2022 Active Inference Livestream Review

December 31, 2022

https://www.youtube.com/watch?v=4IL6KtlCn_o

Reviewing the livestreams we did in 2022!

SESSION SPEAKERS

Daniel Friedman, Dean Tickles

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TRANSCRIPT

00:08 Daniel:
Hello and welcome, everyone. It's December 31, 2022. We are here in the 2022 Active Inference Livestream review. Welcome to the active inference institute. We're a participatory online institute that is communicating, learning, and practicing applied active coherence.
This is a recorded and an active Livestream, so please provide us with feedback so we can improve our work. All backgrounds and perspectives are welcome. We'll be following good video etiquette for Livestreams Head over Active Coherence.org to learn more about getting involved in live streams or various other projects and learning groups at the institute. Well, today is going to be great and fun. We are simply reviewing our streams from this past year.
We're going to touch lightly or mildly on all the streams that we carried out from 2022.
01:11 And by way of doing that, we may end up reflecting and preflecting thinking about where we're going to head in 2023. So we'll begin with just an introduction and a hello, I'm Daniel. I am a researcher in California and I'm excited to reflect. This is like the dot zero preparation, dot one, dot two discussion, and then afterwards we reflect.
This is like the bookend reflection for all of those. And so it's like an even deeper level of nesting. When we're going to Juxtapose. So many things that we talked about, and I'm sure at some neural level, whether somebody was familiar with the streams or whether they listened to none of them, there's going to be something about just touching on so many topics and so many perspectives being juxtaposed that I think is going to be really pleasant to you.
02:15 Dean.
Yeah.

02:16 Dean:
Thanks, Dean. I'm Dean. I'm here in Calgary. Maybe I'm a revised or recycled researcher.
I don't know what my title is now, but after Daniel said, yeah, I think we should do this again, I was like, yeah, we absolutely should, because my metaphor is that it's kind of like double frying those French fries. It just adds an extra layer of integration or crispiness that's hard to resist. The way that we present these things is hopefully a way of integrating a bunch of information because we talk amongst ourselves and it's helpful. And then you look back at yourself talking about yourself and others, and you just get a whole different perspective on it. So I actually am really looking forward to sort of running through these things.
It's going to be a sprint, but that's okay. It still gives you a chance to figure out what the milestones were. It's like seeing the entire Tour de France in 30 minutes, which is kind of fun.

03:21 Daniel:
It's like we completed that marathon and now we're high speed watching the recording from our body camera. All right, well, we'll keep with some patterns from the more paper centric discussions, like leading with big questions.
So what was our stream of attention in 2022 and where and how will we stream in 2023? What did you have to add on these questions?

03:53 Dean:
Not a heck of a lot. It'll be interesting given the amount of time that you committed to the endeavor of here's 2022. I wonder what we'll fill it with. I'm curious now that now that you're on the back side of that, what parts of what you hoped would be achieved came about and what parts do you think there's still room for some backfilling?

04:20 Daniel:
We'll come to that after we've touched on everything.

04:27 Dean:
Yeah.

04:28 Daniel:
I really liked what you added here, though. In a world that is becoming more familiar with correlation and digital mediums and spaces, is our use of technology more than an easy way to gain information access? You can be in the library all you want and you won't read a book. We can have all the access to information in the world and we won't necessarily digest and incorporate.
We can have all the generative AI in the world writing in these amazing essays and making art. But where does that put us as information forager and then you added, can we turn figuring out into out there figuring? And as more and more people start to want to figure out active inference, it's not a Rubik's Cube on the table that gets finished. And by putting it out there, figuring is where active inference are.
05:31 So I think that's really exciting.
Like, we do have so much to figure out from all backgrounds, and yet we want to be out there figuring and having impact.

05:44 Dean:
I think that's where your background and field research and my background in sending people out into professional settings, they're very different, but also structurally very similar. There's no substitute for actually picking yourself up. It's a form of migration. You like you use the word stingrate.
Until I can actually figure out what my pheromone trail is, I'll let you have that piece of it. But I mean, I understand it. I get it. And yeah, let's see where it takes us.

06:20 Daniel:

All right.
Roadmap. So maybe we should have done like a rear view mirror or something. But we had 87 streams in 2022. The live streams. Table has 87 rows.
So it was an amazing year. And the numbers are shown here. We're going to touch pretty lightly on all of the streams from two through nine. The roundtable symposium, math stream, Jorge stream, Twitter spaces, guest stream, model stream, and bookstream. And then we're going to slow down a little bit and talk about some of the papers that we discussed.
So first, the overall review, though, for a general Institute level review, check out our quarterly roundtable number four. So that's where we talk more about the Institute's directions, other projects, and learning groups. But today we're just going to talk about the Live Streams.
07:23 All right, what did you write with these questions?

07:27 Dean:
Yeah, I'm often curious because when you're when you're busy constructing 87 rows, when you reached whatever that limit is, is there a big picture that has come about as a result of that stack. Again, it'll probably be something we'll be able to answer better at the conclusion of our chat today, but I think it's something to try to keep in mind. I don't know that we can say with certainty that your big picture and my sense of that same picture is the same interpretation. But it's a good idea to keep a sort of a general level sense of so. Did this all come together? Or how did the live streams intermingle with some of the guest streams intermingle with some of the bookstream stuff that you and is it Tyler and Bleu are looking at right now?

08:27 Daniel:
Yeah, well, the links here can all be accessed through active inference. And of course, one project of note is the active inference journal, where all of the live streams, through the incredible work of Dave Douglas and others, get transcribed, archived and versioned up on the GitHub. So that is one structural development of the live streams. Is there a big picture? It really can feel like just moving pebbles back and forth, and there isn't necessarily a vision of what the final nest looks like.
So I hope we can kind of look back on it once we've gone through it. All right, let's jump in. First roundtables. So we have a tradition of four quarterly roundtables at the institute scale. The first two one we'll notice are ActInf lab quarterly roundtables, and the third and the fourth are active coherence institute roundtables.
09:37 Because in the middle of 2022, we had, of course, our transition from being active inference lab to active inference institute. So here's an image meme that we have from the fourth quarterly roundtable and these roundtables the screenshots with who's there and who shows up, but also just what we discussed are like planting a series of flags in the ground and they're an absolutely honest representation of who we were and what we were doing then. And so I really enjoy sometimes even looking back and seeing how things have happened. So that's not as scientifically or philosophically concept of a live stream series. And the information in certain ways is out of date because it's more of an informative, participation oriented communication, but nonetheless a great series.
10:42 And also, before we head in and to avert saying this, of every single series in stream, big appreciation for those who had the bravery and capacity to join, whether they joined repeatedly or one

time, it's been awesome and it's totally co created with the people who are there in the most just unbelievable ways. All right, to the symposium. So this was our second applied active inference symposium. The focus was on robotics, and the first applied active inference symposium in 21 was just with Karl Friston. It was a one man show.
And for this symposium, we had some more elaborate developments. We had some entorhinal co organizers in Matt Brown and in Mark Miller. We also wanted to Costa wide variety of speakers and perspectives.
11:46 So we had two four hour sections with 12345 presenters in the first session and 1234 and a half with Friston joining in the second session. And we saw active states of the art in active inference being applied to robotics.
We saw embodied actual robots. We learned about some of the theory. We saw connections to previous lineages of robotics and also more general control. Theoretic Brea each of the sessions closed with a roundtable discussion, the second one being more populous than the first. And when people say like, okay, enough about what active inference is, how and where can it be applied?
And people commonly point to areas like human health as well as robotics as some of the leading areas in the recent and in the coming years.
12:47 And I'm just really happy that we were able to highlight the state of the art. Like, this is what robotics and active inference looked like in 2022. Publish a transcript, make it citable, and give visibility across these different sectors so that they could connect on some of their developments and also their ongoing challenges.
Math stream.

