ActInf Livestream #036 ~ “Modelling ourselves: What the free energy principle reveals about our implicit notions of representation”

Discussion of the 2021 paper by Matt Sims & Giovanni Pezzulo, "Modelling ourselves: what the free energy principle reveals about our implicit notions of representation" https://link.springer.com/article/10.1007/s11229-021-03140-5

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https://www.youtube.com/watch?v=99xQbWozPjc

An introduction for some of the ideas in the paper.

SESSION SPEAKERS

Daniel Ari Friedman, Bleu Knight

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TRANSCRIPT

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00:26 Daniel:
All right. Hello and welcome everyone. It is Active livestream number 360, and it's January 13, 2022. Welcome to ActInf Lab. We are a participatory online lab that is communicating, learning, and practicing applied active inference.

00:43 You can find us at the links here on this slide. This is a recorded and an archived livestream, so please provide us with feedback so that we can improve on our work. And also, if you're watching Along Live, please write any comments or questions you have in the live chat. All backgrounds and perspectives are welcome here and cell be following good video etiquette for live streams. And thanks, Bleu, for helping a lot with those slides and for coming on because this will be a fun pop up.

01:11 Go to Activeinference.org to learn more about how to participate in any of the lab activity or bring some new idea to the lab. Okay, here we are in livestream number 36 in the second half of January 2022, and the goal is to learn and discuss this paper by Matt Sims and Giovanni Pezzulo from 2021. The paper is called Modeling Ourselves what the Free Energy Principle Reveals about Our Implicit Notions of Representation. And as with all dot zero videos, the video is an introduction for some of the ideas and a hasty review. So it's not a review or a final word.

01:53 We're going to have the upcoming two weeks to talk more about this paper and hopefully talk to some of the authors or any other people who are interested in this idea and get involved if you want to talk about the paper. So let's just start with saying hello and an introduction and then what we were excited to read about the paper. I'm Daniel, I'm in California and was excited to read set another paper on representations and the FEP because it feels like we had a stretch back there of five in a row or something. What about you, Bleu?

02:29 Bleu:
I'm Bleu in New Mexico, and I really enjoyed Matt Sims paper on symbiosis that we did a while ago. And I thought this paper was really neat and really a clear elucidation of the different categories of representation and how, like, there's overarching, like representation and non representation and then several different layers within that. So I thought it broke it down in a really clear and concise way, even though it's a lot of material to digest.

03:01 Daniel:
You want to ask the big question? Sure. The big question of the article was can the free energy principle help us advance or even resolve the long lasting debate on internal representation in

philosophy of mind?

03:20 It's a long lasting debate. So this is like the zeros because it's clearly a topic you could spend a lot of time on. So that's our disclaimer. It's a long standing debate. But here's kind of a meme slide.

03:34 So it's the first section of this paper right below the title. It has this question from Walt Whitman and it says hold it up Sternly. See this? It sends back who is it? Is it you?

03:49 And then here are several different images. And just think about your perception of these images and the cultural significance that you might attach to them. Or the way that black and white pixels or gray pixels on a screen give the illusion of depth or mind you of an emergence that you've never had. So that's kind of trippy and representation gets at some of those issues that's one nonphilosophical take on it. What are they going to aim to do in this debate which we're going to sketch out the sides of in this talk or I guess this discussion?

04:29 Do you want to read it Bleu or sure. The authors argue that even if the FEP can't solve this long standing debate, it can play an invaluable role in revealing our hidden assumptions about the very notion of representation and can create some common ground to discuss and negotiate them. So they say our general strategy is to use the FEP for concept clarification of different notions of representation. We work backwards from representational or internal representation interpretation of the FEP's constructs to the various notions of representation that motivate those interpretations. So they claim that it emerges from their analysis that the FEP has been or can be used to implement various kinds of computational models which satisfy the requirements of certain theories of representation.

05:18 Bleu:
Hence, the question of whether or not the FEP entails representations depends on what notion of representation one uses in the first place. We're going to unpack that a lot, but just wanted to give the first coat of paint on what they're aiming and what they claim to do. So I'll read the first half. The abstract predictive processing theories are increasingly popular in philosophy of mind. Such process theory often gain support from the free energy principle FEP a normative principle for adaptive selforganized systems.

05:50 Daniel:
Yet there is a current and much discussed debate about conflicting philosophical interpretations of FEP. For example, representational versus representational. Here we argue that these different interpretations depend on implicit assumptions about what qualifies or fails to qualify as representational.

06:13 Bleu:
The next part we deploy the FEP instrumentally to distinguish four main notions of representation which focus on organizational, structural, content, related and functional aspects respectively. The various ways that these different aspects matter in arriving at representation action oriented representation, interpretation of the FEP area discussed. We also discuss how the FEP may be seen as a unified view where terms that traditionally belong to different ontologies. For example, notions of model and expectation versus notions of autopilsis and synchronization can be harmonized. However, rather than attempting to settle the representationalism versus non representationalist debate and reveal something about internal representation are implication.

07:01 This paper demonstrates how the free energy principle may be used to reveal something about those partaking in the debate. Namely, what are hidden assumptions about internal representation are

assumptions that act as sometimes antithetical starting points in this persistent philosophy debate. There's really two or three pieces to this paper. There's an introduction and an abstract. I guess we can delete that.

07:31 Daniel:
The first part introduces a short summary on the free energy principle and we'll see that Action Perception Recognition Model. The bulk of the paper is in these four segments of each with a dynamics relationship of internal representation and the non representational perspectives. And that section is a lot like a literature review and a philosophical taxonomy of different perspectives and arguments related to representation and the FEP. And these four subdivisions. There's then a addendum on evolutionary function specifically, and that's apt as nothing in biology makes sense except in the light of evolution, as they say.

08:18 And then section Five kind of turns a mirror back on the process and thought, just like those earlier images with the mirror. And that's where FEP differences in perspective are used almost as input data for theorizing and speculating about different things, which we'll get to. So that takes the authors then to the conclusion. So it's a pretty wide ranging paper and the keywords that are here are active inference in free energy principle, predictive processing, generative model, internal representation, action oriented representation, inactivism forward model, and Markov blanket's. There's no single path or single slide that would do justice to all these keywords.

09:07 So we're just going to kind of jump in and knowing that some people will be really familiar with some of these terms and others will be hearing about them for the first time. So first the big topic is representation. Now this is just a quote from the paper. Whether or not living organisms have or need internal representation is an old and fiercely debated topic. So we kind of like unzipped that citation to add the titles and the links and just some of the images from these citations.

09:40 So if these topics or any of this body of literature you feel like is well motivated or well reasoned or you've never been exposed to it, that's sort of the continent we're on. And it is such a large continuum. So the authors write such a debate is reiterated within the predictive processing view. So they're going to tell the story of representation from predictive processing as sort of an implicit starting point from a more specific and mechanistic angle. Assuming the FEP is a good model of living organisms, does it entail the notion of internal representation or not?

10:15 So it's almost like we're conditioning our analysis, whether it's a counterfactual or not, on FEP being used instrumentally. So we're going to use it just like we would use a ruler, not by questioning the ruler against known objects, but by going to unknown objects and investigating them. So that's the way that the FEP is going to be used in this very large scale topic and complex area of representation. Any comments? Lu all right, another big topic and word that comes up in this paper, but also a lot of other of our discussions is enactivism.

10:53 And so who better to hear it from than the radicals? So Herek 2014. I think it's a thesis why radical enactivism is not radical enough, a case for really radical inactivism. So take it up with the author. If this is oversimplifying or that's kind of the joke appeal here, it is oversimplifying.

11:15 And here we see three different framework contrasted against each other cognitivism, radical inactivism and then really radical inactivism. And cognition differs from an activism on the top row in that cognition says basic cognition is representational and enactivism is going to be rejecting that claim

on all accounts. And then where this author is saying that you could even go further into the inactive camp or forest or whatever is you could even deny that
linguistic cognition is representational. So even if it looks symbolic and it looks like it has some representational characteristic and it's the gray zone that makes people go, oh, okay, maybe there is some redeeming aspect of representation, you just have to keep on denying it. So maybe we can pick that threat up again.

12:08 But that's sort of the lay of the land, of maybe the center and activists, the moderates and then the extremists Bleu. Anything? that no. It's so interesting to really think about representation and the brain. I mean, coming from neuroscience, actually okay, I'll add something coming from neuroscience, it's interesting to really think about.

12:31 Bleu:
I mean, the visual cortex is very unique in the sense that we know that there's representation that is replicated in the brain, but everywhere else, it's just kind of like, you know, we've never found like the word for apple in the brain somewhere. Like there's no, like, apple neurons. So it's just an interesting I don't know, just a position, I guess, about representation and language, thinking about it in terms of the brain. Also, one really important aspect that we didn't mention is it's about action. Like, it is basically saying that action is related to embodiment and all these other things, but enactivism is just focusing on action and what that means.

13:14 Daniel:
All right, free energy principle, which we're going to spend a lot of the discussion on. It's an integrative proposal on adaptive self organizing systems that remain far from thermodynamics equilibrium. So that would be cool if we had one common framework for things that maybe were far or close to equilibrium. Currently, we only have some of those areas of Faithbase. It starts from the premise that in order to survive, living organisms engage in reciprocal action perception exchanges with their environment.

13:45 They must do what they can in order to remain within a neighborhood of viable states. That's kind of the cybernetic regulator insight. Then the bottom paragraph, the idea is cast in Bayesian terms by assuming that biological active state state the priors of the agents, the states that an agent prefers to visit become the states that Bit expects to visit. Hence minimizing surprise or its longterm average, which is entropy becomes a primary imperative for living organisms as it permits them to counteract an otherwise unavoidable process of dimension and loss of integrity, which kind of closes the loop back with the resistance to dissipation that was brought up in the beginning. So this is kind of one FEP boomerang from starting switch, a focus on resisting distinctions and then moving thought, the action of perception loop to ecological preferences and facts of the reduction of uncertainty and thus resisting dissipation.

14:47 A partitioning that is natural or at least complementary to the FEP is the Markov blanket partitioning. And we've talked about this in several other streams, so we won't go into it in too much detail. This is from 26. And the Markov blanket condition, at least in its more narrow technical sense, is referring to some set of nodes, representations, statistical variables. And that set of nodes that make up the blanket makes some other sets of model, two other sets of nodes which we can call the internal and the external states.

15:28 It makes those two sets conditionally independent and the edges are statistical influence Bleu. What else would you say about Mark Friston blanket? They say it here beautifully. So the blanket states

act as an informational boundary between internal and external states. And that's like the simplest way to think about it, right?

15:49 Bleu:
Like my skin acts as a barrier between myself and the world. The blanket access as a barrier. Yes. Cool. Okay.

16:00 Daniel:
Leaving FEP land proper, we can zoom out to some related topics that sometimes get brought up in discussions of FEP but often don't. So first is the predictive processing framework. This is drawn from a citation that was in the bibliography but not sure if it was in the text Hohwy 2020. And this is a paper, New Directions in Predictive Processing. So predictive processing asserts that perceptual and cognitive systems engage in prediction error minimization, enabling approximate Bayesian perceptual inference.

16:37 And some, but apparently not all authors emphasize action. So Clark and Howie famously and recently have emphasized that action is essential to predictive processing in the form of active inference, where the system infers its own policies. So really emphasizing that the predictions are not just about sensory inputs but causes of sensory input, hypotheses about latent unobserved causes in the world and also one's own action and policies, what one expects to do. And there's a really awesome supplemental file for this paper that includes a great literature analysis and a lot of keywords and unique prediction and lists of empirical evidence. So this is really awesome work, and it'd be great to hear from people who study predictive processing or are more familiar with it.

17:38 How theory see it in relationship to active inference and FEP, something that's in the overload of predictive processing Bayesian statistical theories, active inference's is the idea of a generative model model. So let's recall from DCM the dynamical causal modeling which we talked about in the previous weeks in number 35. And here in DCM. It is an appealing to biologically grounded models and dynamical systems theory to create a probabilistic generative model of hemo dynamics fluctuations. So what is a generative model?

18:22 It's basically opposed to a descriptive model. So why would one use the generative model in statistics? Because these types of models can be run in both directions. They can be fit from data, but they can also be used to generate data and then they can be used in different ways because of that capacity. Lower dimensional generative models can be very computationally efficient because they only have to be updating a few parameters rather than keeping track of every single data parameter and then a little bit more on the interpretive layer or beyond the merely statistical generative model.

19:00 Model capture some of these openended and creative or complex dynamics that are associated with action and perception and recognition model. Therefore, there are links to not only the cognitive sciences but also philosophy and phenomenology. So it's kind of an idea from statistics that gets connected to some of the fundamentals of neuroscience and philosophy and anything out of that Bleu. Yes. So just when I think of the generative model, having listened to so many people describe it, my favorite description is almost as like the recognition model is more like the hardware or the state space.

19:46 Bleu:
Then the generative model is like the software, the action between them, or like the dominoes and the stock dominoes and then the cascading wave. Right. So the dominoes would be the Recognition model and then the generative model is the relationship between them, the cascading wave of dominoes. I always like to use that analogy, just it's clear for me. And here's one more slide from 26 where the idea

of the Mark Cob blanket, which we pulled from 26 as well is connected to the idea of a generative model in the section on predictive processing.

20:22 Daniel:
And so in this paper so go check out number 26 or the paper on Bayesian mechanics to learn more. But the idea is that it's possible to use the Markov blanket partitioning so that there's the blanket states statistically isolating internal and external states. And then there might be some systems where those partitioned internal states are acting as if they are doing inference on external states. So that would be like if I said I'm going to hold up three fingers and put it behind my back. And then you had a generative model that was about what was the state of that unobserved variable.

21:03 And that's something to look more into from the details on generative model as with other papers. And that kind of brings us to our last keyword, which is active inference. So we'll go into a little more detail here. They describe that active inference agents are selfevident, which is to say that because minimizing free energy over time is equivalent to maximizing Bayesian model evidence or evidence encoding. In longterm active inference, agents seek out or generate those sensory samples that maximize the lower bound on the evidence for an implicit model of how their sensory states were generated.

