IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

UNITED STATES OF AMERICA, et al.,
Plaintiffs,

vs.

GOOGLE, LLC,

Defendant.
_____/

Civil Action
No. 1:20-cv-3010

Washington, DC
October 26, 2023
1:30 p.m.

Day 28
Afternoon Session

TRANSCRIPT OF BENCH TRIAL
BEFORE THE HONORABLE AMIT P. MEHTA
UNITED STATES DISTRICT JUDGE

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I N D E X

E X H I B I T S

**Exhibit provisionally admitted.*

P R O C E E D I N G S

THE COURT: Welcome back, everybody.

Mr. Sommer, whenever you're ready.

CONTINUED DIRECT EXAMINATION OF PRABHAKAR RAGHAVAN

BY MR. SOMMER:

Q. Thank you, Judge. Good afternoon, Dr. Raghavan.

A. Good afternoon.

Q. I'm going to now turn to another area you're responsible for, and that's search ads, okay.

Why does Google show ads on the search engine results page?

A. Earlier this morning, we discussed that users sometimes have commercial intent, and I pointed out they want deals in some sense. They want qualifying offers from good merchants. Merchants are anxious to reach these users in those moments of commercial need, and our ads facilitate that. They also -- obviously the revenue from them, helps make information universally accessible, making Google search accessible to anybody whether or not they can pay for it.

Q. Wouldn't users be better off just getting organic results?

A. That's not what our research shows quite consistently. When users are in a moment of commercial consideration, consistent user studies suggest that they would like to see the right number of tasteful and

well-matched advertisements.

Q. How can users distinguish advertisements from organic search results?

A. I can speak for Google. We try our best to label advertising conspicuously, and periodically conduct user studies to ensure that these labels are visible to users. And wherever we can, we make improvements. And every year or two, we actually make refinements in what we call the badging.

Q. Badging?

A. We refer to it as the badging of advertising.

Q. Does Google serve ads in response to every query?

A. We do not. To give you a rough sense, about 80 percent of queries have zero ads, and the remaining 20 percent have between one and four.

Q. So when there's a commercial query, how does the Google algorithm -- or whatever I should properly refer to it as, how does it decide how many ads should be served in response to the query?

A. It's a combination of factors. I'll try to be succinct. So we take into account the quality of match, how relevant the advertisement is for the query at hand. We take into account the quality of downstream user experience, so it's the landing experience. And we try to discern, obviously, between merchants where they get a good experience

versus the other extreme, a site that might be putting in malware into the user's computer, and elevate the ones to the highest quality. We take into account the bids that advertisers make on the user need at hand. So that's the -- it's a very succinct summary of how it works.

Q. I appreciate that. You mentioned that it's from zero to four ads. Does Google ever show more than four topside ads?

A. No. And if that ever happened, it would be a bug and we would fix it immediately.

Q. It would be a bug, you said?

A. It would be a bug. By policy, we wouldn't show more than four.

Q. And what percentage of the time is Google showing less than four ads?

A. So let's split it up. So the biggest bucket is zero, which is 80 percent; one to three -- which is what I think you're asking, is roughly 18 percent; and four is a little less than 2 percent at this point.

Q. So four ads are shown, and only 2 percent of the time?

A. 2 percent of queries.

Q. Queries, thank you. Are you generally familiar with how many ads are shown by, for example, Bing in response to commercial queries?

A. Only from my experience, and what some of my colleagues have reported when trying Bing.

Q. And is it generally more than four?

A. My impression is that the ad load on Bing is higher.

Q. How about some verticals like Yelp, for example, any insight -- have you ever been on Yelp or had a colleague look at Yelp for you?

MR. HAFENBRACK: Your Honor, I'll object on foundation grounds.

THE COURT: If that's the objection, it's overruled. Go ahead, sir.

THE WITNESS: I've used some of the vertical services. I see far more ads on Yelp and Amazon, for instance.

BY MR. SOMMER:

Q. Now, why doesn't Google show more ads, wouldn't that increase Google's revenue?

A. In the very short term, yes. But really, the way we think of the system is how to deliver long-term value to the advertiser ecosystem into the business. And what we've learned -- and we've actually published on this. There was a publication we did in 2015 by Hohnhold, et al. -- and I'll spell that for the Court: H-O-H-N-H-O-L-D. It was a publication from colleagues that showed that if you crank up the ad load, that has a detrimental effect on the user experience that makes users go away. And so it's not a good

thing to do.

Q. Okay. And between short-term revenue and long-term user experience, which is paramount at Google?

A. We always want the long-term user experience to survive, because we think that's the best thing for our business as well.

Q. Are you familiar, sir, with various innovations that have been made to Google's search ads functions over the years?

A. Some of them, I would say.

Q. Okay. And is innovation something that is going on with great frequency?

A. I would say it's a fairly constant activity, and it's the reason why hundreds of engineers work on this problem all the time.

Q. Let me show you the next demonstrative, it's DXD21.007. Can you describe to the Court generally what we see on this slide?

A. There seems to be a timeline and then an arrow at the bottom. So the timeline begins in roughly 2000 and comes up to roughly today. And I should be clear that the left side of this timeline, I was not at Google and --

Q. Understood.

A. -- observing from the outside. And the slide shows a number of the key innovations as well as ongoing innovation

in something called NLU, natural language understanding.

Q. Does this show all the innovations or is this just a subset?

MR. HAFENBRACK: Your Honor, we'll object, because we don't have any foundation for this demonstrative, and it doesn't sound like the witness created it. Counsel's effectively using what it sounds like is a counsel-created demonstrative to lead the witness.

THE COURT: Do you have any reason to think any of it's inaccurate?

MR. HAFENBRACK: We just received it, Your Honor. We don't have any basis.

THE COURT: Well, it's a demonstrative, so he can use it to examine him.

MR. SOMMER: Thank you.

THE COURT: And as the witness has said, he can identify what he has personal knowledge of and does not.

BY MR. SOMMER:

Q. Dr. Raghavan, does this slide, based on your personal knowledge, represent every innovation that Google has done, even during the period you've been there?

A. No, it does not. This is a subset of salient features.

Q. Now I want to ask you about AdWords. Now, you just reminded us that you were not at Google when AdWords was

launched in 2000. Were you aware of the launch of AdWords in 2000?

A. Very much so.

Q. How so?

A. For the left half of this slide, which is roughly the period I was not at Google, I think I'd say I was in grudging admiration for what Google was doing. AdWords dramatically simplified the buying experience of advertising on search engines. And to set a little context, a few people and the Court may recall that a little before the turn of the century, there were engines like Alta Vista that users like myself used. And there, sometimes you'll type in a query -- for instance, you might type in artificial intelligence, and you get a banner right above for Seven Seas Cruises which has little bearing on the user's intent at the time. AdWords and its precedent, a company by the name Overture which actually invented the idea, put in place the idea of search advertising that was germane to the user's intent at that moment.

Q. Did AdWords separate organic results from ads on the search results page?

A. Absolutely. AdWords had no influence at all on the organic results, as I understood then. I think that would be shocking anywhere in the industry, if the advertising side were to impact the organic side.

Q. How about you're familiar with the acronyms CPC and CPM?

A. I am.

Q. How about using CPCs instead of CPM, was that an innovation introduced by AdWords?

A. If my memory serves me right, it was introduced right around the time. I wouldn't be able to tell you precisely if it first came from Google or Overture.

Q. Let's go to the next demonstrative, which is DXD21.009. What do you recognize this to be, Dr. Raghavan?

A. This looks like an ancient Google search page with a query for Drake Hotel in Chicago.

Q. And I take it from your work at Google, you know that the search engine results page has evolved over time; is that fair?

A. It definitely has.

Q. Let's go to the next slide, which has sort of a side-by-side. What do we see now on the right side of the slide?

A. The same query on a more modern Google search page. And what you see now is -- in the original version, there was something that said sponsored links to the right of the organic results. Now it's above the organic results, and the badging that I referred to earlier is far more prominent than before.

Q. Okay. So just to be clear, on the right side, the word "sponsored" is the badging you described; is that right?

A. Correct.

Q. And that indicates it's an ad?

A. It's a paid advertisement.

Q. Okay. What else about the current version of the results page do you see that's different?

A. Well, so you see much richer image-heavy content which came in, in this case, in an ad. But one of the things that evolved was user's expectations grew to demand more visually rich content. And I spoke earlier of how technology rises to meet user's expectations. And in this case, what happened was the available bandwidth to serve visually rich results in ads was there to deliver this better experience.

Q. Are you familiar with something referred to as ad extensions?

A. Yes.

Q. What are those?

A. So these are features within an advertisement that -- and I'll point to an example here, that allow a user to navigate directly to some point within an advertiser's website. So, for instance, if a user were to see the advertisement on the top, and they were perhaps not interested in booking the hotel any longer because perhaps they'd already booked it, but they wanted to know what dining

facilities were available, they could click directly on that link below the main link that says dining at the hotel and get there.

Q. Okay. And was that an innovation that Google introduced into this --

A. I believe it was Google that first came up with this.

Q. These types of innovations, these -- excuse me, these new features where you can click on dining, for example, is that a benefit to users?

A. I would hope so, because for users, they want to continue their journey as efficiently as possible. This is a means to not have to go first to a home page, and then click their way down. It's also a case where an advertiser indicates what it is about their site might be of the greatest interest to users issuing this query. And this advertiser, for instance, says -- felt that dining at the hotel or viewing guest rooms would be especially useful in continuing the journey of a user directly.

Q. Let's go to the next slide, which is DXD21.010. What we've put up there is something called long-term value. Are you familiar with long-term value?

A. I am familiar with the idea for long-term value.

Q. And did you become aware of it when it was launched by Google?

A. In that terminology, yes. The general idea -- you

know, being outside Google, I'd heard that Google was contemplating this question. It was a very interesting way of thinking about it. But, yeah, in that -- with that terminology, long-term value, when it launched.

Q. And what does that terminology refer to, long-term value?

A. So here's the idea: When you place advertisements to a search result, you can estimate a potential revenue for a user who clicks on one of those ads, right. But when you place a number of advertisements, you have to assess the user impact of that slate of advertisements on the user's experience. So by that I mean is it too many ads, are they of low quality, are they poorly matched to the user's intent. And so you try and compute, you try and estimate the user impact, and subtract that from the revenue component with the premise that doing so adjusts any revenue upside for any potential downside from a bad user experience. And that composite -- I've described it in a very simplistic fashion, because over time that has become a fairly sophisticated mathematical function.

Q. And -- I'm sorry, were you --

A. But the idea is really to manage the composite value and estimate long-term value from this particular slate of advertisements.

Q. And is that all part of the ads auction process,

these factors you just described?

A. The way you should think about it is the long-term value function is a large component and the objective function that the auction considers, so that it weights both the user experience and the revenue in concluding which ads to serve up.

Q. What was innovative about the LTV function that got introduced that still is there?

A. I would say a couple of things. To my knowledge, it was the first formal quantification of user impact. And that's an incredibly hard thing to do, because you have to look at an event that's happening billions of times a day, and each single time come up with this value assessment. And then the second piece of it was to actually reduce the revenue upside so that we would have to consider the user impact, and make sure that the user got value -- enough value to come back. And establishing that connection is hard, but that's what the LTV function has been after.

Q. How, if at all, did this innovation distinguish Google from competitors like your former employer, Yahoo!?

A. Back when I was at Yahoo! and Yahoo! had a search engine, there wasn't as clear a quantification of long-term value. It's a hard problem, but we were not able to get quite the same quantification.

Q. Are you familiar with an innovation known as

second-price auction?

THE COURT: Before you do that, I'm sorry, can I just ask a follow up question, Dr. Raghavan?

THE WITNESS: Yes.

THE COURT: Can you just give me a sense of what are the components -- component parts of evaluating long-term value?

THE WITNESS: Yeah, there's a few things. So one piece that we learned early on as an industry, but I think Google got there first, is when you present an advertisement to a user, what is the likelihood that the user clicks on it, okay. And I say this, because the classic example was circa 2000 on Yahoo! and other early engines. eBay would bid on virtually every keyword. So you might type Boeing 747, and you would get an ad that said: Buy a Boeing 747 on eBay, right. And the point is no user would actually click that, because no user querying that query would click it. So what this function managed to do was to say, well, nobody's clicking on it, so let's penalize this ad. That's one piece.

I'll give you one other example, right. When the user does click-through, what is the quality of experience they're about to have. Now, that's very hard to quantify, again, but we try and machine learn a bunch of signals to estimate what is the quality of the downstream experience and bring that as well. And if all of that is good, then we say it's better for the user's long-term value.

BY MR. SOMMER:

Q. Dr. Raghavan, I was just asking you, have you -- are you familiar with second-price auction?

A. Yes.

Q. And was that a Google innovation?

A. A little bit of history is in order.

Q. Okay.

A. So the original notion of a second-price auction is some decades old. It's due to three economists: Vickery, Clarke and Groves, and I believe they got a Nobel Prize for it. And the idea was to better design auctions so that participants lost the incentive to shill bid and gamify the auctions. So let me give a simple -- a very simple example that was the foundation for second-price auctions. Let's say I'm auctioning this bottle of water, and everybody here makes a sealed-bid, okay. And let's say the winning bid -- it's a dollar, somebody else bid 90 cents, 80 cents and so on. So I'll give the bottle to the winner, but the idea of the second-price auction is to not charge them a dollar, but the second highest price which is 90 cents, okay. And the intuition is nontrivial and draws on game theory, and it's actually a fascinating journey.

I set up that background, because then we come to what does it have to do with Google's role in this, right. Prior to Google's entering into this stage, search ads were sold

using a first-price auction, meaning the winner paid what they bid, not the bid below. The upshot was a lot of gamification and shilling, which has actually been captured and published scientific work. And the minute the second-price auction was introduced at Google, all of that went away.

Now, you're going to say wait a minute, Google isn't selling a single bottle of water. There are potentially four ads lodged, so what's really going on. So what Google did was the winner paid the second highest price, the second slot paid the third highest and so on. That auction became known as a generalized second-price auction. And the generalized second-price auction has now been the subject of hundreds of papers of scientific work with lots of variants studied in textbooks, courses and so on.

And I mention this, because there was the second-price auctions before Google, but the implementation in Google AdWords, I would say, had two side effects. First, Google was able to say to ad bidders: Come on in. We'll only charge you for clicks, and we'll never charge you more than you bid. That's number one. The other side effect -- which I actually think is just as important, not just for Google, but for the community, is this led to an instant sort of explosion in an area that's now called competition game theory where computer scientists and game theorists got

together and developed many, many versions.

So that the study of these auctions is very systematic, and has been fairly well developed over the last 15 or 20 years. And that, to me, is actually a profound impact on the technical community.

THE COURT: I'm sorry, what gaming of the auction did the second-price auction -- at a very high level, what did it eliminate?

THE WITNESS: Yes, let me illustrate that further. Let's pretend that you bid a dollar and he bid 90 cents. The gaming that comes about is as you're entering a bid, you're saying should I bid a dollar; let me try and guess what the other person bid and drop my bid to see if I can get away with it, right. So what this led to is a behavior where nobody in the system was bidding the true value, true rational valuation for the bottle of water or the ad slot, right. Game theorists call an auction incentive-compatible if everybody is motivated to bid their true values, and the second-price auction fixes that.

BY MR. SOMMER:

Q. Let me ask you about another innovation that the Court's already heard a little bit about, and that's called keyword match types. Are you familiar with that?

A. I am.

Q. And let's advance to DXD21.012 -- there it is.

First, could you very briefly remind the Court what keyword match types are?

