

Numberphile Podcast Transcript

Episode: The Accidental Streamer with 3blue1brown

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Grant Sanderson from 3blue1brown returns to the podcast to talk about live-streaming lessons, tracing coronavirus, and a technical mishap.

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Grant Sanderson [GS]: While we're interrupting can I do something terribly rude?

Brady Haran [BH]: Yeah.

GS: [laughs] I'm making some bread and I have to for like one minute go and turn them all so...

BH: Go for it.

GS: Like for one minute I'll pop over, great.

BH: Go for it, mate.

[gentle music fades in]

BH: Grant Sanderson from the Youtube Channel 3blue1brown was our guest on the first ever Numberphile podcast. And today, well, he's back. In recent weeks Grant's made some fascinating videos about the Coronavirus Pandemic and even more recently he's started live streaming lessons for high school students who are stuck at home. He's doing really interesting stuff during what you could perhaps describe as the most interesting of times. Here's our discussion.

[music fades out]

BH: So you were in the first ever Numberphile podcast, and you're back.

GS: I had the honor.

BH: You had the honor, and you're now back. You're not the first repeat though. You're not the first person to make a second appearance. I'm sorry.

GS: Hmm.

BH: Hannah Fry beat you to two.

GS: As well she deserves to. I mean I would listen to a podcast with her and her alone if that's how you want to steer this thing.

BH: So when I think of 3blue1brown videos I think of meticulous preparation, sometimes months and months of preparation. Carefully plotted animations that have been like hewn from nothing like, that's kind of like your calling card. And now you're doing something a little bit different.

GS: If this is not the polar opposite of the usual style I don't know what is. In short I'm doing live streamed lectures. Which...

BH: Yeah.

GS: So one it's different because its live, meaning instead of taking one month to produce a video, you know, it takes sixty minutes to produce a sixty minute video. Second it's live action, so I'm like on camera, pencil and paper, I'll have some animations but just as like the occasional thing that I pull up if it seems relevant in a screen capture.

BH: Yeah.

GS: And then also it's like directly targeted at high school students, which, I aim for most of the videos to be, you know, as approachable as possible, but realistically I know the demographics, like the majority, it's eighteen to twenty-four year olds or twenty-four to thirty year old, so it's like the college students and the yuppies. So it's like alright I'm gonna shift format, do it live and target it at an explicitly different audience. Let's see how this goes.

BH: So, okay then. Let's deal with the more obvious things first. Why? Is this because of...

GS: [laughs]

BH: Is this because of the lockdown? Have you sort of seen this need all of a sudden? It seems like everyone's creating education content for kids who can't go to school. Was this precipitated by that? Was it something that was in the

works anyway in your mind? Why are you doing this?

GS: It's definitely the impetus. And you know the stated reason, which is not untrue, is that you've got a lot of people who are students who are doing some kind of distance learning and I want to add a resource that's helpful for that. If I was a teacher maybe I'd want to like point the kids to something where I don't have to like come up with how to fill their time in this weird situation. But if that was the only factor at play, I probably would just be doing the normal video style. I think for a while I've felt that it might be nice to just do something totally different, especially pencil and paper just because while I love to animate stuff and visualize it, that doesn't feel like doing and discovering math to me. That feels like presenting an end polished version, right? Whereas just sitting down in a scrappy context with a notebook, like that's what doing math really feels like or a blackboard or chatting with someone. So having something that I produce actually be representative of that feeling and just working through examples, it's like sometimes it's unsexy but you know let's just plow through this algebra. I've had a thought that that's something I kind of want to do. And then the other factor that plays into it which is probably the straw breaking the camels back and like making this happen, I have a good friend, one of my closest friends I used to work at Khan Academy named Cam, he's building this product called Item Pool that's aimed at just being a centralized resource for basically question and assessment items and things and then he and together with another person, many listeners might recognize the name of Ben Eater who does a number of things but among them runs a Youtube channel about computer engineering, have been like tweaking that particular tool to be like useful in like this sort of livestream context. Kind of as a way of launching the product slash just getting some usage and being an excuse to like get what he wants made, made, even though it wasn't originally envisioned as, oh this will be a tool for live-streaming Youtubers. We think that can actually be a fun way to make this a more engaging dynamic. Anyone who watches the first stream might now how [laughs] the first experiment of that turned out but maybe we can talk about that later. Those three things together though are kinda why I'm doing this.