21:46 As such, active inference agents author evidence for their own continued existence via free energy minimizing model minimization. So active inference is using statistics to operationalize some of the information, thermodynamics formalisms of the FEP. So it would be a more narrow interpretation that that carries no or little philosophical baggage or claims to how the world really is. It would be a more broad or stronger interpretation to think that this is capturing actual information dynamics or the actual thermodynamics relationships of systems. But the instrumental usage is more of a statistical similarity or at least attractability argument.

22:33 And that is not without precedent, not even close, because the variational Bayesian methods, which minimize or optimize this quantity called the evidence lower bound, start maximizing the lower bound for how good the evidence is. And others in many places have motivated this fundamental component of modern Bayesian statistics from multiple different areas. And it's kind of like equations are true, so equations can be linked to each other. And it's just kind of cool that these KL divergences as well as free energy and the information or description length criterion all
align. And that's not even like an active synthesis.

23:18 Applying that to inference on action is something that is bringing together a lot of these ideas from variational Bayesian methods with a lot of ideas from control theory, cybernetics enactivism, etc. And again, we can explore back and find out which ideas came from where. But just to keep in mind is Zhat. These pieces were not tied together by active. Those are excellent relationships in the literature.

23:46 But active does integrate the free energy principle and that center meme that they started with, that things have to resist distinctions with all of this philosophy and more quantitative area that have to do with action and perception. And then in the dot one and dot two cell go more into the variational and expected free energy, but kind of wanted to just give a little thought on active inference. And if someone has a different thought, it'd be awesome to hear it as well. But this paper was very precise and very subtle in how I thought about some of these areas. So I think it's really good to be clear about what we're talking about in this case.

24:35 Okay, onto the paper. All right. So this is going to be a flow role of the introduction. There's a

growing consensus in computational and systems, in neuroscience around the idea. The brain is a predictive machine which uses internal or generative models to continuously generate prediction in service of prediction, action and learning.

24:57 So starting with the idea of prediction second sentence. One of the ways that people are studying prediction in the brain is predictive processing. So we talked about that a few minutes ago, the free free energy principle extending predictive processing by providing it with a fundamental principle of adaptive self organization that's the resist dissipation meme that isn't intrinsically within predictive processing framework which might describe audio processing in a radar signal. And so that union of FEP and predictive processing are starting to become prominent outside of systems neuroscience, which might seem like their natural niche or origin, but it's also the case that philosophy in the philosophy of mind are starting to think about it. And despite that attention, the authors are arguing that some of the implication for FEP's existence remain widely debated.

26:03 I think we can agree on that. And they're going to focus on one of the prominent discussions that they think is the most prominent, which is whether the FEP is representational or representational and then to what extent. It is also learning on debates related to internalism action orientation and activism. So just it's all over the map. It's a multi dimensional philosophy force base with the FEP and it's not totally resolved, but that's what they're going to go into in this parse.

26:37 Okay.

26:42 Bleu:
Bleu so they note here that philosophical discussions or representation wars about the FEP have typically been focused on four aspects of the notion of representation. So these four aspects are organizational, structural, content related or functional. And the organizational aspects have some variable inside a system that's separated from that which it represents. Outside the system, structural aspects have representational vehicles that are structurally similar to the state of affairs in the world. that they stand for contentrelated aspects have internal models that either encode environmental contingencies or sensory motor contingencies, specification or description of how the world is taken to be in turn analyzed in terms of correctness or truth conditions.

27:35 And then the functional aspects support vicarious use before or in the absence of external events of internal variables of a model. Whoa. Yep, bit is kind of a woe, but this four field distinction is the structure of the paper. So we're going to do a few fun things to help understand this because it is the contribution and the structure of the paper. So everyone's going to interpret all of this in their own way, which is awesome, but we do really want to be clear about what the author's contributions are.

28:11 Daniel:
So in an almost unprecedented maneuver, we're gain to go to the end of the paper first and then also have the figures out of order. We're going to start with what we can learn from this debate. So if you're not sure if you want to listen to the next like 40 minutes on going into this four Bull distinction, you get it up front. So they're going to review some of the most prominent philosophical interpretations of the FEP. They then summarize those interpretation according to the four different categories.

28:44 that Bleu just red for each of those categories, they're going to consider multiple constructs of FEP, so kind of tools in the FEP toolkit system. And they're going to argue that depending on which perspective you take on which of these categories and which constructs, you're going to come to different conclusions about the representational or representational nature of the FEP. So it's kind of

like a checkerboard that's their first salvo is we're going to outline a flowchart and a grid and a structure, like a taxonomy of philosophy, ideas related to this triple dimensional space of aspects of representation, constructs of the FEP and then the categorical variable representational or non representational claims. And then the whole second part is saying we're going to use that three dimensional phase space to shine a light on one's own implicit notions of representation. So that's kind of like the looking in the mirror strange loop part.

30:00 But the first part is more like a philosophical literature analysis. And their contribution in figure two is to make this awesome flow chart. So this is going to funnel you from the start in the four different domains, four aspects, variational, structural content and function. And then from those four starting points, kind of like sorry board, you're going to get funneled towards representational or representational FEP, depending on decisions. And that's what we're going to unpack in the next sections because again, it's kind of like trippy and there's a lot to think about.

30:46 This is going to be our map. So it's going to be at the bottom of all of the upcoming slides, which of these eight sections were in. It's like a cube divided in eight little cubes or two tetrahedral or some other pattern. But basically we're going to see whether we're in like representation camp or non representation camp and which aspects we're focused on. And then here's that table, but it's just the tip of the iceberg.

31:15 So how can we organize our thinking around philosophy and increase the rigor and the accessibility of different arguments? Because it can be difficult sometimes to parse it in long texts. And so the authors clearly thought a lot about this. So it's a really pleasure to read about it and learn about it. And the flowchart is a great addition.

31:43 So that is going to be our map in the coming slides, right? Thanks for making such a beautiful map. I have to say I had pasted a whole bunch of these ideas and tried to categorize them and then Daniel constructed them into this beautiful flowchart. Well, they made the flow chart, I made the grid. The grid.

32:04 Bleu:
That's what I meant, the grid. The grid. Before we see the grid in action now, let's just recall this action perception loop. And we're not going to go into it right now, but that's definitely for dot one and dot two. What are these nodes and edges and which can and can't happen and what do they representation.

32:24 Daniel:
So that is sort of the partitioning that we're going to be working within, which we brought up a little earlier with the Markov blanket and in a lot of our other discussions. Okay, so let us start in this top left square. So this is the organizational aspect, the representational perspective. So the organizational aspect is describing how variables inside a system are separated from what it represents outside the system. So that's like the architectural take on representations.

33:05 I don't know is it classic representations but internal representation camp are going to argue that internal states are segregated from the external world via Markov blanket. Therefore the brain activity cast as internal states do represent what it doesn't have access to Bleu, what do you think? Or anything else to add on it?

33:33 Bleu:
Nothing I want to delve into here because I'm going to save it for that one. Okay. Okay. In contrast,

there's other people and other perspectives who are going to, in the organizational aspect, take a non representational perspective. And so philosophers of the ecological and activity persuasion have approached that same Markov blanket formalism and basically framed it in terms of representational view of the FEP.

34:07 Daniel:
Like Yellow Brunerberg's paper, the anticipating brain is not a scientist free energy principle from an ecological and active perspective. So they argue in those papers, in a lot of papers by Yellow and others, that just because you deploy the Markov blanket formalism it doesn't imply the behavior of the system is best explained by inferences generated by an internal model, the structure of which is representing that, which is a model of. So read the papers for more detail. But it's like, it's an interesting idea and it was also interesting to read from this paper that the restatement of this argument that these partially informationally encapsulated systems like we talked about in 35 are parsimoniously understood in terms of achieving high relative mutual information between the non representational process of generalized synchrony and Huygens 1673, the pendulum clock. So you can get like oscillating pendulums that synchronize but they don't
have representations of each other.

35:23 Now maybe you need representations to do something else but that kind of gets to that enactivism radical and activist debate. So we'll go more into it later. Just kind of cool old citation and interesting idea. So based upon the organization of the system, there area people who say, yeah, the FEP is representational of course because the internal states are isolated or no, because you can get high mutual information without representation. All right, that's like what Dean called nine o'clocking, it's 09:00.

36:01 Bleu:
That's general synchrony. Exactly. There doesn't need to be a representation of brushing the teeth in the mind or anything of the reader. Okay. Onto the second aspect, the structural aspects.

36:17 Daniel:
So the question to be addressed is whether generative models are structurally similar to their targets or accuracy descriptions of external reality or whether models needn't be accurate but merely adequate enough to leverage for adaptive behavior control. So does. It actually need to representation the thing? Or can bit be just some other representation that is effective enough? So here's the pro and the con for representational.

36:52 On one slot, the top structural representationalist view argues that the generative model has to have some structural resemblance with a generative process in order to be useful for control purposes that's really related to the good regulator theorem from Cybernetics.

37:14 And so the argument there is you're gain to need the good representation about it in order to be on the right page in complex environments.

37:28 Others disagree. So here's one line of argument that the formal constructs in active inference and specifically the generative density G, if it's understood correctly, according to some authors, it would turn out to internal representation. Those authors suggested REM sad at all 2019, that generative models do not meet the requirements of structural representations where some internal structure replicates some structure of the generative process. So the generative model is the organism's model of action. The generative process is the actual world out there, the niche that's giving rise to observations.

38:05 And so, in other words, you might be I don't know if this might be a mal example, but like to run, you don't need to have an abstract representation of your own body. You merely need the action interactions with your body. And so this is kind of arguing that the internal generative density G active doesn't have to have any resemblance structure to even the problem which it's being deployed to solve. Well, and this always goes to the map and the territory and active inference between the map and the territory. So structural similarity, what does that mean?

38:48 Bleu:
Right. So how similar? Is there some metric that you're using for structural similarity? How similar is the map of the United States to the actual United States? Right?

38:59 And so what does that even mean? Structure similarity? Sorry, I'm probably poking the fire bit. Let's hear from Alex Kilner or Maxwell or anyone else who feels really strongly about this issue because we've had some fun talks on it before. And it's just I just like seeing the pro and the con laid out together.

39:26 Daniel:
And then the authors were very.

39:31 Bleu:
I just like arguing what is the difference between the pro and the con? I want somebody to draw the line for me what is similar and what is not similar. Enough niche. Okay, now to the third aspect. So this is the content related aspects.

39:51 Daniel:
Whether the generative models need to explicitly model the ways external states produce sensations, aka environmental models, or the ways that actions produce sensations or sensory motor models, this is very closely related to the previous aspect. So I think it be cool to unpack a little more. But theorem is a little bit of nuance with sensory motor systems, which we talked about in several places, like skilled performance. And basically this is just one subargument within this section, a pro and a Zhang and they're talking about essentially skilled performance, how sensory motor models can afford sophisticated cognitive processing. And so the first agreement here is that here comes that same Jelle Bruineberg 2016 paper the anticipating brain is not a scientist saying that, yeah, actually sensory motor loops.

41:00 If you're going to trust the story for one level of analysis, then why are more so called complex behavior, not just more complex combinations of modules which don't appeal to any representational content? And then the sensory motor dynamics created by those models may be progressively internalized to support mental operations detached from the sensory motorcycle. So maybe like walking and chewing gum or something like that, or maybe think about like an insect flying or walking and how much of that is just the shape of its body in motion and just the way that the muscles and the joints just like flex. And so ascribing the total motion of every joint to cognition actions just is probably asking too much of cognition. Unless taking embodied and morphological computation as another type of computation and then firing back for the representationalism is coming from the area of schema theory which is where there is a nucleus of sensory motor models, but then they're extended to include external causes of selection.

42:16 So that just kind of like a flavor of one of the subdivates. And it would be good to discuss, I

think, how the structure and organizational and content related differ because it is like a nuanced debate. And so I appreciate how clear they did make it given that it's murky waters because these are like four aspects of a philosophical idea. Oh, then of course this meme. Okay, so the embodied cognition literature has shown some practical examples of how good control can be realized using fast and frugal solutions and very simple models.

42:54 This is an example that Dave described on a live stream just recently. One popular example is the baseball outfielder problem or the fact that catching a moving ball may not require a full model of the ball's position, velocity and direction, allowing for trajectory prediction, but a simpler control mechanism that only keeps the image of the ball stationarity on the retina. Alright, so here on the left, this is like the physics class model of some of the parameters. So this is already a map of the territory. We're not going into the temperature of the ball and the wavelength of the grass.

43:30 So this isn't like a world model. This is just the physics reduced model of the physics of the asymptotic ball in this kind of idealized settling range. So that's a lot of parameters like as drawn out there. And here from this Wired article, how do people actually catch baseballs? Here's the apparent ball position as a function of time and just showing how if you're in the position to catch the ball, that there's a simple heuristic line related to the apparent ball's position.

44:04 Whereas Bull that you're too short or too long to catch have a very different visual trajectory. So in other words, an activism is saying this on the left doesn't have to be the representation. that would be something that might satisfy the most formal representationalist. But then this is sort of a gray area. Like what if there is a visual representation of the ball on the retina?

44:30 So there is something that's featuring information about the real world in an actionable way, but it is of a totally different type than the parameters in the physics class. And so that can get, of course, a little sticky. So here is us on the Phillies. We're trying to catch the fly Bull here's. Friston hitting it out of the park with the action perception loop and all the work in this field.

45:01 So what is the equivalent? Do we need to have the physics class model or is bit possible for us to have some other type of understanding? Just a thought. What do you think? Bleu.

45:19 Bleu:
So it just really makes me think about blindness, right? And I know that this seems like a way out there trajectory bit, we know the physics of our natural environment. We know it pretty well. What about when we remove ourselves or like remove one sense, like remove vision? Right now we have like a really different perception of our environment and we have to completely retrain through kinesthetic memory where we are in our environment.