A. Let me develop the setting. Some 10 years prior to keyword match type, I and many colleagues in the industry and in academia were going around saying search challenge is not to match what the user typed, but the intent underlying what they typed, right. And users have a mismatch between their intent and the query they provide, for a number of reasons. They could just mistype it, okay. But let me give you another example. A user has a problem eliminating rodents in their house, and so they want to find traps. They come and type mousetrap, okay. Is the user looking for traps to catch mice or are they looking for theater tickets to a long-running play in London called Mousetrap. Should that depend on their locale; should it depend on time of day even. And those are things -- cases where you have to be very careful about how you take the user's query and match it to what the advertiser might be interested in.

Another example might be the user's perhaps somewhat careless, and instead of typing tennis shoes -- which is what they want, they type court shoes, right. Now, in certain circumstances, that query should trigger an advertisement from an advertiser who offers tennis shoes, right. And so figuring out these semantic matches is the notion of keyword match types. And Google introduced a number of match types

where an advertiser could say yes, please broaden my match so I can reach more of my audience.

Q. Let me just follow up very briefly on the two examples you gave. First, a misspelling. If a user misspells a query and Google can now correct for that, is that good for the user?

A. It's very good for the user I hope. And I hope in the right circumstances, when tastefully done, good for the advertiser as well.

Q. That was my next question, is it good for the advertiser. And I take it if it feeds a relevant ad to an interested user, that's good for both sides; is that fair?

A. That's correct.

Q. And the same thing with semantic matching, by -- I'll give you an example. Women's hats versus hats for women. That was an issue that Google figured out how to resolve with semantic meaning, correct?

A. Correct, but it has to be done right, because that example feels obvious. But if you type in white wine and get ads for red wine, that's not a good experience, right. So it has to be done tastefully, and this is where the technical notions may have come up in prior testimony of precision and recall matter: With what precision are you matching, and how often do you match correctly, right. And that's a delicate balance in the art.

Q. Dr. Raghavan, during your tenure -- early tenure at Google, was there a time you heard from advertisers that Google Ads were difficult to use compared to Facebook, for example?

A. Not early in my tenure at Google, but early in my tenure in Google Ads.

Q. Thank you.

A. My sales team -- our sales teams would come and say that was one of their biggest challenges. Advertisers said: Why don't you make it easy for me; and if you don't, I prefer Facebook ads.

Q. Was that important feedback for you to get?

A. Oh, yes.

Q. And why was that?

A. It's my hope and goal to make our products as useful as possible to all users, including our advertisers.

Q. Does Amazon -- just a quick question on Amazon. Does Amazon also use keywords on search?

A. You mean on search or on search ads? Because they have both -- well, so there's --

Q. I'm really talking about search ads now.

A. Yeah, I was just clarifying.

Q. I apologize.

A. But the answer is yes.

Q. The changes we just discussed, among others -- the

correcting for the misspelling and the semantic meaning, what impact, if any, did that have on Google and its ability to compete with Facebook or Amazon or other platforms?

A. To the extent it was done well, I think it expanded the opportunity to connect -- to be matchmaker more often between users in the right moment and advertisers, and increased advertiser value, hopefully increased user value, and with it, Google revenue as well.

Q. Are you familiar with the references to thinner or thicker when it comes to the auction, the ad auction?

A. I think I understand what those generally mean.

Q. Okay. Do you understand that thicker means more advertisers bidding and thinner is fewer?

A. Let's agree on that terminology.

Q. Okay, good. By correcting misspellings or solving the problem of semantic meaning, did that make the auction thicker?

MR. HAFENBRACK: Objection, leading.

THE COURT: That's overruled.

THE WITNESS: Should I proceed?

THE COURT: You can answer.

THE WITNESS: So it's very hard to make a categorical statement of that nature. This is a point I'll come back to later, because you can always come up with a hypothetical situation. But done right, it will actually have the right

outcomes for all parties: the user, the advertiser and for Google. Done wrong, it could potentially gratuitously thicken an auction, and that would be a bad thing.

BY MR. SOMMER:

Q. I take it that it was Google's intent to do it right?

A. We continue to try and do it right.

Q. By correcting for misspellings -- just the last thing on this, would that have the effect of bringing more advertisers into a particular auction in general?

A. More of the right advertisers, yes.

Q. And does that create -- withdrawn.

How would that relate to the user intent when they put their query in, if you follow where I'm going?

A. Yeah, so let me answer it this way. If the spell correction was done well, it enhances the user's experience by more closely patterning their intent. But if you overdo the spell correction and are careless with it, then you will damage the user experience.

Q. Okay, thank you.

THE COURT: I'm sorry, what do you mean by that?

THE WITNESS: Yeah, so let's say you were to type a query and, you know, it has some matches. But then I correct a large number of the characters in the query, and end up matching it to something that wasn't your intent at all, right. Perhaps the most trivial example is the red and white

wine, right. You type red wine, and I correct enough of the characters to match it to white wine sellers. That's bad for your experience.

BY MR. SOMMER:

Q. What if an advertiser doesn't want to match to something, is there a mechanism for them to address that?

A. There are a couple of ways advertisers can do that. One is they can opt out of some of these broadening mechanisms. The other is they can -- this is a mechanism that they sometimes use. They will put in negative keywords which means -- which is an instruction to us of the form do not match my ads to the following keywords.

Q. Are you familiar with branded keywords versus non-branded keywords?

A. I think I follow the general principle of branded and non-branded keywords.

Q. Okay. Let's start this way: What's a branded keyword, as you understand it?

A. It's a keyword that matches some company's brand, say, Nike.

Q. Let me show you a demonstrative, DXD21.013. In this example, the company is Joanne's Pro Shop. Do you see that?

A. I do.

Q. And do you see the two different pads there extending out from the -- to the right?

A. Joanne's Pro Shop and Tennis Gear Store.

Q. So can you describe the difference between branded and non-branded keyword here, that we're using as this example?

A. So in this slide, someone typing the precise query Joanne's Pro Shop is typing a branded keyword that would match Joanne's Pro Shop. But they could also type Tennis Gear Store, and that may be something that Joanne has bid on and therefore wants to be shown on.

Q. We can take that down. Are there instances when an advertiser might want to bid on a competitor's branded keyword?

A. Well, yes.

Q. And what would some of those circumstances be?

A. Here's the -- let me start with the physical world analogy and then get to the online world, right. The physical world analogy I would offer is you're driving up to a Honda dealership, and there's a billboard for Toyota across the street. So it's similar in it's spherical. In the online world, what often happens is a well-known brand such as Nike is offering their wares, perfectly fair. A less-known brand that you may not have heard of would like to say hey, I exist too, and if you're interested in Nikes, you're probably interested in me, HOKA -- which is a smaller shoe brand. So I would like to bid on the keyword Nike, and

if the user searches for that, give them the opportunity to see the HOKA ad. They may still go away and go to Nike, but at least I would have an opportunity at placement.

Q. In your example, sir, would Nike have any sort of advantage over HOKA in the ad auction?

A. I would say a small advantage. And the reason would be, if you recall, we spoke earlier of the downstream landing page and its match for the keyword at hand as part of the LTV function. In this case, the downstream landing page for Nike is more likely to match the query -- if it's just Nike, then Nike, than the HOKA home page, right. If it's Nike shoes, then the gap narrows a bit between Nike shoes and HOKA shoes. But you get the idea, that there is a slight advantage for Nike.

Q. And would that be incorporated into the quality score?

A. It would -- yes, in the LTV calculation.

Q. Thank you. Let me ask you about another innovation, and if we can go to DXD21.014. We've heard a fair amount about product listing ads or shopping ads.

I take it you're familiar with those?

A. Yeah, I prefer to think of them as product listing ads.

Q. Okay. We've heard different people have different preferences. We'll go with PLAs with you. And again, the

introduction by Google of product listing ads predated your arrival, correct?

A. Oh, yes.

Q. But again, you were aware of it from being in the industry; is that right?

A. I was.

Q. And why was that such a new innovation?

A. Users, when looking for specific product features -- for instance, an electronic device, what is its wattage, et cetera, find it hard to discern that in a bunch of text that's in a text ad, but can easily glean that information by looking at an image and some of the dominant attributes of a product that are presented in this unit. For advertisers, it's sort of creating copy. For every product they had, they'd just upload millions of images and a database of all these product features, and Google can then compose a product listing ad, or a PLA, from the information the advertisers provided.

Q. Let's go to the next slide, DXD21.015. And let's advance to the next -- there we go. Can you describe what we see on this slide, both on the left and on the right?

A. These are instances of PLAs, product listing ads, from many years ago, roughly 15 years ago.

Q. Okay. And the one on the right is more current?

A. The one on the right is a current -- a pretty current

instantiation.

Q. And briefly, how have the PLAs changed over time?

A. There's a couple of things that you'll see right away. Based on user research, we've gone from the vertical ordering of these ads to a carousel, a horizontal carousel. This comes about in part because with smartphones, we find people -- users more able to fling through different ads and pick -- visually cue in on the one they want. Second, the badging is changed.

The final thing I'll point out is this auxiliary content that helps the user decide what product to buy, such as reviews, free shipping and so on. So we find that if there's extra information when added to a PLA, it increases the user's comfort with what they're seeing.

Q. What trends, if any, have you noticed over the last five to seven years between advertisers using text ads versus PLAs?

A. Yeah, the first thing I should point out -- because it's not obvious on this slide, is on a given query, you could have both PLAs and text ads. It's just not visible in this slide, right. As PLAs grew in popularity, advertisers started moving more and more of their budgets from text to PLAs. But then they had to do work, you see, because they had to upload all these images and structured information. So if they did the extra work, they were able to move budgets

to these.

Now, what happens in practice is, depending on the circumstances of a query -- and I'll explain that in just a second, advertisers will freely move money between PLAs and text ads. But the circumstances of a query, it's things like is it the holiday season. Then, for instance, having an annotation such as "free shipping" or "will be delivered by Christmas" helps users make choices. So all of those affect the dynamics of how advertisers behave.

Q. And you mentioned a moment ago that sometimes the search engine results page will show both a text ad and a PLA from the same advertiser; is that right?

A. That's possible.

Q. And does that, from your perspective, mean that those two ad formats are not being transitioned between by advertisers, as you described?

A. I think I said a minute ago that advertisers do transition in near realtime between these types.

Q. Let me ask you, if we go forward in the deck to --

THE COURT: Can I ask another question. We've heard evidence that the text ads, I guess it's on a cost-per-click basis, are more expensive than the PLAs. Can you explain why that is, if that's accurate?

THE WITNESS: It's a very complicated question, and only because they're not uniformly more expensive -- sometimes,

right. Really, what the advertiser cares about in the end is having paid whatever it is they pay, what is the likelihood in volume of the sale that happens at the end of the journey, right. And so they're adjusting their willingness to pay between text and PLAs constantly while observing what gives them the best return on their ad spend, right. So I would say there isn't a simple rule to explain that, well, these -- the one or the more is more expensive. The right way to think about it is which one affords the better return on investment for the advertiser.

BY MR. SOMMER:

Q. And depending on that, is that when the advertiser will, as you said, shift the ad spend from one to the another?

A. They will.

Q. Let's go to the next slide, which is DX21.016. We've highlighted there something called Performance Max. That's something you're familiar with?

A. I am.

Q. Can you briefly describe to the Judge what Performance Max is.

A. I'll try to be brief.

Q. I wasn't trying to emphasize briefly too heavily.

A. Thank you.

Q. But please describe it.

A. A few minutes ago, I mentioned that when I assumed responsibility for our advertising products, one of the biggest complaints -- perhaps the biggest complaint, I heard was how complex it was, to use our advertiser phrasing, products. So I went to the team and said: Look, an advertiser should give us their budget, how much they're willing to spend. They should give us their objectives, like what is the return they want on their ad spend. And the rest should be AI magic. Why are they sitting and having to program the machine with lots of keywords and bids. And some of our larger advertisers have millions of keywords in their campaigns. That's just untenable. A very sophisticated, large advertiser can manage these things, because there are machines doing these things. But for most advertisers, this is way too much work.

So Performance Max was a way to give advertisers a way -- a means to tell us here's what I'm willing to spend on Friday, here's the return I want; I want you, Google, do your magic and ensure that I get the best returns. So that's Performance Max broadly.

Q. Let's go to the next slide, DXD21.017. This is an excerpt from a Google Ads help page. Are you familiar with ads help pages?

A. I am.

Q. And why does Google post those publicly for

advertisers?

A. Like most tech companies, our users -- in this case, our advertisers, want to know how to make use of our products. When they have questions and doubts, they come and check the help pages. So this is a means for communicating to advertisers what Performance Max is all about.

Q. And Your Honor, we've marked this as DX3236.

Are these help pages maintained -- they're put out there publicly in the ordinary course of Google's business; is that right?

A. Yes.

Q. And they're available on the internet; is that fair?

A. Yes.

MR. SOMMER: Your Honor, we offer 3236, DX3236.

MR. HAFENBRACK: One point of clarification. Is this slide 3236?

MR. SOMMER: No, it's in your exhibit binder, the full --

MR. HAFENBRACK: The full. Gotcha, understood. No objection, Your Honor.

THE COURT: So the number's DX3236?

MR. SOMMER: Yes, Your Honor. I think it's the last exhibit in the exhibit binder.

THE COURT: It will be admitted.

(Exhibit DX3236 admitted into evidence)

BY MR. SOMMER:

Q. And on the slide that's up on the screen right now, Dr. Raghavan, there are various words highlighted. But I think you've already described what the goal of Performance Max is, so I'm not going to take you through that. Let me just show you one other demonstrative relating to Performance Max. Can we go forward to DXD21.018.

And again, I'm not asking you to repeat what you've said, but can you describe what we see here?

A. What you see here is Performance Max is a way for an advertiser to come in with a budget and campaign objectives, as I said a minute ago, and not worry about would they be text ads, PLAs or through YouTube or Gmail. It's really a demand to Google to do the right thing and give them the best return on ad spend. And what these arrows are showing basically is all of these delivery vehicles for ads, including Gmail, Maps, et cetera, are available through a single point for the advertiser.

Q. Okay, thank you. I just want to go back one slide to DXD21.016, because at the bottom of this slide that we've been talking about a little bit, there's something that says: "Ongoing NLU innovation." Do you see that?

A. I do.

Q. What does that reference?

A. Yeah, this is an important point. So NLU is a technical acronym for natural language understanding.

Natural language understanding is a subfield of artificial intelligence where we're trying to understand what it is a user is trying to get done, going back to the intent. So the example I'll offer -- I'll offer a small example and then why this is such a big deal. Let's say the user types in HP printer. The merchant says Hewlett Packard model XY3200 or whatever. Notice that what the merchant or the advertiser says and what the users say have nothing in common, and yet we have to perform this feat of natural language understanding, understanding the natural language of the user, and match it to what -- the language in which the advertiser is expressing themselves, okay.

I say this is a feat, because humans express themselves in so many different ways. And that's why you have this subfield of artificial intelligence called NLU. And I point this out, because throughout Google's history, and to an ongoing extent, a large -- easily the majority of our search ads quality work falls in this bucket. I'm distinguishing this from some of the things you've showed above. We have these very impactful things, but this is where a lot of the magic actually happens. And this, together with something else we didn't get into -- you know, it says deep learning for PCDR prediction, are instances where our founder's preoccupation with artificial intelligence came together with the business reality.