BH: Well seeing you brought it up Grant, let's talk about the new tool that your friends have devised. That you're incorporating into these live streams, because I know you're had some teething problems when you got the hug of death from the internet on your first go.

GS: [laughs]

BH: But I did watch your sneaky behind the scenes test run that you invited a few people to come and have a look at.

GS: Oh you did?

BH: Yeah, yeah. I know you just did a brief tweak, so not many people saw it, but I did see so I went and had a look. So I saw it working quite well, which I'm sure it will be working well again soon, and I thought it was like a fantastic addition to this kind of live streamy you know Khan Academy style watch me write on paper thing which can sometimes be a bit, you know, you either love it or hate it.

GS: Mhm.

BH: But I thought the incorporating of this interaction of the questions was a real winner. So do you want to kind of explain to people how you seen that working when it's working at its best?

BH: Absolutely. My mind was blown when Eater showed me the demo. Basically he pulls up this video, I'm in the other room watching his like test stream and he points to me a website that I can go to answer a multiple choice question. So the way I had it, I was watching him on the stream, then on my phone I was on the website. And so he pulls up this question and you see it on the corner of the stream and then you see these bars showing some statistics, and so like I put my answer in and one of the bar changes. Like the action of mine changed what happened on the screen, and its showing like the first place most common answer, second place and such, but you don't see what they are. So you might see, oh wow like fifty percent of people think its some answer, then it's evenly distributed among the rest and then he can reveal, and be like oh looks like most

people chose C, let's discuss. But a lot of you still were saying A, that's a common misconception, we can go into that.

GS: So it's kind of like your live crowd sourcing what kind of your audience's opinion is or what they think an answer is, but you're not necessarily telling everyone what the answer is so they can't jump on a bandwagon.

BH: Mhm.

GS: Because they don't know what the band wagon is.

GS: Exactly. So you can know if there's consensus, but you can't know what that consensus is around until the streamer or whoever's controlling it reveals.

BH: Yeah.

GS: And I'll tell you this, so very interesting you were among those hundred people who I did the test stream with. 'Cause I'd basically just put out the tweet and then I waited til there was hundred simultaneous, then deleted it, which happened pretty quickly. The retention on that was like insane in terms of if you contrast it to usual retention on like Youtube videos, and a lot of that might just be because, oh its this sneaky test thing and we're like this inner audience and like curious to see where it goes. But at the same time I didn't tell anyone their like what amount of time to expect and [chuckles] you know just asking for like an hour out of their day when they were scrolling through twitter. Doesn't seem obvious. So I'm curious to see in contrasting the second stream with the first, when it's a much larger public audience, if having the tool there actually guiding the classes its intended to, the full time, changes like how long people stick with it.

BH: Can I ask about you, like, 'cause you're a guy who does talks and you have appeared on camera before, but at the same time I guess maybe I had this... maybe I had this wrong preconception of you as someone who likes to be a bit of perfectionist and get everything just right and is like maybe a little bit more shy. So how has it been, A, being so front and center, and your face being on screen

for an hour, and secondly being in this situation where, you know, you're gonna misspeak, you're gonna make mistakes, you're gonna... like things aren't gonna be perfect, sometimes you're gonna muck up because in an hour who doesn't muck up? How does that mesh with your brain, your personality?

GS: [laughs] That's a good question. I mean so I'm not CGP Grey to the extent that I can infer the personality type there. But I do... I guess I like when I view a character like Matt Parker and just like his live performances and such, I don't know if envy is the right word, but I have the feeling of like a kid who is like wow, I want to be like you when I grow up. It's just seems like such a compelling skill set to be comfortable in an environment like that and I know that that's not me naturally. Certainly like the first few talks I gave I think were not [chuckles] didn't necessarily go swimmingly. So I know that's something that I want to get better at. That's one of the reasons behind this. It's weird to put yourself front and center because it's so easy to see how normal Youtubers become vain, 'cause you're like prepping, you're like oh is the light right, I'm looking like man is my forehead really that big? Like there's all these thoughts that I never usually have that are centered around very shallow things, right, like appearance or are you gonna make mistakes and things. It's a little unnatural to maybe get that out. But at the same time, you know, like I said real math feels like just going through paper. Real math also feels like making a bunch of mistakes and hopefully being kind of jovial about that and working from them.