45:49 If like the lights go out. I mean, I was without power for 4 hours the other day in the middle of the night and I was like totally freaked out because I live in the country and there was absolutely no light, like none. So in that you have to know where all the things are. So like, this is a structural map in your mind of your reality that's really different from what you're able to absolutely perceive at that moment. Just makes me think of that.

46:13 Daniel:
Nice. That's just a fun slide. Various slides. This is still on the this is I guess on the functional aspects. Alright, so here's the functional perspective or the functional aspects of representation.

46:34 Another way to address the issue of what a representation is and what it is not is by asking what functional internal representation play within a hierarchical architecture. So this is the function, kind of the pragmatics of the representation. What it does. An idea that dates back to at least PSA four is the idea that representation should vicariously stand for something external in its absence and afford vicarious operating plant mental operations using an internal vehicle that are executed before acting on the external preference of the vehicle or even when the external reference is absent. So it is able to be cause and effect within the mental ecosystem
like we'll see from these examples.

47:26 Consider mentally whether one would enjoy eating a pizza with no pizza in sight. So be like okay, think of a pizza. Do you want to eat that? Now imagine that type of food that I previously mentioned and then what type of restaurant it is and what equipment do they have in the kitchen, like an oven or something like that? So there's something that's being functionally carried forth in that cognitive sequence.

47:52 Can that be uniquely explained, predicted, controlled, designed with just sensory motor loops? This functional role of representation has been expressed in terms of whether the agent's internal operations are detached from its action perception cycle and hence autonomously generated versus determined or sustained by external stimuli. So if something were just repeatedly causing visual stimuli and that were causing, like, sort of unaware movements, that would not be one category of phenomena. But what about going on a walk and remembering a five digit number by just chanting it to yourself? Is that sensory motor?

48:36 How is that playing out? And when cognition is playing a functional role seemingly uncoupled from the action perception loop, which is probably not exactly how Piaget framed it, but that's what that notion is. And so within the functional aspect, the FEP is leading on to ask, what functional roles do internal models play during free energy minimization? So just like the memorizing, the number was like a cause and effect of a cognitive environment. Is it the case that the FEP is featuring things that are also causes and effects in the cognition environment?

49:14 And does that resemble vicarious operations in the classical phase based account of representation? And again, it's going to be the dot one, the dot two when we go into the variational and the expected free energy. But that's like, the big picture on the functional aspect is, do these variables play functional roles in a way that's uncoupled from the immediacy of action and perception? I hope I represented that because I'm also not sure how that one okay. Anything to add?

49:48 Bleu? So I think about it in a different way. Like, you're walking down a path and remembering a five digit number, but like, I don't know, something that probably resonates with Sasha or like anybody else that does extensive that lab research. Zhat, you've done. So it surprise me that it doesn't bring its mind for you is, like, thinking about your action.

50:07 Bleu:
It's like a dry run of your experiments the next day. Do I have the tubes I need, the enzymes I need, the reagents I need? Where are all these things located? When it's a really important experiment, like hit or miss, it has to be done now or never. Like, which you know that there are some that are like, that it's important to go through and make sure that you've got, like, a cognitive representation.

50:27 Like, you build it and so it's fresh in your mind for when you absolutely, like, execute the experiments. And so that's like, instead of walking down a path thinking of a five digit number, how

about, like, planning, like, the sensory motor planning of executing a series of experiments. It brings that to mind for me. Yeah, great. And that makes me think, like, let's just say it's a 1 hour experiment that you're thinking about.

50:53 Daniel:
Now, does the motor pattern firing associated with pushing your thumb down on the pipette, does that get engaged during the prospective planning of that event? Who knows to that extent. But that's kind of what's at play here. If there's a totally disjoint neural phenomena associated with the prospective planning, then the inaction we're in one camp of representationism. I don't even know which side of the line anymore.

51:25 But then if you do have that thumb neural firing pattern, like it's just like sped up or just shortened or something, maybe we're in a different area. So let's return to these ideas because, again, it's very nuanced and it's just great the authors laid it out as simply as they did because this is clearly a lot of literature to go through. So that was the eight, the four times two. I won't even go Hinton it, but four times two. And that's the bulk of the paper.

51:58 And then there was this addendum section on representation as an evolutionary function. So similar to other cognitive functions like working memory, planning, cognitive control and attention, or perhaps even to functions like flying or swimming. Representation here intended in the sense of affording vicarious operations and detachment from the current action perception cycle, may be an evolutionary function. So it's kind of like when people argue that consciousness has an adaptive role and that the origination of consciousness could be scaffolded or nurtured or selected for once it arose. This is a little bit less phenomenological and more cognitiveist or computationalist with respect to saying how representation might play an evolutionary role.

52:46 So let's just imagine that there was this detachment between the action perception role and planning. Like here's Pokemon and I'm Ants. Imagine if they're able to perceive the polarization of light or the intensity of the light or the humidity and then have something like a representation that helps them assess whether it's appropriate to forage on that day. That is going to be a more adaptive nest mate for the colony. Does the colony have a representation?

53:19 What level is the representation existing at? Is it the direct target of selection or is it arising from selection on other units? What do you think? Bleu? We were just talking about this, right?

53:38 Bleu:
Is the niche the Internet, right? Is that like the meta representation of humanity? Like the web? That's it. So I wrote that here and things to discuss and the dot one or dot two is external representation.

53:53 Like, how do you offload this representationalism into the niche?

54:00 Daniel:
Awesome question. And I also, I think, probably subconsciously was thinking about that. Like the image on the right is a trail, a truth trail that the Pokemon mermax use. And so it's like it's not going in every direction in this colony. It's only going in one direction, it's along a tree.

54:18 So it's kind of accentuating this natural pattern in the generative process in the niche. But then now that is like an externalized prior for foragers that's based upon the clearing of grass and then they're less likely to go like walk order the midden pile and forage in a different direction. But then it

does happen, so the trail does move. So it's like interesting topics. Yes.

54:43 Thanks for writing down about the internet. Okay, let's continue through a few of these last ideas and I'm glad that we're moving briskly through this long paper. Okay, so let's keep thinking about that detachment of representation from the action perception loop they write. In other words, full fledged decoupled representational capacities might shade off, which I wasn't even sure what the origins were. Maybe it's used in God for Smith 96 into other cognitive or minimal cognitive processes, the dynamics of which are increasingly more coupled to the environment through action sensory perception.

55:23 So it's like being at a levels of cognitive complexity where you can spin up other active entities or like the queen as a reproductive ant is spinning off cognition but not reproductive nest mates. Therefore, when taking functional role as contextualized by evolutionary function as a criterion for identifying when recourse to representation is warranted in explanation, which is a very complexity linguistic clause. But we're finding out when representation is warranted, the criteria for that would be evolution shaping function. So it's a lot like saying nothing in biology makes sense except in light of evolution. And then under those settings it is possible to interpret at least some processes, the ones that involve vicarious variables related to minimizing free energy.

56:24 Under that context, the author suggests that could drive the kind of self organization that FEP would describe as representational. So it's layered, but it's very fascinating because it is just like you had Majid Bleu with our niche, but it's like just stacking rocks on top of each other. It's resisting disorder, it displays culture, but those rocks don't have a self modeling capacity. It's like uni variational multi scale integration the other Sims paper whereas here we have like a human who is part of their niche, has made another adaptive active inference entity and now they're engaged in this reciprocal multi scale integration. And so I think the authors might be suggesting that there's aspects of this settling point might be described as or might be warranted to utilize representation in the exploration.

57:36 What do you think?

57:40 Bleu:
So I always wonder whether we should talk about multiscale integration or thinking thought other minds in terms of translating into the niche. And how do you decide whether we're interactions? As I Dean, I guess there's always this thinking through other mind aspects of, you know, we live like stigma jack traces in our niche environment and then they're picked up by other people or is it really multiscale integration, like in terms of you and I are connecting and forming a bigger unit. I always and this is we were just talking about this like ten minutes before we got here today. So this is something to me that's like this fundamental paradox.

58:26 Like I don't know how to distinguish these.

58:34 I guess that shared informational channel always comes through the niche environment, whether it's the Internet or some knowledge artifacts like a scientific paper or a computer or something else. But my relationship with you or any human
is always through the niche environment. There's always that filtration and whether it's in real time like we are here now, or sequentially. Even if it's so called in person, it's mediated by vibrating air molecules now it's intermediated through routers and such it's utilization of the niche. And I think this is just raising a super fascinating question.

59:16 Daniel:

Cell yeah, thanks for raising this. We'll discuss that and then this is like saying it's one thing to talk through the tin cans. That's like using the direct passive active inference agents even if we could describe the tin can as perception and action. But now what if there's a chat bit that's intermediate between the two of us or it's translating between two different languages. Then where does that put the status of that entire cognitive system?

59:46 How does it influence thinking through other minds when the intermediaries are passive versus adaptive active inference entities? So nice questions. All right. This is the part which also will unpack more in the one and two. This is kind of the wormhole strange loop turning the mirror back on itself part.

1:00:07 So the authors write in much the same manner as arriving at internal representation or internal representation interpretation of FEP. So that's the whole sections that we just spent the whole time on like everything within the realm of actually using the FEP, not taking it as an unknown, but taking the FEP as an instrument and then using it to ask whether it is representation or not on those different aspects. So now we're going to put that behind us and consider arriving at FEP as a synthesis. Depends on which representational criteria are assumed when either considering FEP central constructs or considering specific cognition phenomena through the lens of a process theory under FEP. Hence, in the end, the debate about FEP may reveal more about us, our criteria for representation and our interests in particular facets of cognition than it does about internal representation status of the FEP.

1:01:08 So JFK is out there somewhere. Ask not what the FEP can do for you, it's saying because you can be all over the map. Maybe all of these sectors are in play and all the perspectives in each of those aspects. That means that somebody's posterior confidence in different claims is probably better reflecting of their prior and update process than some sort of objective stance or consensus reality about what the FEP is. As if it could be such a thing independent of how it specifically deployed, as we talked about with model based science and Majid Beni.

1:01:55 So this is a very nice point, I think both. Yeah. I mean, fundamentally, the FEP is a representation. I mean, it is our representation, our model. I mean, it might be the one that we employ with which to it might be an instrument, or it might be a real thing, but still we represent FEP, like, with equations and with ideas and memes and I don't know.

1:02:26 Bleu:
I mean, we impute our representation on it all the time. So whether it is representation itself or we represent the FEP, but there's some, like there's some, like, play there. It's integrated with representation all the time, like linguistically or other or maybe not. Maybe I'm not a radical enactivism enough, or what was the radical inactivist? Really?

1:02:53 Daniel:
Radical? Yeah. Well, I'm sure we'll talk more about it. So just the conclusion and then a few last points. So, nine sentences in the conclusion.

1:03:05 One, they looked at four different aspects of representation. Two, understanding which side of which line to come down on was complicated because the FEP appeals to multiple constructs that don't prior seem to be strongly linked or naturally linked. Like, it's unclear whether one begets the other or whether they constantiate. And that's the kind of work that we're really interested in, in the ontology project and in the knowledge corpus engineering, of course, in the.edu organizational unit of actinF Lab. So the FEP appeals to multiple constructs, and those model can be constructed in various ways.

1:03:48 So it's good to clear up representation into these fourfold distinctions. However, it's complexity still, because the FEP is kind of like a plurality in and of itself. Three, they argue that depending on how you think about things, you're going to think about things differently. They then turn the mirror back and suggest that that's an opportunity. It's a challenge, but it's also an opportunity to reflect upon how we value representation and different features in our model selection related to the main part of this paper.

1:04:25 And then they sort of salvage the utility of FEP, whether heads FEP wins, tails not FEP loses, because the FEP can be heuristic. So, like, kind of good for functionally or pragmatically for philosophy of mind, even if not so much to settle the dispute on internal representation, but to unveil and dissect the hidden assumptions in the debate. So it's kind of like deploying FEP into the representation debate. It's not going to be the judge, it's going to be like some other role. What is the FEP in that setting?

1:05:03 Six, another lesson learning is that some traditional polarizations might be attenuated or dissolved under the FEP. So here we're seeing multiple uses of the free, which is why there's a bunch of different colors on here. It's a theoretical plurality. It has also a plurality of applied models. It's a mirror, it's a bit hedge.

1:05:33 It's a unifier with traditional polarizations like cognitiveist versus an activism. And then here's a really fascinating part. that I know many people in the lab will be excited to talk about the FEP advances a unified view where terms that traditionally belong to different ontologies can be harmonized. So it's an ontological unifier. For example, modeling and expectation is not used in some of the works that talk about autopoeysis and synchronization.

1:06:02 Eight how does the FEP do this? It begins with a strong inactivist flavor and a focus on action that's missing from traditional cognitive theories. So by starting with 1ft squarely in action, it brings something that a lot of neurocognitive theories are missing from and then extends the scope of an activist thinking to territories of, for example, counterfactual thinking and model selection and abductive logic like we talked about also with Beni. So it's kind of like coming from action landia and bringing in inference and then starting from inference landia and bringing in action. Almost like it's called act of inference or that's like a related idea or something.

1:06:45 And then the 9th sentence is just saying the space of the possible is big and we're going to have to reduce our uncertainty by making it happen. So it's a really great conclusion.

1:07:04 Any other comments on that Bleu? Just pretty epic paper. I think it ties together a lot of stuff we've talked about. Stuff we will talk about. Yep.

1:07:16 Okay, final things and things to discuss in dot one and two. Okay, so here is a quote from the paper where they say given the FEP has been implemented in a family of computational models that are by definition fully observable, that's the first part to highlight. So in that sense, are computational models fully observable or what does observation mean for models? What does explainability mean or transparency mean? Is that reproducibility?

1:07:49 Is that perturbability? Is the map fully observable? Is the territory fully observable? Are there settings where one or the other or neither or both are variable? So what is this visual metaphor and what are some of the nuances with like observation and visual perception?