And it's a very interesting segment where our ongoing innovations feed off the AI developments and vice versa leading to such developments that we all hear about such as transformers, that I know the world is so excited about -- so generative AI. And so I like to highlight this as a place where we put a lot of effort. It's actually a large part of the magic that goes on in ad matching, and it has this consequence of spurring the field of AI significantly.

Q. Thank you. I want to ask you a couple of questions about some aspects of the ad auction itself. The Court has heard a little bit about how aspects of the ad auction is a black box.

Do you understand that phrase in this context?

A. I think so.

Q. Why does Google not publish all aspects of how its ad auction works?

A. I don't think it would be wise for us to do that, for a bunch of reasons. First, it's a trade secret. And just like Coke doesn't publish its formula, and various others don't, that's one reason. The second reason is publishing ranking functions in all their detail, whether for ads or for organic, makes it easier for large and sophisticated actors to game those functions at the expense of smaller players.

Finally, and perhaps least appreciated of the reasons, is gamification is not just something that good actors do.

There's actually a lot of bad actors out there, large botnets attack our systems. And knowing how to put in an ad with malware or other, it's the kind of thing you could manipulate easily if you knew exactly the function. So there are many reasons, but these are some of the biggest reasons.

Q. Thank you. You used the -- you've used the term a couple of times ROI, or return on investment. In your experience, sir, are advertisers focused on ROI?

A. In my experience, maniacally so.

Q. Maniacally so, is that what you said?

A. Yes.

Q. Okay. And from your experience, sir, are advertisers able to understand their ROI?

A. I think it's fair to say they're able to get a very good estimate of it. Remember that these are statistics, and a computed statistic is close to but not a perfect computation.

Q. How are advertisers able to get a good understanding of their ROI?

A. It depends on the advertiser. The largest and most sophisticated ones have entire teams and robots dedicated to computing this. The simplest example, I think one we touched on earlier briefly, is Amazon is able to see the full flow. So if Amazon places an ad, they get a click, they're able to watch the transaction at the other end. They're able to say

I spent $5 here and I got $60 here. That's a straightforward ROI calculation, right. There are cases -- so anybody who has what I call full funnel visibility -- which Amazon does -- is able to perform such a computation, right.

We, Google, provide tools to advertisers that are not privy to that end transaction. We can say we sent you so many clicks, here was the average price you paid, and now you go figure the rest, right. So there are tools out there -- so those are estimates. The other thing that happens, there are a number of businesses out there -- third parties not affiliated with Google -- that offer services to advertisers that say let me help you compute your ROI, right. As I said, with the exception of the Amazon full funnel flow, very few of these is a perfect computation. But over time, the sophistication in this area has grown.

Q. And in addition to Google providing tools to assist advertisers in assessing ROI, do some of the other platforms provide tools as well?

A. My understanding is that several others do, including Facebook. And in fact, Amazon does to its advertisers.

Q. Let me ask you this question: If all factors remain the same and CPC goes up, what is the impact on ROI?

A. If all factors -- everything is kept flat and CPCs goes up, ROI goes down.

Q. Okay. And from your perspective, sir, are

advertisers -- I think you said maniacally, focused on ROI?

A. Correct.

Q. What would be the impact to Google if, by virtue of raising CPCs, ROI was going down for your advertisers?

A. So let me break that question up, because I think it deserves some careful discussion. So if I may rewind a bit, remember we talked about auctions and the game theory that accompanies them, right. So what I'll take a few seconds is to outline what is the right way to look at any of these changes, including potentially an increase in CPC, right, because it is a hard science.

So my favorite way of being able to assess any change is to have a game theoretic analysis. And this results in theorems that said this is what happens to user impact, advertisers and the matchmaker -- in this case, Google. Now, such theorems are possible in a few cases like generalized second-price auctions, but not in all cases; some of these changes will not. So the next tool we have is to run live experiments where we take a fraction of traffic and try a change and see what happens. When we run these experiments, we look at a whole bunch of variables -- CPC being one of them, return on advertiser spend, Google revenue. These are all variables we study, okay. And roughly the picture -- I want to take away two conclusions, and then I promise to answer your question.

The first thing to think about any change in auction dynamics -- or for that matter, even some of the matching that we talked about, the keyword matching, natural language understanding, will result in observed -- observed from experiment -- changes to some of these things. I say observed, unless you can prove a theorem about it, right.

Q. Unless, I'm sorry?

A. Unless you could have proved a theorem about it, which in a few cases we can. So when you run the experiment, you will see some change in CPC and revenue, et cetera, okay. First, those are point-in-time observations, meaning you're taking a particular experiment and scenario and seeing what happens. And based on that, you'll sometimes launch one of these features, right. And then we have to observe over a period of time, often three to six months, what actually happens, because users react, advertisers react. And so computing the fixed point of what happens takes a while.

The second thing I would caution is I don't think it's a good idea to look at launches in isolation. Yes, it's good to make a launch decision. But really, my instruction to the team is to look at a sequence of launches, put them together, okay. And all of it is to say your question's not invalid, but I'm trying to say that the way to consider these auction changes or keyword match changes is somewhat harder and deeper.

Now, the short version of it: If CPC increased -- that's the denominator for the advertiser, so their return on investment would go down.

Q. Do you have insight, from your position at Google, into whether advertisers using Google are satisfied with the ROI they are getting by placing ads on Google?

A. In general terms I would say yes, but they're always demanding better ROI.

Q. You just referred to various ad launches. Does Google make many ads launches in the course of a year, quality ads launches?

A. When you say quality ads launches, all of the things that were in that picture that we saw. I would say big and small, of the order of hundreds of launches a year.

Q. Hundreds of launches. And do each of those come to you for your review or approval?

A. No.

Q. I wanted to pick up on the point you made about looking at launches in the aggregate. Let's go to the next slide, DXD21.020. Now, a portion of this, sir, has been redacted because it's got a bunch of numbers. So if you open up your binder -- your demonstrative binder, you'll be able to see it's, in the lower right-hand corner, DXD21.020.

A. Yes, I do see it.

Q. You're there, great. So again, I'd just caution you

not to mention some of the numbers, okay, in the boxes.

Are you familiar with the chart depicted in this demonstrative?

A. Not any of the detail. Actually, the letters are small, sorry.

Q. But you're familiar with the type of chart it is?

A. Yes.

Q. Let's start that way. Do you see at the top where it says: "AQ is creating value. Negative excess CPC." Do you see that?

A. I do.

Q. What does that mean?

A. The slide header refers to the cumulative impact of roughly a dozen launches. I'm not reading any particular numbers, but the cumulative impact seems to say that CPC has come down from the superposition of these launches.

Q. And what does AQ refer to in this?

A. Oh, AQ refers -- is how the ads quality team refers to themselves.

Q. So that's ads quality, okay. And then the negative excess CPC, that refers to CPCs coming down in the aggregate from these launches?

A. In the aggregate.

Q. Now, this document, I will tell you, is from 2020. Is your testimony about these aggregate launches and what

happens, is that still true today, that you look at these launches in the aggregate to assess what they're doing and then look at it over time?

A. Correct, and I'm contending that's the right way to look at it.

Q. Are there some launches that result in CPCs going up?

A. There are.

Q. Does -- and this was asked of a prior witness. Does Google notify all of its advertisers in advance of a launch to let the advertiser know whether the forecast is that their CPC will go up or down or stay the same?

A. We do not.

Q. Is that -- well, let me back it up one second. Are there some times when Google does announce certain launches?

A. So, two things. Number one, yes, for some of our biggest launches. But even there, it would be really difficult to say to every one of 3,000,000 advertisers: Here's what we think will happen to you, because it is such a hard dynamic system to estimate in this fashion.

Q. You beat me to it. 3,000,000 advertisers on Google, correct?

A. Correct, roughly.

Q. And any particular launch could have a different -- theoretically could have a different impact on all 3,000,000; isn't that right?

A. Oh, quite likely will.

Q. So is it feasible for Google to try to forecast and tell each advertiser what a launch might or might not do for each individual advertiser?

A. Not with fidelity.

Q. At the end of the day, sir, notwithstanding any aggregate launch -- withdrawn.

At the end of the day, notwithstanding any aggregate increase in CPC or decrease in CPC, who decides how much to spend on an ad?

A. The advertiser.

Q. You've described to the Court now over several -- many years that Google has invested significant resources in improving its ad auction and the overall experience for advertisers.

Why does Google invest so much in that process, to make the ads auction best of breed, for lack of a better term?

MR. HAFENBRACK: Objection, leading.

BY MR. SOMMER:

Q. Why does Google invest so much money?

THE COURT: I missed the first question that was objected to, but what was the second question?

BY MR. SOMMER:

Q. The second question is why does Google invest so much in its ad auctions platform?

THE COURT: You can answer.

THE WITNESS: I can answer, okay. Because advertisers who are focused on return on ad spend have other places to take their budgets. If we don't make it easy for them and if we don't provide value to them, they evaporate.

BY MR. SOMMER:

Q. And when you talk about other places, you're talking about the competitors you've mentioned before?

A. I think, yeah, I've mentioned a couple.

Q. Okay. We've talked about -- I want to turn now to some of the competitors Google has when it comes to ads. We talked about on the user side, and now I want to talk about on the ads side.

Does Google compete with Amazon for ad spend from advertisers?

A. Absolutely.

Q. Does it compete with Meta and its platforms?

A. Yes.

Q. Does it compete with TikTok?

A. Oh, yes.

Q. I want to start with some of the social platforms. Facebook, Instagram, TikTok, what makes those social platforms such significant competitors for Google for ad spend?

A. Yeah, you may recall earlier today I talked about

latent intent, and the fact that people, especially young people, are spending many hours each day. And over the course of those hours, they're emitting signals of latent intent so that volume of data is put together extremely effectively by TikTok, by Instagram, Facebook to glean insights about when a user is ready to purchase whatever they have a latent intent for. Although on the face of it, it's distinctive from the patent intent they express at a Google or a Bing, right. In the end, what the advertiser cares about is whether they were able to make a sale through their ad spend. And so this vast accumulation and divining of latent intent is what makes TikTok and Instagram and others so powerful.

Q. How does Meta's platforms, how do they compare in terms of digital ads business to Google in terms of size?

A. They're smaller than us, but they've been fairly consistently -- with few exceptions in the last years, been growing faster than us. So they're effectively taking share from us.

Q. Does Google perform competitive analyses on Facebook in the digital advertising space in the ordinary course of its business?

A. There are various people who look at different aspects of a player like Facebook. But we also hear from advertisers what they're seeing. One indication we've been

getting fairly consistent is from one of the largest marketplace platforms, it's a company by the name Shopify. Shopify has been telling us that their merchants are consistently getting more traffic by advertising on Facebook than from us.

Q. In your exhibit binder as opposed to the demonstrative binder, the second binder there, there's an exhibit marked DX163. It's a slide deck titled 2020 Global Ads Marketing Plan: PR Review. Can you find that?

A. I see that.

Q. Okay. And is this the type of competitive analysis that Google does in the ordinary course?

THE COURT: I'm sorry, where are you again?

MR. SOMMER: Your Honor, DX163.

THE COURT: Okay, sorry about that.

THE WITNESS: This is a case where, as I --

BY MR. SOMMER:

Q. I just want to ask you a couple what's called foundation questions, so just stick with me for one second. This is a deck you're familiar with, correct?

A. Somewhat, vaguely familiar with it.

Q. These types of analyses are done at Google; is that right?

A. Yes.

Q. And they're kept in the records of Google?

A. Yes.

Q. In case I ask you to dust one off and show it to me; is that right?

A. Yeah, yeah.

MR. SOMMER: Your Honor, we offer DX163 into evidence. And also, there's a native version, DX163A, that's more legible that we'll offer with it.

MR. HAFENBRACK: Your Honor, we have no objection except to the extent that this document does contain some embedded hearsay.

MR. SOMMER: Same ground rules, that's fine.

MR. HAFENBRACK: Yeah, so same ground rules on the standing objection, we're fine with that.

THE COURT: Okay, so it will be admitted.

(Exhibits DX163 and DX163A admitted into evidence)

BY MR. SOMMER:

Q. Now, what is being reviewed and looked at in this particular deck, sir?

A. So this deck, as best as I can reconstruct, is the marketing team's -- just one of the teams at Google, plan to compete more effectively with Facebook. It says 2020, so in October 2019. So they were making a proposal for the year 2020 in the fall of 2019.

Q. Could you turn to page five of this, it's .005. Again, I'm just going to alert you that some of this has been

redacted.

But at a high level, Dr. Raghavan, what does this show in terms of Google's focus on Facebook as a competitor for digital advertising dollars?

A. I think what we're seeing here, it's the marketing team is saying that with Facebook being the strong competitor it is, we need to solve for it.

Q. As you said, this is late 2019. What was Google's conclusion in late 2019 as to the growth of the online ads industry at that time?

A. Growth at that time was decelerating in a secular manner.

Q. And did something happen shortly after that that changed the trajectory of that industry?

A. Oh, yes.

Q. What was that?

A. It was COVID.

Q. What did that -- what impact did that have?

A. COVID messed up many of these forecasts. It began by jamming supply chains to the point where it wasn't interesting to advertise because you couldn't get goods to consumers anyways. So that was roughly the movie of the first half of 2020. But then, as supply chains got unclogged, you had this unprecedented massive shift of offline commercial activity to online platforms. So you had

this amazing increase for a few quarters in online marketing.

Q. I just want to ask you one additional question on this slide on page five. On the right side, do you see the bar chart there?

A. I do.

Q. And again, without reading any of the numbers, what is the general conclusion reached by Google as a result of this particular analysis?

A. Qualitatively, I'd say our marketing team was finding that advertisers preferred Facebook to Google.

Q. And how does an analysis like this impact you in your job and what you direct folks to do in terms of additional innovation on ads products?

A. We touched on some of this earlier, but the push to my team was go back and build a better product to better compete with Facebook.

Q. What, if anything, has changed since this analysis in regard to Google's perception of its competition with Facebook for digital ad budgets?

A. Substantively, it's the same dynamic as before.

Q. They're still out there fighting with you?

A. Yeah, I think we need to be a little careful, because we were using the word Facebook, but increasingly it's Meta -- which they re-branded themselves. But that umbrella includes Instagram which has been one of their most fast

growing offer offerings.

Q. Let's take that down. Let me -- back on the demonstrative deck, can we turn to DXD21.022.

What do we see here, Dr. Raghavan, with respect to TikTok?

MR. HAFENBRACK: Your Honor --

THE WITNESS: This is a visible --

MR. HAFENBRACK: Your Honor, I apologize, but we object to this one. These are hearsay statements from non-Google employees. We don't think this is a proper basis to question the witness with.

THE COURT: Well, let me see what the question's going to be, so go ahead.

BY MR. SOMMER:

Q. Are you familiar with articles about TikTok and a buzz about TikTok over the last couple of years?

A. Abundantly so.

Q. Yeah, okay. And so in your position at Google, is that something you care about?

A. Yes.

Q. And when you see articles such as these, does that influence how you think about a competitor like TikTok and what Google's strategy should be?

A. Very much so.

Q. So why don't you just take us through your thinking

about seeing some of these headlines.

A. It's beyond the headlines, just to be clear. Because TikTok does not report as a public company in the U.S., we've been, like many of us, trying to estimate their ad revenue growth. And we look at a number of these sources, such as the ones represented here, to try and estimate how quickly they're growing. And the conclusion I have to arrive at is they're growing faster than us. And it's also clear that they have an extremely compelling product, especially for a younger demographic.

And so all these various socials -- including eMarketer there, which is a fairly good source, telling us that Gen Z adults start their online product searches on TikTok rather than Bing or Google is deeply concerning, and we have to figure out how to respond.