BH: Yeah.

GS: And if I can be a little bit more representative of that rather than the oh here's the platonic realm of black background pristine animations. If this isn't what your homework feels like then things are going so wrong. Like, you know, there's the potential disservice out there if I didn't have any of the raw uncultured... just this is how it is, this is who I am, kind of up on screen out there.

BH: Grant do you worry though about the big how, like of course you can write a wrong number or a wrong sign and then pick that up and go oh silly me, let's

cross that out and fix it up. But what about that mistake that, you know, build on over fifteen to twenty minutes and this kind of big fundamental thing that you've taken people down this complete wrong lane. Do you live in fear of that? Or are you sufficiently prepared that you think that can't happen, or?

GS: [laughs] Well so I'll try to prep, right, I think the goal in the same way I did that little test stream that you were a part of. That was not just for the technology, that was also just so I could practice the lesson. Hopefully if I prep well, in the same way that if any teacher preps well, that's not super common. It'll happen though. I'm error prone, everyone is. That's gonna happen. I am... mildly terrified, maybe, but I think there have been some other times I've watched like a YouTuber make a video, an education one, and then they have some kind of follow-up that is about their own misconception that's like pretty uncharacteristic, most people don't really do that, they'll just sort of like shuffle it off as an error... correction in the description or worse case they'll like take down the video and put it up and kind of rewrite history. But in the times I have someone be like you know I said this thing, that was wrong, here's what you guys told me and here's what I learned. I just felt myself feeling such respect for that, and recognizing wow that actually was a way better experience for me as the viewer than it would have been if you'd just retroactively changed it so that it was always correct. So again in the same way that I look at someone like Matt Parker on stage and say I wanna be like that when I grow up [chuckles] you know I can look at those sort of examples and say, you know, how can I try to shift things to be more comfortable with that because it's not natural for me, I think, to know that there will be a big mistake that leads us down a wrong path.

BH: You mentioned sort of the vanity and the lighting side of, you know, that vlogger existence. I have to say I was very struck by how glossy and nice your set looked and how like glowingly handsome you looked. What's going on? [laughs] I mean not that you're not a handsome guy but like, it looked really good. [laughs]

GS: No... all of that... so we're doing all of this from Ben Eater's house just

because there's a number of reasons, like sort of an easier set up there and such and he's got a lot of good professional equipment. So he's got the two cameras, the overhead on the thing, the face camera, with like a really good lens. He's got all the lighting and he was like finicky about setting it up. So one hundred percent of the credit there just goes to the fact like his perfectionism and little bit more comfort with live action shooting translated. I'll give you an illustration of what it looks like if I do things left on my own, okay? So when I was earlier this week just playing around with the broadcasting software to try this out and anytime you download new software you just kind of poke around and try to see how it works. Maybe a tutorial if you don't find it intuitively obvious. So I download OBS and it's like you know log-in, punch in this key from Youtube to like hook it up to your Youtube channel, like yeah okay that's something probably I'll turn on later. And I'm just poking around at buttons and then a couple minutes later I hear from down the hall Eater's voice. He's like, uhhh Grant? I just got a notification that 3blue1brown is going live. [laughs]

BH: [laughs]

GS: I'm like, I'm sorry what? [laughs] And it turned out I streamed myself for three seconds as I was just clicking around. So as a public notification event, there is a three second video of me just like starring confusedly at a screen with like a crappy webcam. Like clicking once and then like clicking twice.

BH: [laughs]

GS: And I changed it from public to unlisted decently quickly but because that goes into people's emails and such, there's fifty thousand people who have now just watched the three seconds of me like clicking. [laughs]

BH: [laughs]

GS: Once and then twice.

BH: Nice. We'll put a link to that in the show notes [laughs]

GS: I will absolutely... the comment section... I was dying. It's actually super funny.

BH: Brilliant. You mentioned how you were trying to reach a different demographic like from that kind of quite mathy smart yuppie type to want to hit school students but I imagine, you know, you're gonna hit your core audience a lot too. All the people really really have loved your content for a long time are gonna wanna watch this too? Do you worry about alienating them, or them remaining your constituency and you sort of drifting towards catering to them more than the school students, like how are you gonna ride that delicate balance?