1:08:10 And then here is FEP as a unifier. So it's less surprising if one considers FEP unites notions that are generally considered antithetical some meaning like contrary to each other, most notably the notion of internal generative model, which is usually associated with representationalist theorem, and autopoeicis, which is usually associated internal representation inactive approaches. So I think just who considers which notions antithetical? Some classic examples area provided here, like To, Helmholtz and Maturana and Area. But just who disagrees and why?

1:08:54 And what can we learn by just hearing different perspectives on some of these debates? And then how is representation related to autopilotis? So autopoetic systems are those that are variable of producing and maintaining themselves by creating their own parts. It's kind of a classic complexity idea and it made me think about poetic naturalism and then all these other proposals like the metapoetic naturalism and stuff. And then there were zero Google hits for autopilotic naturalism.

1:09:32 But I think it's very related to what we spoke about with Majeedni and science as modeling in the world and about, of course, the title of this paper and the representations questions. So this is just a very provocative paragraph that brings a lot of ideas. In Bleu it's also just the middle way, right? Is it this or that or maybe some combination of these two things? Is the right thing the depth perception, as Dean says?

1:10:09 So then one more sort of general comment and then we'll go to the specifics to discuss next time. So this is the FEP as mirror. So one can use the debate on representation in FEP the other way around, not as a way to resolve the issue at stake, but as a mirror to look at one's own implicit notions of representation. So here's a paper that I wrote with my colleague Eirik Sovik in 2019, where we talked about scientific theories for consciousness. And so instead of using a model of consciousness for granted, like integrated information theory or some other quantitative measure of consciousness, we took the system as the recognition, which
was an ant colony, and then reflected back on different scientific theories of consciousness, what that Majid about, what people value, about, for example, anatomical versus functional linguistic behavior, components of systems.

1:11:09 And so we talked about like forward tests, where you're good with your tests, you've got a calibrated instrument. And so this is like what the bulk of the literature review was in the first half of this paper, which was like, we're just going to go with the FEP as what our framework is, and then we're going to assess there's still a diversity of perspectives on representation, even if you think the FEP is totally the Goto theory. So this does not mean that you eliminate ambiguity. It just means that you're using your tool in a deployment oriented way versus the reverse test, which is like taking things that are known in the world or some sort of internal preference data and then shining it back as a mirror on the test and comparing amongst tests, which also does, of course, recurs because it's a test being applied to do so. But that's where the real revolutionary science happens.

1:12:09 And so this paper by Pezzulo and Sims showed both modes in total harmony. And so I think it's an awesome contribution from velocity of science perspective. So I look forward to talking about that and about Ford and reverse tests. And then here's a bunch of other stuff. What are you excited about here?

1:12:33 Bleu:
Bleu this is just stuff I wrote down to talk about, like cell. I was just taking notes while we were talking today about what might be cool to discuss in the one and two a lot about the sensory motor loop,

mental engagement, mental action. Does. That trigger the same kind of biological response as an actual action, and then the idea of thinking through other minds versus multiscale integration, what might be similar or different there, and the independent evidence of the FEP? Or is it just a mere we hold up?

1:13:07 Maybe for ourselves, but I think that this paper was provocative and great. I have been a big fan of Tesla for a long time. More recently a Matt Sims fan, but probably I've been reading Pazilla's papers for ten years and excited to have the chance to really dissect a paper by him with more than just myself. Great. Well, glue.

1:13:31 Daniel:
Thanks a ton for the awesome work on the dot zero. I think we were trepidacious to jump into this paper, but then you were prediction no problem. I got it. I'm processing it's. True.

1:13:48 Bleu:
That's easy. Yeah, we got it. One week, sure. Three days for double zero. We got it.

1:13:53 We're good. I read a long time ago also. Yes. We just hope that anyone who wants to ask a question can. Even if it's long past the one two.

1:14:04 Daniel:
If you're listening to this in time, then congrats. And you should definitely get involved conversation and otherwise we'll see you around the lab. So thanks again, Bleu, and thanks everybody, for watching. See you later. Thanks.

1:14:17 Bleu:
Bye.

Session 036.1. January 19, 2022

https://www.youtube.com/watch?v=YKn2njZ_ICg

First participatory group discussion on the 2021 paper by Matt Sims & Giovanni Pezzulo, "Modelling ourselves: what the free energy principle reveals about our implicit notions of representation."

SPEAKERS

Daniel Friedman, Bleu Knight, Dean Tickles.

CONTENTS

TRANSCRIPT

00:21 Daniel:
That was just Blue's entry music. Hello and welcome, everyone, to ActInf Lab livestream number 00:36 one. It's January 19, 2022. Welcome to the ActInf lab. We are a partner participatory online lab that is communicating, learning, and practicing applied Active Inference Lab.

00:43 You can find us at the links here on this slide. This is a recorded and an archived livestream, so please provide us with feedback so that we can improve our work. All backgrounds and perspectives are welcome and will be following good video etiquette. For live streams. You can check Active Inference Lab.org to learn about how to participate in any active lab events which go beyond but also support the live streams.

01:08 And also the Coda site at the bottom will give you access to the table with metadata on the past and ActInf Livestream. All right, today in Active stream number 36 one, we're going to be discussing and learning and seeing who joins for the paper. Modeling ourselves. What the Free Energy Principle reveals about our implicit notions of representation by Sims and Pazulo. 2021 we went over some of the background in 360, and today we're just going to introduce ourselves, say hello, what we were excited about in the paper.

01:48 And then we wrote down some things to discuss. But I'm sure both of you have other random things you wrote down. And anything that people write in a live chat, we can also look at. So I'm Daniel. I'm a researcher in California, and I think I'm excited to just hear Dean's marginal comments and just see where it goes, because there's just a lot in this paper and so it'll be a thick one. Dean?

02:22 Dean:
Well, I'm Dean. I'm here in Calgary, and I really didn't know if I even had time to even look at this paper. And then I listened in on Daniel and Blue's conversation in the zero, and it piqued my interest. And so I read the paper and I was really happy to read this paper because where Daniel and Bleu kind of took a path to introducing the material, this is kind of familiar ground, familiar territory for me, which is very unusual because most of the stuff that we look at, I'm looking at it for the first time.

03:05 And so I'm really excited, and I don't want to detour anything that you guys want to sort of look at. At the .1, maybe at the .2 point of this process, we can look at section five of this paper. What can we learn from this debate? Because I think that section five of this is super interesting and not just trippy. You guys use the word trippy, which I thought was fantastic, quite a good description.

03:32 But I think we can pull parts of this out and look at them and reassert them and reattach them in our own way and actually come up with something pretty amazing. I'll pass it down to Bleu.

03:49 Bleu:
Hi, everyone. I'm Bleu. I'm a researcher in New Mexico. And this paper was great. Like Dean was saying, it was familiar to me, but not because of my background.

04:02 I thought it really explained and summarized a lot of like different points in the FEP active Inference lab and how we use it to model ourselves. And it pulled out a lot of really important questions, I think, that I'm looking forward to discussing with you guys.

04:29 Daniel:
So we wrote down some things to discuss, but maybe let's start with just a blank slate. Dean, what do you think would be some approaches that we can take or some starting points because we already have other cards up our sleeve. Cell. I don't want to be a guy holding up the flag and detouring your conversation. One of the things we might get to near closer to the end, hopefully, is the authors speak to the possibility of, you know, when you set up your table.

05:06 Dean:
Daniel, one of the things that they potentially talked about in the section five of the paper is the idea that the lines are a little bit fuzzy here, maybe they're broken. And the idea of, in some cases our ability to move from internal representation into the representational. It's kind of a big deal because you can have the debate that says here's the parts that would align with a non representational view and here's the parts that would align with a representational view. But then they insert this part that says but maybe we slip into and out action action action action action, action oriented representation into and out of the cue density. And so maybe at near closer to the end today, we can tap into that a bit.

05:57 Daniel:
Let's start with that grid. Yeah, because this is the structure of the paper and the elucidating contribution. And also I think Dave left to YouTube comment or something like there's other dimension. So this is kind of pointing away towards an interesting approach to making sense of some philosophical debates, kind of laying them out in tables like this. So how should we approach it?

06:32 There's the representational and the nonrepresentational perspectives or stances or modes or archetypes that is definitely very blurry because of course it depends on what you mean by representation and that can have some fundamental ambiguity and then that representational versus not continuum or dialectic is then separated into a few domain. I think we could talk about what are the similarities and differences because some of it was a little nuanced and I wondered if there was other categories or they were organizational, structural, content related and functional. So then this is your game board of eight lower dimensional projections that the thought can be in. Or it's something like one of these eight octants. And then a lot of the papers going through some of the literature and rhetoric for and against each of these, using the FEP as kind of the interpret what is being interpreted to speak for one of those eight cells.

07:53 Whether either of you want to continue it there. Well, on the Action D, Maisto that sensory motor stuff and yelly, bloomberg talks a good argument around the idea that, for example, I could be in a flow state and there is no model or plan that I'm necessarily following. And that's true if we're talking about extension and embedded as two of those four Es, you don't necessarily have to move to that place that requires something to work off of. You could just be flowing and working in something, right? That rate of change is you extended.

08:41 Dean:
So there are times when you've you literally don't have to be working off of a plan. You could also be moving from a blueprint to some kind of outcome that you want to achieve. And then it's pretty obvious then that the representational piece has to exist. So maybe the argument isn't that both aren't at work. It's how we cognition from a density out of a density and then back into a density, something to at least have a conversation about.

09:24 Because I think Bleu was touching on this last time too. She said, I just want somebody to be able to show me how these lines are in this sort of structured relationship exist. When I heard her say that, I was kind of like, no, I think that's a fair question because those lines seem to be blurred.

09:49 Bleu:
So something that came up yesterday is the idea of free will. And I just wonder how that might play into these different grid boxes. Is there free will in all of these or in none of them? Or is that even relative?

10:17 Daniel:
Okay, let's write it down.

10:24 One interesting thing about this is it has a little bit of that visual illusion with the black grid and the white dots at the junctions. So it's kind of a interoceptive artifact just sort of messing with our visual representation. And the visual representations are when you see it, you believe it that kind of focus system in a lot of the active literature and vision. Okay, so let's save free will and the blurriness for later and then come to some of the things we wrote down for the previous list.

11:13 Okay, so in what sense can or are computational models or any other kind of models be fully observable?

11:28 Dean:
Can I give maybe a possible real life example that maybe speak starts to speak to that? Sure. Okay, so in the paper, the authors say, however, these differences matter if one considers structural aspects and the degree of resemblance between hidden variables and environmental dynamics. So I was thinking about your question, and so I wrote this down. If dynamics, then the material I e, the content, the structure, and the organization is going to have a different change rate than the function.

12:05 So the first three columns are going to behave differently than the fourth. For example, the screwdriver as tool remains very stable, hopefully relative to the spiral effect or function that it can generate on the screw to the one driving the screw. There are now two rates to juggle the assumptions that the tool applying the function as a rule is stable and consistent and the effect sought will be a form change, meaning action orientation, where a new representation outcome happens. You quite literally start an end with a dance between the stabilities and the dynamics leveraging off of each other. So back and forth.

12:52 So we need to keep open the possibility that the stable or the representational and the dynamic, which as Cell points out, can be nonrepresentational as well, are both in play. And then I wrote here because I've used the expression when in doubt, zoom in, zoom out. When Markov blanket zoom in, zoom out. So in terms of the computation, there's actually two computations. One around what we think should remain relatively consistent and one which we then apply that consistency to something that we actually want to see a rate change expedited.

13:37 So there's actually I think there's two calculations here to the person that's trying to figure out how they're going to see what's on the other side of the blanket.

13:56 Daniel:
Very interesting. Lorenzo Laje.

14:07
Bleu:
I like this idea of zooming in and out with a markup blanket and I think it speaks to the way that agent are nested or anything is nested. I don't want to necessarily ascribe agency or free will to different levels of organization, but I think when Markov blanket zoom in different Markov blankets, zoom out different Markov blanket. So for me it speaks to multi scale systems and how applying markup blankets is kind of scale friendly or imputed onto the system in question.

14:53 Daniel:
One extension or maybe example of that, we've probably talked before, like the table, it's in the process biology, it's material that's tabling, but then that Attial is also process based. So sort of this multiscale process ontology and the identification of a given system of interest. At stationarity like an object that can be tracked, but there's objects that are too fast to be tracked and there's objects that are too slow to be tracked below the just noticeable difference. And so within a given measurement or active inference regime, a given entity can have attention on a given system of interest. It can't have attention on things that are slower or faster, like out of its frequency band.

15:42 But that's discarding 99% of the system to not consider outside of the frequency bands. It's like the observables are just one, they're very boundary and so the slower things are, the larger things and the faster things are, the smaller things. So that's kind of a nice.

16:09 Bleu:
And. Let me just piggyback on that. And if we're talking about specificity or scale friendly versus cosmic and scale free, that's also part of that zoom in, zoom out exercise because there are quite literally elements of this that are still scale free. Again, as they said, modeling ourselves. We can start from that position of scale free and then find the specifics, or we can find the specifics and ask ourselves how far out can we

extend our confidence that the stability will hold?

16:55 Dean:
So that's, again, piggyback on what you just said, Daniel. There are all kinds of ways of interpretation zoom in and zoom out. And I think that's maybe that's one of the insights that we get when we don't get ourselves hung up on being a really radical enactivism. Even though I'm of the camp that says we start out internal representation, an activity leaning side, and then the plans and the representations and the effects of that are representational. All right, I'll think of an example that a wet lab example.

17:37 Daniel:
So I'm thinking of doing PCR or a wet lab technique where you're not observing perhaps the outcomes of what's happening for multiple steps. And even then it might be a color change or a number on a screen. And so then you get limited observables. Those are sometimes your degrees of manipulation, like in a thermocycler that's changing the temperature. The only thing you're measuring during the reaction is the temperature.