Q. How about the one -- the headline on the right, that was just before this trial began. What's that about?

A. So --

MR. HAFENBRACK: Same objection, Your Honor. This is a hearsay statement from --

BY MR. SOMMER:

Q. I'll rephrase, I'll rephrase. Did there come a time, Dr. Raghavan, where you heard or learned that TikTok had introduced an e-commerce site within its platform?

A. Yes.

Q. And what was your understanding of that new e-commerce platform that TikTok introduced?

A. So they were clearly going towards -- and TikTok is also a partner, but they were going towards the work where a user could initiate their commercial need on TikTok and complete the shopping task right there on TikTok. So you have, in some sense, the best of the Instagram world where you divine latent intent, inspire a purchase, but then you close the loop -- so Amazon on the other side. So you have the best of Instagram and Amazon coming together in a very compelling capability.

Q. We can take that down. We've talked about some of the social platforms on the ads side. Let me just quickly go back to Amazon on the ads side.

Does Google also do competitive analyses with respect to Amazon as a competitor to its advertising business?

A. There are many analyses of Amazon at Google, yeah.

Q. Let me ask you to find in your binder, the thicker binder, DX126. It's actually the first one in the binder.

Do you see that?

A. One moment. So this binder?

Q. Yeah, I think it's -- it says Amazon Overview on the first page. It's the first exhibit.

A. Oh, yeah, sorry.

Q. Are you familiar with this type of analysis done at

Google?

A. This is one of many decks that have gone by me regarding Amazon, yes.

MR. SOMMER: Your Honor, we offer DX126.

MR. HAFENBRACK: No objection, Your Honor, subject to the same standing of that hearsay objection.

THE COURT: So 126 will be admitted.

(Exhibit DX126 admitted into evidence)

BY MR. SOMMER:

Q. And generally, Dr. Raghavan, can you describe what the purpose of this deck was?

A. The purpose of this deck was for the authors to look at Amazon's ads business -- I'm looking at the date, in 2018. At that time, numerically it still felt small, but these authors were raising the possibility that it was one of the fastest growing ads businesses.

Q. Has anything happened since 2018 with Amazon's ads business that has changed that view, that it's one of the fastest growing ads businesses?

A. They're one of the very fastest growing, yes, certainly growing faster than Google. So some of the prognoses by these authors is coming true.

Q. If you could just turn to page -- we're going to go through a few pages really quickly before our afternoon break. If you could turn to page five of the document. And

again, there's some redactions with boxes on this one. Just look up when you're there.

A. Okay.

Q. Again, without disclosing any of the specific information, what is the analysis going on in this slide?

A. So the authors are trying to take the valuation of Amazon and break it down into its constituent businesses.

Q. Turn to page 19 of the exhibit, .019.

A. I'm there.

MR. SOMMER: Actually, Your Honor, I think this page is no longer confidential, so we can show this one.

THE COURT: What's the number again?

BY MR. SOMMER:

Q. This is the same exhibit, it's at page .019. It's Exhibit DX126.

What's being addressed here, sir? I'm under the heading Risks from Amazon.

A. I think the authors are talking about areas where Amazon and Google compete more or less directly.

Q. So it says: "Google and Amazon have tons of overlapping products," and then there's a list below that. And we see some of the ones we've heard a lot about in this case: We see search ads, PLAs; we see display ads, we see video content.

A. Ad platforms is one.

Q. Right, thank you, ad platforms. And so is the point here that these are various products that both Google and Amazon are out there competing for ad spend?

A. Both of them offer this. An advertiser sees both.

Q. Just turn to page nine in the same exhibit. Let's take that down for a second because there's a red box on it. Is that now unredacted? Okay, let's just leave that one down.

What's being analyzed on page nine, sir?

A. It's talking about Amazon's ad business.

Q. In the years since this analysis was done, Dr. Raghavan, have you and your team continued to watch Amazon's ad business grow?

A. We have continued to watch it grow.

Q. And let me show you in a demonstrative, DXD21.023. Is this the type of article you have seen from time to time over the past several years about Amazon?

A. Increasingly so.

Q. And what impact has that had on you in terms of your view of the competitiveness of Amazon vis-a-vis Google?

A. I think they're doing a great job of using their closed loop to attract ad dollars in a way we cannot because we don't have a closed loop.

Q. And just to quickly define closed loop for the Court -- and that may have come up, but just to make sure.

A. It came up briefly. It's the idea that a user who shows up on Amazon and searches for a product, Amazon knows their trajectory all the way to the cart and the transaction, and so is able to attribute to an ad click on Amazon a dollar volume of transactions.

Q. Let's pull up DXD3.005. And again, this is eMarketer data that you described. You've mentioned a couple of times that Google's -- Google has lost out to some of these competitors over recent years; is that right?

A. I did.

Q. And if we look at this chart, Google is in green, correct?

MR. HAFENBRACK: Your Honor, we'd object to questioning the witness based on this. We understand this is prepared by an expert who is going to be testifying pretty soon before the Court, this is not an ordinary course document.

MR. SOMMER: I'm not offering it as such. I'm offering it to elicit from Dr. Raghavan his view of the competitors that Google is dealing with in this industry.

THE COURT: I'm sorry, is this already -- I think we've seen this before, haven't we?

MR. SOMMER: Yes, Judge. This was --

THE COURT: Was it not admitted?

MR. SOMMER: This was offered, and then when one or the other plaintiffs objected, we said we would offer it with the

witness who actually prepared it. So we offered it subject to that at that time, and that's still what's going to happen based on my expectation.

MR. HAFENBRACK: It's a document prepared by their witness -- by their expert for this litigation and not an ordinary course document.

MR. SOMMER: Again, I'm not offering it --

THE COURT: Hang on, hang on, hang on. Let's get one thing clear, just because it's not an ordinary course document doesn't mean it can't be presented to a witness. So let's get that out of the way, one. Two, what are you going to ask him? I mean, if you're going to ask him about the shares, then that may not be something he knows about.

But what's the question that's going to be asked?

MR. SOMMER: Just trends that he's personally aware of that are made quite visual by this chart. I mean, I could do it without the chart, but quite honestly it's easier to follow with the chart.

THE COURT: Well, why don't you -- it's fine. I'm not going to seek to admit it at this point. If you want to just ask him whether this chart in general terms reflects his observations, then he can certainly --

MR. SOMMER: I was going to even make it narrower than that, starting --

THE COURT: Fine.

BY MR. SOMMER:

Q. -- with Google, his knowledge of Google.

So Dr. Raghavan, if we look at this chart, we see that over the past seven or so years, Google's market share has slowly declined. Do you see that?

A. I do.

Q. And to what do you attribute that?

A. So let me just point out something to the Court before there's any confusion, because this is also a period during which the pie of digital advertising has grown significantly. So that the shrinkage of Google's share is not at odds with any financial performance of Google, any numbers that you see.

Q. You beat me to the punch again.

A. So that's important to understand.

Q. Let me back it up, ask two quick questions, and then I'll get back to my question. So the digital advertising industry as a whole is growing, correct, so there's more ad spend?

A. Yep.

Q. And so when we see decline here on Google's part, does that indicate shrinking revenues in a growing market?

A. It does not.

Q. So to what do you attribute that Google is losing market share?

A. It's clear without doubt from the chart that the big winners, from all we can see, are Amazon. And for the most part, barring a little bit of slack in the middle, Meta/Facebook.

Q. And you've discussed TikTok a little. If you look at the pink one, like the fifth -- if you go to the 2022 column, the fifth one up is pink and that's TikTok.

That doesn't even appear on 2019, correct?

A. TikTok's rise has been mercurial, and it's now actually visible on this chart. And I expect it to grow again at the expense of some of the others.

MR. SOMMER: Judge, is this a good time for the afternoon break?

THE COURT: Sure. How much longer in your direct exam?

MR. SOMMER: Less than half an hour, Your Honor.

THE COURT: All right. So let's go ahead and take our afternoon break. We will return at 3:15. See everybody shortly.

(Recess taken at 2:59 p.m.)

(Back on the record at 3:17 p.m.)

THE COURT: Welcome back, everybody.

Mr. Sommer, whenever you're ready.

BY MR. SOMMER:

Q. Dr. Raghavan, just two last topics that I want to ask you about. The first one --

THE COURT: Mr. Sommer -- oh, go ahead. I was going to ask somebody to shut the door. Thank you.

Go ahead, Mr. Sommer.

BY MR. SOMMER:

Q. The first one you actually briefly mentioned a while ago, artificial intelligence?

A. I did.

Q. How long has Google been using some form of artificial intelligence in its products?

A. Between 15 and 20 years now.

Q. So it's not an entirely new thing for Google; is that right?

A. The field is about 75 years old, and at Google it's about 20.

Q. Can you briefly describe to the Court some of Google's recent developments in the field of artificial intelligence?

A. There's a couple that I would especially highlight. There's a paradigm called reinforcement learning that has come into great use of late. The first artifact that was visible to the world kind of blew me away, was when one of our systems beat the world champion at Go.

Q. At what?

A. At the game of Go, which I did not think was feasible in my lifetime. But then that wasn't just some pastime, the

successor to that system solved the protein folding problem -- which is of humongous importance to medicine and drug discovery. To put that in perspective, the protein folding problem takes a protein and tells us how it sits in three-dimensional space so it can be used for therapies.

Typically, folding of protein is a biology PhD thesis. And AlphaFold, our program, folded about 200,000,000 of these at one shot, and it's now in the hands of drug discovery. That's something I'm really proud of. The second has to do with techniques from what are called deep neuralnets. In particular, a family of deep neuralnets that are called transformers that we published, I would say, 2016 or 2017. And what these transformers do is take an input and spit out an output in a way that transforms an input potentially from a user into an output. The input could be a sentence, the output could be a paragraph, it could be an image. It's very exciting technology.

Q. Google's work on transformers, did it publicly publish that?

A. Yes.

Q. Why?

A. Because it's breakthrough science, and we have a tradition to publish breakthrough science.

Q. Are you familiar with something called ChatGPT?

A. Yes.

Q. To what extent, if any, did that incorporate Google's transformer work?

A. The second of the Ts in ChatGPT is transformer, and I think they made adroit use of transformer technology.

Q. You're familiar with the term generative AI?

A. That's a term that's commonly used.

Q. What does that refer to?

A. The idea of using transformers to generate artifacts which could be -- as I said, it could be a paragraph, it could be an image, in response to a stimulus which could also be an image, but it could also be two words.

Q. In I think it was February of last year when ChatGPT was released, there was an enormous buzz. What impact, if any, have you seen from this -- now this generative AI having on both the search side and the ads side?

A. Let me take two things apart, right. So ChatGPT was, I think, introduced the previous December, and immediately got caught up in the popular site -- you know, a thing you could chat with, very engaging experience. Wonderful stuff, right. But I think the question you were asking has to do with what transformers have to do with search or potentially search advertising. We've been using transformers in our search stack for over five years at this point. But visible artifacts didn't come to light until recent.

So let me take a moment to explain that. It won't

surprise many of you if I gave you the following statistic: Namely, 99.3 percent of all search queries contain a noun. And we were serving those queries fine, but user expectations increased to the point where every query had multiple nouns. So for instance, they said "small vacuum cleaner" -- or "vacuum cleaner for a small apartment with pets." And to make sense of that query, whether the user wants an apartment, a vacuum cleaner or a pet, took transformer technology embedded in our search engine to do the understanding of the query. This ties to the natural language understanding I said.

So we brought that in in 2018, and have been using it for document and query understanding for a while, okay. ChatGPT was a change, because it put the transformer technology directly in view of the user, something we'd been testing previously. And our sense was it was not quite yet responsible to put that technology out in front of users because of concerns about factuality and toxicity. Factuality meaning these things get responses wrong more often than we would tolerate at Google. And toxicity, they can sometimes go on a rant about something. So we were keeping it behind the covers, but were gradually developing it.

We've now put it out in the market on a limited basis -- I believe only in the U.S., Japan and India at this point,

but with all sorts of caveats on how things can go wrong. Because we're still not completely certain in our responsibility in doing this.

Q. On the Microsoft Bing side --

THE COURT: I'm sorry, can I interrupt. What you were just discussing, are you referring to the Bard product or something else?

THE WITNESS: Okay, two answers. So Bard is where you directly interact with the language model, much as you would with ChatGPT. ChatGPT is built on a bunch of functionality; Bard is built on a bunch of functionality. In addition, within the search product, what we now do is provide what we call a generative experience; which is you still get the search results that you would normally get, but we preface it with something of an abstract, of here's what you're about to see. We call it the search generative experience, and it's only available in what we call the Search Labs. So users have to opt in saying yes, I know I'm getting into difficult territory. So both are out in the marker right now.

BY MR. SOMMER:

Q. I was just going to ask, to what extent has this new technology been implemented in any way on the ads side?

A. On the ads side, we have -- the first concrete instantiation which we announced, I believe, at the end of May was an offering where an advertiser can come in, and

instead of thinking about exactly what creative I should write for my company or my product, they point Google to their website. And we grab the website, feed it into the language model, the transformer, and it comes back and says: Here are half a dozen potential creatives you could use for advertising, make sure they're okay. And once you approve some subset of them, we will run experiments to see which one performs the best for your return. So in that sense, transformers have...

Q. And is there an impact on the search side as opposed to the advertising side that you have either seen or are starting to see?

A. An impact of transformer technology, yeah, it's the thing I described all the way leading up to the Judge's question. Which is, we were using it within the stack, but now we're giving that synthesized abstract of here's the search results page that you're about to see, but in a limited labs artifact.

Q. Thank you. All right, last topic.

THE COURT: I'm sorry to interrupt. When you say synthesized abstract, is that something that would also -- would that be a result produced in response to a commercial query or to a non-commercial query or any query?

THE WITNESS: Any query -- actually, let me be careful how I answer that, right. So we assess the quality of the

synthetic responses on various families of queries. In some families, we feel good about the result, in some other families we don't. So for instance, if the user appears to be asking for legal advice, we would probably pull back and say, you know, we don't want to be making up stuff about the law. If it's medical advice, we are similarly circumspect, right.

So for commercial queries, yes, we will say here are strollers you can purchase or whatever. But for many query families, we pull back because we don't as yet feel good about the quality of what we're doing.

THE COURT: So when you say an abstract, do you mean to say a written narrative of some kind; is that what you're referring to?

THE WITNESS: It typically will have a written summary with corroborative links; it will have some images; and it might have a table occasionally. So those are the elements that go into the abstract.

THE COURT: Thank you.

BY MR. SOMMER:

Q. Last topic I want to cover with you, it's a brief one, and that's privacy. There's going to be a different Google witness who will cover that more extensively, but there are a couple of questions I want to ask you about privacy.

What is your involvement in Google's privacy efforts?

A. It's a couple of things. One, for the products I directly oversee, I am responsible for the policies we adopt. But I also serve on a cross-company privacy council, which is a bunch of senior leaders whose job it is to coordinate these policies across different parts of the company, and to ensure that we remain in good compliance with regulations.

Q. What considerations does Google take into account in determining whether and how to implement changes to its privacy protections?

A. By far, the biggest factor that I always push for is user research, which is what is it our users have come to expect. And I will say user expectations have changed over time, especially beginning about five, six years ago when things like Cambridge Analytica came to light. So we have to react to how users see online tech platforms, and so that's the biggest consideration. The second thing we look at is will a proposed privacy change impact the user's experience negatively in any way.

