of a 2022 white Dodge Ram 1500 TRX truck?

11 A. No.

12 Q. Okay. Were you aware that that specific
13 vehicle was equipped with ANC or active noise
14 cancellation system?

15 A. No.

16 Q. Were you aware that that vehicle also
17 featured acoustic glass and enhanced door seals
18 specifically designed to reduce external noise
19 entering the cabin?

20 A. No.

21 Q. Were you aware that foam and dampening
22 pads are used throughout that specific vehicle to
23 further reduce noise and vibration levels?

24 A. No.

25 Q. Were you aware that the cabin of the

1 vehicle was secure during the recording? And what I
2 mean by that is there's nothing open. The doors are
3 closed. The windows are closed. The sunroof is
4 closed. It's a sealed cabin.

5 A. I did not know that, but, again, nothing
6 in the analysis of the acoustics would make that a
7 surprise.

8 Q. Okay. Would it have -- given the fact
9 that you were asked to analyze specifically, can we
10 identify any gunshots coming from outside of the
11 cabin? Does that matter to you at all? Is that an
12 important piece of information to have, some of those
13 things that I've just listed?

14 MR. TINSLEY: Object to the form.

15 THE WITNESS: The -- I guess what I would
16 say there is that I was asked about, in the second
17 part of your forensic question, whether there were
18 any audible gunshots that could be attributed to be
19 outside the cabin. And as you saw from my
20 conclusion, I couldn't conclude that --

21 BY MR. O. MARTIN:

22 Q. Okay.

23 A. -- to be true. So possibly one of the
24 explanations for that would be the acoustical
25 properties of the vehicle, but, again, that didn't

1 enter into the report.

2 Q. Right. And I guess that's sort of what
3 I'm getting at is, would those noise reduction
4 features on that vehicle impact your ability to
5 detect sounds originating outside the cabin such as a
6 gunshot from some distance away?

7 A. I think yes. A reasonable person -- and I
8 consider myself a reasonable person -- would figure
9 that would have an effect, yes.

10 Q. Okay. Speaking about -- continuing on
11 this line with facts of the case, were you aware that
12 Mr. Spivey was at least 75 feet away from the white
13 truck that Weldon Boyd and Kenneth Williams were in,
14 the truck the recording was being made in, was at
15 least 75 feet away?

16 A. The description that -- that I was working
17 with was 35 to 40 yards --

18 Q. Okay.

19 A. -- I guess would be the description. So
20 -- so it would be -- the estimate would be greater
21 than 75 feet --

22 Q. Okay.

23 A. -- based on that assumption, but I've not
24 seen any diagrams or crime scene information.

25 Q. Okay. So -- and he talked with you about

1 this a little bit, but there were 11 -- were you
2 aware that there were 11 shell casings found in and
3 around Mr. Spivey's vehicle?

4 MR. TINSLEY: Object to the form.

5 THE WITNESS: No. As we discussed, I had
6 no need for that information, and that was not
7 provided.

8 BY MR. O. MARTIN:

9 Q. Okay. Were you aware that there was an
10 additional 20 shell casings located in and around the
11 vehicle in which this recording was made, Weldon
12 Boyd's vehicle?

13 A. No, I was not.

14 Q. Okay. So in total of all, we've got --
15 there's 31 shell casings, which would indicate at
16 least 31 shots were possibly fired. Is that correct?

17 MR. TINSLEY: Object to the form.

18 THE WITNESS: Well, you're asking a
19 question that again is outside my audio forensic
20 expertise. Shell casings, my understanding is it's
21 not clear sometimes when they actually were fired.

22 BY MR. O. MARTIN:

23 Q. Let's assume --

24 A. They could have been from a previous
25 incident, you know, weeks -- weeks before.

1 Q. Right. And so --

2 A. Or could have picked some up at the scene.
3 Who knows?

4 Q. Right. But I'm just -- just a reasonable
5 person, not in an audio forensic capacity, we've got
6 an active shooting scene here. We've got 11 shell
7 casings surrounding one vehicle. We've got 20
8 surrounding another vehicle.