13:16 Dean:
Yeah, go ahead. I hope that at some point, and I don't know, timing really matters, but I hope at some point, people in other more dedicated learning spaces, like formal education spaces systems, will find themselves asking questions around how things that we've been talking about and we've been interacting on might complement the way that things happen in those systems. So it's not, let's go build a robot that does x. It's actually taking the active and the inferred and taking action on hidden states as a complement to we've got to get a certain score on an Sat.
I think it would be very interesting to see when that coming together on the horizon.
14:19 We know that the train tracks remain parallel, but as we look at that, there's a name for that. You probably know what it is, but when it reaches that horizon, it appears they've come together. So I'm hoping that that isn't sort of lost in some of these other initiatives that I know would actually be easier to do because there isn't such a history and a whole bunch of people who are very vested. In maintaining the status quo as opposed to really journeying in ways that are not discarding what we know, taking the priors and allowing for some new priorities.
So just want to kind of toss that in there.

15:02 Daniel:
Awesome. Thank you. We had just one math stream, formerly with David Spivak and Bleu, facilitating on category theory. This is a few train stops away for some of us individually and for the field.
But this year there have been some incredible advances in active inference and category theory. So the

field is being fertilized and prepared for an incredible regenerative category theoretic implication of active inference. But that's all we'll say for now. Here in the streams we focus on the intersection of active inference and organizations. We had two streams.
First one was with Eugene Leventhal from the Smart Contract Research Forum, and the second stream was with Bijan Hezri, whose book Governing Continuous Transformation is also the focus of the bookstream, which we'll get to in a second.
16:11 And both of these were awesome streams.
There are hidden states for both. All only say what all say, which is that they both were incredibly informative, and the Triangulation active inference lab for both of them was something that was incredibly natural coming from, as in Bijan's case, somebody with decades of executive experience who completed his PhD dissertation on free energy governance and sees the framework specifically as a vehicle for moving the frontier of leadership in organizations. Or Eugene, whose fluency with internal and external organization made it a natural and enjoyable conversation. And we connected a lot of topics of interest in online and web three organization.
17:17 So it was a great time.
Yes.

17:22 Dean:
If you want to do something interesting, watch the orchestra with Bijan and then watch the live Stream series number 36 about modeling ourselves. And you'll very quickly see that Bijan was close to the end of the year. But many of the things that he spoke of, we were talking about in detail with one of the papers that we took up basically a year ago. That's the interesting that you don't realize that until you're on a day like today.

17:56 Daniel:
Awesome. We had one Twitter spaces. The title was, can Web Three survive Without Cognitive Modeling? It was a provocative clickbait headline and we had a chance on this discussion to talk about the active block, for instance, project with Yakup here as one of the primary developers and advocates and stewards of that project. And we discussed this question, which is can web three or cyber physical systems more broadly exist in an increasingly complex present and future without something like cognitive modeling, for which we believe active inference is the most composable and flexible, generalizable and powerful framework.
So I forget whether it's never ask a question in the headline if the answer is yes or no, I always forget, so I never know.
18:57 So I always approached those headline based questions with an open mind. But we had a good time in this discussion and these kinds of informal formats might have a lot of applicability. We didn't really need to prepare much. There also weren't any slides.
So for those who are interested in this genre of social audio or whatever it is called, there's a lot of opportunities for frankly just interacting with people where they are talking about active inference and making the compromise in the improvised moment. All right, we had quite a handful of guest streams from number 14 to number 31, so I'm going to just briefly try to recall and mention those who joined. Jorge Esteves discussed osteopathy and mental health in a 14, bobby Azarian in 15.1 and .2 discussed

Universal Bayesianism.
20:06 Mark Solmes joined for 16, discussing consciousness as precision optimization, which also was published by the Active Inference Journal in one of the most manually crafted and beautiful publications. Mao Albarasan spoke in guestroom 17 about epistemic communities under active inference, which is an area of increasing importance.
Iain Robertson, Michael Markov and Julian Kiverstein discussed the literalist fallacy and the free energy principle, where that was only in March, it was on Pie Day, and we reawakened the kraken of the realism instrumentalism dialectic, which I know that we're going to touch on today again. 19 Markov decision discussed extended predictive minds ActInf lab Gueststream 20 Shannon Proach discussed coordination dynamics of multi agent interaction, and the screenshot on the bottom left is showing a slide from her presentation.
21:13 I think it was an amazing presentation. It's very accessible and very cutting edge work on multi agent active inference and also in the very fun setting of music listening and creation, so it was very engaging. Adam SAFRON in guest room 21 discussed free will.
Anna Lemke in guest room 22 discussed Dopamine Nation, and that's a fun one to view and share because Anna comes from a psychiatry background, not familiar with active inference too much, but open hearted, open minded and engaged with real people and with research every day. So we had a really affable conversation. In guest room 23, Maxwell Ramstead and Dalton Activity Devil joined for rebooting the free Energy Principle literature, which was a paper discussed that was not the title of a paper, but a paper was discussed that got folded into the pre play for Livestream.
22:25 49 so we'll talk more about Bayesian physics then. Esteves Grossberg joined for guestroom 24, explainable and reliable AI and also a commendation there to Ali, who did incredible preparation and facilitation as well as editing the transcript here and made this an incredibly high quality experience for everybody.
Guestroom 25 Brett Anderson discussed the continuum of traits between autism and Schizotype. So that was kind of interesting work and speaks to a lot of areas of meaning. In guest room 26, along with my colleagues at Common Sense Makers, Data ShahF, Lauren Hebert, Ozan Tamari and William Fisher, we discussed from users to Sense Makers and about Stigmurgy, which is cognitive behavioral algorithms that modify the environment in the context of sense making.
23:29 ActInf Lab Gueststream 27 was with John Verveake, and we had a great time. We had a stool with three legs, predictive processing, relevance, realization, active inference, and Dean and I were preparing those slides.
We had the stool going and then we flipped a stool and it was upside down and then that was just one of many inversions and transformations. And John has a very delightful and mindful way of approaching dialogue, as those who are familiar with his work know, and so we had a great time in 28, Giovanni Rolla discussed reconceiving, rationality and active cognition. Guest room 29 Shauna Dobson on making up our minds. Imaginative deconstruction in math art. For those who are looking for the triple play of math, art and philosophy, there is only one unicorn in this forest.
24:39 Guest room 30 with Kiritanatrades was on the human governance Problem complex Systems and the Limits of Human Cognition. This was a very fascinating presentation of an artificial intelligence system that was churning in the background while we had a discussion. And so it was quite visually and conceptually interesting. And then most recently, in guest room 31, Brett Kagan and Adeel Razi

discussed biological and synthetic intelligence from the free energy principle perspective and some of their empirical work with neurons in a dish playing video games, and the way that they were modeling that with active inference. So we had a great set of guest streams, and we look forward to a diverse and comprehensive set for 2023.
25:40 So if you want to join for a guest stream, or if you want to recommend or introduce somebody, this is very low bar. It can be a presentation they've given somewhere else. Some of these presenters requested us to do background, which we're happy to do, prepare questions, others just show up. So if you think there's somebody who could fit in well in a guest stream, even if they're not in the center of the active inference research developments ongoing, we can absolutely make it happen. Dean, what would you add on the guest streams angle?

26:17 Dean:
If I could invite five people out myself at the same table, and I could get Dalton and I could get Shauna, yourself and John Verbaki and me just sitting around and just talking about stuff, I think I probably would be about as good as it gets. I think that would be just one of the most amazing dialogues, and you wouldn't know where it was going to go. And that would be half the excitement, is just people who can basically have a conversation with anybody about topics that are incredibly sophisticated and yet seem to be able to bring it to a level where, as you said, it's engaging, it's amazing. And this is not to downplay all the other guests that were kind enough to join, but again, if I were to do something on a social level, on an informal level, all of these people, thank you to all of them.

