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EP 133 | The Epistemology of Investing: A Near Insurmountable Challenge

Rob Campbell (00:00):

The word epistemology comes from two Greek words: episteme, or knowledge; and logos, reason. Thus, epistemology being the theory of knowledge. How do we understand the world around us? And how do we learn in order to make better than random predictions about the future?

In some parts of our world, knowledge building is quite robust. My kids have learned quickly, for example (one the hard way!), that when the burner on the stove is glowing red, don't touch it—it's probably hot.

On today's podcast, Justin Anderson joins me to talk about the epistemology of investing and—spoiler alert—why genuine knowledge building in investing and the ability to learn effectively is so hard. Given his role as leader of the Mawer Lab, Justin is the perfect guest for this topic. Not to mention that one of the things that I appreciate so much about Justin is that he revels in tackling challenging and complex problems. Justin explains what makes investing different than other "harder sciences" like physics or engineering, but also talks through some of the workarounds that our Research team and the Lab specifically have developed to help us with the challenge of learning and establishing a foundational culture of continuous improvement. And so here we go: my conversation with Justin Anderson.

Disclaimer (01:31):

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Rob Campbell (01:48):

Our topic today is a mouthful, but here's where I think we should start: Paul Moroz, who's our CIO, was on the podcast not that long ago to provide a summary of the post-mortem process, and for those of you who listened, this was the look back to last year and the team's most notable learnings. Having participated in the post-mortem, there was one observation, Justin, and really was a question that really stood out to me and it was something like, "many of these learnings sound like the direct opposite of what we said we learned the year prior." In other words, bull and bear market learning seem to be diametrically opposite to one another.

I think the comment was pretty blunt, it was, "what's the point of all this? How do we even know that we're learning the right things?" And I know this is something that you've been thinking a lot about, so can we start there? Do you share that same skepticism?

Justin Anderson (02:35):

To your point, it can kind of get frustrating at times when we go through these learning exercises and it seems like one year we learned X and next year we learned that X isn't actually true. I think it's a problem with the investment industry in general that the generation of knowledge is this incredibly difficult thing.

When I heard those learnings I had a very similar reaction to yours, and my thought was, "Can we kind of pull this apart a little bit?" Like learning seems to be in a different market. You come to different conclusions. Let's double click on that and dig into what is it about learning that is so hard in the investment industry?

So when I saw those, I pinged you and said, "Hey Rob, I think we might have an interesting topic here. Why don't we dig into this topic of learning about investing and why knowledge creation in investing is so hard?" So yeah, we're definitely on the same page of this being a major problem in the industry.

Rob Campbell (03:27):

Excellent. And let's back up even further—forget learning about investing, learning in general! This process of knowledge creation. What are the fundamental building blocks? We'll work backwards [and] connect it to investing, but let's just talk about the process of knowledge creation in general.

Justin Anderson (03:43):

And that's exactly where my thinking and pondering on this went. What is knowledge? If the listener takes a step back and thinks, "what is knowledge all about?" There [are] different definitions and academics have studied this. The theory of knowledge is called epistemology. The question is, what does that mean? How do you create knowledge in a field?

And the way I kind of think about it is, my definition of knowledge is a non-random forecasting. The ability to predict something about the future that cannot necessarily be explained just by random chance. It's a much more well-defined version of knowledge and it means it has to be something that's useful so that you can use that knowledge to predict something relevant about the future.

If we start with that as a definition—what knowledge is in general—we can then break it down and have a framework for, well, how do we go about creating this non-random forecasting capability in any industry? Whether it be investing or something else. The building blocks, as far as I can tell, are deductive- and inductive-type reasoning processes. And this has a long history in science and epistemology.

Justin Anderson (04:44):

Inductive is the idea of learning from experimentation, fundamentally. What does that look like? So for example, if you and I were living a thousand years ago, we might have this inductive evidence that the sun rises every morning. That's experimentation. We don't really understand why it rises, we don't understand all the theory of how the earth is flying around the sun and all the rotation, but it happens every day. We've got this experimentation and we sort of can predict based on that inductive evidence that it's going to rise tomorrow.

Justin Anderson (05:10):

So, that's the sort of non-random prediction we can make: tomorrow the sun will rise. And I'm basing that prediction on that inductive learning.

Rob Campbell (05:19):

So, a consistent enough series of observations, basically.