18:03 Sometimes you might also look at like the optical property, but usually just changing the temperature. And then it's very representation like to have a mental or cognitive representation, which can include extended phenotype like the notebook and the computer. But that's pretty representational to have counterfactuals about what molecules would do that have never been visually observed. And so science becomes representational. And I think how far does that reach back?

18:43 And it kind of blurs off into increasingly internal representation forms. Not saying that science is the most representational thing, but what are the most representational things? Back and forth on that is what I'm seeing with the 2ft in, 2ft out. But you just hit on a really important point because you said science becomes so what makes up the becomes like, what exists in that space prior to it us all agreeing that it's now science. And I think that's what this I think that's what this modeling as opposed to us as model asks us to consider.

19:31 Dean:
You touched on the big deal here, Abductively. So what makes up that? What has to be present for us to be able to say, okay, now you've crossed a threshold and now we're talking science? Yes. It reminds me of the paper of Brunberg anticipating brain is not a scientist.

19:55 Daniel:
And we can just take the always prescient titles and content of these papers to be targeting attention point like is the Markov blanket a valid or useful construct? More recently, but back several years ago, identifying some similarities or at least an area of interaction with the anticipatory and cybernetics of systems, which is pretty system agnostic, can apply to very abstract representations as well as perhaps real systems. And then the physical brain hypotheses and the inactivist and ecological perspectives on cognition with this activity called science and the role of a scientist. And so a few ways to parse science. One is, as we heard from Majid Beni recently with model based science.

21:01 So that's one relevant way that we learned about it and talked about this recently, like science being the application of models, but then other systems are perhaps doing something different. Well, what is science? Anyone in the live chat should definitely respond, what is science? And also, I would like to hear what both of you think and how that relates to anything we're talking about here or ever. So I always think about science as the implication of the scientific method to anything, right?

21:35 Bleu:
So observations, hypothesis, experiment, etc. Force. And because I think of science like this, science itself is just a model also, right? So we use science. We build a model of whatever phenomenon it is that we're trying to replicate or observe or test or whatever.

21:59 And we do. We experiment with our model, essentially. So the scientific method itself is a model for doing science, and then the process of doing it is creating a model of the world. So it's like nested models

all the way down in science in my world. So, Bleu, can I ask you a quick question?

22:21 Dean:
What do you think precedes the engagement with what you're describing?

22:30 Because the authors always say assumptions matter. What assumptions do you think goes into a person saying, okay, well, now I'm going to use scientific method? Are there things priors that we should sort of pull out and examine that are consistent when a person gets to a place where they say, okay, I'm going to do that? Yeah. So there's a lot of stuff that's in the scientific method.

23:00 Bleu:
When I say the scientific method, it encompasses things like scientific bias and positive control and a negative control. And so all of these things are kind of this in this umbrella category. When I say scientific method and experimental design is not always simple, but definitely what precedes any science happening is simply observation. You have to be observant and to have conversation. You have to have some instrument with which to measure or gauge the phenomena which you're trying to examine, right, even if it's just your brain, which is probably the most powerful instrument of all of the instruments, because it's fundamental to any testable instrument that tests anything in the world like that.

23:57 So that's a lot of priors, I think. So is it fair to say then, that to get to a place of adopting a scientific method, one might first possess before they can actually get into the formalities of that, a field seeking curiosity and a way finding bias? And those are two different things, right? One is, I can be a spectator. The other one is, I've got to get in the boat.

24:31 Dean:
I've got to get my skin in the game. Do you think that those two things are necessary to adopt scientific method or to commit to scientific method.

24:46 Bleu:
So I'd like for you to unpack those a little bit more. Can you just describe what you mean about, like those two, the way finding and the curiosity? Yeah, the field seeking curiosity. Well, curiosity, I mean, it's kind of got four parts. There's an epistemic piece, there's a sensing piece.

25:09 Dean:
I can't remember what the other two are right off the top of my head. But bottom line is the curiosity, it's not sort of a monolith part of that determination because you don't know, but you're prepared to put in some time and effort to get past. Not knowing means that you can take one of two essential paths you can find out. Right. You can go to a source that already knows where you can figure out based on sort of collecting and curating evidence.

25:51 So that's the field seeking piece wait. What'S the difference between finding out and figuring out? Like, to me those are the same. So like, whether you're collecting evidence from Google or from that's epistemic. Right?

26:05 But to figure out is to not have a source already, not a single source of truth. That would be the difference. So one, you can find a truth source and then either believe it or not. And the other is you have to develop your own truth through it takes a lot more time because you have to go around and gather a whole bunch of other bits of information that aren't necessarily prepackaged for you. Does that make sense?

26:40 Bleu:
Yes. And also, like, what is truth? Right? I mean, you ultimately have to be the one that decides that, right? Whether to trust and have confidence in something or not.

26:53 Dean:
Cool. Lots of really go for it. No. Go ahead, Daniel. So let's pull one level back or two from one and a half fractal dimension.

27:07 Daniel:
From the curiosity fourfold distinction, there was like the personal factors. So the question was what precedes the type of engagement that might be called scientific? And there's some personal factors that are basically psychodynamic or like situational behavioral archetypes, but there are things about individual people, humans.
What other kind of factors, even if the individual is the nexus of agency, what other factors come into play? And like, what precedes the kind of engagement that might be called scientific?

27:39 If the person is our system of interest, how do we zoom in and out from there?

27:46 Dean:
Cell that's my question. My question isn't I don't have an answer necessarily, but what I leave it to before the big bang kind of thinking, we don't know. But is it possible that there actually is something that we can put our finger on that leads someone to have confidence in a scientific method and not just sort of remain kind of in a place of stasis and not be curious? Right? Because there's lots and lots of people who are kind of quite comfortable just going along with whatever is happening around them but then there's others that appear to have a potential for a deeper commitment.

28:31 So for example when we were talking prior to magic coming with us on with us, Bleu raised the specter that genes don't necessarily have to have time in order to be considered prediction matter expertise because it has both the cause and the effect included in the structure. So that got me curious, right? For some people just making that statement or asking that question blow right by them, they wouldn't even give it a second thought. But then for some people just making that claim arrests them, slows them down and gets them asking questions on their own. Now so that's why I'm asking this in the context of so why would somebody now go from I don't care, I don't give a rats backside about science to I'm very passionate about science and I'm very interested in learning this method.

29:38 Bleu:
So I think science really is seen by many as a kind of truth finding endeavor because whether it's through mining previous knowledge or generating new information, maybe knowledge, either one of those is definitely like a speaking of the truth. And in that way aren't we all just looking to minimize our uncertainty, reduce our uncertainty? So I look at science, it is an uncertainty reduction task. I mean that's the point of it perhaps. So I don't know what factors other than the fact that maybe we're in a simulation like we could go there because that would precede the scientific endeavors that we undertake in our truth finding efforts.

30:41 But really the knowledge of science as a way to determine truth I think might be part of it and maybe not everyone has taught that I think about like, you know, in western culture we're all like indoctrinated with the scientific method from I don't know, fourth grade on or something like that, right, indoctrination.

31:06 Daniel:
And then they give you the PhD at the end when you're fully indoctrinated. But here's the thing Bleu and this is but you bring up a really cool point in fourth grade indoctrination. And I think one of the things you and I have kind of gone revolving back and forth is so, yes, science. And so somebody has said this has got some practical things and some truth finding things. But I've always come back with great science plan.

31:35 Dean:
These are material things. My question has always been when? And you bring up the well we've decided when it's grade four but I'm not sure that someone who's graph four least me see that'd be about 910 years of age. It's the same sciences for somebody who's 29 30 or 39 40, right. So we can save clients now but what I'm suggesting is that before the plan or the science there's something before that some really important things that we're just assuming or willfully ignoring because now we're onto the plan, right?

32:19 Because that's what has been reified and given the holy blessing sort of thing. So I think you're hitting something that's critical and it's why I'm disagreeing with you. So I don't think that the science that you're doing when you're nine is that different from the science that you're doing when you're 39. And the

perfect example of that is Feynman I was reading I don't remember, maybe it's in the meaning of it all, like, maybe it's in that book, but he talks about how, like, for him, he just plays, right? And so a lot of his science is like, oh, I get to make this toy and play with it and try to look at it.

32:59 Bleu:
And I keep playing with it and I keep playing with it. And so this is something, I think, that's innate in us to just the figuring out part, like the truth finding part. So even as a baby, like, from the time you can sit up, like, what is this block? Like, what is this shape, what is this flinky? Right?

33:15 It's finding out and figuring out what are the affordance of the objects. Some of them are imposed by the outside. Like, don't stand on the chair because kids will use chairs as tents and step tools. Some of it we impose some structure on. You can't use this toy in that way, but really, like, kids will they don't know they'll use anything anyway.

33:40 Like they do all kinds of crazy things, like they'll slide down a mountain on a trash bag or something, right? So they don't know what the limits are and so they'll explore new limits. And I think that scientists, at least the ones that really leave to do science, play a lot also. So, again, the trial and error piece can be like the triangles piece. It can be scale free.

34:12 Dean:
And I would never push back on that piece. The Epistemic and the specific is what you just described. The other two parts of curiosity are the distributed and the sensing. And that's kind of the sort of the more active part where you have to kind of go out and do the skin in the game. You have to get in, get in the boat across the South Pacific.

34:35 You can be doing the epistemic, value the specific as well because you can be taking samples, but you can kind of see that there's another side to this. So my question around the when isn't around the ability to see the scale free part of it. My question is, if I'm a ten year old and there's something before the plan, how sophisticated is that something relative to the something before the plan? As a 40 year old, I just don't think that the experiences that a ten year old has and the resources that they necessarily draw upon are the same. So I do think there's also a specific and a scale friendly part to this.

35:25 Would you push back on that?

35:31 Bleu:
I mean, I think that we all kind of just operate on whatever level. I do agree that the knowledge of a ten year old isn't the same as the knowledge of a 40 year old, but I think we just operate at whatever level that we're at. Similarly, like a baby, you know, like they're just doing their own kind of truth finding. But so the process is the same. Like even though a priori may differ, I think the process is similar.

35:58 Daniel:
This reminds me of indeed linguistics guest stream with Elliott Murphy, how there's the view of language as the construct, like subject, verb, object, and then there's the language as learned by each learner. And so I'm almost hearing like Bleu saying it's the same process. Everyone's on the same trip, but of course recognizes that each learner is going to have individual factors, including like, what they specifically know maybe has some correlations or whatever with age or with other features. And then that's I feel like maybe partially reflected with the specific of the curiosity is the nine year old and a four year old learning the same science. It's either like pansy's or unisollopism scientism.

36:52 Everybody's in their own scientific niche. And so it's just a million different granules. And then the other hand, the other end of that extreme debate would be it's all one integrated, extended cognitive process, which I wrote some notes on. So Dean go for that and then we'll think about it as more of an extended continuum process. Yeah, and again, I'm not trying to I don't want to sort of shoehorn something in here.

37:20 Dean:

So I would always hear from people in my history the expression, well, I know that's a problem there. I guess you're just going to have to get creative. You're going to have to think outside the box. And being the insurgent and the non compliant person that I am, I would say I would come back with and I was reporting to people I would come back with, so tell me about this box. What makes up the box, what makes up the process?

37:51 And of course, that didn't make me very popular because nobody could get specific about what's inside or what makes up that three dimension space. And I think it's the same thing with we can say, well, there's a process. Well, tell me then why a ten year old thinks in the same way as a 40 year old Dutch. What evidence? What are you hooking that assumption on?

38:23 And again, I'm I'm not, not trying to be a pill here. I'm really curious. What would make a ten year old think the same way as somebody with an additional 30 years of experience? They want uncertainty reduction. That's a generalization that I can agree with.

38:44 But what about the specifics? I'll give a specific in general. I think that for disciplinary education, some of the questions might be very. Similar. Like why is this leaving group superior to that one in organic chemistry?

38:58 Daniel:
I think if somebody were very precocious in ten and learning about the halodes as leaving groups or if they were learning about it in adult education, they would ask that question and then once they got the answer, they would have moved on in their learning in that disciplinary finding out way. Like here's the periodic table, here's why the trend is this way. So that's not the whole of education, but in that mode which many of us have come from and exist within, that was the education, that's educational instruction. So that's the instructionism component and then I think it becomes different as you move away from that spotlight. So then a few other
comments about the specifics of how the different age would be different.

39:50 There's the biology of how the individuals would be different, like in some of their cognitive features, whatever it meant for that person, from working memory to the specific long term memories and other capabilities, they have perspectives they've learned about.

40:12 They're a different, complex system, but they can be a complimentary part of the system. Like older people providing mentorship for younger people. But I think that's what kind of comes to some of these notes on science as an extended cognitive phenomena, which is partly what has been got at. So science has many different possible goals and sometimes scientists in an ad hoc way will appeal to different components. Like science is correct because there's technology, like it's demonstrable or it's useful, not always providing a Bull hypothesis for what we would have if we had done something different.

40:53 But there are all kinds of different ways to look at it. But it deals with individual cognition features and learning in action in their niche. But it also refers to broader phenomena. Like maybe a differentiating question is can one person on an island by themselves do science? And if the answer is like yes, they could explore a hypothesis test, then that's one perspective.

41:19 Another perspective would be you're only doing science when you're using this interpretation of the scientific method and you're using science as a body of knowledge, like you're using the literature with the dos. And some people go as far to say that you need to have a career in a certain specific institution or a specific degree or a specific training or approach. So that is clearly not applicable to the one person on the island. And not that one of them is better, but that whole apparatus, that's part of the extended niche. And then also there's at least in our case, the emphasis on the digital or at least informational stigma g.

42:00 There's a cognition in science in a different way than there's many books you could read on tying knots, probably a lot of YouTube channels. Is there a DOI for information on knots? Probably not, but that in science is a big emphasis. Reading and writing the literature, at least in the way that we know it today. But again, that could also perhaps not be as much of a core component anyway, just like if you point it maybe

now we'll bring it back to this paper.