27:27 Daniel:
Great.
All right. In the model streams, we like to highlight modeling, and we had three absolutely cutting edge presentations with interactive components. Model Stream Five with Pietro Masaglia and Tim Verbelen. We discussed contrast of active inference, which uses some current threads in non active inference machine learning like contrast of learning, and brought it into the context of active inference to facilitate learning in noisy environments. In Model stream Six, Teofil Champion joined to discuss his quite prolific and creative avenue of research into branching time.
Active inference. And Yakup and Ali are here also did a lot of background to prepare and as we entertain larger and larger state spaces and deeper and deeper possible futures with more and more and more affordances and affordances on preferences and affordance on affordances on preferences, these state spaces become vast.
28:45 And things that you can write down on the back of an envelope might take all the heat in the world with current computers to run. Just like you could write down two large numbers and multiply them, but you could look at each number and it's just a number. Well, you can draw a Bayes graph, and yet to run that Bayes graph might be not plausible.
So there's a lot of relevance in this area of research of finding out these computational acceleration methods. And Heuristics, as well as even just qualitatively this idea of branching time, branching and pruning time, and what kinds of strategies are used to branch and prune time adaptively. It's very exciting. And then in Model stream Seven, Conor Heins and Daphne Demekas joined to discuss Pymdp, which is rapidly becoming the Python active inference implementation approach of choice in

the community.
29:48 And it was great because we were able to ask basic questions, we were able to hear about the intentions of the package.
And we're going to have a dot two in just a couple of weeks. This is something in terms of the package. It's something where more and more of our work in the Institute is going to use this package. And the interoperability of different generative, models and processes and simulations written in Pi MDP is going to facilitate the accessibility, rigor and applicability of active inference. So great work to all those who are contributors on this package and everybody who is out there applying active inference computationally and shared it with us this way.
All right. And the last non paper Livestream is the bookstream. So the bookstream is being led by Bleu and Tyler Solberg.
30:51 And when they got a hand on Bijan Kezri's book governing Continuous Transformation reframing the Strategy Governance conversation, they jumped on it and they said, how can we do some kind of a regular series? How can we increase our accountability in reading and understanding this book and also make something for the community?
And they said, we want to do a weekly ish book stream. So we've done that for the past several weeks, and there will be many more sessions to come, including discussions with the author. So great initiative, and it's keeping the stove warm on these topics of organizational development, which are just absolutely evergreen.
All right, on to the Paper Livestreams, which we don't play favorites, but we love the paper livestreams.
32:00 Go ahead, Dean, start us with 35. Where were we in January 22 when we were reading A Tale of Two Architectures free energy, its models and modularity by Sajid Beni?

32:15 Dean:
I wish I could say that I looked a lot younger back then, but I looked old back then, too. I think a year ago we were pretty excited because I think it felt as though things could go in a number of exafferent directions and that we as a community that were discussing a lot of the most cutting edge on the sort of bow wave of information that was coming out of people's research.
It kind of felt like we weren't just aggregating, we were actually kind of one step removed. We weren't getting too locked into any one particular facet of this multifaceted idea. And it could really blossom into something like what we thought was this kind of magic acorn or unicorn or whatever.
33:18 And how it would be viewed 360 some days later, we didn't really know. But we also weren't afraid to kind of test the limits.
That's what I felt 22 was more than anything else. It was an opportunity to test things. And that didn't mean that we were out to prove people wrong. We just wanted there was now enough information, a large enough sample size, that we could do some cross checking. And that sort of allowed the people that were doing the cross checking, the ones that were reading this long list of papers, a chance to kind of go, huh.
Okay, well, I think I've seen that over here, but there seemed to be some hesitation around how far that rule holds under this set of circumstances in Yada yada. So 350 started out I've just put my notes here as a formal treatment of what graphical modeling can look like.
34:20 I e. Our DAGs are cycle list while DCM are cycle based. And for me, the introduction of a term

joint probability.
Up to that point, I had never heard of that expression. And we ended up using joint probability in a lot of the papers that followed. So there was a bit of you could start weaving golden threads between things. Majid, who eventually joined us for this, nothing but props for that guy, for again pulling in what are seemingly really distal concepts and making us realize, oh well, if you do do that, you gain insight pretty quickly.
Then we went on to 35 one which was which do we start with representation and or effect? Both in order to model?
So recognizing the importance of partial information encapsulation that everything doesn't have to be absolute, especially over different time frames, not brain architectures, although that term was in the title of his paper.
35:32 But the role of the architect, someone who is an applied structure, if there is such a thing, and the sort of arbitrary nature of that, how does it remain arbitrary? Well, by not being absolute. A real clear way of understanding the difference between function and effective connectivity. That took up a lot of our conversation, proximal consistency through time and introduced the term perspective swaps.
I didn't realize that I'd introduce that into the conversation then. But yes, that's where it all was seated was back in January, almost a year ago. Then 35 two. What are we trying to trace? Separation and or boundedness?
The answer to that, as Magee clearly concluded, depends on what's available. So availability not just our regime of attention. So I thought that was an incredible thing to bring up a year ago. Do we keep that? What?
36:32 That we are the tracers and the modelers and the separators and the boundary in the front of our minds as we analyze situations? If learning is the sought after effect, when does that help? Does this lead to a year of holding up when we are looking at a target system, say active inference is subject and when we as observers might be using active inference in formal ways, ie. For allowing errors to not get in the way of new insights. Assuming insights are a priority for agents and I was interested in thinking I wonder how they would be able to get that into JF's robots, right?
So that's an interesting thing to me. This is the divide between being a programmer of a robot where the priority is learned, versus dictating how priors are amassed and organized and then inhabiting a programming or participatory experience, one where deconstruction is adaptability until ultimately something called complexity dominates the conversation.
37:44 In both of those situations, priors and priorities work in concert, but in the latter the humanist case are on opposite sides of a Markov blanket. So at least partially hidden but also partially encapsulated. We talked a lot about duck rabbits that are not riding two unicycles concurrently, whereas the robot might.
That's an interesting difference there. And for humans, riding two unicycles is equal and complete partitioning or encapsulation. So that's why it's hard to do. Takes much training to be able to carry that out. So that's the was Sajid and bringing the science and the modeling and the abductive.
And that was our conversation, even though his paper was in response to a couple of other authors arguing that there's only one way really to model. And so again, lots of things grew out of a paper that was meant as a response and created a whole different ecosystem.

38:52 Daniel:
Awesome. Wow. I'll just give a short thought.
Graphical models and network theory are at the heart, active inference lab as well as many other Fields. And what it means to have a network or a hierarchical model is to represent a system or a model in terms of nodes and edges. And exactly what those nodes and edges are matters a lot. And in this diagram we had the parable of Bob and Alice who brushed their teeth at a similar time because people in that region just happened to do so. And we discussed how the statistical connections between their activities in terms of the functional and effective connectivity are not the same as what is touching what in the real world.
And this very straightforward deflationary approach to separating the map from the territory came back again and again and gain it.
39:54 Was like we were on the carousel of functional and effective connectivity and the map territory and the math is not the territory. All of those topics are so central because when we're looking at those generative models, we're looking at a graphical map, not a picture of the territory. And it's easy, even when you know, to forget.

40:24 Dean:
And again, I often wonder how because Daniel reminds me, no, people vote which papers we're going to do. And sometimes it's just availability of authors. But the next paper, which was 36, could not have been a better coordinate with Majid's work. It was like the perfect follow up. Matt and Giovanni's work on modeling ourselves.

40:59 Daniel:
Yes. Give an overview. Go for it.

41:02 Dean:
36 was the importance of working backwards. The way that you and Bleu set up the entire paper was, well, we're going to go to the end and we're going to work our way back through this paper just so that it makes sense.
Because I think there was a bit of a woo woo kind of sense from reading the paper because it was very deeply philosophical. Also. Introduction the claim that in order for internal representations to be wiped out, we need to marginalize the unit, call an action really radical, as if adding an exclamation point to your claim somehow changes the relationship of an action which is a part to the entirety, which is a whole. So when you guys first picked up Parr and you're doing the dot zero already, there was like, okay, I wonder what we're getting into here. You also asked indirectly how artists indirectly how artists, people with good entorhinal who are good external external representationalists maybe have a different gapping or a way of entangling or both the organizational, structural and content related and functional aspects as either representative or non representative within parameters.
42:22 You had a nice table there set up which, boy, you got a lot of shelf life out of it. It was useful for all three livestreams. What I found most interesting was that to be an activist meant to you the use of simple heuristics means control mechanisms do not need to get to the level of sophistication more than what short, catch and long. You had a great diagram of the baseball Karl hitting it out of the park.