Justin Anderson (05:22):

That's right. And the key thing there is exactly that—it's repetition. It's a number of iterations. And so we'll come back to that a lot when we get to investing. And then the other component of knowledge is deductive. And deductive is much more where you have… kind of a robust model about the thing that you're predicting.

For example, let's say we were going to send a probe to the Alpha Centauri System to try to measure something on the Alpha Centauri System. Well, we've never actually done that before. Unlike the sun, which rises every day, we've never sent a probe to the Alpha Centauri System.

So, all of our forecasting about how that probe's going to react to the atmosphere of the Alpha Centauri System and of the different planets in the system, that's all going to be based on a model that we create from physics and be able to predict phenomena from that sort of underlying model.

Those fundamentally are the two building blocks of knowledge—inductive, repetition-type learning and deductive model-based predictions about the future.

Rob Campbell (06:15):

If that's what it takes to create knowledge, what are some areas where… I'm thinking if I flip a coin 10 times and it all comes up heads, I might think that the coin on the next flip has a greater probability being heads, but of course as we know, it's kind of random.

So, can you just talk about some of the pitfalls of relying too much on the observation set that we've looked at?

Justin Anderson (06:33):

I like your coin example because it really plugs back into this idea of non-random forecasting, which is our original definition of knowledge. So anytime we think, "Are we in an area that's actually creating knowledge?" We should always be asking ourselves this burning question, "Can I explain this with randomness?" And we always need to be very humble about that question. Let's look at some examples of industries where we can ask that question, "is there randomness involved here, or is it non-random knowledge?"

Justin Anderson (07:03):

I like to look at the airline industry. So, 120 years ago, the Wright brothers, they barely took this plane off of the ground, off the runway, and they started [the flight age]. And that was 120 years ago. And you can actually look since that time, [there's been] this incredible evolution of flying and technology beyond flying. Now we're flying planes at 800 kilometres an hour with 500 people in them, incredibly safe, and just this amazing amount of knowledge creation that has happened. And why is that?

And that's because you have a very robust inductive system. So, you're making lots of planes, you're engineering, you're testing them. And deductive—you understand Bernoulli's equation, you understand the science behind flight and lift and all these principles. So, because those two mechanisms—inductive and deductive learning—is so robust, you have this incredible evolution in knowledge creation.

Justin Anderson (07:46):

And so that's something you see. You could contrast that with something like say, astrology, which 120 years ago just like when flying was invented, also had predictions about the future. And those things, unfortunately, they do not have a robust deductive mechanism and inductive mechanism for learning. And so astrology's predictive power today is probably as good as it was 120 years ago. So it hasn't [had] much evolution.

And I think that the difficult part is when you look at investing, unfortunately, it often mimics a lot closer to the astrology side of the equation than the flight side of the equation. So that's partly where it comes back to these contradictions and learnings that you discovered at first.

Rob Campbell (08:22):

I did appreciate your example of the airline industry just given your background as an aeronautical engineer, but let's get back to investing. So, I think you touched on it—there's something different about investing that makes it more difficult to create knowledge. Can we dive deeper into that? What is it about investing that makes it more like astrology and less like flight?

Justin Anderson (08:43):

Pounding on this inductive/deductive sort of mechanism, let's look at those two [and] pull them apart in investing.

In investing, inductive learning: we as investors, we make long-term investments into stocks. It might take five to ten years before the outcome of the stock investment is sort of known. First of all, right off the cuff, we have this difficulty because our timelines, our testing timeline, is in many years as opposed to, say, subjecting a plane to a quick test every month or every day if I have a wind tunnel or something. So, there's that kind of repetition problem that we have in investing.

The other problem, deductive. The markets are fundamentally a chaotic system and there's so many different factors that are coming into play—human emotions, psychology, macro factors—that are in the system. So, we don't really have a unifying model, predictive model that we can build and say, "okay, when this happens, this is going to be the outcome. This stock will go up, this stock will go down."

Justin Anderson (09:43):

Because you have this fundamentally chaotic system, deductive reasoning can be very difficult to bring to bear to investment type questions. And because you have these long cycle times between when you make an investment to when the outcome is fundamentally known, your inductive processes are difficult. So, that sets up for that… more analogous to astrology situations. [It] doesn't mean it's the same and there are potential workarounds, but it definitely means it's an extremely challenging environment to build true knowledge in.

Rob Campbell (10:05):

[It's] important that individuals gain knowledge even [when] facing the challenges—this is what you and others on our team have devoted their lives to do. And I think a big part of the culture is to try and get better at what it is that we're doing.