9 It would be logical to draw the
10 assumption, if you add those up, we've got 31 fired
11 rounds.

12 MR. TINSLEY: Object to form.

13 THE WITNESS: So yeah. From an audio
14 forensic standpoint, I'm counting 29 audible gunshots
15 in the --

16 BY MR. O. MARTIN:

17 Q. Well, and that's where I kind of -- that's
18 what gets me to my questions here is there is other
19 evidence. As you noted in your report, you've got to
20 look at evidence. You've got to look at photographs,
21 crime scene, interviews, you know, look at what the
22 police have done to try to supplement and to try to
23 get a complete picture of everything that has gone
24 on. So in doing that you've come up with 31 shell
25 casings. It's entire -- but you said you only

1 identified 29 clearly audible gunshots on the
2 recording. Right?

3 A. That's right.

4 Q. Okay. And you attribute all 29 of those
5 gunshots as having originated from inside of the
6 cabin, if I understood your prior testimony
7 correctly?

8 A. Yes. That would be a correct
9 interpretation of the report.

10 Q. Okay. And you were not -- you were only
11 able to -- you weren't able to identify any audible
12 shots that came from outside of the vehicle. Is that
13 correct?

14 MR. TINSLEY: Object to the form.

15 THE WITNESS: Yes.

16 BY MR. O. MARTIN:

17 Q. Okay. So to see what I'm getting at with
18 this, we've got Mr. -- you were not then able -- it
19 is clear that Mr. Spivey fired his weapon at least
20 10, 11, possibly 12 times based on the evidence --

21 A. I don't know.

22 Q. And I understand -- I understand your
23 answer you don't know. I'm just saying the evidence
24 is -- is -- there's evidence there to indicate that.
25 Yet you cannot identify a single gunshot on the

1 recording that came from outside of the vehicle. Is
2 that right?

3 MR. TINSLEY: Object to the form.

4 THE WITNESS: That's correct.

5 BY MR. O. MARTIN:

6 Q. Okay. So it's entirely possible given the
7 information I've just given you that there were
8 gunshots that were fired at the beginning of this
9 recording, during the middle of it, at the end, at
10 any point during this whole recording, it is entirely
11 possible that there are gunshots being fired that you
12 are not able to pick up?

13 MR. TINSLEY: Object to the form.

14 BY MR. O. MARTIN:

15 Q. Identify?

16 A. Yeah. I can't answer something I don't
17 know. And so what I do know is that out of the audio
18 recording, I'm able to identify 29 shots that are
19 attributable to being in the vehicle where the
20 recording was made.

21 Q. And none from the outside?

22 MR. TINSLEY: Object to the form.

23 THE WITNESS: Right.

24 BY MR. O. MARTIN:

25 Q. Okay. You did state in your report at one

1 point -- and I just wanted to ask you about it
2 because I didn't quite understand it, but you stated
3 in your report that the occupant's speech or
4 utterances did not indicate any gunfire prior to the
5 identified in-cabin shots at 3:33.95. What exactly
6 do you mean by that?

7 A. All I was wanting to get across is I -- I
8 didn't hear a statement of, ooh, he hit us, or, ooh,
9 there was a shot or we've been -- you know, there's a
10 hole in the windshield or some statement like that.

11 Q. Okay.

12 A. So that's all I was referring to there. I
13 didn't encounter any utterance by the occupants that
14 was indicative that there had been a gunshot.

15 Q. Would you agree necessarily though that
16 the -- you have listened to the audio. I'm assuming
17 you listened to it like me over and over and over
18 again.

19 And you even wrote it on your report where
20 it says "This dude has got a gun. He's got a fucking
21 gun." Followed by: "Back up, Weldon. Back up. Put
22 it in gear. Back up."