Categorizing the FEP equals you can be all over the map.
Does that mean we can engineer a bridge to everywhere? Which was one of the questions I'd written down, actually, after watching you and Bleu do the dot zero, then in the dot one, how does transition go from materialized to non materialized and then back? And that brought us to the idea of what's stable and what's dynamic juggled as a process of predictivity in order for representation and non representation to coexist.
43:28 This was the great thing they are bedfellows. Dean and Bleu debated the scale freeness and the scale friendliness of science.
I. E. Observations, recordings, analysis and prediction. So modeling ourselves in real time with Daniel substituting disciplinary for generalization as modeler strategy, the question was raised around what must exist pre plan, pre model. And then I don't know the lady's name who joined us for the Danielle Daniel, we got into some really interesting loops with your table.
Again, we were looking at organizational, structural and content related as probably more stable things that we want to anchor with those edges and nodes represented and not kind of moving around all over the place or without edges. You can have a gap. Like, there was a point that came up was the black lines separating the rows and the columns, were they solid or were they actual gaps?
44:40 So that was kind of interesting. And then there was a functional as radical dynamic and dependent on those stabilities.
Now is modeling ourselves how, when, where, what if and which? If we act, how does that impact the model that we believe exists as we boundary cross, which again, if you take it to the stuff that Bijan is talking about on an organizational level, that's combinatorially exclusive. So it's interesting that how we model ourselves has a huge impact on how do we model ourselves as an organization, as a weave, that which we'd like to remain constant with, that which we'd like to see changed. So that was modeling ourselves. And again, Matt and Giovanni didn't show up, but man, would have been awesome to have them there and kind of lead that circus because it was great.
45:41 It was great debate between Bleu and I because she really wants science to be seen as it, and I really like science to be seen as specific. And you are the great moderator and said, no, it's both. So I was 36 bottling ourselves.

46:00 Daniel:
Wow. Yeah, I totally forgot about Karl hitting.

46:06 Dean:
It out of the park.

46:07 Daniel:
About Karl Bonds.

46:13 Dean:
Fantastic.

46:14 Daniel:

Hitting the particle out of the Parr and about where is representation? Oh, representation. Where art thy sting? It was too fun.
It was too fun. And also, just so people know, the live stream page has the slides. For every single live stream that we're discussing, you can find the live stream, the title, the paper, the transcript, the GitHub, where you can contribute to the journal as well as the slides. So when we're pulling slides, you can also look at them. So, yeah, this was 36 was awesome.
All right, 37. 37. Free Energy a user's guide by Stephen Francis Mann, Ross Payne and Michael Kirchhoff from 2021. You want to take a first pass?

47:14 Dean:
Well, I just remember that as much as I'd like to be able to say I could do the math if somebody else does the math and I can follow along at my own pace, this is where I learned Jacob's gift.
Basically, that's what my first pass is. I know when I'm in the presence of people who could go a lot further on that plane than I can.

47:50 Daniel:
The paper is an excellent users guide or introduction. One memorable section was on this trilemma or trilectic of general or philosophical claims, mathematical claims and empirical claims. And they went through edge by edge and they asked how do claims from each of those three vertices justify each other? And so we hear that all the time people speaking about active inference in other areas. Well, because the brain is this way, we use this equation or we use this equation because the brain is this way or because of this philosophical belief, we use this equation.
It's like seeing it laid out that way brings a huge amount of rigor. And it also helps us understand that rigor is not just increasingly technical math.
48:55 Rigor includes the relationships among mathematical, philosophical and empirical claims from different Fields. So that was one key takeaway for me and another was the three piece, the tale of three piece. And it was a focus of the paper to point to the unconventional way in which preferences are utilized.
Active inference Lab which is not as a reward or a goal function but rather something that is kind of the fundamental frequency of the generative model. And so you have entities striving to return to the bottom of the bowl in terms of the path of least action, in terms of the frequency that they want to be at and that is the embodiment of preference. And as we came to see later, homeostasis and allostasis but there isn't some sort of dual track between what is and what should be.
50:03 Rather there's a bowl that represents what could be and is and should be through its shape and it's about the ball moving on that shape by which preferences come to be enacted. So that was something that was pointed to and very approachable and they talked a lot about how they situated the audience of the work in terms of wanting to speak to philosophers who really did want to learn about what free energy principle is about.

50:38 Dean:
One of the things that I got kind of reinforced in my mind is because I kind of believe that priors are on one side of a Markov blanket and priorities are on another. What that tail of three P s kind of in my

head gave me a little bit of latitude on was. Preferences can be on either side of the blanket. They can literally cross through. Preferences can pair up with your priors.
You can figure out what those things are that have been sort of burned into your neuro desire lines and they can also preferences can also be working with your your priorities in this moment right as you find yourself now okay, this is what the niche is, the information, the niche is sharing with me. But what's my priority, what's my preference as well. So that was what the three piece thing I remember now when we were talking about that going, okay, don't get the three things mixed up.
51:38 Give each one of them their time in the spotlight.

51:44 Daniel:
All right? Live Stream 38 was Evolution of Brain Architectures Force Predictive Coding and Active Inference by Giovanni Pezzulo, Thomas Parr, Karl Friston from December 2021. And the topic here is so important what is the evolutionary neurophysiological basis of cognition? And how do complex cognitive phenotypes arise at a developmental timescale, at an ecological timescale, and ant an evolutionary timescale? And where this paper eventually takes us is into thinking about the graphical models again.
Remember what we discussed just a few slides ago about graphical models, the graphical models which enable or facilitate or underlie different kinds of functional outcomes, and then how structural modification on graphical model architectures enable different traits to emerge, diverge, duplicate, and innovate.
52:54 And so here we see on the right side, it's a tree of options, starting from a relatively simple initial graphical model, how different kinds of modifications, duplications, et cetera, can result in the kinds of functional as well as structural phenomena that we observe in living creatures today. And whether that's the redundancy of gene regulatory networks or the paralyzed architecture of the mammalian cortex, these are the kinds of phenomena that this paper set out to bridge the gap with between simply representing things as they are as graphical models and understanding. What if you weren't just studying the amp brain today, but what if you were studying the ant brain over its phylogenetic history? How would those generative model models be changing?
How do things like temporal depth or intermodal fusion come into play?
53:58 And so that was a nice paper that connects to evolution and a bunch of other behavior areas.

54:08 Dean:
Really helped me understand or confirmed in my mind that there's a big difference between a person who makes a model and somebody who has to interpret somebody's third party model. Because I remember going through this, I felt like I was learning on the fly, because even as I was reading the paper, there was a lot there to try to parse and just having to be able to converse with you in Bleu. And I think Esteves was a part of this one as well for a bit of time.
Made it a lot easier for me to kind of understand as an interpreter of models as opposed to somebody who's, here's my model. What do you think of it? It was taking some of these really complicated models that other people have designed and then trying to make it into something that I had adopted.

54:55 Daniel:

Nice. Okay.
Live stream. 39 morphogenesis as Bayesian inference a variational approach to pattern formation and control in complex biological systems. By franz Kuchling karl Friston georgi georgiev and Michael Levin this paper took what in many other situations are a mathematics of structurally stable but dynamically signaling architectures like the brain and considered the case of structurally volatile dynamics signaling structures. And so they focused on one of the key model systems in the leaven lab, which is the plenarian morphogenesis. And upon cutting this animal, it quickly reforms into a selfsimilar body plan.
So that has implications that are being developed in a whole host of areas related to health and development and disease.
56:05 And the paper uses a somewhat technical Variational Bayesian mathematics, which we also jumped into. And we had Franz join us here in the office overlooking some gray featureless landscape and had just incredible insights to share. And we talked about the environment, what are developmental priors and trajectories, what are preferences over morphologies. And this really opened up the discussion from, as mentioned, ant the beginning systems that have a structural stasis, that do signaling in that structural stasis, like all the computers are hooked up and now they're talking to each other, but they're hooked up the way they're hooked up.
Well, what if the computers can change how they're hooked up? Or what if they're moving around?
57:06 That is another space that also connects us to a lot of the physics of the embodied world. Maybe there's friction, maybe there's viscosity, maybe there's a razor that splits two halves from each other. And it was a great discussion to see how the mathematics of the Variational Bayesian approach is able to accommodate these different focal systems which speaks to the generalizability of active inference.