So, what is the answer or the solution to this difficult problem that you've identified?

Justin Anderson (10:22):

Just to add to your point there—just because these challenges are extremely difficult, it doesn't mean you don't want to tackle them. You don't just ring your hands and say, "Ah, to heck with it!"

Another extremely challenging, chaotic problem would be, who do you make friends with? Who do you marry? There's all sorts of chaotic, difficult challenges in life where learning isn't easy to bring knowledge to bear and yet they're very important questions. So, it doesn't mean you sort of give up.

To your question, I would say that you can try to tackle these questions. The starting point needs to be just an extreme amount of humility about the scale of the challenge that you're taking on when you're trying to create knowledge in the investment world. You don't want to be glib with your learnings. You want to be very, very careful with how you go about doing it.

And the other thing I would add is, I think there are ways—and this is partly what I want to talk to you about Rob—but I think there are ways that you can make workarounds to inject types of [improvement to] the deductive and the inductive systems inside of investing to make it so that you can make some headway on learning.

So, I think there's hope. It's difficult. It's a huge challenge. It's this fundamental problem, but I think people can try to tackle it.

Rob Campbell (11:30):

I'm reminded of a comment that I think Jim [Hall] made… I can't remember when, but a little while ago. He was reflecting on when he was earlier [along] in his career, he was a lot more sure of things. And as the years have gone by, and he's gotten smoked in every way possible—that's not the right way to say that [laughter]—but just as the years have gone by and he's made more and more investment errors, of course that aren't avoidable, he has just realized how little he knows for certain in the world. So, I think that rhymes with what you said.

Justin Anderson (12:02):

I really like what you say there about Jim, because I worked with Jim for a while on our Canadian equity fund, and one thing he said a lot was his approach to the markets now after a long career in it, is evolving to this kind of "win by not losing" strategy. And as I think about that more, I'm very much in a similar camp where I started off as a young investor and you think, "Okay, I just got to buy this stock or buy that stock." And over time you realize, well, you can't really predict that. These are highly chaotic processes at work.

But the thing that you can do is you can try to manage your mistakes as an investor. You can try to focus on, okay, my cognitive biases, my diversification—all these different systems where I know I can fail and focus more attention on that. And I think as I learn from him and others, I think that's what he kind of means by "win by not losing"—is try to minimize the mistakes that you make as opposed to thinking that you can be the hero who, in a chaotic system, can pick that great winner.

Rob Campbell (12:54):

And to connect this back to those who listened to the post-mortem podcast, I think that's in part what Paul was suggesting with respect to emotional intelligence and just being faster to recognize one's biases and the psychology and the errors. The quicker you can recognize them and mitigate them—and to your point, Justin, avoid them—the better that is.

Let's go back to what we can do, some tangible things people can take away. What are some of the workarounds for learning in investing?

Justin Anderson (13:21):

I'll do a quick introduction to Mawer's Lab, which is a team that we have that's embedded inside of our Research team, and it's fundamentally a technology team full of developers and folks with more technical background[s] but mixed with analysts who are more traditional stock-picking type roles, and they work together collaboratively on two fundamental issues.

One is improving our investment process. So, that's taking our existing processes around building DCF models and trying to understand stocks, and helping make it faster, make it better, and there's a myriad of different ways that we try to do that.

And then the second kind of bucket is knowledge building. So, fundamentally this epistemological bucket that we're talking about today. We call that at Mawer, "calibration culture." What we mean by that calibration is measurement culture.

If you go back to the inductive learning kind of mechanism, the key with inductive learning is you have to have a prediction, which is how you start inductive learning. "I think X is going to happen" (I think the sun is going to rise tomorrow), and then you have an outcome—the sun actually rose tomorrow. You need that feedback loop.

In investing, it's extremely common for us to just focus on outcomes and then fit the past to our outcomes. Okay, "here's what happened, now let's tell a story why that happened." And that's not learning, that's storytelling. Learning is much more… here is how I am going to document my predictions, and then here's the outcome, and then going back and measuring prediction and outcome and adjusting accordingly.

Justin Anderson (14:47):

You'll see in all the great sport players of all time—poker players, which we'll get more into—they're always documenting their predictions and then assessing the outcomes after the fact, closing that loop on inductive learning. So, a huge part of what we're doing at the Lab is helping the team document predictions, if you will, before we reach the outcome.