So, as an example, for a user who queries for plumber, you have to give them plumbers in their vicinity. And if we don't know where they are, then it's going to be very hard to give them useful plumbers. I don't want to give them plumbers in Australia when they're here, right. So we assess the user impact. In all cases, we also ensure that we can

train various models for both search ranking and ad ranking, and keep them fresh and useful to users and advertisers.

Q. How, if at all, do the privacy practices of competing companies impact Google's analysis of whether and how to implement changes to its own privacy protections?

A. We -- well, we have access to them, we look at them. But to me, that's not the principle dimension to look at here. It's what our users want, and how we can keep our products relevant to our users and advertisers.

Q. Let me put up on the screen what's in evidence already as UPX501, and if you can just highlight the top there.

This is an e-mail from you to Benedict Gomes in June of 2019?

A. Yes.

Q. And you've had a chance to review this e-mail before, correct?

A. I have.

Q. Okay.

A. But let me keep it in front of me.

Q. Yeah, I hope we have it in the binder. Let me just check.

A. I see it.

Q. Yeah, UPX501.

A. Yes.

Q. Do you need a moment to refresh your memory on it or should I proceed?

A. I think we can proceed.

Q. I'll push forward. What's the issue here? What's being discussed in this e-mail exchange?

A. So this was a discussion that came through a forum we had at that time called the Consumer Council that consisted of, well, all the addressees on this e-mail: Ben Gomes, myself, Jen Fitzpatrick and Cory Ondrejka. And the proposal was that a competitor was making some privacy changes, and suggesting that we were failing to make those privacy changes.

Q. Let me stop you for one moment. Who was the competitor?

A. In this case, it was DuckDuckGo.

Q. Okay, please continue.

A. And the team that came forward with the proposal said we need to do exactly what they're doing. And my pushback was maybe we do, maybe we don't, but I'd like to see the data on the impact on users, and on our ability to build a good search and search ad system.

Q. Let me stop you there for a moment. Can we just highlight the top e-mail here that's Dr. Raghavan's e-mail. Go ahead.

A. Yeah, so my advice, my feedback was this is an

important area, and it's captured very succinctly in the words "space of private search," right. And I was seeking far more careful data and analysis to see what it is we could do to serve users the best.

Q. Let me -- I want to put up a chart that was sent with the e-mail, which is in evidence as -- at page 4420 of this same exhibit, I believe -- I'm sorry, UPX811.

A. I see that.

Q. At 4420.

A. 811?

Q. Yeah, it will be up on the screen in a second, and I think we can do it from there.

A. Okay, good.

Q. Can you see it on the screen?

A. I do.

Q. Do you remember this chart?

A. I do.

Q. And what does this chart -- this came to you as part of this same proposal, is that right, or in connection with the proposal?

A. In that Consumer Council meeting, yeah.

Q. And what does the chart on the right show, what is it trying to show?

A. So the team was arguing that there were features DuckDuckGo had implemented and marketed that Google had not

implemented, and was arguing that we replicate those features.

Q. I just want to go quickly through the features -- at least the ones that -- the X under Google, does that represent that Google does not have that feature at that time?

A. Or not in quite the same way, because you'll see the words "eventually expires" in some cases. So it does not replicate the features, that's correct.

Q. Let's just go through each of them quickly. First, does Google log the user's IP address?

A. It does.

Q. And why?

A. A good example is the example I just gave, which is if you're looking for a plumber, one of the best signals of your coarse location is your IP address. And I want to give you plumbers in your locale, within a few square miles or whatever.

Q. Okay.

A. Another reason where IP address can be useful is looking at sequences of events with IP address and some of these others gives us excellent signals to detect botnets and fraudulent clicks. And I didn't want to lose that ability in a hurry.

Q. Can you explain, in general terms, how IP addresses

are used to combat botnets or spam or other bad things?

A. Yeah, when these attacks happen, typically a system combs through the logs and detects a certain recurrent pattern that a certain IP address is engaging in behavior at very predictable and periodic intervals. I don't want to go too much into this, because there's a lot --

Q. That would defeat the point.

A. Sort of. But that was a very simple way. Analysis of logs with IP addresses can indicate to us that a fraudulent attack is underway.

Q. How about for security, is there an aspect of saving IP addresses that is for security, user security?

A. It is useful in some ways to secure a user without excessively annoying them. You know, that, again, goes to both the IP address and the third row cookie ID where we sometimes know that it's the same user who's authenticated themselves recently to us. On the other hand, if I appear as a user today here, and hours later appear in Armenia, then that's a signal to our systems that something's going on.

Q. Let me go to the second item on this list, which is user agent. First, what's user agent?

A. It's an indication of what kind of client the user is using: is it a Safari browser perhaps or Edge browser, is it the Chrome browser, et cetera.

Q. Does Google log the user agent?

A. We do.

Q. Why?

A. Partly in continuation of the previous point on detecting bad actors. But also, the user agent in some cases can tell us this user is on a browser but on a mobile device. And so the aspect ratio with which we format our output should change depending on what kind of user agent it is, so that's one more reason.

Q. In other words, if I'm on a mobile device, that might have some impact on the results I get?

A. And how they're laid out in front of you.

Q. Got it. And then the third item refers to cookie IDs. Does Google log cookie IDs?

A. Yes.

Q. And why does it do that?

A. So the simplest reason is the one I gave you earlier, which is to not constantly annoy you to re-authenticate. There are a couple of other reasons. For instance, Google search itself has minimal personalization, but in your suggestions we do personalize your recent activity, your recent query activity. Cookies are a good way to keep track of that.

Q. Does Google save click and query to a user ID?

A. Click and query to a user ID, yes, and for signed in users.

Q. And why does it do that?

A. I mean, you're saying doesn't save, I think -- or sorry, maybe you should repeat the question.

Q. Well, in the context of this slide, I'm reading it as DuckDuckGo doesn't save, Google has a checkmark next to it which I assume means doesn't save?

A. Yeah.

Q. Then there's words under it. If you could just explain those to the Court.

A. Oh, those words simply mean that if you're not signed in, there is no user ID to log against.

Q. And how about the last one: "Doesn't target search ads based on search history." What does Google do or do not do in that regard?

A. So our search ads can adapt to your search history, but the user has a bunch of controls to turn that off. They can decree that all search ads personalization be off. We also provide them capabilities, as users, to come in and say: I don't want to see any ads of a certain topic. It's an interface we call My Ad Center. So it's don't personalize in these categories I consider sensitive. So there are various controls we give users, so that's what we mean here.

Q. Did Google implement the proposal that came to you in this DDG deck?

A. Not in the form it was proposed, no.

Q. Has Google adopted privacy policies that mirror DuckDuckGo?

A. No.

Q. Why not?

A. Going back to where we began, the right thing to do is look for what our users are seeking and give them those controls. Our user research suggested a few things. One that I just mentioned on ads personalization. Another thing we learned was users sometimes will forget that they set or did not set something. But in the instant, they sometimes will have some activity, and then they say oops, I wish Google would forget my last 15 minutes, whatever I did. And so we give a facility to turn off your last 15 minutes of activity. And those were things that we felt were user-impactful, and we do allow that.

Q. And apart from what DuckDuckGo is doing, has Google implemented its own changes to address privacy issues over the past several years?

A. I think I gave you two of the examples. There were a few others. One, we've said to all our incoming users that their location history and their search history will be automatically deleted after 18 months, but the user themselves can elect to delete it all and make us not remember any of it. So these are all controls we've been using.

Q. And finally, I take it Google is also constantly monitoring anything from any regulator in terms of new privacy policies in response to that as well?

A. Inevitably, yes.

MR. SOMMER: Thank you, Your Honor. No further questions.

THE COURT: All right. Why don't we begin with cross-examination.

CROSS-EXAMINATION OF PRABHAKAR RAGHAVAN

BY MR. HAFENBRACK:

Q. Your Honor, Joshua Hafenbrack for the United States. Dr. Raghavan, good afternoon.

A. Good afternoon.

Q. It is a pleasure to meet you.

A. Likewise.

Q. I represent the United States, I'll be asking you a few questions this afternoon. You mentioned -- and I'm not sure you spelled this out in your direct, the products that roll up to you. What products do you oversee?

A. Google Search; Google's GO division which includes Maps and Waze; Google Assistant which includes Bard; Google's Shopping team, Payments team and the Ads team.

Q. And do you oversee Google Search as well?

A. Yes, that was my first --

Q. Oh, got you. I missed that, okay. And am I correct

that you have been the head of Google Ads since 2018, and the head of both Google Ads and Google Search since 2020?

A. Correct.

Q. You testified on direct about -- on your direct examination about competition that Google faces from social media sites and from vertical search engines.

Do you recall that?

A. I do.

Q. Let's -- I have a few questions about TikTok, since you mentioned TikTok at various points in your direct testimony.

Are you, yourself, a user of the TikTok application, Dr. Raghavan?

A. Not a frequent user, I'll confess, but I've played with it.

Q. Okay. Users do not have to enter a search to view content on TikTok, correct?

A. They do not have to enter a search.

Q. And Google has described TikTok as a query list format, correct?

A. I don't know if I used those terms, but if I did, I did.

Q. Okay. Users of TikTok can scroll through a video feed that's based on an algorithm of their engagement with past videos, right?

A. Correct.

Q. And the ads that are shown on TikTok are usually videos or sponsored posts that are embedded in the user's feed as they scroll through, correct?

A. Correct.

Q. They're social ads, right?

A. I'm not sure what you mean by social ads, but you described functionally what they were, correct.

Q. And they're ads that are not served in response to a query, correct?

A. Those ads are not typically served in response to a query. You can query TikTok.

Q. And if I do a search on TikTok, what I'll get back are TikTok videos, correct?

A. Potentially with advertising.

Q. And it's a walled garden, right?

THE COURT: A what?

MR. HAFENBRACK: A walled garden, Your Honor. Have you heard that phrase in this trial?

THE COURT: I don't think I have.

BY MR. HAFENBRACK:

Q. Okay. Well, let me ask it a different way then. When you do -- if you do do a search on TikTok, what you get back is TikTok content, correct?

A. Correct.

Q. You don't get back non-TikTok content?

A. As best as I know you don't.

Q. And TikTok doesn't provide any links or information from the open web, correct?

A. Correct.

Q. It doesn't provide 10 blue links, correct?

A. Correct.

Q. And you have no reason to think TikTok is drawing results from a web index, correct?

A. I have no knowledge of that, what TikTok is planning to do with the open web.

Q. Can you think of any reason TikTok would need to index the open web based on the services they provide today?

A. Oh, yes.

Q. Okay. Google indexes TikTok, correct?

A. Not quite. We have access to some of their videos of their choosing.

Q. And the videos that you get will be included in appropriate search engine results page if the query matches the video?

A. That's correct.

Q. TikTok doesn't provide users with written information, news articles, stories from the open web, correct?

A. As far as I know they don't.

Q. If I want directions somewhere, Google will give me the answer, TikTok will not, correct?

A. When you say Google, you're talking about Maps?

Q. Google Search. If I enter a query for directions somewhere into Google Search, I'll get the answer, correct?

A. We typically get a link to a map, and then it will open up your Maps app for directions.

Q. And TikTok would not be a good source of information for that query, correct?

A. For that particular query, no.

Q. Have you ever searched "coffee near me" on TikTok, Dr. Raghavan?

A. As I said, I'm not a common frequent user of TikTok.

Q. Okay. Fair to say there's not a lot of mystery with that query, when someone enters a query for "coffee near me," Google would assume they're looking for coffee near them, right?

A. In the case of Google, you would actually enter that query. In the case of TikTok, my analysis -- or my understanding of the user research is they get inspired for coffee near them. And the statistics are stunningly high, that people look for coffee near them through TikTok.

Q. Let's put up a demonstrative, I think it's UPXD19.

A. From -- oh, okay.

Q. It's there on your screen, Dr. Raghavan. And this is

a demonstrative I created yesterday --

MR. SOMMER: Sorry to interrupt. Do you have a set of demonstratives for us, counsel?

MR. HAFENBRACK: Oh, I do. Sorry about that, counsel.

MR. SOMMER: No worries. Thank you so much.

BY MR. HAFENBRACK:

Q. Dr. Raghavan, I've handed you a demonstrative. You've got it in paper form and on the screen, you can look at whatever you prefer. This is a demonstrative I created yesterday. Same query, same location a few blocks from here. And you can see TikTok's results on the left and Google's results on the right.

Do you see that?

A. I do.

Q. And these two results pages look nothing alike, correct?

A. That is correct.

Q. And as between the two, Google's results page, far more likely to fulfill the user's intent of finding a place to get coffee near them, right?

MR. SOMMER: Objection.

THE COURT: Basis?

MR. SOMMER: It's calling for speculation. I don't think the witness can know the relative likelihood, especially since he's not a user of TikTok, with any frequency.

THE COURT: That's sort of his area of specialization. If he can't answer it, he can't answer it. You can answer the question. It's overruled.

THE WITNESS: I'll try. So I don't know how to conclude the one or the other is far more likely. I'd love to do a user test. I do know that TikTok users look for lunch places and restaurants near them using TikTok.

BY MR. HAFENBRACK:

Q. The TikTok videos, you don't even know if the videos will have relevant information even if you watched them, correct?

A. I don't.

Q. The Google --

A. Magically TikTok users seem to know.

Q. The Google results provide the direct answer to the query, correct?

A. They answer the query. The experiences are quite different, that's clear.

Q. You can take that down, thank you. I think you mentioned in your direct testimony that TikTok is a partner with Google?

A. In that they provide some videos of their choosing to be shown in our results.

Q. Is that the only sense you meant that Google and TikTok are partners?

A. I think they also advertise their app through our systems in our app advertising product.

Q. Dr. Raghavan, in the Chrome browser, Google's the default search engine, right?

A. In the Chrome -- it depends what the user sets.

Q. Out-of-the-box?

A. Out-of-the-box, yes.

Q. And users, to your point, can navigate through the settings menu and change the default, if they want to, right?

A. They can.

Q. And they can pick from a list of options that Google provides, right?

A. Correct.

Q. And TikTok is not among the options to be the default search engine in Chrome, right?

A. TikTok is not a potential default search engine, yes.

Q. All the options to be the default search engine in Chrome that can be chosen by users on the screen are general search engines, correct?

A. Yes.

Q. You mentioned Hotels.com and Home Depot earlier. Those are not options to be the default search engine in Chrome on the alternative list, correct?

A. I don't recall, but you're probably right.

Q. And you showed a picture of Walmart. Walmart's not

an option to be the default search engine in Chrome, right?

A. Because a default search engine has a specific connotation to the user, so the Chrome team includes whatever they think of as default search engines.

Q. And what is the connotation that a default search engine has to the user, to your understanding?

A. Not to the user, to the Chrome team, first of all.

Q. Okay.

A. They put in that menu, as I understand -- I'm not responsible for Chrome I should tell you -- as I understand, engines that do traditional web search.

Q. That provide all-purpose answers to all different types of queries, right?

A. Yes.

Q. And nor is Amazon or Facebook an option to be the default search engine in Chrome, right?

A. I don't think of Amazon or Facebook to be general purpose search engines. But maybe you can help me understand how this is coming together, and I'll try to answer you better.

Q. And because Amazon and Facebook aren't general purpose search engines, they're not available as options to be set as the default search engine in Chrome, correct?

A. Correct.

Q. And the same is true with Safari, that none of these

services that we've been talking about -- TikTok, Facebook, Amazon -- are options to be the default search engine in Safari, right?

A. Correct.

Q. Dr. Raghavan, do you agree that some users might have concerns about downloading TikTok on their phone because of foreign ownership of TikTok?