57:42 Dean:
There are a lot of formalisms there, but it didn't feel formal talking with Frank and it just felt like the possible with regeneration had a whole bunch of Fields that yet to be explored and the kind of openness thinking openness that opens up possibility. That was really cool about that live stream set.

58:08 Daniel:
Awesome. All right, 40. Who could forget a free energy principle for generic Quantum systems? 2021 paper. In fact, a year and a day ago by Chris Fields, Karl Friston, James Glazebrook and Michael Levin. So this paper we needed to situate ourself on one hand here represented as the X axis. Sometimes we find ourselves going back and forth between more talking about free energy principle and active inference, other times discussing literature or ideas that are outside of the free energy principle and then orthogonally. We can think about this continuum between not quantum and quantum perspectives from physics.
And we were in the upper right quadrant or another way of saying that is we were everywhere because we were quantum and non quantum and we were in FEP.
59:19 We had the authors join for both of the streams, the 40.1 and 40.2. So here we are with Bleu and Esteves, us and the authors. And every sequence of symbols that these fellows added was immense. And to be able to make that daredevil jump across the Grand Canyon and connect the most advanced perspectives on quantum mechanics, quantum physics, quantum computation, unconventional

computation more broadly today, for example, thinking about the perception, action and memory phenomena in terms of repeated measurements of a quantum observer with their reference frame and looking ant the holograph.
1:00:21 It was a great and memorable sequence.

1:00:26 Dean:
It literally materialized the bridge to everywhere, being in that upper right quadrant, which is a fascinating thing because I don't know how you engineer a bridge to everywhere, but the possibility means you have to open up to more than somewhere. And I think that was, again, one of those sets where you're kind of going, am I really doing well? You wouldn't say this, but I would say this. Am I really doing this?
Am I really having a conversation? Do I get to sit at the same room with people of this capacity? It was really fantastic. And I got to talk to Mike Levin for privately after that because, yeah, the idea of prediction matter expertise intrigued him. So that was very cool.

1:01:16 Daniel:
Great. Wow. All right. Carrying through 41 extended active inference constructing predictive cognition beyond skulls, by axel constant, andy clark, Michael Kirchhoff, and karl Friston. So here we had the all star team.
We had Bleu, you and I. Trust is like glue. If you don't have it, you won't be able to stick together. And our team talked about trust active inference lab models. And I remember this section of the discussion where we had two systems, the Bleu and the orange.
And we discussed what is their border, what is their interface? Is it another region? But then if it's another region, isn't there a region that borders that and what is on the outside of that? And so how does all that connect to extended cognitive systems?
1:02:18 Extended relative to what?
And so this topic of extended inference was dealt with thoroughly here, and the mathematics and the applications of extended cognition are so promising. I also remember you discussing the difference between a type of active versus a passive offloading. There's a difference between somebody writing a code on a Post It note that only they know. So if they look at it later, it's like it helps them remember what they were thinking of. But to somebody else, it doesn't mean anything, and it doesn't do anything as just notes on paper versus JF creating a robot and sending it into the environment.
Yes, it might still need recharging and so on. So it's not like it's totally disconnected, but it's doing things actively. And that kind of active or passive offloading and the way that that facilitates our cognitive goals was very rich discussion.

1:03:26 Dean:
Axel being the first author of this, to me, he's like Sajid. He brings in active coherence, and how long do you stick with something before you no longer carry something on?
He's such a good explainer of you realize that the environment is actively inferring you as much as you are inferring it. That's really hard for people to get their minds wrapped. The first time you hear that, you're kind of like, what? But he does such an amazing job of explaining that it doesn't seem like

people talking about some silly thing like fairies dancing on the head of a pin, you actually go, Wait a second, you're right. It would have to the environment would have to be scrutinizing me as much as I'm scrutinizing and and trying to figure it out.

1:04:27 Daniel:
Nice. All right. 42. Robot navigation as hierarchical hierarchical active coherence by Ozan Catal, Timberbellan Tune, von Deneve Bart Dot and Adam Saffron this paper was an incredible example of applied active inference. They in this paper represented the full rainbow from conceptualizing a generative model to implementing it and making a robot that actually enacts that generative model in a warehouse setting.
And what that warehouse setting required from the generative model was that there was two levels at which the generative model was playing out. At the higher level, which we were thinking of in terms of strategy, the robot decides where it wants to be, where it prefers to be, and where it is. At a lower level, which we connected to tactics is related to the kinds of bodily moves that it can engage in.
1:05:31 It's more movement affordances. And this discussion facilitated a lot of action into the math, the computation, the embodiment, the robotics, and give some of the clearest examples of applied hierarchical model modeling that came back again and again and again.
So that was fun. All right, 43. Paper 43 was Predictive Coding a Theoretical and Experimental Review by Beren Millidge and Neil Seth and Christopher Buckley. This paper was quite a doozy. It was very mathematical and quite long.
The memorable part of this paper to me was collaborating with Maria on the Dot zero. And Maria's philosophical knowledge with predictive processing took us way back.
1:06:37 And that was rooting the discussion in the ancients and thinking about world knowledge, traditions and ant and Helmholtz. We hear a lot more about that kind of 1718 1900 philosophy time. But this pulled us temporarily back and helped bridge the math of this paper, which was technical to the ways that people have simply perceived, cognized acted and thought about the world around them. And then to speak to the math, this paper almost the entire thing before something like the last several pages. It's about hierarchical predictive processing architectures, but there's no action to be found. It's just about inference, inference going up and down, priors and observations and prediction errors, all of that.
1:07:41 And then at the end, oh, yeah, we're going to be doing inference on action. We're going to be doing active inference.
And with that tiny twist of the knife, active inference becomes. And so it's just amazing to see how purely inferential architectures, when they're doing inference on action, the consequences of action are taken into account. Policy selection is treated as a formal thing to do inference on. You get active inference, and it really isn't too much more complex than that. And then just a last point, just like we had the three areas of claims justifying each other from Livestream 37 with the general claims, mathematical and empirical claims.
We had another triangle in 43. So here we had on the top biological systems and what they were doing.
1:08:43 On the left we had philosophy and qualitative claims, and on the right we had formal quantitative claims. And so we made another triangle with pretty much the same three vertices, which is mathematics, philosophy and empirical biological phenomena. And we took another first principles

pass on constructing those three areas and what are the nodes, what are the edges, and how are inference and action at the heart of all of it?
All right, 44 44 was the Therapeutic Alliance active Coherence Lab the Role of Therapeutic Touch and Synchrony from 2022 by Zoe McParlin, Francesco Cerritelli, Karl Friston and Jorge SVIS. So this paper was awesome.
1:09:44 Also here, from the screenshot of the event, we have Iain Tennant with the Inner Sense Channel and Project, who saw this paper, brought it to our attention, said, I want to facilitate this discussion, and I want to connect exteroception and the Therapeutic Alliance in a Modern context to active inference. And I want to bring in these awesome authors and make this a conversation that really hits home. And so thanks, Iain, for joining and helping.
That way, the paper focuses on the Therapeutic Alliance, which is like the clinical or medical or therapeutic niche. It's the people in the room, it's the receptionist, it's the nurses, it's the surgeon, it's the physical rehab practitioner, it's the family of the patient, it's the patient themselves, it's the physical surroundings.
1:10:45 And to be able to very broadly discuss that vital setting while connecting it to key active inference topics like generative models, synchrony and so on, as well as to see their delightful figures and the way that they represented the same bunch of authors joining for both of the discussions. And it was an awesome series.
All right.

1:11:28 Dean:
This 145, this is when I come back from the dead, and this is what I walked into.
I knew there was a reason why I wasn't called away. It was because of 45.