We do that through a process, we call it "journaling." And [we do that with our internal database tool called] M42, where analysts, whenever they're talking to, for example, managers, we're documenting those interviews; when analysts are putting ratings and putting their views on stocks… that's all getting documented. Every single time we run a discounted cash flow model, we document the outputs for that model into the database.

So, it's sort of this plethora of data that's getting documented, including the decisions we make. And then that gives us the tools that we need later when the outcome—a successful or unsuccessful stock outcome, for example—happens, we can go back and look at all that documentation and try to close the loop on learning.

Rob Campbell (15:49):

As you were describing that, I was recalling Tetlock's book, Super [Forecasting], and one of the things that I took away from that was the, "by when?" The forecast had to have a definitive endpoint. As the Lab develops this data set, is that an aspect that's missing? Or, how do you work around that aspect of it? To your point from the beginning that, yeah, in investing you don't know for five or ten years. You can create the discounted cashflow model, but who knows… it's going to take years for you to be able to test whether you were any good at it.

Justin Anderson (16:17):

I really love that question because the journaling step in inductive learning is not an easy step. It's very easy to say, "Hey, this is too much work. I just want to focus on predicting the future and thinking about the future." But it takes this huge amount of discipline to stop yourself and say, "we're going to document this and we're going to document properly."

And there's—to your point about timestamping, that's one component of a proper journaling process, is you're making sure that you're timestamping the event properly. There's another key point which is governance in general. Governance of the journaling process. You want to make sure someone can't go back and adjust the journal post hoc for whatever reason. There needs to be a kind of governance process in the journaling.

And it's very easy to slip into some of these biases because we're human and we want to kind of just [go], "Oh, I actually meant this, or I actually thought this," and it's quite simple to violate those, but if you're going to do proper journaling, timestamping, governance, these are critical elements of doing it properly.

Rob Campbell (17:15):

I'm reminded of—I think it was Will Rogers who said something like, "Investing is simple. Just buy stocks that go up and if they don't go up, don't buy them."

Justin Anderson (17:23):

[Laughing] If it were that easy.

Rob Campbell (17:26):

Can we dig into some of these other adjacent games that you guys have found helpful in the Lab or within the Research team that help improve or increase the speed of the cycle times or help improve the learning process?

Justin Anderson (17:38):

Well, you mentioned Phil Tetlock and his work on forecasting tournaments, and that would be an example of what I would consider an adjacent game. What do I mean by "adjacent game?" It's essentially a game that has some consistency with investing. It tries to avoid some of the learning problems that are inherent to investing and it kind of shortcuts some of those, but be analogous enough that you're still kind of flexing the same muscles that we flex in investing.

A forecasting tournament is a really good example of that because what you do with a forecasting tournament is you define a very specific question that you might want to predict. For example, we recently ran a forecasting tournament, [and] one of the questions was, "estimate what the e-commerce penetration rate globally will be according to this report on this date." And then it provided some buckets of percentage that it's going to be here, there, or what have you. Our team kind of engaged in that; it forces the team to go through this process of actually documenting, so there's that journaling step, but the nice thing is you then have instead of ten years for the outcome to come to pass, the outcome might come to pass in six months. You kind of shorten the cycle time materially. And you're also working that same kind of muscle that goes into investing, which is you're making these complex predictions and trying to leverage different information sources to come up with a relevant prediction of, in this case, the e-commerce penetration.

And so the idea is to try to tackle more tractable problems than say, "will the stock go up or down?" Something that is more, where you can bring data to bear and work those similar adjacent mental models and processes that you do when you're doing stock-picking type work.

Rob Campbell (19:12):

Thinking of another area where there are long cycle times—in some ways, some sports have much shorter cycle times because you have a game every other day, but for others they're quite long. And I'm thinking specifically about World Cups or the Olympics that happen once every four years. Are there lessons from there that we can apply?

Justin Anderson (19:27):

Yeah, exactly. So, like in the Olympics, the main event is very similar to say, investing, in the sense that once every four years you get this incredibly volatile outcome of whether or not you're successful during that Olympic event and you've got the four years or the eight years or your lifetime to sort of prepare for that.

So, the question is, well, do athletes sit there and ponder the main event? Of course they do, but what they do is they break it down and they train and they train and they train and they study and it's through repetition and iteration that they prepare for that big event.

Justin Anderson (19:50):

And so that kind of goes back to this concept of adjacent games where it's like, hey, can we break down some of those investment processes that we do and play games that are analogous enough to investing but have short cycle times so we can work those muscles and kind of improve our investment intuitions through the back door, through these workarounds?