42:35 But science is kind of the representational paradigm and I think Dean's question is getting at what is before? What's the before and the after or the subconscious or the submerged of science. And when we're talking about that representational piece and when we're talking about science, we typically talk in terms of isms what is where is how is when we set up our hypothesis. And I think, what this paper if we're bringing it back to the paper, I think what section five of the paper speaks to, especially when we're talking about the functional dimension, is the if, the counterfactual, and how they talk in there about how I'm not sure if it was Clark or Hohwy or one of them talks about the fact that so a bacteria doesn't typically ask the question what if?

43:32 Dean:
When it's sampling its environment. So that's pretty science. Yes. And I think that relates a lot to Martin Boots's guest stream, I think twelve on the event based cognition and how if there is an event based structure to cognitive events then for any given parameter in that model it can be otherwise you could say like the ball is rolling off a table. The ball is not rolling off the table, the cup is rolling off the table.

44:04 Daniel:
Like you can start to just do single mutations, especially the important counterfactuals for linguistic structures. And then that might be closer to what we've seen discussed in other Sims papers as the adaptive active inference agent. Going back to earlier paper citing that but just that was our previous discussion with Sims. This paper has sims, like the pendulum, does not have a counterfactuals about whether it could go on a different axis. It's mechanically constrained whereas cognitive structures can engage in counterfactuals play in a way that the pinball machine can't.

44:51 Even if the pinball machine has chaotic or other types of seemingly agency behavior.

45:02 Dean:
In that space, I can be at the top of the ski hill prior to a gradient descent and I can be adaptive, meaning I can close my eyes and do a visualization. And I can also be variational, meaning that I can try to recreate through my interoceptive sensors a sensation of floating pre, pushing off and engaging with that process. Right. So again, the win of this, I think is something that really matters. I think we gloss over it or we don't even pay any attention to it typically because we want to get to in the paper it's figure two.

45:46 We want to get to figure two. But I think before there was a figure two, before there was a plan or a representation, we might want to ask when plan if I'm engaging in counterfactual inference prior then doesn't everything in the diagram depend on prospecting up the nodes in that representation? All right, do I not have to provision up a format that will be potentially something that others can comprehend as now organized? And don't I have to propose alternative paths? As Ines, like, all of those things are pre planned, all of those things have to be present prescience.

46:36 So we can say, well, I'm not paying attention to that now because I'm busy putting processing something that I can now transfer to other readers and viewers of this diagram. But I think to ignore those things is to ignore the difference between a ten year old doing a science experiment and a 40 year old doing a science experiment. Let me give one thought on that. It actually speaks to this question of whether science is the same for everybody or different for everybody. Is this the board exactly as laid out that everybody has to play by that's like the game of life, the board game, not the cellular automata simulator, but the board game.

47:25 Daniel:
There's one path or there's limited points of agency and then everybody on the board on that layer, one is moving through life on the same or on a constrained set of trajectories. So it's like are these the immutable railroads of decision making and thought? Or might other people have different connections or different decisions or totally different railroad stops or different dimension or just represented in a different format? Is it like, well, here are the battle lines that are always going to be the case for philosophy and there's going to be some people whose situation and neurodiversity leads them to be on this side or this quadrant or

emphasize this component, the regime of attention? Or is even that layer shifting because there isn't any stability to be found in counterfactuals?

48:26 Dean:
There you go.

48:30 Daniel:
Back to the questions.

48:37 It was a great early point about the rates of change being different because also that does at least talking about rates of change kind of evoke numbers gets the scientists excited because could there be like a number? Could there be a sentiment score? Or could it be like, this sentence is totally consistent with both, or it's inconsistent with this? Could we annotate the literature and measure or do surveys or actually measure those rates of change in individuals on their learning trajectory or in fields? How could it go from just being a really insightful philosophy paper with a lot of scholarship into being something where we can use some numbers or something?

49:23 Dean:
So I see the first three columns, organization, structure and content as the more stable. I think you had another diagram where you were showing that going out over longer periods of time, right? So which one do you think is the most rapidly changing function?

49:48 Daniel:
Okay, so let's kind of recap them. So organizational seems to be related to the encapsulation the organization like brain architectures features of the world such that the representation is separated from what is represented. So like you could have representation of the sun but then that's very far physically from the sun. The structural aspect is related to representational vehicles toot toot that are structurally similar to the state of affairs in the world they stand for. So that is the abstract structure of the representation having some congruence or isomorphism or similarity to what is being represented.

50:37 This one is super dependent on the definition of representation because someone go well, you can't represent a car in your head because your head is not a car.

50:47 Content related having internal model models that either encode environmental contingencies or sensory motor contingencies, specification or description of how the world is taken to be turned analyzed in terms of correctness or truth. So that seems to be more consistent with the car content. You know, it's like the YouTube content, the car content can be represented if it stands for something. The content of that message was an invitation to the birthday party. So that is related to the information like the memetics, especially in an actionable way and then the functional role.

51:33 This is where we're going to highlight and hopefully Dean, I want to hear a little more about why this one is different. Supports vicarious use before or in the absence of external events, internal variables of model that was discussed in the paper a lot in the context of sensory motor detachment and there have been some blurry lines down there for sure, like motor replay and preplay. So we know that it is on the spectrum of existing that neural dynamics but cognitive dynamics involved during are involved echoes or anticipations
of them are involved in the before and in the after as well as counterfactuals before and after. So what is happening with internal representation and then maybe how does it relate to active and FEP? Yeah, so I know enough about dreams and subconsciousness just us to get me into trouble.

52:28 Dean:
But the first three when we reorganize through our dreaming and whatever those representations are or internal representation spending on your wish, those are all backwards looking typically and then the functional that's what segregates it out is it's forward and backwards. So that's to me a huge differentiator right there in terms of how much or how long we expect something to stabilize versus how much we want to act on something and generate that change or outcome that we're seeking. That's why I get back to that

search field being different than a framework.

53:24 Daniel:
Okay, it's a lot to think about but it's interesting. The organizational maybe there's some dissenting view from this but this is related to how the system is arranged. So this one can be thought to be slowly changing because we're talking about things which means we're talking something that has persistence and so the organizational aspects of systems tend to be the slowest changing perhaps like the organization of the servers changes on a very slow timescale relative to the processor. Then the structural aspect also it's very important that it has persistent like storing a variable in memory. Like you want things to stand for each other for a long time.

54:13 You kant the DOI to be a representation of that paper for a long time. Those are also related to like it's sort of the functional side of organization like form and function a little bit. But I know function is used later. So not to confuse the term function, but this is related to some of the performative aspects of organization and infrastructure and architecture. So that's also like you don't want the screwdriver to be a different thing in your hands that's too slow.

54:44 But maybe it'd be cool if you could modify or tweak the tool or like, you know, unscrew it and bolt something in a little slower to make it different. But usually you don't want to change too fast then.

54:56 But what about the content related? This seems to be also changing somewhat faster because environmental or sensory motor contingencies that seems like that could change on the fly and then I agree that the functional role as defined here like vicarious detachment, including counterfactual and self modeling counterfactuals, this is like some of the most rapidly mutating. But what do you think about content also changing fast? Well, I think whenever image a mistake and I accidentally hit the Deneve button on my notes, how upset I get because the stability of the content is lost. So I actually see it is still relatively stable as opposed to something that's changing rapidly.

55:51 So these four columns here, there is a different temporal aspect which relates to what you asked earlier about when representation. So instead of the possessive do organisms have representations or the identitarian action, action oriented representation, the definitional, what are representations? This is the temporal or the dynamical when our representations well, that's not complete. You have to say what it is. You can't just say when it is well, couldn't you just flip the words?

56:30 Wouldn't it be just the other person's perspective? You can't talk about is without when, so why is that one okay? Why are there papers about what is a representation? What is it like to be a bat rather than when is it like. I don't think it has to be or I think it's both.

56:50 Dean:
The other thing that I think we need to maybe think about is the first three tend to be on a continuum that's orthogonal to the fourth. I can organize, I can structure and I can content build. Function now is orthogonal stat I will because it's going it's used before. So again, back to that temporal aspect, it's both. And I wouldn't drop any of the four columns.

57:27 I'm just saying that I think that the fourth column is maybe on a Y axis relative to the first three that are on the X plane. Okay, a few notes here. So before or in the absence of right now, isn't it the case that usually anticipation entails something being both before and in the absence of I wonder what it will be like when my friend comes over. That's in the absence of the event and it's a counterfactuals before, but it may happen. It's a prediction, it's an expectation and maybe even active inference lab.

58:02 Daniel:
It's a preference. So I agree, like even the way that the authors have written it, these are related to architectural and performative features of like basically functional or structural definitions of representations, what they are, what they do. And then this is even uses temporal words as well as counterfactual words, though and those are probably like used elsewhere in the paper. But that's a very interesting distinctions. And so it's like there's our map, but how easy is it to just lay out the map and go, all

right, here's Northern California, here's a map instead of the temporal aspect.

58:44 And I think that also shines a light actually on another feature of what people would call science, which is like science the metric system. And then, okay, you've gone too far with the metric dime, but then pretty much on a lot of the other fronts, except in the United States, the metric system has hold as how people are sense making in terms of like distance and time and other units and that's chronos like chronology and time in the decimal time. And then kyros is like the timeliness and there's other ways to think about time. So we kind of open it up and it just makes me wonder, okay, what else is handed with the map? Is there a time object?

59:28 How do we share time along with the map? Is that attention is focus times, time Ines all these other things? So how do we convey the temporal aspect instead of just this gene regulatory network or this is the map here or the map and the math and the territory, how do we bring the temporal along?

59:55 Bleu:
I wonder about the temporal also and especially now that we're kind of delving into like quantum aspects because the simultaneous existence of more than one state right, is possible. And so is it possible to be like building and executing your model at the same time? Is it input then output? Is it always sequential or is there some kind of like simultaneous happening that's going on there? I don't know.

1:00:36 Dean:
Oh, Bleu. That's perfect. For the next question I wanted to ask. So is one of the assumptions here that there's a continuum, like if then between I can and I will, because this was a debate that I got into with people forever when I was in education, that there's some sort of an assumption that because I can, therefore I will. Well, I wouldn't jump off a cliff even with a parachute on.

1:01:02 There's no will for me to do that because that's just not my jam. But orthogonally speaking, if organization is on the X and structural is on the X and content is on the X, but functional is on the Y, now I can separate the two things out. And as you said, if I go back to the quantum level now, I'm predecision branched in that diagram, do you notice that the diagram is basically unidirectional? It's always heading to a particular outcome. It's always I can make this decision branch moment, therefore I will arrive at representational or nonrepresentational and I'm with you.

1:01:50 I'm not so sure that previous to this that it isn't bidirectional, it isn't function, it isn't orthogonal. I think it could be all three of those things.

1:02:03 Daniel:
Hello. Would you like to say anything or can I? All right. Two points I would be remiss not to make. First, the Tetrahedron and fuller synergetics gives us a mnemonic to have four spatial dimensions.

1:02:16 So this four column scheme, all of them can be four intersecting spatial dimensions. They're coordinated at 60 degrees, not 90 degrees. And then the second point is like this onedirectional maze reminded me a lot of the way that people study decision making and path finding or figuring, whichever 1 may be in ants, which is there some laboratory maze, like a Y maze or T maze or maybe some branch on a tree in nature. And then for the purposes of the science, so called the paper, it's going to be like we counted them as going down a certain branch, making a decision at the node when they went 5 branch point and didn't return. So it's like this is the line that you trip when it goes from zero to one on that number.

1:03:08 And that's what gets fed into the scientific process and the method and observations of the literature and the statistics and all of that. But then if you're watching the ant or if you look at the video, maybe they dwell at the node or they turn around or they walk down one and then they come back. Or like even they go far down one and they come back. So it is very interesting and it's a subtle graphical point, but one that would be almost seen as like, what do you mean? How could these be undirected edges?

1:03:37 Well, what if we say, hey, let's start at representational FEP, it's just where we're going to start today, and then let's pull back to the vicarious use of variables. Now where can we go from there to sensory

motor detachment? Or we can take no and all of a sudden we're a internal representation FEP because they're only one step away, because they're both outcomes of the decision about the vicarious use of variables. So I hope those are some interesting points and I think that relates a lot to the discussions that we've been having in.edu about cyclic curriculum. And you touched on it I'm going to just bring it I'm gain to reduce it.

1:04:17 Dean:
Not
over reduce it. I'm going to reduce it. To your point, Daniel, there can be a yes, there can be a no, and there can be a maybe. The maybe part is what's being left to out of this. Cool.

1:04:32 Daniel:
I'll read a comment from Serval in the chat, who I was also thinking of when we talked about like, science as a human phenomena and all of that. I think she'll have a lot to say on that. Serval wrote, considering many world hey, Dee, I'm going to read Serval's comment. Considering many world type theories, is it possible that can entails will? It would be a distinctions property, though, not a trajectory property.

1:05:06 Dean:
Okay. I have to think of that in terms of how I set up entailment.

1:05:15 Maybe I'm not trying to duck. I think there will be times when my confidence, through my ability to say that I've done something before, leads me to a lower threshold around will. But then sometimes it doesn't. So I'm not trying to be evasive, but I can think of times when it can entail, and I can also think of times when it very much does not. So will, it's a short English word.

1:05:49 Daniel:
It could refer to something that will happen, like the ball will go to the bottom of the bowl unless anything else stops it from doing that, or it can refer to sort of that motivational ecological energy, which is related to agency. And so it's kind of an interesting congealed word because agency and will are very related. And I'm just trying to think if they're positively related, like, to feel that you have the choice is to have the agency. And that can be seen as willpower. Whereas willpower doesn't come into play in situations where there's no agency.