1:11:43 Daniel:
45 was the free energy principle, made simpler but not too simple. By Karl Friston, Lancelot Costa, North Sage, Conor Heins, Kyle ulholtzer Grigorios, a pavliotis, Thomas Parr well, I think the best way to summarize or crystallize the experience of this stream was Bleu, and I spent many hours preparing for the dot zero. We were having separate meetings and doing asynchronous work to really work through and understand the mathematics of this paper.
And we did the 45.0 in May. It was all great. We Beren looking forward to June. We had invited the authors. We didn't really know what was going to happen.
And it was several minutes after the hour where we were supposed to start. And so we usually just try to start on the hour or a few minutes after the hour. Why wait longer?
1:12:44 And we just didn't have anyone else on stream. So we said, all right, this is it.
We floundered through the dot zero. Let us swim again into the one. Yes, please.

1:13:00 Dean:
Dean, I'm sorry, but you're not telling the whole story when you are completely out of your niche. And you guys worked so hard to make sure that you could adapt for this, but then you took the the year courage and the strength to literally jump out of the ocean into the boat.
And then all you wanted was come on. It would be wonderful if somebody could show up and at least

tell us that jumping out of the ocean was a good thing to do. And then just like that.

1:13:34 Daniel:
Just a few minutes after, we started to come.

1:13:37 Dean:
Along and say, hey, how's it going? Here catch and release. It was so amazing. You may not believe that it was that big of a deal, but it was.
And it was amazing.

1:13:51 Daniel:
Yeah. Just a few minutes after starting with the two of us, first Karl Friston joined, and then several minutes later, Thomas joined. So, yes, it was one moment, but it spoke to putting it out there and being ready to show up and being ready for others to show up, but also for these two sessions that both Karl and Thomas joined for. For those who want to know about the mathematics of active inference, there's many miles to go with making it accessible, rigorous and applicable.
So, not to be denied, but if somebody wants to know the absolute state of the art, these conversations, you're hearing it directly and the questions and the discourse are 100% approachable. So this was just some of the highest density learning and higher learning.
1:15:00 It was an institute of higher learning.

1:15:04 Dean:
If you want evidence of naivete, which is not something you want to remain as all your life, but those moments when you allow yourself to be naive and how that can be a feature, watch this. If you ant a first step, you might look at going, I don't know anything about active inference.
Just still, you may not understand some of the things that were discussed, and that doesn't matter. What you really will appreciate is the generosity.

1:15:36 Daniel:
Yes. Great. All right. 46. So 46 was active.
Inference models do not contradict folk psychology. By Ryan Smith, Maxwell Ramstead and Alex Kiefer So what is there to say? We are folk psychology. We are them. And this is also a topic that people bring up all the time.
Oh, preference. Are we talking about like, that? I prefer to have this happen in my life. Belief. Are we talking about what it feels like to believe something?
And this paper just absolutely squarely targets those questions. And the conclusion is in the title for the authors. It's not a reification of folk psychology. It's not chapter two on folk psychology. It's not a nullification, it's not a contradiction.
It is a non contradiction, which is exactly what it sounds like, which may infuriate those on any side of multiple fences.
1:16:48 So it was a great conversation because the topic was so directly tangible and accessible. We did want to connect the math and formalism active inference lab to how people talked about folk

psychology, which is just like us day to day, talking about our feelings. So that was an amazing concept. And also the sort of fun stream memory was I used social media to communicate that the dot zero was beginning, I guess, on June 14 here, and Ryan Smith just says, hey, I don't know if I'm going to be free later, but I'm free now.
So we had Ryan in the saddle for the dot zero, which was the.

1:17:37 Dean:
First time we ever had the first.

1:17:41 Daniel:
Time we ever had an author join and bring that kind of insight into the dot zero. So class was held, Court was in session, and Ryan has joined multiple times and has so much incredible clarity on the math and on the psychology and the applications of active inference. Anyone studying his publication or presentation career can know that.
So it was a great conversation with Ryan and then also with Alex Kiefer joining in the subsequent discussions. And Dean, you brought so many fun images and motifs to bear. It was just like it was such a fun house.

1:18:31 Dean:
Well, here's the thing. And again, this was by June, right?
We started in January trying to figure out, what do the lines between mean? Right? So is active inference a divider? Active inference lab an enveloper? What this paper said was, it's not contradictory to appreciate that it could be both, that if we have a circle, you can be inside with the spokes or you can be outside and be the contact service.
If it's a divider, it can be on either sideline. But if it is both, then why would you always feel that you're doing something wrong by holding up both? Right? Why is both the contradictory aspects of this, which again, encouraged me and my mintu I don't care how you want to do it. You can collapse past that.
But if you want to get to fractalization, fractalization being the moment that you're literally in the gap or on the line or on the boundary, right.
1:19:42 That's what affords fractalization is the fact that you don't necessarily go, well, that's action prediction. And Clark. We're done. No, I have to stick to something simpler because I will not accept a contradictory space.
There are times for absoluteisms, but there's also what Ryan was pointing out, which is that maybe that's a feature. Maybe this ability to see both is something we should just you don't have to accept again, counterfactuals, what if you did? So it was really good. And then Alex showing up afterwards, kind of plain cleanup. It was really cool.

1:20:24 Daniel:
Yes. So that was taking us to the end of June. We then took. A few weeks off of discussing papers, and in that inter semester break, we came to 47. So I'll let you describe 47.
It was active inference and abduction. 2021 by Ativeco, Piateran and Majid Beni and an active dynamic

social cognition and active inference by And S. Hipolito and Thomas Vaness. 2021.

1:20:59 Dean:
Yeah.
Well, again, I guess there was an attention on my part to get, first of all, muster up the courage, because these people have spent a lot of time putting these papers together. But my sense of it was I've got both eyes open. I'm not focused on instrumentalism or action or taking a realist stance or taking a non realist stance. And yet there was all of this conversation around those things as to which one entails the other or which one came first. And all I wanted to do was hold the papers up side by each.
And rather than having people having to defend one side or the other, I wanted to hold it up as here's, two sides to the same coin. We are on the edge of this coin. Now, looking down on both, what does that imply? That's essentially what that was about, because I think at the core or the heart of prediction matter expertise, not just active inference as something that we can subjectify, but that we can act upon in formal ways, not just informally.
1:22:16 That's when you know you've entered the divide or you're on the boundary, which leaves it up to you as the person now that's taken up those coordinates to do things like we're doing today.
Reflect back on what got you here. Was it one leg or the other? Right. It's like saying, oh, well, it was my left leg that got me here. Well, it was, but it was also the right leg.
So how do you square that in some of these debates where people, like I said, they invest a lot of time and energy and effort into trying to make sure that what they're saying is correct, to the point where they almost feel like they have to defend something because it narrowly fits. And I wouldn't argue against that. But if we're talking about both scale free and scale friendly, which we are, I think we all kind of accepted that.
1:23:19 Now then, how does that work? And mejee, despite the fact that he was not under the most optimal health conditions, was super kind, showed up and once again graced us with trying to explain some things, despite the fact that I know he wasn't in the best of cognition to do that.
So, again, another shout out for Mashid Beni and his willingness to go the extra mile.

1:23:53 Daniel:
Yes. And for you in breaking the one paper per series speed limit and having us consider two papers wholeheartedly.

1:24:07 Dean:
So that was hopefully it was helpful. That's all I was hoping is that it wouldn't be seen as being disrespectful because we weren't giving enough attention over to something.
We were actually entertaining availability with attention. Again, we were mintwing things. That was cool. Thank you. Thank you.

1:24:31 Daniel:
48 communication as socially extended active inference lab and ecological approach to communicative behavior. By Ramit and Pierre Jorge. This paper brought together a lot of the topics that we've mentioned earlier. Communication, extended cognition, social. And we had you, Bleu and I with Remy

both times.
What can you say?

1:25:07 Dean:
Remy is a great defender of an action, fantastic defender of an action. And he also has partial encapsulation. Whether he would have described it as that or not, he is a partial encapsulator. So there you go.