Rob Campbell (20:16):

I presume this is where the poker topic comes up.

Justin Anderson (20:19):

[Laughs] Exactly! I have a kind of rule whenever we do our annual learnings that one of my learnings has to be poker related. This one it sounds like it's no different, but for me, poker is almost one of the ultimate versions of this shortening the cycle time that's inherent in investing.

What I like about poker is it's got a couple aspects that are analogous to investing. One is you fundamentally think of the world stochastically, probabilistically. When you have a hand, you're never thinking, "okay, the next card is going to be X," you're thinking, "it might be X, it might be Y, it might be a whole slew of other cards," and you adjust your game based on that probabilistic thinking, which in my opinion in investing is a very healthy way to look at the world. It's not that there's a single thesis-driven investing approach, "this is what's going to happen in the world," it's more fundamental uncertainty than that, and you think about setting up your portfolio in a way that makes it robust to all the different scenarios that can happen.

Justin Anderson (21:10):

The other thing I really like about poker from a perspective of learning investing is the short cycle times. The time from when you're dealt a hand to when you finish the hand can be a minute, and you contrast that to the years that you kind of wait for the decision to come in on an investment. So, you're learning a lot of those decisions under uncertainty and trying to make the right kind of bet under uncertainty, but you're able to get in a lot more cycles.

So, another example of an adjacent game that can help work those investment muscles.

Rob Campbell (21:38):

Is there a risk that these adjacent games might cause you or the team to shift our focus? And what I mean by that is, yeah, poker's great because you get lots of cycles, but it's very short term in nature, at least if I understand it. Or, yeah, we can play these forecasting tournaments where you're trying to guess how something might evolve by a specific time and yet that strikes me as different than one of our mantras of, "filter don't forecast."

Can you connect the dots for me as to how this ultimately helps us?

Justin Anderson (22:09):

Yeah, I love that, Rob, because nothing is cost-free and it kind of makes the point that whether it's a forecasting tournament—another example I would use is a mock portfolio. Something that we've constantly thought about is, hey, maybe we should have our analysts (and I know some firms do this) actually run their own well-governed mock portfolio, and then we can kind of look at their portfolio and eventually maybe they would become a portfolio manager if they're doing very good and whatnot, and also they can learn.

A lot of these things sound great in theory, but they come with costs and in the case of forecasting tournaments, it's incredibly time-expensive to properly govern and set up these processes. The cost can be time; the cost can be like you say, it can be focus, where the analyst is focused on something different than what we maybe we want them to focus on. It's not easy. It kind of ties back to this overall problem of, learning and investing is difficult. And if you're going to tackle it, you got to be ready to pay a big cost because there's not just some simple technique that you can run to get there.

Rob Campbell (23:05):

Presumably one of the things that helps with learning has to do with, you might have touched on this a little bit earlier, but what are the preconditions within an organization. Some of our listeners might have their own investment teams and have to think through this.

What are some elements that you think are fundamental to increasing the chances of greater learning within an organization?

Justin Anderson (23:23):

Let me use an example on that. You've probably heard the term "wisdom of the crowds" type effect, and this is a very interesting one because wisdom-of-the-crowd effects can actually be very positive if you have the right conditions. They can also be very negative if you have the wrong conditions in an organization. And what are those conditions?

So, in the case of wrong conditions, those would be when you have strong authoritarian bias in the organization—people are trying to please the leader. And what actually happens is you get into kind of a groupthink place. Instead of the positive effects of wisdom of the crowd, you get this overconfidence that there's consensus on a particular opinion when there might be a lot more different views that should be voiced and so you might overly confident go down a certain path that is destructive.

And conversely, if you have open culture, you have a high trust culture. Where people can speak their mind without being afraid that they're going to be punished for that, and also they're fundamentally curious and they're willing to take risks. That can lead to the best aspects of wisdom of the crowd, which is where people—because we're all exposed to different parts of the world. You're sitting in Toronto at the moment and you're hearing different pieces of information; I'm here in Calgary—different pieces of information. And if you and I come to the table as high-trust partners, then we can learn from each other and you can provide a perspective that I just can't see, and vice versa. You scale that up and that's where you get the positive win-win that comes out of wisdom of the crowds.

So, fundamentally it can be a really positive thing if you do have those correct conditions in the office environment.