1:06:32 If you just need to sit in the seat on the airplane, it doesn't require any willpower agency for that action to occur. So I'm just thinking about learning the distributional property, like counterfactuals, do we engage with them as a possible cosmological reality, like in the many world type theories or just cognitive possibilities so they can be engaged with without taking on like a cosmological meaning? And then what does that mean about RN equals one trajectory, the specifics of our kind of entity in motion, and then the distinctions of perhaps different types of counterfactuals or different kinds of possible stochastic rollouts of the system given really similar starting conditions. And that's where the will can entail. The can.

1:07:33 Dean:
I can start out by asking what if? But I still have to select the can the which if again, at some point we can see a relationship of entailment. But I think as a quantum question, they're orthogonal. Can and will are dot. One leads necessarily to the other.

1:08:02 Bleu:
So just to kind of play on words and loop back around to what I was talking about earlier, can is an affordance. Right. So if you have an affordance, that doesn't mean that you'll use it. Right. And will I will choose or implies that you have some agency.

1:08:23 Right. I choose to not start a fight with a flight attendant while I'm sitting in my seat on the airplane or whatever, because you can do all kinds of things. You get many affordance. And I just wonder how this ties into these representational and non representational aspects of the FEP. Like, really, when I was talking about free will earlier, if interface states are a direct representation of external states, it seems to me like I kind of feel like there's less options there, whereas internal and external states have coupled

dynamics.

1:09:05 That kind of leaves some mystical fluff outside that I can essentially leverage with my own choice or something like that. I mean, I don't know what to call it. Mystical fluff. But it leaves something unfed. Right.

1:09:21 Like there's a coupling. It's like a hidden there's a hidden states there that are only that. That's where I can impose my will cell. I'm going to put that fluff on a pedestal. I'm going to honor the fluff because I do think that there are actual times when the ability not to be captured by our observations is actually an advantage.

1:09:46 Dean:
So mystical meh may be uncertain. Yes. And are there advantages to that at times? Yes. So we can call it fluff, but I think sometimes we don't pay it enough respect.

1:10:04 Daniel:
I think that relates to the cloud of unknowing, which is perhaps a text if somebody wants to go into a more esoteric avenue. But I'd like to return to the figure and ask what either of you thought about figure one. How does that play into this conversation we've been having? Like, what does this entity and action partitioning have to do with science? Is this partitioning unique to active inference or other partitioning as possible?

1:10:36 Does it could it be another way?

1:10:44 Dean:
I think this is a pretty stable representation, and I think it does honor to the scale free aspects of what the free energy principle is pointing to in terms of a statistical pathway.

1:11:05 Daniel:
Yeah. I mean, how many debates and uncertainties could be prevented by saying this is a representation of an entity and having people know what was meant by representation. Right. Because it's like, I made this representation of an entity. I think it does this useful thing.

1:11:26 Those points cannot be false. They're assumptions by a person. And what would be disagreed with that? It's not a representation. Someone would say there's a more useful representation or more good, true, beautiful, simple, but then let's see it and then we can use science to compare representations because that would be okay.

1:11:51 Dean:
Right. And then you said it does honor to the scale free. So the only thing that kind of hints otherwise is the person. And the world kind of gives a scale indicator for this model, but without that iconography, it would be and also adding in perhaps a legend or description of what the edges mean because it does say schematic of reciprocal exchanges. And it uses statistical vocabulary, but it also uses actual, like, ontological vocabulary in the terms of actuators.

1:12:33 Daniel:
So are these the physical things that are doing the actuating, or are they the statistical or informational exchanges? Or is this the representation, the form of a scientist model? So we're only ever talking about scientists using these models so we're only ever talking about that kind of nexus where we're referring to both loosely and so it shouldn't be interpreted as either of them specifically it's just dialogue. There's a lot of ways to interpret what the edges are and they might have similar different labelings and different schemes. But it is statistical, it is quantifiable.

1:13:16 It'S amenable, it's a qualitative topological partitioning that is amenable and beyond to certain quantitative analysis. Like if you can draw it like that, you might be able to do a Bayesian graph and then there's software toolkits and there's implementable algorithms and then there might be some quite interesting guarantees or tendencies with brain architectures. For example, to perform predictive

processing or to have learning anticipation of memory or to engage in control or anticipatory control.

1:13:53 But that's definitely some of the most core iconography that we've seen. I mean, 50% of papers or what cell find out Bleu have the action loop. Because what's a little side hustle of you Bleu got going here?

1:14:14 We're trying to read more papers together and learn about them. Okay, but it's interesting how often this has come up. And sometimes authors draw on the same image, other times they do different. And sometimes the arrows are just the clock, like just a unidirectional flow. Other times there are some bi directional arrows and there are several guest rooms on the more technical aspects there.

1:14:46 But let's return to the general questions. Anyways, anything else to say on figure one, though? Like just on this? Like what is this and how is it? I think it represents better the Pyfixating on the pot fly than it does on the physics model.

1:15:07 Dean:
And so I think it's until somebody, as you said, until somebody comes along with a better representation, one that seems to give us the maximum amount of information that we need versus the maximum that we can handle. I think this is a good rep. Great and very satisfying conclusion.

1:15:33 Bleu:
Sorry I really think that what's not shown in this representation and what I feel like is always left out is the fact that some states are hidden, right? And so where is the hiding here? What is hidden from what in this? And so like the sensory states we don't even know if we perceive I mean we know that we all perceive temperature differently some people I'm cold in this room but many people would be comfortable and some people like. My favorite colors purple.

1:16:08 My daughter's favorite color is yellow. So like we don't perceive things in the same way. And so there's always something hidden from everyone else. And I think that this schematic kind of leaves that out. I've seen the hidden states represented well in other action perception loops, but I think that it's important to recognize what's obvious and what's not.

1:16:35 Daniel:
If I could give one thought there, then Dean. So I think there's two levels of like what are the hidden states from the perspective of the internal states, the system of interest, the external states are hidden states implicitly or explicitly modeled, but they're the ones that are never directly observable. They're only observed through their proxy sensory states and enacted or the transition frequencies are modified through policy selection, through action. So within the model, within the Tetrahedral, the hidden states are relative to the internal states on the other side of the Markov blanket. And then there's like the implicit Tetrahedral, which is like
us modeling this four field partitioning and then everything that's not included as a variable in that statistical model is like implicitly a hidden state.

1:17:26 But then what is that? But then we'd have a different model if it wasn't a hidden states.

1:17:33 Dean:
And the other thing I think is that the vertical line between sensory states and active states, if you tip that 90 degrees, it would look like a blank, even though it has two points on the end of it. And I think that blank is by definition hidden states. It's to be filled in. So I think again, you can fill in the blank or you can leave it blank and say because it's blank, that is by definition hidden. So another related point, thanks for bringing that up, Dean, is there's one edge that's not shown here but has featured very importantly in recent discussions on active and that's the sigma or the mapping function from number 26 and number 32, a mapping function of internal states to external states.

1:18:29 Daniel:
Now look at Axel Constant and Yellow Bernard's work to think about how the niche is also doing like anticipatory modeling of the individual. So the other way, but let's just focus on the entity and its mapping to

external states. It's predicting external states or at least acting as if, or can be modeled as if. So there is an edge there that we've seen in modern work, it's not drawn here, which actually might suggest either the inheritance of a legacy graphical pattern or some preferences or conclusions about what these edges do represent, again, even though they're unlabeled. So that's one edge that we've been hearing more about.

1:19:09 And then I think another edge that Dean just highlighted is this one directly between sensory and active states. And again, the clock flow doesn't have this, the one that's just internal action, external sense, that doesn't have the sense action bridge. And it depends a lot on what these things mean. But it'd be cool to understand what is meant by the backwards connections as well as by the vertical connections. And why are there not backwards connections between action and internal and sensory and external?

1:19:51 It's like it's really a four by four matrix with some connections. And that's how we've seen it represented as the sparse connectivity matrix in number 32. And thinking about the way that we model complex systems and generate approximations that sometimes can also retain some other features, like the highly optimistic exponent. So some thoughts there, Bleu. So we've definitely seen internal states and sensory states like that reciprocality happen, but I always wonder why, especially since we did the mental action paper, how action states don't influence internal states.

1:20:34 Bleu:
And so for me, when you take action, like when you practice playing the piano, that affects your internal states totally, not just through external states or even mental action like where you're doing nothing with external states, it's entirely internal. And so I always wonder why that action and internal is there, but I less so wonder why there's not a reciprocal loop between external states and sensory states. Like I never want the sensory states to go back to the external states. For me, that doesn't make sense. And maybe you guys have an example where it does make sense, but I always want the action and internal states to loop together to have it bi directional.

1:21:19 Daniel:
Here's one possibility on the sense back to external, but it depends of course, on a specific interpretation of those. A photon. Let's just assume it's out there. It hits the retina. If we talk about the retina as a sense state, using it very loosely, not the statistical variable correlating to the sense state, but the actual retina, it's the absorption of the photon that changes the niche to be sensed.

1:21:47 Like if you're going to be sensing molecules from the ants cuticle, you have to take some you could sense from the ground the Ines that have already been deposited. But if you want some from the thing, you have to take a sample. And so that may whether that would be better understood as being an action in the niche is another question. But like you do have to change the external state to be have skin in the game. No, and I just thought of it as you're saying that like the observer phenomenon, right?

1:22:18 Bleu:
So there's that too, right? Just the act of sensing it chang. Kim or is the observer phenomena, does that come from sense? Does that come from internal states? Does it come from action states?

1:22:33 Daniel:
Are the observers just acting in a way that might fit in within an action state? But those are really interesting questions. Dean. No, I just think you're right. I think both of you we're getting closer.

1:22:50 Dean:
I don't think we'll ever fly directly into the sun, but we're getting warmer. Yeah. Cell have another few minutes to talk. This has been a really great discussion that I look forward to relistening to it and discussing more. Then, of course, feel so appreciative that we have a dot two as well, so we can return to some of our early ones free will.

1:23:14 Daniel:
Maybe save it for the dot two. Or if we want to talk about it now, I think we've blurred and fuzzed some of these lines a little bit, so we did kind of get there. Let's see what else we had down. And of course, if

anyone in the last 30 minutes has any questions, they want to write. So Stephen wrote, I like your method to work backwards in the flow diagram.

1:23:35 Start at representative or nonrepresentative assumptions, or perhaps conclusions like starting at those endpoints as assumptions, then looking for prediction errors in our action perception. This maintains uncertainty in ways that does not happen when following the causal effective correlations.

1:23:56 That's sort of like 20 Questions is framed as a game of, oh, I'm sorry, I didn't know that mentioning common children's games was funny. That's framed as a game of going from the most uncertain towards more certainty. Like if you were asking uninformative questions, what are you doing? If you're just getting and that's information theory kind of exemplified you're reducing the set of what you can be guessing with the preference to win within 20 questions. And then this is, as Steven is pointing out, kind of the other dimension.

1:24:37 But then what does that look like? And that is almost inflating uncertainty, at least in the information theory sense. So here's Stephen's question and then either of you, if you have a thought on this, do we model the temporal DAGs in dynamical change between sensory state in relation to changes in action state?

1:25:01 So maybe a related question would be how do active states and temporal lags play into our modeling of action exteroception and cognition?

1:25:15 Dean:
That's why I kept saying, young people, when in doubt, zoom in, zoom out. And it wasn't just zoom in, zoom out in a sort of in a visual sense. You have to zoom in and zoom out on a temporal sense as well.

1:25:32 You have to think about the unit of analysis both as an object, but also as the length of time if something can remain stable or not.

1:25:50 I don't think we're naturally inclined to include the time frame as much as we're inclined to include the did it chang kim, it float, did it burn? Whatever it is that we're waiting to see what happens next, we don't tend to give as much attention over to how long did it take?

1:26:13 Daniel:
I'll give a complimentary thought, which is more related to the kinds of models that we've specifically seen in ActInf Lab, the deep temporal models or sophisticated active inference in, for example, a three time step model. At timestep one, it's doing inference. On one, two, and three, that's learning as inference in anticipation. At timestep three, it can still be calculating the model in light of incoming evidence about time step one, two, and three, which is related to memory and learning and all these other sorts of socalled, backwards looking types of inference. So there's like, anticipation, there's now casting, and then there's reconstruction of your recent and long term past and how that's related to identity.

1:27:01 So I think the question do we or how do we model the temporal or just the temporality of sense and action states? The answer from model based science is, what's the time horizon parameter on the model that we ran? Oh, it was 15 days. Okay, well, then we modeled the temporal lag up to 15 days, and that is what we modeled. And that is sort of where the scale free becomes the scale friendly, becomes the scale specific, and then that's the most that it contracts down to is that one specific model as deployed by those researchers.

1:27:48 Here's another question from Stephen. When do we sense and when do we act? When do our sense states update? When does our generative models update, and when do our action states update? I'll start with the model based science one, which is again, it would just be the specifics of how the pseudocode and the actual computer code were written.

1:28:08 Which line of code updates first? That's the narrow answer. But what about a more broader answer?

1:28:17 Dean:
Does it depend on how open we are, how confident we are in staying in an uncertain, nonspecific space? And can we necessarily know going in how long that will be? I don't know. I don't know how long. And what about cognition, right?

1:28:44 Bleu:
Like, if we expand to that possibility, I knew that was going to happen. I mean, that happens to all of us. We all emergence. That like, oh, I knew that was going to happen. Like, if I step on this ice cube, it's going to like this ice pile, it's going to crack through to water or whatever.

1:29:00 I knew that was going to happen. So we're able to kind of perceive things before they happen. And so I don't know, is there not necessarily the temporal separation? This makes me think back to, like, Shannon Dobson and like, the flattening of the time diamond, right? So really, like, is it necessary that there is sequence here or can it just all be happening simultaneously?

1:29:27 That kind of relates to what I was asking earlier to you. Is there some kind of simultaneous update sensing action possibility? And I think that there is. I mean, I don't think that not in a computational model because code just runs like it is, but I think in our model it's possible. Yeah.