1:25:25 Daniel:
Yeah, it was awesome to have him on. And the open endedness of the conversation as we took a look on the social, which can get one Costa from the first moment, and maybe that's not even a bad thing, but we lost more than we've ever found in that niche of exploring and discussing. All right, getting into the last three papers here.

1:26:02 Dean:
Yeah.

1:26:03 Daniel:
And the reason why I mentioned the gap between 46 and 47 was because we came back with a fury, and we were mad at anyone.
We were angry, but we were furious. And we had some incredible streams. So almost center in representing that for me is in Livestream 49, a worked Example of the Bayesian Mechanics of Classical Objects by Dalton Sakthivadivel Devel. So for this paper, Ali Yacob and our colleague Conor, we met weekly for about two months to prepare for this discussion, because this paper, and more generally, Dalton et al's.
1:27:03 Advances in merely 2022, have transformed the status of active inference in the free energy principle.
If you want to learn more about what that really means, check out Live Stream 49. Ali Yakub and under put in a ton of work. We worked as hard as we could leading up to the dot zero, and then Dalton took us on a journey in the dot one and the dot two. We couldn't have asked for a better elucidation or a more enthralling presentation of Bayesian physics. I really mean it.
And whether you're working in classical thermodynamic or quantum mechanics, or whether you're not familiar with those areas, this direction of work and specifically the presentation and the answers that Dalton provides and just the spirit that he brought are absolutely memorable.

1:28:18 Dean:
So I'll just give you a little aside. This is the only time on any live stream ever where instead of playing music, when I'm doing my workout, my third listen my third listen of the dot one of 49 one was while I was working out, because it's that good. And it had to be my third listen, because the first two listeners, I was just, like, having to pick my job off the floor. But by the third time, I wanted to listen to it a third time.
Instead of listening to music, I was listening to you guys work through this stuff. And I was just like,

this path integral stuff changes everything.

1:29:01 Daniel:
Yeah. Just briefly, for the conceptual, here are the three phases of Bayesian mechanics using a system and a scheme that's presented in this research and in earlier research by Dalton and Maxwell et al. One setting is where a ball is resting on the ground and it's not moving.
That is kind of like a distribution, a belief distribution that's getting new input, but it's not updating. It's just getting the exact information it expects. It's not updating, it's not moving. In contrast, when new information is provided, the prior updates to the posterior and it moves to track the mode of the new optimum. So that's like if you had a ball on a staircase and you pulled one stair and it fell down to the next one, and you pulled the next stair and it fell down to the next one.
1:30:02 Those both represent taking densities over states, like preference as a state, observation. As a state. States can change through time, but they at any given time, are state based, in contrast. And that's where we have the non equilibrium steady state nest density. So all the discussions we had about non equilibrium thermodynamics and non equilibrium steady states, all of that nest density discussion is on the states.
What some of these recent developments in path integrals gauge theory, caliber theory, maximum cal, as well as the dual the discovery of Dalton about the duality between the constrained maximum entropy principle and the free energy principle when we calculate densities over paths. There does not need to be a ness assumption or a discussion of a mode.
1:31:03 But you can get path tracking, path of least action tracking without appealing to this intermediated nest.
It's only been a few months, but there's so much more to come here on the mathematics and on the applications. It's incredible. And a year ago, we couldn't have said any of this. So a lot has happened in active inference, but in the 49 dot zero, you'll see us grappling with the eras of active inference and FEP and about what phases in epochs. And even now we can acknowledge that we're in a post Dalton era.

1:31:58 Dean:
Yeah, and it's funny, because before hearing this, it almost felt like you had to go down the vertical and then across the horizontal, and then down the vertical and then across the horizontal. And then all of a sudden, he introduced the wheels and the bike went riding down the steps. That's how different it became. Now, that's still a bumpy ride. You have to go quite quickly to smooth things out.
Right. Smoothing. But that's essentially how dramatic it was like it was like introducing the wheel.

1:32:41 Daniel:
Yeah.

1:32:44 Dean:
It'S only a wheel. Right.

1:32:47 Daniel:

Wheels within wheels now. All right, 50. So in 50, the paper being discussed, I didn't bring it in, was exteroception as modeling, alastasis as control, with Eli Senate and Jordan Thorough, who are here as well as several other authors, karen Quigley and Lisa Feldman Barrett, maybe some others.
So what would you and on 50.

1:33:12 Dean:
Well, just that again, you would see that interraception would be its own field and allostasis as being a separate field. And then there's this lab somewhere in northeastern United States that's trying to DeField bring things into an opportunity to be integrated. And it was fascinating to try to see how people address operationally and formally things that seem to be pretty messy and hard to manage when we're talking about things like we don't have necessarily access to the information in a mathematical way. It's called a feeling.
So how do we blend those things together? And again, I'll be honest, I was the most skeptical and became a fanboy after having great conversation with Jordan and Eli.

1:34:14 Daniel:
Yeah, that was memorable discussions. Eli gave a presentation that helped us really, like lock in conceptually how they were framing it and what they did. Some of the statistical transformations are evergreen in the sense that there was a capacity curve, a probability density implied by a capacity curve, and then a responsiveness that was a log probability density.
And now whenever we see one of these, we see all of them, right? Because they're all just transformations, either PDF to CDF or log probability densities. Check out the stream to learn more. But whenever we see these, we can kind of see all of them. When we see one and see one thing, see multiple things, learn one thing, learn multiple things.
1:35:16 It was awesome. All right, and the final Livestream discussion paper. So this was canonical neural networks perform active inference. 2022 Paper by Takuya IsomerA, Hideaki Shimazaki, Andy Clark Friston and it was a fun and an honor and a learning journey for me. I prepared the dot zero myself, which hadn't happened for a little bit of time by then.
This was just in November. And then in both the dot one and the dot two, it was just Takuya and I. And the paper's implications are so stunning in light of the prevalence of neural networks and artificial intelligence machine learning. The paper supports a claim that was agent within an earlier research paper by the authors.
1:36:21 But they kind of completed the loop in this paper to really reinforce it that as per their figure one, every neural network canonical neural network listen to the Livestream slash.
Read the paper to learn more. Every neural network in engagement with the environment through perception, cognition and action can be understood using the particular partitioning that we use in active inference, where the generative process engages the generative model of an agent. Also in terms of perception, cognition and action. In fact, the training by which agents can learn from their own experiences about what to do in the future is also analogous as well. And here we see some message passing reflecting that the discussion was technical, yet asked basic questions, and everybody who works with neural networks or knows somebody who does, I'd recommend that they check out this discussion and paper because it was a perfect example of making the bridge.

1:37:48 And here we see the min two of min two s. We see the partition between a generative model and a generative process and then two views on that being juxtaposed. And so now when we see a neural network, we can think that there's a generative model that might reflect the semantics of what the neural network does, even if the structure of the neural network is arcane. And in contrast, when we see a generative models, we can imagine that there are some neural network architectures with arcane topologies that implement that generative model. And so as we build these rigorous Bridges, we see more and more with the same visual input.
And so that is really advancing the field. And also, again, could not have been Seth a year ago.

1:38:41 Dean:
Is it building a bridge to everywhere or is it moving in that direction?

1:38:47 Daniel:
Let's go to Reflections.

1:38:50 Dean:
Okay.

1:38:52 Daniel:
If we built Bridges to everywhere, it's like paved paradise. Put up a parking lot. We wanted people to be able to drive all over paradise and park wherever they wanted.
So we paved it. We put up a parking lot. I don't think that's what's happening. What is happening?