23 And then you can tell that the inflection
24 in the voices were rising. Would you agree with
25 that?

1 A. I would agree with that.

2 Q. Okay. Would you -- wouldn't you agree
3 with me that that audio right there before the --
4 clearly the audible gunshots began would -- why
5 they're not saying bullet or gun or fired, would you
6 not agree that those words indicate that some sort of
7 event is occurring?

8 MR. TINSLEY: Object to form.

9 BY MR. O. MARTIN:

10 Q. That they are perceiving something at that
11 point? Maybe don't know what. Can't say what.

12 MR. TINSLEY: Object to the form.

13 THE WITNESS: Yes. I think that -- that
14 is what I would say, yes.

15 BY MR. O. MARTIN:

16 Q. Okay. Could the yelling and shouting
17 inside of the cabin of that vehicle have interfered
18 with your ability to accurately detect less prominent
19 sound from outside the car?

20 A. It could have interfered.

21 Q. And I think you may have answered this
22 question already, but I'm going to ask it once again.
23 Would the type of firearm have any bearing on your
24 analysis being used and being able to detect
25 something from outside of the cabin?

1 A. The type of firearm wouldn't change the
2 analysis, but physically that could change the
3 audibility or the sound level.

4 Q. For example, if it was a -- a supersonic
5 weapon versus a subsonic, the rounds being fired,
6 would that make a difference in -- and I'm just
7 generally asking. In -- in your line of work in
8 analyzing gunshots, especially in -- given these
9 particular circumstances, if a weapon is firing
10 subsonic rounds or supersonic rounds, would that
11 affect the detectability of gunshots at all?

12 MR. TINSLEY: Object to form.

13 THE WITNESS: It could conceivably affect
14 it. The supersonic ammunition, the bullet itself, as
15 it travels through the air creates a shockwave under
16 certain circumstances that can be detected on a
17 microphone. So you could have a situation in which
18 there would be a combination of the supersonic
19 shockwave report and then the muzzle blast of the
20 gun.

21 BY MR. O. MARTIN:

22 Q. Okay. Have you ever analyzed or studied
23 the accuracy of gunshot sound detection under these
24 exact same or similar circumstances before?

25 MR. TINSLEY: Object to the form.

1 THE WITNESS: Talking to engineers, it's
2 always hard to say what "exact" means. So are you
3 referring to gunshots --

4 BY MR. O. MARTIN:

5 Q. What I'm talking about is -- is -- is all
6 -- all of these -- all of these factors that we've
7 sort of talked about and that have been discussed,
8 the fact that you got somebody with a weapon that is
9 30 to 40 yards or 75 feet or more away, inside of the
10 closed cabin of a vehicle that is equipped with noise
11 canceling or -- or acoustic dampening technology, I
12 mean, that's what -- these exact circumstances.

13 A. No.

14 Q. Okay. Do you acknowledge, Doctor, that it
15 is possible even if you believe it may be unlikely or
16 not that there could have been gunshots undetected in
17 your analysis of the recording?

18 MR. TINSLEY: Object to the form.

19 THE WITNESS: It is -- it is technically
20 possible, yes.

21 MR. O. MARTIN: Doctor, I think Mr. Moss
22 has covered just about everything else that I would
23 ask you. So that would be all of my questions for
24 you. Thank you so much.

25 EXAMINATION

1 BY MR. TINSLEY:

2 Q. Very brief. So one of the last points
3 Mr. Martin was making, this idea that -- your
4 critical listening, is there an indication that
5 somebody is being fired at. If you looked at page
6 13, your Figure 8, somebody says "fuck" during the
7 middle of the sequence, that's the kind of thing
8 you're -- you're talking about?

9 A. I've included that reference there because
10 there's a -- an audible factor in this particular
11 section, and that was my subjective interpretation of
12 what someone said.

13 Q. Right. I mean, we know it's during a
14 shooting sequence. But I mean, you don't hear any --
15 any language like that or anything from them other
16 than he's got a gun prior to the first audible
17 gunshot. Correct?