GS: I'll tell you what, you hit the nail on the head for what's hardest about this. My goal is try to teach a high school lesson in a way that's unusual enough or like relates to patterns later on enough that even someone who feels like they're pretty comfortable with math or is maybe in like the usual core audience, finds it interesting. The very first stream I did yesterday it was about... I mean on the surface its about the quadratic formula and difference of squares. Like these two sort of standard things one might need to learn. But the hope was that I could offer a little bit of perspective on each one that is not what people usually see in school. I learned that evidently the way I was showing things is kind of similar to what some Austrian and German students learn which is cool, but most school systems have like a different tactic. And if I can, you know, procure enough thoughts like that where it is a high school lesson but it's atypical enough that maybe the core audience still finds it interesting. My hope is that success. The other factor is even when people are you know really into math, or they find themselves oh can you please go into this complicated topic or such, like the reality is math is hard for all of us and even the seemingly simple stuff has just this plethora of insight to be gained if you look back at it with a keen eye. Even arithmetic, even if I look back at how to add numbers or things like that, there's always some pattern that I realize only because of math that came later on that lends a certain appreciation down on that rung. I could easily see accidentally alienating the audience or feeling this pull where oh was this a complicated enough topic and then accidentally alienating the high school students it's

targeted at. I think if I did my job well it's definitely possible not to do that and it's just a matter of appropriate preparation.

BH: What does this mean for like, you know, your standard fare. The traditional 3blue1brown video that we all know and love? Like are you still gonna be able to knock those ones out? Are you putting them on the shelf for a while, while you go into lesson mode? What's the thinking there?

GS: I don't know if I would comfortably use the phrase knock them out, but...

BH: [laughs] No!

GS: I'm working on them in parallel. [chuckles]

BH: Yeah.

GS: I mean there's at least one more that I'll put out that's relevant to kind of the Coronavirus Pandemic stuff, and that just because of the timeliness, it pulls you to work harder. But then there's also a bunch of other content that I've been like promising or which are like collaborations in the mix. That again I have this pull of like well I really can't delay this too much. So I think really it's just gonna mean that I work more hours for the next couple months, which is fine. But we'll see how realistic that ends up being.

BH: Do you see the lessons going as a long term thing? Is it something you're just planning to do during this kind of crazy lockdown period we're in or do you see it as like a new permanent part of your life? Have you thought about that?

GS: Obviously it's entered the mind. My thought right now is just run with it for a couple weeks, see how that feels. If it feels great and like I'm totally comfortable just maintaining that forever and people are deriving huge value from it... yeah I might put it on another channel, just so that there isn't that pull between audience types. Maybe the higher probability case is that we let this just be like a nice one time thing that maybe I spin it up again as like a future season one time but it's not gonna be a recurring, every week I do one of these streams.

But honestly ask me in five weeks and we'll see. If I'm sufficiently exhausted maybe there's a different answer.

BH: I notice that you... you're doing it at the moment... as things stand at the moment the plan is to be doing it on Fridays and Tuesdays. Why oh why in your banner on your channel where you promote when people can watch them, does it say Fridays and Tuesdays, and not Tuesdays and Fridays? [laughs]

GS: Oh... [laughs] Oh I never thought about that. Um... maybe subconsciously because the very first one was on a Friday...

BH: Yeah. [laughs]

GS: So in my mind I'm like number one's Friday then Tuesday then repeat.

BH: Okay. [laughs]

GS: Yeah I dunno... I'll go switch that, I admit...

BH: It does my head in. [laughs] But I dunno why. I'm not even normally one of those people but I'm just looking at going... Fridays and Tuesdays. Hmm.

GS: You know what I'll do, I'm gonna go I'm just gonna leave a note for myself to change that right now.

BH: [laughs]

GS: I had no idea that some people could be so very finicky about this kind of thing. [laughs]

BH: I like it. And I like your answer, I mean I did imagine that was the answer, 'cause you started it on a Friday but I just thought it was as a... I dunno, I just noticed it. It's just one of those things.

GS: No no, that's hilarious yeah.