A. I don't know that to be true.

Q. I'm sorry, what?

A. I've read accounts of this, but I don't know that to be true.

Q. Okay. Based on your experience as head of Google Search, do you have any understanding that a lot of people might be wary of using TikTok because of privacy and security concerns?

A. The data I am privy to suggests that users pretty much everywhere are busily downloading TikTok, so that's the evidence I go by, except where it's banned.

Q. Except what?

A. Where it is banned.

Q. Let's turn to your demonstrative. Can we put up page six from demonstrative. It is DX21.006. Here it is. Thank you.

This is -- Dr. Raghavan, this is a page that shows five websites. You see Wayfair, Amazon, Google, Overstock and

Walmart, right?

A. Correct.

Q. And these are all websites that will provide answers to shopping queries, correct?

A. Correct.

Q. If I did the "coffee near me" query that we were just asking about, which of these search engines would provide a good result?

A. Probably Google would.

Q. Okay. And none of the others, correct?

A. Correct.

Q. If I wanted to research medications, only Google on this page would provide good results, right?

A. You might get something from Amazon and Walmart, but probably not Wayfair or Overstock.

Q. If I wanted to find an attorney or a plumber or a music teacher, Google is the only option on this page that would provide good results --

A. Correct.

Q. -- right? Yes?

A. Correct, yes.

Q. If I want to look up how many points Michael Jordan scored in game six of the 1996 NBA finals, only Google would tell me the result, right?

A. I think I get the drift of your question. Maybe we

should get to the premise you're aiming for, and I'll be happy to --

Q. I would just appreciate it if you answered my question. The only one that would provide --

A. Yes.

Q. -- a good result to that query is Google, right?

A. Yes.

Q. You can take that down, thank you. You're familiar with -- strike that.

Google has revenue share agreements with Android partners to distribute Google Search on Android phones, you're familiar with that, correct?

MR. SOMMER: Objection, beyond the scope.

THE COURT: Let's just see where it's going. Go ahead.

BY MR. HAFENBRACK:

Q. Thank you, Your Honor.

A. I'm generally aware of this.

Q. Okay. And those agreements contain a provision that restrict Google's Android partners from downloading general search services on Android phones, correct?

A. I'm not aware of those details.

Q. Are you aware that Google's Android phones prohibit the pre-loading of general search engines like Bing and DuckDuckGo, but not TikTok, Facebook and Amazon?

A. I'm not aware of the details of those agreements, I'm

not party to them.

Q. During your direct testimony, you talked about competition that Google faces from Amazon, correct?

A. Correct.

Q. Are you familiar with a project called Project Charlotte?

A. The name rings a bell. The challenge is Google has so many project names, I have trouble keeping them separate. But generally, I'm vaguely familiar it had something to do with Amazon.

Q. Something with Amazon, okay. And you recall the purpose of Amazon -- strike that.

And you recall the purpose of Project Charlotte was to try to analyze or quantify the impact of Amazon on Google's queries and search ad revenues, right?

A. Generally, that's my recollection.

Q. Okay. Let's take a look at a document, UPX344. UPX344 is in evidence, Your Honor.

Dr. Raghavan, you've got a binder with the document. We're going to put the relevant portions on the screen, so whatever is more convenient for you.

A. Which -- sorry, three --

MR. HAFENBRACK: We need to hand that up, Your Honor. May I approach?

THE COURT: Sure.

THE WITNESS: Did you say 344?

MR. HAFENBRACK: Yes, sir.

THE COURT: Sorry, is this a different binder or just the same?

MR. HAFENBRACK: The same binder that I just forgot to hand up to the witness, Your Honor.

THE COURT: Okay.

BY MR. HAFENBRACK:

Q. Dr. Raghavan, 344 is a document with the cover slide entitled Project Charlotte Exec Update, January 24th, 2019. And you were the custodian on this document.

A. I see.

Q. And let's take a look at the first page, the next page. And there's an executive summary there, do you see that?

A. I do.

Q. And you're familiar that what Google had done in Project Charlotte, is it had analyzed the query behavior on Google of Amazon users, right?

A. Not quite.

Q. Okay. Please explain your understanding.

A. Yeah, if you look at the page next to it -- which I think has the page number 3059, it says: "No observed impact on inferred search ads revenue for 12 weeks after becoming a shopping loyalty member." The reason I'm calling that out,

that is a very different and smaller cohort than Amazon users at large.

Q. Okay, and we'll get to that. Take a look at the first bullet point that's here on the screen.

A. Yep.

Q. And you see it says: "We have found no evidence of short-term negative per-user revenue impact or a negative query volume impact or a meaningful shift in query volume of Shopee queries away from Google resulting from a user becoming an online retail loyalty program member or being active on large online retailers."

Do you see that?

A. I do.

Q. And when the first bullet point says that there was no meaningful shift in Shopee queries away from Google, do you understand that to mean retail queries?

A. Roughly.

Q. And Shopee queries are a subset of the overall commercial queries; is that right?

A. It's not a well-defined subset. I'd have to go back in here to see the exact definition of Shopee queries, but I think what you're indicating is commercial queries.

Q. And this is -- this bullet point's saying that when a user signs up to be a loyalty member at Amazon or another large online retailer, there's no observed negative impact on

how many queries they do on Google, right?

A. For that cohort of users.

Q. And that cohort for Amazon would be like Amazon Prime members, is that your understanding?

A. I don't know what -- I would have to go back to refresh my memory in what they mean by loyalty member, and why they used those words as opposed to Prime -- which they might have used. But some loyalty -- oh, yeah, I don't want to speculate. Some loyalty program was considered, and for the cohort that were loyal shoppers in the sense of the word, they reached these conclusions.

Q. And the cohort that you're describing, the loyalty cohort, you would expect it's a cohort that's heavier users of Amazon and the other large online retailers, right?

A. I'm not certain of that; I couldn't tell you for certain.

Q. Wouldn't you expect, Dr. Raghavan, a loyalty member of a large online retailer to have higher than average dealings with that retailer?

A. That's a good question. I haven't seen data on that.

Q. Okay, fair enough. Let's take a look at the second bullet point. And there, the study says: "In fact, engagement on large online retailers and query on G.com" -- and that's Google.com right?

A. Correct.

Q. "Are positively correlated. We have observed that loyalty program members and regular shoppers at large online retailers have higher query volume on G.com, including higher query volume in Shopee verticals."

Do you see that?

A. I do.

Q. And so loyalty members, Amazon Prime members tend to do more searches, not fewer searches on Google.com, right?

A. That's correct.

Q. And that doesn't just apply to Amazon Prime or loyalty members, the same positive correlation exists for regular shoppers of large online marketplaces, right?

A. That's what it says here. I haven't been able to find or recollect a notion of regular shoppers in this analysis.

Q. And Amazon -- this is also saying, Dr. Raghavan, that Amazon users tend to do more queries on Google.com, even in the verticals where Amazon is particularly strong, right?

A. The members of the loyalty program -- or whatever their definition of the cohort is, have satisfied this property.

Q. So even something like, I don't know, TVs where you would think Amazon has a particularly strong presence, Amazon Prime members correlated with doing more searches for that type of item on Google?

A. That may not be surprising, actually.

Q. Okay.

A. That may not be surprising, because when we -- it's coming back to me now. When we discussed it, one of the explanations I offered was Prime members who in any way intend to shop at Amazon might come to Google and do a lot of research before they do it. So we will see that correlation, yeah, as reported here.

Q. So your understanding is before someone goes and buys a TV on Amazon, they might do a lot of research about the TV options that are out there on Google?

A. About features of TVs, and should it be Samsung or whatever else before purchasing. Research is one of the things users in the commercial mode do a lot of on Google.

Q. And the positive correlation between Amazon and other large online retail use and Google queries found in this Project Charlotte study was statistically significant, correct?

A. I believe so. I don't recall the exact numbers, but I believe so.

Q. And if you could flip to page 13.

A. One moment, please.

Q. It's the one that ends in Bates 069. I'll just ask you to read the first bullet point to yourself, and then I'll re-ask my question.

A. Yep.

Q. Let me re-ask my question. And the positive correlation between use of Amazon and other large online retailers and Google queries found in this study was statistically significant, right?

A. That's what it says, yes.

Q. Okay. Let's take a look at page three.

THE COURT: Can I just pause for a moment and just ask precisely what this is suggesting, which is that if somebody visits an Amazon, is the idea that that visitor to Amazon will also increase their searching on Google?

THE WITNESS: I wouldn't state it as a causation. I think what he's talking about here is a correlation that people who end up spending more time on Amazon might also be the same kinds of people who spend more time on Google. The one does not in any way cause the other.

THE COURT: Right.

THE WITNESS: And then there's the general population, which does not belong to this cohort, whose behavior is whatever it is. We make no conclusions about that.

THE COURT: Okay, thank you.

BY MR. HAFENBRACK:

Q. So the next slide I wanted to ask you about, Dr. Raghavan, is on the screen. And you see the title there is No Observed Impact on Inferred Search Ads Revenue Over 12

Weeks After Becoming Shopping Loyalty Member. Do you see that?

A. Yes.

Q. And then I just wanted to ask you briefly about the analysis notes at the bottom. Do you see that?

A. I do.

Q. And the first bullet point, it's redacted there so you don't have to say the figure in court, but that's describing the sample size of this analysis, right?

A. Yes.

Q. And below that -- and I believe you mentioned this earlier, the bullet is describing how this study was conducted over a 12-week period, correct?

A. I see that.

Q. This was a detailed study, correct?

A. When you say detailed, sorry, help me.

Q. You have referred to this study in subsequent correspondence as a very detailed longitudinal study that Google conducted, correct?

A. I don't recall that.

Q. Sitting here today, do you agree with that?

A. I haven't gone through all the details. I mean, this is dim in my memory, but if I went through it again, I might come to that conclusion.

Q. You see the date of this study was January 2019th --

January 2019, I'm sorry. You see that from the cover page, correct?

A. Let me take a quick look, sorry. January 2019 is the date on it. Ah, interesting. Yes, and in very fine print that unfortunately I can barely read, there are also a bunch of caveats in the executive summary on this analysis. I see that now.

Q. And if you'd look back at DX126 from the binder that your counsel handed you this morning.

A. 126, yep.

Q. Yes, sir. You can see that DX126 is from an earlier point in time, correct?

A. Yes.

Q. You can put that one aside. Dr. Raghavan, you're not aware of any study done by Google that is inconsistent with the findings of Project Charlotte, correct?

A. So the specific question of does, shall we call it, the prime cohort have more of your queries, I haven't seen anything to dispute that.

Q. And you've certainly never seen any study at Google that concludes that Amazon's rise in growth has come at the expense of Google's search ad revenues, correct?

A. I'll answer that, but want to make sure that this is distinct, it's not a follow-up question to the earlier question?

Q. It's a totally distinct question.

A. It is the same question?

Q. No, no, it's a separate question from what I just asked.

A. Okay, I want to make sure I understand it.

Q. Let me ask it again.

A. Thank you.

Q. You have not seen any studies at Google that reached the conclusion that Amazon's rise in growth have come at a cost for Google's search ad revenue, correct?

A. I mean, I think there are public studies that show them growing more search ads revenue and us not getting the search ads revenue, to the tune of $40 billion a year right now.

Q. My question was about studies at Google. Let me ask again, one more time. You have not seen any studies at Google that reached the conclusion that Amazon's rise in growth have come at a cost to Google's search ads revenue, correct?

A. I cannot recall a specific study.

Q. You can't recall -- is it a no or is it can't recall?

A. I really cannot recall.

Q. Do you recall being deposed on this matter on December 14th, 2021?

A. Somewhere back in 2021, I was.

Q. And you were under oath at that deposition?

A. Yes.

MR. HAFENBRACK: May I approach, Your Honor?

THE COURT: Sure.

BY MR. HAFENBRACK:

Q. Dr. Raghavan, if you could -- actually, you were deposed on -- over two days, December 14th and December 15th in 2021, correct?

A. I believe those were the dates.

Q. And if you could turn to the -- your December 15th deposition and go to page 441, starting at line three, sir. I'm going to read the question and answer. Let me know when you're there.

A. 441?

Q. Yes, sir. 441, starting on line three, there's a question and answer by you. I'm going to read the question and answer:

"Question: Have you seen any studies at Google that reached the conclusion that Amazon's rise in growth comes at a cost for Google's search ad revenue?"

"Answer: I've not seen a study that reaches a conclusion."

Were you asked that question, and did you give that answer?

A. Yes.

Q. You can put that aside for now. Sir, is Amazon one of the largest advertisers on Google search?

A. It is one of the largest.

Q. And any idea of the volume of advertising that Amazon does on the Google search engine results page?

A. Roughly. It varies a lot by season and year.

Q. Okay. What's the rough number?

MR. SOMMER: Objection, Your Honor. It's confidential information.

THE COURT: It sounds like it's a rough number.

MR. SOMMER: Even a rough number can be confidential.

THE WITNESS: It is a material non-public --

THE COURT: I'm sorry, this is a material public proceeding, so I think a general rough number is okay. Go ahead.

BY MR. HAFENBRACK:

Q. Please answer.

THE WITNESS: Sorry, did you -- Your Honor, did you say a general rough number?

THE COURT: A general rough number is fine.

THE WITNESS: Billions of dollars.

BY MR. HAFENBRACK:

Q. Okay. Multiple billions; is that right?

A. Sorry?

Q. Multiple billions; is that right?

A. Billions of dollars is what I would say.

Q. Switching topics, you discussed latency a bit in your direct --

A. Yes, I did.

Q. -- examination or direct? Okay. Search engines compete for users based on latency, correct?

A. Latency is one of several factors that users consider in picking a search engine.

Q. When users are picking a search engine, they might consider latency, correct?

A. They might.

Q. And search users systematically drop off with even a few extra milliseconds in latency, correct?

A. I don't recall the exact sensitivity, but you're generally correct that latency is not a good thing, and latency causes users to drop off.

Q. And it causes them to drop off with even surprisingly just a few milliseconds in difference, right?

A. Yes.

Q. And Dr. Raghavan, Google can reduce latency by investing in computing capacity, correct?

A. That is one lever. In my experience at Google, that has not been the most effective lever. Great engineering has been a much better lever, and that's what we put in place.

Q. Engineering, one lever, right?

A. Yes.

Q. And computing capacity another lever, correct?

A. The latter if in fact you're constrained by serving capacity, if an engine is constrained by serving capacity, yes. But unequivocally you can say that better optimized engineering in the stack will lead to latency improvements, and that's what we -- in my direct testimony I was discussing.

Q. And another way Google can reduce latency is by building more data centers, correct?

A. Not necessarily. Not necessarily.

Q. And again, you recall you were deposed in this matter, correct?

A. Yeah.

Q. Let's take a look at your first deposition from December 14th, 2021. Please take a look at page 48.

A. From December when?

Q. December 14th, sir, the first one in the binder.

A. Okay.

Q. I'm going to ask you about the question starting at 48, line 12. Let me know when you're there, and I'll read you the answer -- or the question, rather.

A. Page 48?

Q. Yes, sir, line 12.

A. Yeah.

Q. "Question: If Google builds more data centers closer to wherever people are, that's sort of a hardware way of reducing latency; is that correct?"

"Answer: That would -- you know, to the extent that we're constantly doing that, yes, absolutely that's something that reduces latency."

Were you asked that question, and did you give that answer?

A. That differs from your question, the one you just asked me, because Mr. Dintzer asked me closer to where users are. My point is that's why I said not necessarily, it depends on where you build additional data centers.