Rob Campbell (24:56):

Justin, in your time as an investor, I know we've talked a lot about how difficult it is to create knowledge or learn. What are some of your biggest lessons learned throughout your career?

Justin Anderson (25:06):

I would say I'm kind of on that Jim Hall path [laughs] of coming to this idea that, you can't predict the future. The best you can sort of try to do is minimize the mistakes that you make. And those are a little more tractable problems to tackle, where it's like, "Hey, I'm tired right now. I shouldn't make a decision," or "I'm emotionally compromised," or whatever the situation might be. Trying to avoid either those behavioural or other situations where you might be making mistakes.

I think when I started my career, I was a lot more stock-picker oriented, where I thought, "I can pick the next winner." I think there's a little bit of that in every investor. That's partly what attracts us to the industry is this exciting thing of, in this soup of chaos, can I actually predict that this stock is going to do really well? So it's hard to get away from that. But yeah, I think in general it's a very slow, painful migration to that philosophy of, call it, "less prediction and more building your portfolio and your life around a robust strategy that can handle a wider range of scenarios."

Rob Campbell (26:03):

Last question I want to ask you—the last couple of months there have been some pretty phenomenal announcements with respect to AI. ChatGPT and just… speaking personally, [I'm] just kind of blown away by what some of these models are able to produce.

How do you think that will impact this learning process within investing? And I know with the Lab… but just putting [on] your own forecasting tournament—and I probably won't get the governance aspect right or the timeline—but looking ahead the next five or ten years or whatever it is, how is that going to impact the industry and the job that you and others do on behalf of our clients?

Justin Anderson (26:36):

Obviously, it's a fundamentally uncertain question. Because we can't really predict how that's going to play out and it's kind of a function of how it plays out. I think if I kind of give you my framework for thinking about that question in general, I would look at it in a similar way that I look at quant funds today and funds that try to leverage computers to predict and make stock decisions. And I think in general, those have been pretty reasonably successful in very small niches such as around trading volumes and trying to anticipate and get ahead of certain large trading volumes.

But outside of that, more fundamentalist type quant I think has been more of a challenge for the investment world. I don't think there's been a lot of success there. And I think that it's fundamentally related back to our whole discussion today, which is, inductive and deductive learning are so difficult in this industry.

Justin Anderson (27:24):

There isn't a model—unlike that probe that we sent to Alpha Centauri—there isn't really a model that we can program that is actually going to be able to predict. So, if I kind of layer that on, I would say I think AI falls into that similar bucket where, we don't have good deductive/inductive models.

In those industries where we do, I think AI is going to have a massive impact because of the scale and the speed at with which it can move. In investing, I don't see it as much. And maybe that makes me a little bit of a skeptic, but I think the learning environment is more challenging for AI in investing.

Rob Campbell (27:55):

But just maybe to ask it a different way—you talked earlier about how creating a narrative isn't learning, and in a way I imagine some of these models would be extremely good at creating narratives based on what's happened in the past that may not be predictive going forward, but I think my question was more… how will it help us in the process of learning, as opposed to being able to actually invest?

Justin Anderson (28:15):

Yeah, how can AI help us in the process of learning? I don't know if it's so much AI, I would say, as the evolution of the cloud and the speed and the cost with which we can document data.

The cost of engaging in journaling and in governing adjacent games such as forecasting tournaments, some of these things that we discussed today—those processes are getting fundamentally easier and easier to manage. And so I think we will get better at that.

I think AI, for example, one of the (for me personally) I think big benefits of it will be [in] actually an improving our UI (user interfaces), for how we interface with technology. And that almost certainly will make us better investors.

So, imagine you have a hundred apps on your phone and 50 apps on your computer—rather than having to enter the app and then do what you want to do, you could just tell the AI, "Hey, I need to do X," and it'll open the relevant app and get you to where you need to be right away. I think it'll help make things smoother, but I don't see it fundamentally changing the game, but with the huge caveat that I have no clue. We're talking about the future and I'm giving you a very lightly held opinion on the matter.

Rob Campbell (29:19):

Despite that—I still probably have more questions on that! We may reconnect at some point in the future—but I think that's a great place to end, just with the sheer challenge of the task. I liked what you said earlier with respect to, just because something is hard, it doesn't mean that we shouldn't apply ourselves. And so Justin, as always, thank you so much for coming on the podcast and look forward to chatting again soon.

Justin Anderson (29:39):

Yeah, absolutely. My pleasure, Rob. Great to be with you again.