1:39:14 Dean:
Well, again, I get the ambition of trying to take some statistical models and see where they might be inserted in things that are going out and doing the exploration. See that my Continuum attention active inference lab is because I believe it is a way when you're ready, it is a way of generating way more insight, way more, AHA moments than what I think is a kind of unidirectional approach or a hierarchical approach that says, amass all this information, put it, synopsize it into your own, synthesize it, synopsize it and feed it back to a board or a review committee or something like that.
1:40:27 I understand how that works and why that serves a certain agenda or intent. I think what active inference does is it opens things up so that you do not have a ladder to climb or at least they haven't invented a ladder to everywhere. I think that's what it does is it creates options and possibilities and sees things as it could be this, it could be that.
So from a humanist standpoint, it just makes available, provides affordances that's kind of at the Jorge of the work that's being done.
It enables the use of things like counterfactuals, why that matters, why it's just as important to ask what if as it is to ask what is.
1:41:27 These are all things that I think don't even have to be stuck in narrative spaces. I think it's what you now can choose to try and make some sense out of. And I think a lot of times in order for people to become specialists and experts at something they have to really focus their attention on something. But I think what active inference says is the more times you vary your attention and change your attentional

space, I e.
Make yourself available to ideas and phenomena that you otherwise would ignore because you think it doesn't really matter in this particular moment, the more AHAs, the more insights you yourself gain. So I don't know that we're paving over anything. I don't think that the bridge has to be something positive and material.
1:42:29 In fact, as we talked about at that very second set of live streams this year, is the hidden states hidden because a shroud something that's material, something that blinds us to the situation? Or is it simply something that we just haven't given our attention to over yet?
Do I need to build a bridge across the Grand Canyon, or is seeing across it to the other side enough? That's what active inference asks us to explore. I think if people want to come and find an opportunity to socialize with other people around references, there's work to do that to do with that around stuff that Bijan Chaos written about and stuff that Karl has written about. And those are fantastic exercises, but I think there's more to it than that.
1:43:30 And I think the everywhere part is something that, again, it gets reinforced when you're putting on a live stream that you put in hours and hours and hours of preparation on and you don't know whether or not the person who actually was the author of the work is going to be able to show up or not?
Because these are busy people and then they do. That's an active inference moment. That's a kind of a dedication to a philosophy. And I think that's where Karl said there's a lot of stuff that still has to be worked out by the philosophers. Well, I continue along with Thomas and Dalton to try to work out what the formalisms and the operations are.
So I think and eye on each is kind of where we are today. There's probably less room for people to say, no, it's one or the other. I think there's a lot more room to say, well, if we put this and this and this together, I wonder what kind of smoothie that derives.
1:44:32 That's my sense of where we are at the start of 2023.

1:44:37 Daniel:
Yes, it was like, in the beginning of the year. If only we could just pin it down. Is active inference realist, or is active inference this way? If we could just get it on the table on procrusty's bed, then I would be able to approach it.
I'm too busy right now. I'm too overwhelmed right now. It's too complex right now. It's too ambiguous right now. It's changing too fast right now.
If you could just stabilize it in this one dimension, then I'll meet you, and I'll be ready to talk and out of that environment, the doorway was dialogue and getting different perspectives together beginner intermediate and beyond. Today it is becoming a growing ecosystem of education, research, applications and service where it's not just that there can be the coexistence of different perspectives, it's that there are, there must be.
1:45:53 And we love that.

1:45:57 Dean:
It seems it seems bit counterintuitive. But if there is a nature part to this, one of the things we might discover at the end of 2023 that are that there's more pockets of feral and wild behavior and activity as

opposed to less.
That the more times people come and say, is there a packaged version? Is there a Disneyland version of this that I can use as my entry point? Perhaps what they'll discover is there's an opportunity when you hit your ball out of bounds in Costa Rica, there's a sign that says do not find your ball. There are scorpions, there are snakes, and there are crocodiles. Crocodiles don't just inhabit the water areas, they literally hang out in the forest.
And so you respect that, right? Unless you're going to properly protect your nine iron ain't going to save you is my point.
1:47:05 But there's a piece of this that's highly groomed, highly formalized. And I think there's also a piece of this that from a behavioral active standpoint, we might find a year from now is a lot more enabling, is a lot more feral who wants to go into those marginal areas and really poke around a little bit. And I think again, what people might find is that active inference isn't a shield, but it is an anchor. It provides the organizational, structural and contentrelated stabilities that people can anchor to so that they can then go out and play with those edges or the non edges. They can function in ways that they probably didn't imagine if they believed that active inference was a ladder to something specific.
1:48:08 So again, there's a creative side of this that I think a year from now. Again, I know that there's a bunch of people in business that want to do capture work around this and there's a bunch of scientists that want to get confirmation and I get that. I get what their goals are and I respect them. But I also think there's a connectivity piece to this that's just percolating below the surface and that when it's given a chance to run its course, it could be amazing in terms of what people generate.

1:48:47 Daniel:
It made me think a shield is not a sarcophagus. An anchor is not a pillar driven into the ocean floor. Even something that is stabilizing and defensive must have a loose tethering and an optimal grasp. And if it's better to be stabilized, why not just put the pillar down? Like that is one direction of thought and it may be valid locally or at a meso scale situationally.
We're not looking to resolve these questions in the abstract. There may be a case where you do want to get inside the iron sarcophagus and hide. But when we are out there figuring and balancing that with figuring it out, we need to also see those two in conversation or in dialectic.
1:50:00 So it's not like we can just figure it out such that we're going to derisk and achieve out there. It's not the work itself. It isn't even interestingly enough the exact preparation for the work itself out there, but also if we're only out there, so much happens that we lose valuable opportunities for preflection and function, and we lose those opportunities to figure things out while the iron is hot. And so we grow and we act infer and we serve less than we could, which again, may not be a bad thing, and maybe no lives are lost for it. But how to read and speak between the lines and make sure that the Active Inference Institute is accessible to all language and mathematical backgrounds.
1:51:09 As our usage of the active inference ontology and the formalisms becomes increasingly sophisticated, as demands from industry, from professionalized research and all of these other sectors become increasingly intense as well, how will we be able to provide services to our community and niche that neither exactly square with what their priors are?
Because if it did, they could have done it themselves. Nor do we want to come from a different wavelength or planet where the material are failing to make impact because they're not accessible,

applicable and rigorous.

1:52:06 Dean:
Here's an interesting thing to think about as one of the people who spent countless hours growing this idea. I don't think back in January of this year you could have taken the words from Sajid, where he was talking about partial encapsulation and envisioned a direct application to the idea that the active inference lab had to be only partially encapsulated in order for it to morph into the active inference institute. These are the things that we, upon reflection, can look back and go, well, we were talking about it as an idea, but here's an example of where it actually became true.
And I didn't know at the time that the active inference lab was going to turn into the institute. That's what active coherence allows for. That's what's really fascinating. And again, I'll say this. If you really want to learn, go through an exercise like you and I just went through today, because it gives you the opportunity to say, oh, by the way, if you want some real evidence without pre staging the idea that I want to prove this.
1:53:20 I want to prove that there's a parcel encapsulation, just live it out, migrate through it, go through that space time, come out the other side, look back on it and go, wow. I guess what we were talking about eleven months and 26 days ago, in fact, could turn out to be pretty prescient, because there's no way we could become an institute today if we didn't leave a gap open for that possibility. So it's just really interesting. Again, if you want active inference to be a repeat of what you have already been habituated to, you can make it that, or you can stick around and kind of go only mackerel. It wasn't just in theory.
In fact, it materialized in the ways that the theory said it could, not would.
1:54:20 And that's the bridge to everywhere.

1:54:27 Daniel:
Well, we put up our canonical final slide. Thank you, Dean, for this, Dean, and for all of the others and everyone who came on. If you're listening this far, thank you for your regime of attention. We are looking to make 2023 and years beyond it better. And this was a great year.
So it's no slight on where we've been. It's just a spiral of developments. Any dimension or divergence from your highest preference is either feedback you can provide the Institute or engagement that you can yourself make happen. You want to see a certain kind of stream happen, you want to see another language other than English,
you want to see a different kind of educational material become accessible, either provided as feedback, or let's figure out how to make it happen with your engagement.

1:55:39 Dean:
We'll go out there anytime.

1:55:43 Daniel:
Wow. Well, no word can close the year, so we'll just leave it at that. Thank you, Dean. Thank you, All.

1:55:54 Dean:

Till next time, my friend.

1:55:56 Daniel:
Till next time.
Act! Infer! Serve!

1:55:58 Dean:
All right!