Q. Let me ask you again, then.

A. Okay, please.

Q. Google can build data centers closer to where people are, and that is a way of reducing latency, correct?

A. Potentially.

Q. Absolutely that's something that reduces latency, right?

A. We've made changes in our system where it's not always the case that putting data centers closer to users is the best way of improving latency. And that's because we've invested a great deal in optical fiber, so that getting to a distance data center, that latency has come down dramatically.

Q. Let's take a look at a document. If you could -- we're going to pull up UPX223.

A. Yes, one moment, please. Is it in this witness binder?

Q. It's in the white witness binder, exactly.

A. Yes.

Q. And you'll see the slide is Radical Latency?

A. Yes.

Q. You're familiar with this document, right?

A. I am.

Q. And you're the custodian for this document. The date for it is 2020. And Dr. Raghavan, you recall a proposal for a radical latency project around the 2020-2021 timeframe when you were head of Google Search, right?

A. Yes, this came in right around the time I assumed responsibility for Search.

Q. Understood. And let's take a look at slide 42.

MR. HAFENBRACK: Before we put this one on the screen, I just want to confirm: This one's okay?

MR. SOMMER: What's the page number in the bottom corner?

MR. HAFENBRACK: It is -- just a second, Bates 122.

MR. SOMMER: Just one moment.

THE WITNESS: 122?

MR. HAFENBRACK: Yes, sir, Bates 122.

MR. SOMMER: Yes, Your Honor, there is a confidentiality

issue with respect to the very right part of the chart, the red arrow. That's proprietary.

MR. HAFENBRACK: If I may, Your Honor. We don't really agree, this is six years old -- yeah. It's showing -- it looks like it's at least four or five years, even the most recent period.

THE COURT: I guess I'm just not seeing the harm that would come up making this a public document -- or at least displaying it publicly. Can you articulate what the harm would be?

MR. SOMMER: Judge, everything to the left of the red arrow on the right we have no issue with. But there is sensitivity on the part Google with respect to the data on the right.

THE COURT: Okay. So I haven't heard you explain --

MR. SOMMER: Judge, we just got this at lunch from the government. So literally the first time I'm seeing this page is right now.

THE COURT: I don't see how that's possible, because it's got your little red line around it. So somebody has seen this before it was introduced just a couple minutes ago, right, on your side? Because I didn't make the red box nor did the government.

MR. SOMMER: The red line is our red on the original document, not the --

THE COURT: No, no, I'm talking about the red line around it, around the page.

MR. SOMMER: Well, I don't have that on mine.

THE COURT: I've got it on every single page of the exhibit.

MR. SOMMER: That just means it hasn't been reviewed for confidentiality.

THE COURT: Right. In other words, it's something that you've seen before a few minutes ago is my point.

MR. SOMMER: We were not on notice that this was going to be used, so it hasn't been reviewed for confidentiality.

THE COURT: All right, let's show it on the record. I mean, unless you can articulate to me right now why this is going to create competitive disadvantage for Google, then let's show it, because I haven't heard an explanation of why. Thank you.

MR. HAFENBRACK: Can we put that slide on the screen? Thank you so much.

MR. SOMMER: Judge, I'm sorry, I would ask that if there are going to be additional documents that we weren't told of that are designated for confidential review, that they be disclosed to us so I at least have a chance to talk to my client.

THE COURT: That's fine, and we've put a process in place. But let me -- we can take this up afterwards, we

don't need to interrupt this with Dr. Raghavan's testimony. Go ahead. Sorry, sir.

BY MR. HAFENBRACK:

Q. Dr. Raghavan, you see this is a slide that is showing growth in Google's latency over a period of 2010 -- 2011 to 2020, correct?

A. Correct.

Q. And you see latency grew steadily throughout that time period, correct?

A. Correct.

Q. That means that when users enter queries into Google, the results they were getting back were getting slower and slower over time, right?

A. Correct.

Q. And you see the scale of the increase that built up over this time period was 500 milliseconds, correct?

A. Roughly.

Q. And that's a significant amount of increased latency, correct?

A. Yes, it is.

Q. And you testified earlier even a few milliseconds is something that might affect user behavior, right?

A. Indeed, which is why I brought that latency down by 500 milliseconds.

Q. Let's take a look at slide seven.

A. Sorry, could you read the number at the bottom, please?

Q. Yes, it says 087, Dr. Raghavan. You see the title of this slide is Google vs. Bing, right?

A. I do.

Q. And what this is comparing Google and Bing on is latency, right?

A. On specific queries.

Q. Exactly. You see five sample queries that are listed here, right?

A. Yes.

Q. And these are all pretty common queries, would you agree?

A. Some of them are.

Q. Would you think all five of these would be considered head queries?

A. I'd say they're all important queries.

Q. And for all five, Bing -- at least at this time in 2020, Bing was faster than Google in loading the results, right?

A. Noting that what Bing loaded may not match what Google loaded. In other words, very simple example, the Google results were more visually rich, then there is more stuff to send to the client. So that's why I'm a little careful on the specific queries as opposed to a general query

sample, which is more representative.

Q. Okay. But whatever metric you were using here to compare Google versus Bing, Bing was significantly faster on all five of the queries listed here; is that correct?

A. Load some results, that's the point I want to emphasize. Because what they load might be a text only page, and that is much faster in general.

Q. If you take a look at the car rental query, the fourth one down. Do you see that?

A. I do.

Q. And you see the difference in load time is almost 400 milliseconds there, correct?

A. I do.

Q. Let's go to one more page on this exhibit, it's page 13, Dr. Raghavan. And if you want to look in your binder, it's 093, the Bates number on the bottom right. The headline here is Radical Latency in a Nutshell. Do you see that?

A. I see the headline.

Q. And under impact, the team is outlining a goal to decrease latency that's redacted. Do you see that?

A. I do.

Q. And it's outlining a goal to decrease latency over an 18-month estimate, correct?

A. Correct.

Q. And you chose not to fund this radical latency

project, correct?

A. I chose not to fund this radical latency project, because I didn't think it was the right project to reduce latency.

Q. You can put that one aside. Switching topics to data privacy. Search engines -- general search engines, including Google, compete on data privacy, correct?

A. As always, it's one of many dimensions. We just spoke of latency, so there are many dimensions. The quality of the output is the most important thing.

Q. Latency and privacy both dimensions of competition among general search engines, you would agree?

A. I would agree.

Q. And you also agree that consumers should and will consider how a search engine uses their data in picking a search engine, correct?

A. In principle, yes. In practice, most consumers don't get into the nuance of exactly how data is retained and governed.

Q. Just to make sure I'm getting a clean answer, I'm going to ask that one again. You agree that consumers should and will consider how a search engine uses their data in picking a search engine, right?

A. I would agree they should. It's the "will" part that I'm unsure about, simply because it's a complex topic most

consumers don't really understand.

Q. Let's go back to your deposition binder again, page 269, starting at line five:

"Question: And do you agree that whether the search engine maintains that individual's data might be one of the factors that some consumers consider when choosing a search engine?"

"Answer: I absolutely say consumers should and will consider that."

Were you asked that question, and did you give that answer?

A. I'd say they should. Some will.

Q. Sir, were you asked that question, and did you give that answer?

A. Yes.

Q. And in fact, Dr. Raghavan, Google has conducted user research that shows that users -- search engine users care a great deal about privacy, correct?

A. I don't know about great deal, but I recall generally that users -- our user research show that search engine users do care about privacy.

Q. Let's take a look at one such study. If you could look at DX183 in the white binder I gave you. It should be the first document in there. This is in evidence, Your Honor.

The title here is Search Trust Drivers Analysis from 2020, and you're the custodian for this document. Let's go to page one -- page two, rather. There's a research objective, and what's it's describing, Dr. Raghavan, is the purpose of this study was to identify the strongest drivers of trust in Google in four countries, including the United States, right?

A. I see that.

Q. And that's an important question to Google, whether users trust the company, right?

A. It is.

Q. And let's go to slide 15, which is Bates 892. This is a slide that shows that in this study, Google had weak performances on data privacy and data security in all four countries, correct?

A. I want to make sure. The red boxes, I think, are in the original study, not because of any highlighting, correct?

Q. Yes, sir.

A. Okay, yeah.

Q. Yes?

A. The numbers are in the 20s.

Q. And you see at the top Google had weak performance scores, right?

A. Yeah, 24, 17 percent have rated us as good on privacy.

Q. And those two categories, data privacy, data security, were the most important attributes in this study for creating user trust in Google Search, right?

A. Yes.

Q. You can put that one aside. Let's talk about the data Google collects from search users, okay?

A. Okay.

Q. By default, or without the user taking any action, Google collects and logs the search history of its users, correct?

A. Yes.

Q. And that's true for both signed in and signed out users, correct?

A. Up to that 18-month window that we talked about earlier.

Q. And the distinction there between signed in and signed out users is if a user has signed into their Google account before they're -- at the time they're conducting their search, they'll be considered a signed in user, right?

A. Correct.

Q. Let's talk about signed out users for a couple minutes first. For signed out users --

THE COURT: I'm sorry, when you say signed in versus signed out, you mean, for example, with a Gmail address, that's how somebody is signed in to their Google software

that's available?

THE WITNESS: Yeah, the scenario that makes it the simplest to think about is let's say you have the Chrome browser, you've signed into your Gmail. Maybe it could be Calendar, but most commonly it's Gmail. Then you open a new tab and you run a search. That is what counsel is referring to as a signed in user, I believe so.

BY MR. HAFENBRACK:

Q. And to pick up on the Court's question and your answer, if someone signs into their Gmail account, they'll automatically be signed into Google.com the next time they go to do a search, correct?

A. In Chrome. That's not true necessarily of Safari, for instance.

Q. If I'm a Chrome user, I sign into Gmail, the next search I do on Chrome or on Google.com I'm going to be signed in, right?

A. In fact, the next activity on any Google service. So for instance, you open the Calendar on a different tab, you're signed in. So the idea is your identity is preserved across the services.

Q. And it's valuable to Google if users sign in, right?

A. And I hope it's valuable to users as well.

Q. And Google takes a lot of steps to encourage users to sign in, right?

A. I think the most natural scenario is people signing in through Gmail without which they don't access their e-mail or calendar or documents. So that is by far the biggest source of sign ins.

Q. But if you're searching on Google.com and you haven't signed in, you're pretty likely to see a prompt, a pop-up prompt nudging you to sign in, correct?

A. Actually, I don't know that because I've always remained signed in.

Q. Fair enough. You're a good employee. Back to signed out users for a minute.

THE COURT: Let me assure you, you do get a prompt. Go ahead.

BY MR. HAFENBRACK:

Q. Thank you, Your Honor.

For signed out users, Dr. Raghavan, Google collects and logs search history by default, and ties that search history to a unique identifier that's created by Google, correct?

A. So for signed out users, so we maintain a log and it is tied to the user without their identity.

Q. It's tied to a unique cookie that Google creates for that browser or that device, right?

A. For that browser at that time, yes.

Q. Let's put up UPXD17, another demonstrative. Thank you. And this is Google's privacy policy that is available

online. You see in the bottom left it says policies.google.com/privacy?

A. Yes.

Q. And Google publishes its privacy policies for anyone to see, right?

A. Yes.

Q. And in the second paragraph there, the privacy policy reads: "When you're not signed into a Google account, we store the information we collect with unique identifiers tied to the browser, application or device you're using."

Do you see that?

A. I do.

Q. And that's an accurate statement, correct?

A. It is.

Q. And the unique identifier that Google creates, is something called a Zwieback cookie?

A. I don't remember the names. We have these cookies, so that could be what it's still called. I think way back many years, when I first heard about these things, they were called Zwieback cookies.

Q. Okay. And for the court reporter, that's Z-W-I-E-B-A-C-K.

You see in the next sentence here on the privacy policy that one of the things that Google does with that uniquely device identified data for signed out users is to use it to

help target ads to them, correct?

A. Based -- so such as preferred language and relevant search ads based on recent activity.

Q. Google uses the search data it collects by default from signed out users to inform personalized advertising to that device, right?

A. It does.

Q. Is that a yes?

A. Yes.

Q. Am I correct that Google doesn't ask or prompt signed out users whether or not they want Google to log their searches when they're signed out?

A. Let me make sure I understood. Do we prompt people asking whether they want that logging to happen?

Q. Yes, sir.

A. Again, I'm not sure I know, because I haven't been a signed out user in a long time. But I'm not aware of such prompting.

Q. Now let's turn to signed in users, okay.

MR. HAFENBRACK: Oh, Your Honor, we'll offer UPXD17 because it's a Google web page.

MR. SOMMER: Judge, could we just check it overnight? Because we just tried to access it and couldn't get it using the URL, so we'll get back to counsel on that.

THE COURT: Okay. So it will be provisionally admitted.

(Exhibit UPXD17 provisionally admitted into evidence)

BY MR. HAFENBRACK:

Q. Signed in users. For signed in users, by default Google logs my search history and ties that search history to my Google account, correct?

A. Correct, signed in.

Q. Signed in, yes, sir. Correct?

A. Yes.

Q. It's a personalized search history, right?

A. I wouldn't have used that term, but we do what you said in the log. We have the identity and the query history.

Q. It's not an anonymized dataset like Google uses to train its algorithms, correct?

A. So for -- it depends on which algorithms you're talking about. But generally, our algorithms that have training will not use your user ID.

Q. They won't use your data that's tied to your Google account?

A. To the Google account, yes.

Q. And you mentioned this on your direct. The default data collection period for signed in users is 18 months, correct?

A. For signed in users, 18 months, yes.

Q. Do you know what it is for signed out users?

A. It's whenever the cookie, whatever it's called these

days, expires. I forget the expiration period at this point.

Q. By default, Google logs every query that a signed in user enters for 18 months, correct?

A. Correct.

Q. And Google logs for 18 months by default every web page and every ad that that user clicked on from the search page, correct?

A. Correct.

Q. And Google also logs whether the user went back to the search page after clicking on any link or ad, right?

A. Correct.

Q. And Google logs by default for 18 months every location where a signed in user conducted a search, correct?

A. Every location, so we hold the IP address. We have a separate control for your location, and if you turn that off, then we cannot use your fine-grained location, right. So we can only use the IP address which gives us coarse-grained location, so I want to make that distinction.

Q. If you opt out of location tracking, you won't -- Google won't track your location, right?

A. Your fine-grained location.

Q. But by default, Google logs every location where a signed in user conducts a search for 18 months, correct?

A. Yes.

Q. If I conduct a search outside the courthouse, Google

will log my query and log the location where that query occurred, correct?

A. Yes.

Q. And Google doesn't just log clicks and queries for 18 months, it also tracks detailed information about signed in user's engagement with the Google search page, correct?

A. So to make sure I understand, when you say detailed engagement, what do you have in mind?

Q. Fair question. Google knows and logs my swipes, scrolls, hovers on the search page, correct?

A. I don't know that's true for all users, actually.

Q. For signed in users, Google -- let's take them one at a time. Google -- for signed in users, Google for 18 months logs my swipes and scrolls on the search page, correct?

A. I don't know that for a fact. I don't recall, actually.

Q. Do you have any reason to doubt that?

A. No.

Q. And it ties that activity to my Google account, correct?

A. Correct.

Q. Now, Dr. Raghavan, Google implemented the 18-month default collection period in 2019, right?

A. I don't remember the date, but somewhere in that vicinity.

Q. It was right before you took over as head of Search, right?

A. I think so.

Q. And before that, from Google's founding up until 2019, Google collected search history indefinitely, correct?

A. As I think most search engines continue to do.

Q. Forever, correct?

A. Correct, forever.

Q. And before 2019, users had no option to tell Google to autodelete their search history at set intervals, right?

A. That's correct, and we provided it based on user research that said users wanted it.

Q. Users wanted an option, correct?

A. Correct.

Q. And the research that Google did showed that users wanted an autodelete that was much less time than the 18 months that Google settled on, correct?