18 A. That's correct.

19 Q. All right. And now, you complimented
20 Mr. Moss on being a -- a zealous advocate and he is a
21 zealous advocate. And, you know, he was giving you
22 sort of a hard time on Figure 1, page 5, where he had
23 circled the number of gunshots that he found, the 11
24 gunshots he circled. Do you remember that? Maybe we
25 need to see his --

1 A. Yes. I remember that.

2 Q. All right. And for the record because he
3 didn't mark it, if he circled 11, 10 of those were
4 after the first audible gunshot. Do you recall that?
5 Maybe you need to see it again. Do you want to see
6 it again? Here.

7 A. Yeah. If it's a question like that, I'll
8 need to see it again.

9 Q. Sure.

10 MR. TINSLEY: And maybe we can just --
11 we'll just mark that page if that's okay, Kenny, or a
12 copy of that. We'll make -- mark that as -- that
13 will be 9.

14 (Whereupon, [Exhibit 9](#) was
15 marked for identification.)

16 THE WITNESS: Yeah. Again, I'm real
17 hesitant to --

18 BY MR. TINSLEY:

19 Q. Well, I'm just asking -- I'm just
20 asking --

21 A. -- making a comment about circles on a --
22 on a printed page.

23 Q. Oh, I understand. But -- but the circles
24 that he indicated that he saw, ten of those are after
25 the first audible gunshot. Is that correct?

1 A. Yes.

2 Q. And -- and what that figure is, is
3 essentially a representation of -- and in summary
4 fashion of a lot of information that if we zoom in
5 on, if we change the scale, we can see it better, can
6 we not?

7 A. Yes.

8 Q. I mean, that -- when you performed your
9 acoustical analysis, you're not looking at a figure
10 from a mile away. You're -- you're zooming in and
11 trying to listen and see what you actually see.
12 Correct?

13 A. Yes. That's -- that's how a forensic
14 analyst will -- will work.

15 Q. That's right. And -- and, in fact, if you
16 look on page 7 of your report, Figure 2, which is
17 [Exhibit 2](#), you see there we are more zoomed in on
18 what's happening than we are in the figure that
19 Mr. Moss circled. Right?

20 A. Yes.

21 Q. And the node and the waveform and then the
22 line he says he sees in the spectrogram, you can't
23 see the line in the spectrogram once we zoom in say
24 in -- in Figure 2, can you? I don't know that you --
25 that you can see it in Figure 1. I'm just saying

1 once we zoom in, it's -- there's no -- there's no
2 line in the spectrogram that would be indicative of a
3 gunshot in your opinion, is there, sir?

4 A. No.

5 Q. And he talked with you a long time about
6 reverberations and reflections and surfaces and the
7 way that gunshot acoustics work. But aren't those
8 things all reflected in the waveform that you get?

9 In other words, I assume in the paper
10 where you're doing an analysis of a shooting where
11 the gun is moving and the shooters are moving and
12 there are multiple shooters, we're going to end up
13 with waveforms that are dramatically different from
14 one another as opposed to what we marked as Exhibit
15 4.

16 A. The expectation would be if the
17 circumstances changed, the firearm is pointed in a
18 different direction, the microphone moves, a
19 different firearm is discharged, all of those changes
20 would be expected to be reflected in the recording.
21 So those differences would be discernible.

22 Q. Right. So the -- so the wave is going to
23 look different?

24 A. Correct.

25 Q. All right. And -- and, in fact, in your

1 introduction you talk about the way that the acoustic
2 energy is expelled in all directions but primarily
3 the direction the barrel is pointed and that that
4 energy reflects and hits and makes its way to
5 whatever device captures the recording. Fair?

6 A. Yes.

7 Q. And so if -- if -- and you say that. It
8 is inevitable that the mixture of sound due to the
9 direct sound of the firearm alone and overlapping
10 acoustic reflections and reverberation creates a
11 complicated pattern. That's what's represented in
12 [Exhibit 4](#), is it not?