BH: So you mentioned Coronavirus. COVID-19. The pandemic that we're going

through at the moment and you've made, you know, you've made some outstanding videos which surely everyone who listens to this had already watched but if they don't, I will link to it. How are you feeling about things, the Coronavirus in all ways, but I guess mathematically? [laughs]

GS: Mathematically... okay... well I'll tell you this the very first I made was just about exponential growth where I remember looking at the data and being kind of gobsmacked by how if you excluded China then rest of the world was following an exponential weirdly perfectly. And it was small enough numbers at that point, I think it was like twenty thousand cases outside of China, that it obviously it was in the discussion, but it feels like there was this turning point between it when it was one of the common topics of news to when it became what everyone was talking about all the time. So this feels like it was before that turning point and I was in a little bit of a rut, associated with content making, so I was telling myself you know what I just want to see if I can produce a video in forty-eight hours, just to know that I can. And like pump that out and I felt like oh okay it feels like a good excuse for a math lesson it's sort of telling people sometimes things grow more than you think they will. I was concerned that it would spread more. I was shocked by how much it ended up affecting lives, not associated with the disease but with things like the lockdowns and like turning off the economy and all of that. If you had asked me then what's a world gonna look like a month from now I would not at all have predicted that my trips to the grocery store would be this weirdly apocalyptic situation. Where like everyone's wearing masks and like told to be away from each other and you've got these eerily calm voices coming from the intercom telling people like what the proper protocols are. So it's weird and [sighs] it's hard to know where my head is right now because mostly I guess I'm just kind of frustrated that testing hasn't become more widespread because it is the case at least as I kind of look into it that epidemiology done right involves a much more targeted approach where you're able to like test for the cases that exist, isolate those people and isolate who they've been in contact with and we as humanity since say like the 1918 Spanish Flu like we're really good actually at knowing how these things spread and knowing what it takes to stop it. And the idea of having everyone like go inside

feels like a very blunt tool. There's just a cost to that basically where I'm obviously very pro like social distancing and I think it's the right thing to do but at the same time it's hard to ignore the fact that you know you have more calls made to the suicide hotline that are from high risk people. Or you have like unprecedented unemployment numbers, at least in the US, I assume this kind of carries over elsewhere. You have like increases in domestic abuse and things that are not making a appearance on you know a central website that we can look and see these numbers ticking up. No one sees like the suicide numbers slowly ticking up because it's not as a reported. I guess the second video I made was about simulating epidemics and just kind of looking at, you know like let's make a toy model and see what works and what doesn't and it wasn't meant to have a conclusion per say but if there was one it was [chuckles] just sort of this like regret that we didn't have better testing earlier because that so clearly stops things in its tracks without halting the rest of life. But the very last thing I want to make which is less... also a very atypical video. There's this illustrated explainer a friend of mine named Nicky Case put together, talking about contact tracing apps and like the cryptography behind them. And I was shocked actually when I read like what is possible and he made it all public domain and I also kind of got his permission and talked with the epidemiologist he worked with. I basically want to do the video equivalent of a retweet of like putting that and kind of adding some extra commentary. 'Cause I think one thing that's gonna become much more part of the discussion in the coming months than it is now is this perceived trade off of privacy versus global health where what you want is for it to be the case that when someone is tested positive, one you tell them to self isolate but you also say everyone you've been in contact with in the last like three days let's inform them to self isolate. The traditional ways to do that would be like interviews, this would be like pre-cellphones. You just interview them, ask them who they were in contact with and find them. For an outbreak of this scale that's just way too slow. There's no where close to that many resources. So the draconian authoritarian way to do it is to say okay, seize over the geolocation information of your phone and then we'll find everyone who was also in those locations which some countries would be tolerant of but like it is... it would be

like a very big violation of civil liberties in some people's minds to mandate that.

GS: hm.

BH: Now there do exist apps, and I know that Apple and Google, I don't know if they've put them out but they're working on a collaborative effort to this effect, to implement something called the DP3T algorithm. Where here's what it can do. If you test positive you can tell the app, oh I've tested positive. And then it will notify the phones of the people you've been in contact. You've been physically near, like within a certain distance of.

BH: Is that just everyone I walked past in the supermarket, like, that sounds... it could be extraordinary numbers if I was out in a major shopping mall that day.

GS: The papers I've read usually have a number around if the phone's talk to each other via bluetooth for more than like 5 minutes that's when they exchange...

BH: Okay.