A. I don't recall the exact results from the research, but these questions were explored in the user research for sure.

Q. Half of the people in the user research said one month; isn't that true, sir?

A. I don't recall that.

Q. And Google today -- there's an 18-month default, and there's a dropdown menu where users can change the 18-month

default. Are you familiar with that?

A. I am.

Q. And are you aware it takes 10 clicks for a user who knows where that is to find that page?

A. I'm not.

Q. And are you aware that the lowest option, the least data retention that's available in that screen, is three months?

A. I don't recall that.

Q. Now, Dr. Raghavan, Google uses the search history that it collects from users to serve personalized ads to those users, correct?

A. Correct.

Q. And Google serves personalized ads to users based on their search history by default, correct?

A. By default, with the option of turning it off.

Q. And Google uses search history for personalized ads both on and off search, right?

A. Help me with that, please. What do you mean by on and off search?

Q. One category Google uses user search history to personalize ads on the Google Search results page, right?

A. Yes.

Q. And another category Google uses user search history to personalize ads when they're on YouTube, Gmail, the

Discover product, correct?

A. I see, yes.

Q. And so, as an example, if I'm -- if I type "need a plumber now," and I've been searching for a plumber on the Google search page, I might get an ad for a plumber when I'm watching videos on YouTube, right?

A. Yes.

Q. Dr. Raghavan, as head of Google Search today, you would sign off to any major change to Google's privacy policies, fair?

A. Any major change, yes.

Q. And before implementing a privacy change or a privacy enhancement, you would consider whether that change will result in more or less queries for Google, right?

A. That's not the primary thing I would look at. Did you literally mean more or less queries? Because the first thing I would look at is the impact on the user's experience before I looked at that question.

Q. At least one of the considerations in whether you'd approve a privacy enhancement is whether that enhancement led to less or more queries for Google, yes or no?

A. One of several considerations, yeah.

Q. Yes?

A. Yes.

Q. And in considering whether to sign off on a potential

privacy enhancement for Google Search, you would consider whether Google is losing queries to any rival on the basis of privacy, correct?

A. So just to make sure I understood the complete question, is one of the considerations how well users are responding to other search engines? Yes.

Q. The question is --

A. Please.

Q. -- in considering whether to sign off on a potential privacy enhancement for search, you would consider whether Google is losing queries to any rival, correct?

A. If it is relevant to the privacy proposal, yes.

Q. You discussed with your counsel the discussions that were going on in and around June 2019 about privacy messaging by DuckDuckGo, and whether Google should respond to that?

A. Yes.

Q. Let's take a look at UPX500. Dr. Raghavan, Mr. Sommer showed you a different fork of this e-mail, which was UPX501. This one has the same first e-mail from Cory Ondrejka, so I'm going to ask you a few questions about this one, and then I'm going to ask you a few questions about 501, okay?

A. Is there a paper form of this I can look at?

Q. Yes, there is, it should be in your binder there.

A. One moment, please.

Q. This 500's in evidence, Your Honor.

This is an e-mail exchange between you and Cory Ondrejka. Do you see that?

A. Yes. One moment, please.

Q. Sure, take your time.

A. Okay.

Q. E-mail chain between you and Cory Ondrejka, correct?

A. Correct.

Q. And Mr. Ondrejka was a VP at Google?

A. Yes.

Q. And you see, if you look in sort of the first couple of paragraphs of Mr. Ondrejka's e-mail to you, he mentions that -- he talks about the DuckDuckGo discussions.

That's what you discussed on your direct testimony, right?

A. Correct.

Q. And he says: "DuckDuckGo is having a successful marketing moment." Do you see that?

A. I do.

Q. And that was around attacking Google on privacy in the public, right?

A. They were insinuating that we weren't private enough.

Q. And you see Mr. Ondrejka -- we'll zoom down to his proposed action items, which is just below. And he references a Kathy, and that's Kathy Edwards, right?

A. Kathy Edwards.

Q. And she was -- Ms. Edwards was one of the employees at Google working on privacy and trust issues around this time, right?

A. At that time, yes.

Q. And Your Honor, we have designated deposition testimony from Ms. Edwards.

And you see, Dr. Raghavan, the first action item there from Mr. Ondrejka is about gathering data around users switching between Google and DuckDuckGo. Do you see that?

A. Yes.

Q. And you see he asks whether users are migrating to DuckDuckGo, and whether there's data you can leverage to better understand that, right?

A. Correct.

Q. Let's look at your e-mail at the top of the string back to Mr. Ondrejka. I want to ask you in particular about your point number two.

A. Okay.

Q. And you asked for a study analogous to what impact is DuckDuckGo having on our search volume. Do you see that?

A. I have asked for that.

Q. You saw that. And the very detailed longitudinal study you mentioned there refers to the Project Charlotte analysis we discussed earlier on, right?

A. I expect it does.

Q. And what you were suggesting here was that before Google enacted any response to DuckDuckGo in response to this messaging campaign, you wanted to see data on whether Google was actually losing queries to DuckDuckGo, right?

A. I wanted to see data.

Q. And you wanted to see data on whether Google was losing queries to DuckDuckGo, right?

A. I wanted to see data, correct.

Q. You wanted to know if it was just a PR problem or if it was actually a query loss problem, right?

A. Correct.

Q. Let's look at 501, the one that your counsel showed you. This, again, has the same sort of base e-mail from Mr. Ondrejka, and there's a different fork above it. I want to direct your attention to the Ben Gomes e-mail.

A. The e-mail from Ben?

Q. Exactly, from Mr. Gomes.

A. Okay.

Q. Your Honor, I think we'll be hearing from Mr. Gomes next week.

Mr. Gomes was a senior vice president or a vice president in search at this time; is that right?

A. That's correct.

Q. Do you know which it was?

A. He was -- oh, you were asking me his title?

Q. Yeah, well, general.

A. Sorry, senior vice president for search.

Q. Okay. He was head of search at this time?

A. That's correct.

Q. And you recall that during these DuckDuckGo discussions, Mr. Gomes, among a few others, was an advocate for making a product change in response to DuckDuckGo, right?

A. Correct.

Q. And it was the view of Mr. Gomes, along with Nick Fox, another VP in the search department, that if Google didn't take action you'd lose queries, right?

A. Correct.

Q. And you disagreed with that, right?

A. I wanted to see more data before agreeing with that conclusion.

Q. Let me put it this way: You weren't convinced with their case, right?

A. That's correct.

Q. You wanted to see more evidence?

A. Correct.

Q. Let's take a look at your e-mail at the top. And this is the one that your counsel spoke with you briefly about. And you send, I think it's fair to characterize, a sharply worded response to Mr. Gomes. Do you agree with

that?

A. It's likely more sharply worded than I might like to. I'm generally mild mannered, but yes.

Q. You were making your point very clearly?

A. Sharply.

Q. Let's take a look at the first two bullets in your e-mail. You say: "I agree that there's something worth exploring in this space of private search."

And the space of private search would be offering search options that have enhanced privacy protections, right?

A. Correct.

Q. You write: "But the working teams have to do much more careful work before wasting our valuable time," correct?

A. Correct.

Q. And the much more careful work you had in mind there was similar to the query loss data that teams had done around Amazon previously, right?

A. That's one instance of how it could manifest itself, but really what I wanted was thorough analysis.

Q. The second bullet that's highlighted on the screen says: "I want to see evidence that there's a real impact on Google users attributable to this factor." Do you see that?

A. I do.

Q. And the factor there would be privacy or privacy messaging, right?

A. But -- I agree that the sentence is sort of left incomplete. But the fact there would specifically be the features that DuckDuckGo put forth can be attributed to those and impact on our users.

Q. Understood. And one more e-mail from you. I think a couple lines down, there's a bullet point that starts with: "I disagree with the methodology that consists of conflating people care increasingly about privacy. DuckDuckGo is making a lot of noise about it. Sundar mentioned it in the IO. All true statements. Then concluding that this needs a product change."

Do you see that?

A. Yes.

Q. And the reference to Sundar is Mr. Pichai, the CEO?

A. Correct.

Q. And the IO is a big conference Google does every year?

A. Correct.

Q. And the CEO had mentioned privacy as a focus at the 2019 conference; is that right?

A. I vaguely recall he did.

Q. Okay. And when you said all true statements, you meant that you thought it was true, that people do care increasingly about privacy, right?

A. I do -- I did, sorry.

Q. But that's a separate question, people caring about privacy, from whether Google needed to enact a product change to prevent query loss to DuckDuckGo, right?

A. That one had to make a product change in light of all of the above.

Q. You can put this one -- take this one down. Subsequent to this e-mail exchange in 2019, Dr. Raghavan, Google has not run any studies or surveys, to your knowledge, on whether -- to follow up on whether Google is losing queries to DuckDuckGo, correct?

A. I don't recall any.

Q. You don't recall any such studies?

A. I don't recall.

Q. And as head of Google Search, you could ask for such a study or survey, correct?

A. I could ask for such a study.

Q. And you haven't done that, correct?

A. No.

Q. Dr. Raghavan, you have referred to DuckDuckGo search engines that attack Google on privacy as, quote, ankle biters, unquote, correct?

A. I may have used that unfortunate term.

Q. Okay. That's a yes?

A. Yes.

Q. The Court has heard testimony from a couple witnesses

previously in this trial about incognito mode, and particularly how it relates to browsers.

You're familiar with incognito mode, correct?

A. It has different semantics in different places, but yes -- the general idea, yes.

Q. And Google offers an incognito mode for the Chrome browser, right?

A. For Chrome, and separately for Maps where it means something else.

Q. And I want to ask you about something slightly different, which is incognito mode for Google Search, okay?

A. Okay.

Q. And you -- okay, strike that.

Today, Google doesn't have a generally available incognito mode for search, correct?

A. That's correct.

Q. But around the 2019 timeframe we were discussing, Google did consider offering an incognito option for Google.com, right?

A. And beyond, actually, yes.

Q. And beyond 2019 continued to consider it?

A. Yes.

Q. And what Google contemplated was a standalone search site where incognito mode would be the default, right?

A. Yes.

Q. And it would have -- and that proposal, had it been enacted, would have offered users an option for searching where Google would anonymize the user's data and never log it, right?

A. Correct.

Q. And Google never adopted that proposal, correct?

A. Correct.

Q. And one of the concerns was if Google adopted that proposal, users would pick it and Google would lose billions of dollars in revenue, correct?

A. That was only one of the concerns, yes.

Q. But that was one of the concerns, correct?

A. Yes.

Q. And Google could offer an incognito mode for Google Search if it wanted to, right?

A. It's not as simple as that. Part of our challenge is we already have two incognito modes in our products, and we've had fairly vigorous debates about how not to add a third incognito mode that means something else. So one of the things we are trying to do is figure out how to reconcile this variance.

Q. But certainly as a technical matter, and as a matter of priority, if Google wanted to, it could put a little toggle on the Google.com search bar that let people click on incognito mode if they wanted to?

A. As a technical matter, yes. That doesn't make a good product design.

Q. And you could launch a separate search site, like you've discussed in 2019 and beyond, for incognito mode?

A. Again, that may not be the product design, but yes.

Q. And similar to Google.com, Dr. Raghavan, Google does not offer an incognito option for the search widget, the Google widget on Android devices; is that right?

A. We do not offer an incognito mode in search, correct.

Q. Google is the default search engine in Safari, yes?

A. It's whatever the user sets, but yes.

Q. Out-of-the-box?

A. Out-of-the-box.

Q. And if I enter a query into the Safari query bar, browser bar, using the default settings with Google as the default, that query goes to Google, right?

A. That query goes to Google.

Q. And for those users -- Safari users conducting default searches using all the default settings, Google doesn't offer an incognito mode for them either, correct?

A. Correct.

THE COURT: Mr. Hafenbrack, I can ask you where you are in your examination?

MR. HAFENBRACK: I'm switching gears now, so it's a good time to stop.

THE COURT: Okay, so why don't we stop for the day and then we'll pick up tomorrow.

Dr. Raghavan, we are going to conclude for the day and we will resume tomorrow. So we'll look forward to seeing you in the morning. We'll start at 9:30.

THE WITNESS: Yes.

THE COURT: And I'll just ask you not to discuss your testimony with anyone overnight.

THE WITNESS: Of course.

THE COURT: Thank you, sir. And you can just step outside, thank you.

(Witness not present)

THE COURT: I'm just trying to get a sense of tomorrow. We have Dr. Raghavan. How much longer do you think you'll be, Mr. Hafenbrack?

MR. HAFENBRACK: I would say around an hour, Your Honor.

THE COURT: And the States?

MR. KAUFMANN: Half hour approximately.

THE COURT: Okay. How does that put us in terms of getting to Dr. Fox tomorrow, Professor Fox?

MR. SCHMIDTLEIN: He will be here prepared to begin his testimony.

THE COURT: Okay. And I assume -- well, let me -- is it still the case that Mr. Pichai is scheduled for Monday?

MR. SCHMIDTLEIN: That is correct, Your Honor. If we are

not concluded with Dr. Fox tomorrow, we would ask that we take him sort of out of order.

THE COURT: Sure, that's what I figured. That's what I wanted to talk about. So at least the plan would be -- look, it seems unlikely that we would finish Dr. Fox tomorrow, so we would begin Monday with Mr. Pichai's testimony first thing in the morning.

And with respect to Mr. Pichai's testimony, we might as well just talk about it now. Is there any anticipation of a closed session with Mr. Pichai?

MR. SCHMIDTLEIN: No, we're going to try to work around it as best we can. There may be some segments where we're going to have to navigate around it, but our intention and hope is that we will not have to do that.

THE COURT: Okay, terrific. I appreciate that. Thank you. I think that concludes what we need to get done for the day.

Are there any loose ends or anything else we need to talk about?

MR. GOWER: Cameron Gower for the United States. We have designations and objections for the final four witnesses for our opening case -- or our case-in-chief. And there's a cover letter here explaining the details on a flash drive.

THE COURT: Okay. Terrific, thank you.

MR. GOWER: As with the previous --

THE COURT: Go ahead.

MR. GOWER: As with the previous witnesses, the videos will follow.

THE COURT: Okay. Terrific, thank you. Just one quick observation I'd like to make. In terms of the redacting of documents that are being presented -- and I know the parties -- let me just first say the parties have worked very hard to work on redactions in advance of their presentation in court, so I'm grateful for that.

The one thing I would just make an observation is with respect to numbers -- and I just mean that in a very broad sense, all numbers are not the same. I think we ought to just be a little bit more careful about what is being redacted as a number. You know, just one example that stood out, as I was looking at things today, you know, the sample size of one of the surveys, for example, was redacted. That doesn't need to be redacted.

Again, I go back to the market share percentages. Again, these are -- it may be the case that these are not otherwise public, but we are operating under different parameters here. And it is not -- it's fair to say that it's not ultimately a party's responsibility to do the Hubbard factor weighing, but I would just ask you all to be more -- to be mindful of that when it comes to numbers, and that essentially all numbers are not the same.

All right. Thank you, everybody. We will see you in the morning.

(Proceedings adjourned at 5:04 p.m.)

C E R T I F I C A T E

I, **Jeff M. Hook, Official Court Reporter,** certify that the foregoing is a true and correct transcript of the record of proceedings in the above-entitled matter.

October 26, 2023

DATE

Jeff M. Hook