13 A. Yes.

14 Q. A complicated pattern that has been
15 captured by this microphone?

16 A. Yes.

17 Q. And whatever its limitations are, that's
18 what we have?

19 A. That's right.

20 Q. And that pattern, if we had multiple
21 firearms in different orientations that are
22 dramatically different from shot 1 to shot 29, we
23 would see a variation of those patterns?

24 A. That would be my expectations, that those
25 physical changes would be reflected in the recording.

1 Q. But if you have one firearm that's in
2 generally the same orientation to the microphone, the
3 acoustical surroundings, meaning inside the cab of
4 this truck, aren't changing, and its relative
5 location to the microphone isn't changing, is it your
6 expectation to a reasonable degree of engineering
7 certainty that you will end up with waveforms that
8 are substantially similar?

9 A. That would be the expectation.

10 Q. And is that what we have in [Exhibit 4](#)?

11 A. Yes.

12 Q. Okay. My -- my last question, I hope, is
13 -- and I think earlier I misspoke. On page 10 of
14 your report -- I'm sorry. It's not 10. Page 9 of
15 your report, I -- I think that -- that I had
16 attributed the remaining 12 shots, but actually shots
17 18 through 24, not 18 through 29. It's your opinion
18 those shots came from a different firearm than what
19 we see in exhibit --

20 A. Yes.

21 Q. Yeah, I'm trying to remember -- I think
22 it's -- it may be 1, the first -- the first 17.

23 A. Yes. The change in cadence and the
24 different audible character and the different
25 waveforms I was detecting started at shot 18.

1 Q. And -- and -- and it's your opinion to a
2 reasonable degree of certainty that 18 through 24 is
3 most probably a different firearm than 1 through 17?

4 A. Yes. That was the conclusion I came to
5 because the waveforms, the acoustical character, and
6 the spectral character were different for those shots
7 than the first ones.

8 Q. And then is it your opinion to a
9 reasonable degree of certainty that the remaining
10 shots of the 29 are the first weapon?

11 A. No. I think the way I did it in the
12 report in looking at the waveforms, I had the
13 determination that shots 18 through 29 were from --
14 likely from the same weapon, same firearm. There was
15 nothing distinguishable in those group other than
16 that they were distinguishable from the first 17.

17 MR. TINSLEY: Okay. All right. I think
18 those are all the questions I have for you. Thank
19 you.

20 MR. MOSS: No. We don't do any recross.

21 THE VIDEOGRAPHER: Okay. That will
22 conclude this deposition. The time is 4:29 p.m.

23 (Whereupon, the deposition
24 concluded at 4:29 p.m.)

25 SIGNATURE RESERVED.

Robert C. Maher, PhD, PE

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DEPONENT'S CERTIFICATE

I, ROBERT C. MAHER, PhD, PE, the deponent in the foregoing deposition, DO HEREBY CERTIFY, that I have read the foregoing - 175 - pages of typewritten material and that the same is, with any changes thereon made in ink on the corrections sheet, and signed by me a full, true and correct transcript of my oral deposition given at the time and place hereinbefore mentioned.

ROBERT C. MAHER, PhD, PE

Subscribed and sworn to before me this _____ day of _____, 2025.

PRINT NAME: _____

Notary Public, State of Montana

Residing at: _____

My commission expires: _____

Robert C. Maher, PhD, PE

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C E R T I F I C A T E

STATE OF MONTANA)
 : ss
COUNTY OF GALLATIN)

I, Deborah L. Fabritz, Registered Professional Reporter and Notary Public for the State of Montana, residing in Bozeman, do hereby certify:

That I was duly authorized to and did swear in the witness and report the deposition of ROBERT C. MAHER, PhD, PE, in the above-entitled cause; that the foregoing pages of this deposition constitute a true and accurate transcription of my stenotype notes of the testimony of said witness, all done to the best of my skill and ability; that the reading and signing of the deposition by the witness have been expressly RESERVED.

I further certify that I am not an attorney nor counsel of any of the parties, nor relative or employee of any attorney or counsel connected with the action, nor financially interested in the action.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my notarial seal on this 21st day of September, 2025.

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