GS: This information. And what they exchange looks like gibberish. It's literally pseudo-random numbers. They just exchange a set of pseudo-random numbers with each other. And then basically your phone sends out a thing that says the holder of this phone has tested positive and then a central database sends out something that says okay any phone's out there who have received this specific bit of gibberish, this like weird pseudo-random numbers, if you've ever seen that in the last couple days what that means is that your phone was near the phone of someone who has now tested positive. Because it's gibberish, it doesn't use your location. It doesn't know who you are. Basically in all of the ways that you want it actually protects your privacy. So to me this feels like the only plausible end game. Because we can't just wait til there's a vaccine for very good reasons that will take at least a year, and I just would be shocked if this level of like economic shutdown could be prolonged for anything close to that long. And its very counterintuitive the idea that contact tracing [laughs] it's such a bad name.

Contact tracing feels like the biggest Big Brother thing you've ever heard, right?

BH: Yeah.

GS: It has the word tracing in it for god's sakes, so maybe they need a rebrand.

BH: [laughs]

GS: But it turns out to be possible to do in like a very thoughtful way. The code is open source so people can check that it does what it's saying it does. And that's probably the last thing that I'll put out about it because the internet is a little bit of a all coronavirus all the time channel right now that can wear on people.

BH: Yeah. Grant how do you... I mean you're obviously someone who takes an interest in, you know, the world at large as mathematical literacy and interest in mathematics. How well do you think people have understood all the mathematics that suddenly have been thrown at them? Suddenly we've got mathematical models and exponential curves on the front page of newspapers.

GS: [laughs]

BH: And people who don't know anything about mathematics talking about flattening curves and looking at graphs and all these numbers. Do you think people have done well? Like or do you think people are sort of fumbling in the dark. How well do you think the average Joe has grasped that side of this calamity?

GS: That's a good question, I have a skewed perspective maybe because of what my like feeds will look like. I think it's been a great boon for understandings of exponentials and logistic curves. Never has the world had a clearer picture of what those feels like than now. I think it's probably been great for lending math and mathematicians a little bit more legitimacy, right? I mean if you have someone abstractly talk about a set of three ordinary differential equations, it's like yeah okay but get back to your blackboard, I'm busy with my own things. But as soon as they're telling you that this is modeling, you know, the susceptible

population, the infectious population and the recovered population and you have someone with the communication skills of say like a Ben Sparks on a Numberphile video like thoughtfully tweaking these graphs and showing the implications of different parameters I think that can do a lot to make what otherwise seem like, maybe not useless but disconnected pieces of study actually feel relevant and remind people that even when it doesn't look like something is related to you, you never know what next year's gonna look like. And it's worth making sure that the researchers in certain areas are still doing what they're doing for the times when they're work because unexpectedly relevant.

[gentle piano music]

BH: So Grant I've been doing a wonderful job tonight helping you promote some of your latest work, I need your help promoting something of mine now.

GS: Anytime. [laughs]

BH: [laughs] I want to talk brief, very briefly about another channel that I do called Objectivity.

GS: Ooh, yeah, yeah!

BH: The last time I saw you just before everything got really serious, you were in London and Objectivity video's for people who don't know about them, and there seems to be a lot of those people. [laughs]

GS: [laughs]

BH: Are these videos that I make, mainly at the Royal Society where we pull objects out of the science archives and talk about them. It's just for fun. And Grant came long to the Royal Society and I think two videos ago on Objectivity you were on special guest and you were gonna be out special guest again in the video next month so if you wanna see Grant in them go and have a look, but, how have you reflected on your visit? Did you enjoy going down into the vaults?

GS: I loved that. I absolutely loved the experience. So it felt very like VIP,

because this is places that normal people can't necessarily go and you've got Keith there like oh here's a first edition Newton's Principia. I'm like, are you kidding me? [laughs] Like I was the day after for comparison I went to Cambridge and you know they've got their Trinity Library and inside this enclosed piece of glass that you can't get anywhere near there's this first edition Principia. I'm like my hand's were on one of those yesterday, this is nothing. [laughs]

BH: [laughs]

GS: Like, it was very surreal. You obviously made it a blast too with the... and I don't know if you wanna tell people the...

BH: Oh no we can! We were very naughty, so in the first video... normally I get things out of the archive that will pander to people's interests. So, I did get some mathematic stuff for Grant, but the main thing we got out and the thing we made the video about was about eyes. 'Cause I have an undue fascination with Grant's hetochromialsectorial* whatever it's called thing, the three blue one brown, I always bring it up much to his disappointment. So I got out a whole bunch of things from the archives all about eyes and we talked about all cool sciency eye stuff.

*[Ed. note: Sectoral Hetochromia]

GS: No it was great. And like I loved how you sort of jibed, the implicit fact that I've walked myself into this with the channel name, right? Like...

BH: [laughs] that's right.

GS: I'm asking for any trouble that I get.

BH: You have no defense.

GS: I will say it was also very interesting, right?

BH: Yeah.

GS: I think the like the level of artistry that people used to put in their scientific papers, hand sketching these things, even though that was kind of meant as a joke [chuckles] when we were like, Ah! I feel like I have a deeper appreciation for what it was like to write a paper back then.

BH: Everything's cool, and I will give a spoiler if someone's listened to the podcast for this long they deserve a spoiler. In the next one that Grant is in, next month, he does this thing we call the White Gloves of Destiny where you put on the gloves and you shut your eyes and you just pull random cards out of the card catalog and then whatever you pull out of the card catalog we go down into the vaults and read those documents or look at those things. And unbelievably Grand pulled a real mathematical number one, like the chances of him pulling something that was directly mathematical was very very slim but he did it and we got a real like... we got a lovely coincidence coming your way.

GS: That was fun. That was lots of fun.

BH: It was good. It was good so we'll get you... once this all over you can come back again and put your grubby hands all over those Newton manuscripts.
[laughs]

GS: I will say actually, I... maybe this is more egotistical than it should be, since I was on it and then I saw you post it, I like started poking around at the rest of Objectivity which I should have before, I don't know why I didn't, but you know there's lot of things on the internet.

BH: [laughs] It's alright [laughs]

GS: I actually loved it a lot. Like the chests one that you guys had as the channel trailer.

BH: Yeah.

GS: I just thought that was a lot of fun. So...

BH: Yeah, it's a fun channel I can't get 3blue1brown viewing numbers on it but I

love making them nonetheless.

GS: That's the most important thing. I mean it's like doing what you love and just making things that you love without like caring about the numbers that feels much more important. I don't know, like the channels that I respect the most, I think, are the ones that... hopefully they do like grow huge and, you know, every one of these deep sciencey honest channels becomes like Mark Rober level but realistically, you know, sometimes there's just the smaller niche audience, and we're saying small like hundreds of thousands is like huge [laughs] in terms of Objectivity like subscribers and such but that is what I think I love the most about the internet and things like Youtube as contrasted with what, you know, cable TV has to be, is that you can have the existence of something like Objectivity or something like anything of these channels that I love that just don't need... they don't need a huge scale to operate properly.

BH: Well, they kinda do in the end otherwise you got out of business, but yeah... [laughs]

GS: I guess. Well, in this case it's sort of fueled by your own passion to some extent.

BH: Yeah. It's a loss leader. [laughs] So Grant, thanks so much for your time. Again, you can go and watch his new lesson videos, these livestreams, on Fridays and Tuesdays.

GS: [laughs]

BH: Or Tuesdays and Fridays, whichever you prefer. [laughs] He keeps people up to date with when they're happening. You can follow him on Twitter and all that stuff. You already follow 3blue1brown, I don't even know why I'm telling you people these things, but they'll be loads of links in the notes for this podcast that you can click on to go and watch all the videos, the live-streams, there've already been, what's coming up. Grant on Objectivity. His Coronavirus videos and most importantly we will link to that 3 second video of you trying to figure

out how to work the software. [laughs]

GS: [laughs] Yep. [laughs] Thanks so much for doing this, Brady. I really appreciate helping to get the word out.

BH: No, no. It's good. Always good to talk. I hope we don't spend the rest of our lives talking to each other like this over Zoom and we get to hang out in the pub sometime in London.

[gentle music fades in]

GS: So do I.

BH: As usual there are gonna be links to all the things we were discussing in the show notes for this episode. My name's Brady Haran, you've been listening to the Numberphile podcast. You can find out more at [Numberphile.com](https://www.numberphile.com). Thanks so much for listening, we'll be back again soon.

[music fades out]