1:29:49 Daniel:
Okay, one more general and then more specific comment. The 4D spatial model tetrahedral cybernetics geometry. You have space and time, four dimensions spatially represented rather than the XYZ. You have three spatial dimensions. And then there's like, the special question of how does t come into play.

1:30:06 So some is known there and some is not known there, but when and where and how are of course very linked. And if we take model based science seriously, then they're also very enabled and constrained by the kinds of models we have. So maybe it's related to how we think about geometry and then the sense and action. Are they continuous or are they discrete? We've Dean Decety Costa at all like the synthesis of active inference on discrete state spaces and then we've also seen some of Alex Shance's work on the continuous control settings with like the mountain car, which is not just the discrete case.

1:30:52 So it's just interesting to see how some of the theory goes out in front and then there's parallel Ines of mathematical development with continuous and discrete modeling like digital and analog modeling. And sometimes those types of modeling scientifically are very well reconciled and other times they result in pretty fundamentally different patterns. Like there are certain equations where the discretized form or the version that's computed without really high precision numbers on a computer has really different behavior than the other kinds of models, which gets at the importance of thinking about how the model is framed and then also applied. Because, like if the precision of the processor matters for what the paper discovers, then shouldn't that be a part of the consideration?

1:31:44 Dean:
Yeah.

1:31:48 Daniel:
Okay, here's a few of the other comments for by the way we'll write down any other questions. So if anyone in the last few minutes has some questions they can ask and we'll be just writing things down, getting excited for dot two and if anybody wants to join who wasn't here today, they're also very welcome too.

1:32:12 How is representation related to autopoeysis? So refresher autopoetic system is capable of producing and maintaining itself by creating its own parts. So how does representation differ? Or does it differ for a system that is just engineered and secreted into the niche like a computer versus potentially something that is reassembling its parts continually? Why does that matter if it does?

1:32:50 Dean:
Is that a thing to look at in .2? Daniel, that sounds good. I'm not trying to push it on, but I mean, the reality

is that we can take each of the different segments, the organizational, the structural, the content related, and then put them through the auto poetic grinder and see what pops out the other side. Okay, great suggestion. Apply this to the four columns.

1:33:18 Daniel:
What other things would be fun to discuss in dot two or what else can go through the four column grinder? Or what would be any other question that any of you have.

1:33:37 Dean:
In the .2? Also we can spend a little bit of time on some of the comments that were in the action five of the paper, specifically around how we face state from potentially they didn't say that this is true, but they said if this claim is true. We could be faced from non representational, internal representation, maybe. Could we spend a little bit of time not just looking at the autopoesis aspect of that, but how does that density form in relationship to this idea of modeling ourselves? Great question.

1:34:19 Daniel:
Here's a question that Steven wrote. So feel free to give a thought on it. Or we can push it. It was will robotics or neuro phenomenology help most in testing these complex temporal dynamics in a realist way?

1:34:42 Dean:
I'm just going to say that's a great question and I think we need the person who asked the question to come on and chat with us about that a little bit.

1:34:52 Daniel:
We're just delegating so hard here. Bleu, go ahead. So something that I've brought up, I think in the dot zero is like I would really like to tease apart the similarities and differences between structural aspects and content related aspects. I'm not entirely certain, like, that's a fuzzy, blurred line for me there. So maybe we could get into that a little bit more.

1:35:22 Dean:
I agree. It's fuzzy for me too. These are awesome questions too. Thanks for learning it's all. Bleu cell.

1:35:30 Daniel:
We have multiple pages. We have auto policies from non rep to rep and back and forth, whatever else. How does that form in the concept of self representation? I think there's a few Hamlet quotes that will come into play there. Then Stevens question about technology and realism, structural and content action, action oriented representation.

1:35:57 The neurobehavioral systems in the sensory motor loop, niche modification, stigma g and the digital case, extended cognitive systems that include digital and mirror active klaas. Stephan singing 80 songs in the chat, I believe. Thinking through other minds and multi scale integration. One of Simpsons other papers. How are they related?

1:36:27 Does the FEP exist independently or only in the mirror? Lot of ways to answer that one.

1:36:37 One part we could look into now or maybe in the dot two would be the free expected free energy and variational. Free energy and how they play different roles in the FEP. These are also some things, like if people are watching live or in the next few DAGs, then they can write a comment on it or get in touch with us. Like if they want to submit a question or they can come on and discuss it in the dot two too. Variational and expected free energy.

1:37:13 There's a lot of parts to the paper and action oriented representation, we didn't get to that slide in the dot zero, but just what is action oriented representation? We've talked internal representation today, but then did we talk about where we implicitly talking about action oriented representations? Are those a sub class? How are they different.

1:37:48 Bleu:
In our system? In human cognition, there are some hard coded representations that we have, like actionoriented, maybe one of them like kinesthetic memory and also like visual recognition systems. And it's really interesting that and perhaps easy to apply the FEP to specific cognitive systems like subsystems. But it's really much more difficult when we have multiple competing processes. Like we're not just playing the piano and we're not just looking at the piano keys.

1:38:32 We're doing both of those things at the same time and lots of other things. Like we might be, you know, having some memory of one time that we heard the song that we're playing or something like that. So it's really interesting to think about representation and all the ways that it exists also even in memory, right? Like the memory representation not a hard coded thing. It's really squishy and it's subject to change through time.

1:39:01 And we might remember a situation like you can tell me your phone number right now and I'll remember it in five minutes, but in five days, no, or something like that. So I don't know. It's really interesting to think about the FEP and how it can apply in this overarching way where there are multiple computing goals and priorities.

1:39:28 Daniel:
One thought I hope I'm not misrepresenting an empirical result was in fruit fly the Drosophila. They found that shortterm memories didn't require protein synthesis like just second to seconds. Some sound or some symbol could be associated with a preferred or repulsive outcome. But preventing protein synthesis block the consolidation of memory and perhaps that's similar to other systems. And so there's kind of like the resonant neural structures that are just using the system's connections as they are.

1:40:07 That's sort of one perhaps faster mode of cognition that's like running around figure two. And then there's a restructuring that requires changing the model like structure learning. But that also connects to realism because we're talking about the synapses and the neurogenesis like of specific cells that could be maybe measured and then the neurophysiology and the behavior can be observed as well. If we have interoceptive framework like Active, it also relates to Dean's comment about the scales the Timescales will Chang Kim neural circuits cannot be changing at a time scale faster than neural firing. So how does the spiking component or the other sensory transduction or other chemical components, how do those overlapping active states coordinate?

1:41:02 Bleu:
This reminds me to Daniel of something that we talked about, like the very first time we met because it was a recent experiment at that time about the memory transfer between snails via interactions of RNA. So that was like an interesting possible memory storage and I'm not sure what else has developed from that. But also we've talked about ants and how they leave. Like, you told me that they're just throwing up RNA, like they're throwing up all the time all over the place and maybe leaving chemical RNA traces for each other. We talked about that too.

1:41:39 So maybe I don't know if you want to expand on that or does that tie into
this protein synthesis thing. One, I found that it was a recent ant paper where basically the act of mating, which we won't describe on this familyfriendly discussion directly, infuses neurotransmitters into the recipient, and that changes their behavior and induces all these other hormonal changes. And so the realism of cognition, like the embodiment and the physicality of these systems, it is perturbable by infusions of neurotransmitters in other neural systems and in us. So that's sort of where realism can't be eradicated amidst all of these representations because things do hit our head and molecules do diffuse it's, kind of like grounding it. And that's, I think, why it's such an interesting and integrative area with a lot of contention, because the four E side is holding down that real side and then the science side, socalled, is holding down the abstractions and the representations.

1:42:54 Daniel:
And then cognitive science especially is applied to humans is kind of where it meets in the middle. It's like, well, yeah, you're talking about embedded cognition and active cognition, but that's your cognition that's

modeling. And so then you get all kinds of fun viewpoints and ideas because of how mixed and complex that area is.

1:43:27 Thanks Bleu and Dean and those who participated in Chat for this really great discussion. I hope you can digest it and learn in the next week and reflect on some of these questions. And anyone can ask more questions or start to prepare some thoughts so that they can also be involved, because this is really fun. All right, one question. Yes.

1:43:52 Dean:
Statement.

1:43:55 Every one of these live streams. I don't know ultimately how it's decided which order that we do them in, but the fact that we've gone from Connor's paper to Madiz paper to this one, whether it was done with some sort of intent and looking back to the future or it was just, okay, well, I think we'll do this one next and see what happens. I think the order of these last free papers in particular has been pretty just. The order in which we've looked at them has generated a whole bunch of interesting ideas, including sort of the idea of intransitivity in the last paper now potentially influencing how we've discussed this paper. So, again, I don't know how much prethought goes into that, but if there was some prethought that went into putting these papers in this particular order, it's been very helpful.

1:44:51 And one other thing. If I find something happy because it's true, I'm going to laugh. And if I find something happy because it's playing a game like 20 Questions or any game, I'm going to laugh. So if I can't be if I can't enjoy and really appreciate the sophistication of the conversation here, I probably wouldn't show up. So thanks to both of you.

1:45:21 Daniel:
You can make me read academic papers, but you can't make me have fun. But just to give it one closing answer information for anybody who wants to get involved with the discussions, here's our Coda for the.com unit. And so here's the live stream table, the one that gets represented on The Viewable, public one. So we have all the papers planned, like in this case up till 373-8394 up through the end of March. So we try to plan the papers in advance so that people can have time to read them and commit to collaborating on the Dot zero background video.

1:45:55 And then we have papers to potentially discuss. And so here people add papers and then they click a heart. And Dean, we just sorted by hearts and then we picked the papers that were on the four top papers and we said, okay, we're going to read these four for 36, seven, eight, nine, those. And then we emailed the authors and so we have different papers and we said Cell, what dates might work, because we always will prefer to schedule a paper that we want to read when the authors want to join. And so that's kind of our first, like the way that we pull papers out, like we set the dates for the Quantum Free Energy discussions in March and then we work backwards from there.

1:46:43 And then just try to not do two, not even overlapping papers, just try to provide rhythm and novelty and philosophy and technical details. So it's sort of a local decision making based upon the votes that people provide who are participating in the.com unit. And pretty random. Yeah. And just what people surface?

1:47:09 Dean:
I was going to say that's a pretty serendipitous order then that's fantastic. It's fine. And if anybody watching or listening wants to suggest a paper for the Livestream, please do so. Yeah, alright. Thank you, Dean.

1:47:25 Daniel:
And Bleu. So see you all next week for the Dot two. Bye.

Session 036.2. January 26, 2022

https://www.youtube.com/watch?v=Lo95GakwV5w

Second participatory group discussion on the 2021 paper by Matt Sims & Giovanni Pezzulo, "Modelling ourselves: what the free energy principle reveals about our implicit notions of representation."

SPEAKERS

Daniel Friedman, Bleu Knight, Danielle, Dean Tickles.

CONTENTS

TRANSCRIPT

00:26 Daniel:
Hello and welcome everyone. This is ActInf Lab Livestream number 36 Dot Two. It's January 26, 2022. Welcome to active inference lab. We are a participatory online lab that is communicating, learning and practicing applied active inference.

00:46 You can find us at the links here on this page. This is a recorded and an archived livestream, so please provide us with feedback so we can improve our work. All backgrounds and perspectives are welcome and we'll be following good video etiquette for live streams. Check Active Inference.org if you want to learn more about what Active Lab is up to or if you want to participate in any of the activities which include live streams in the Communications organizational unit. But a ton of other stuff is happening today in 36.2, our third discussion on 36, we're going to continue to learn and discuss this paper by Sims and Pezzulo 2021, modeling Ourselves What the Free Energy Principle Reveals about Our Implicit Notions of Representation.

01:39 And we're going to have a nice jumping off dot two as we do and have some questions written down and prepared, other things will spontaneously arise. And if anyone watching Live wants to just write a question in a live chat, we can also address that. We'll start with an introduction. So we'll go around and introduce ourselves. People can say anything they want and they can also add just what got them excited about the paper in general or for this dot two discussion specifically.

02:15 So I'm Daniel, I'm a researcher in California and just excited to see how this representation discussion influences our own self representation and that at the individual and the lab scale. Moving forward. I'll pass it to Bleu.

02:40 Bleu:
Hi. I'm Bleu. I'm an independent research consultant in New Mexico, and I am excited by this paper because in our previous discussions, we're as usual, left with more questions than answers. And also I kind of am finding myself like, swayed by the different internal representation, structural contentdriven, internal representation, like these different arguments, and I just find them very interesting. And I just want to know if at the end of this, if I'll be swayed more or less in certain directions or maybe just be more open to other interpretations of SAP.

03:17 And I will pass it to Danielle.

03:22 Danielle:
Hello, I'm Danielle. I'm a cognitive scientist at Google with a background in language evolution, language development. I'm really interested in thinking about how humans evolve, the ability to model other minds. So interested in how this discussion can contribute to that and generally interested in how really good frameworks like the FEP can help kind of encompass other frameworks and revise them. Awesome.

03:51 Daniel:
Dean.

03:54 Dean:
Hi, I'm Dean. I'm up here in Calgary in Canada, and a little bit of recency effect. I started watching Ozark the plant season. And so I'm trying to plug this paper into what would Marty bird do? So that's kind of my little twist on modeling.

04:13 So back to you, Daniel, who is. Marty Bird and what would he do? Right? Exactly.

04:25 Daniel:

Great question. Well, that's all we prepared for today. So we'll go into the discussion, but we have some things written down. Is there anything just off the bat that anybody wants to just ask or jump into or like a figure or a quotation to begin with? Or we can look at some of the things that we had written down.

04:50 Okay, let's just start with what we've written down and then of course, at any point we can branch off.

04:58 Okay.

05:01 I think a big theme that we will probably return to again and again is this idea of moving back and forth from representational forms to representational forms. In the paper they introduce four different facets of representation and then how each of those facets can be approached in a representational or non representational way. And although the image here shows some solid black lines, that was kind of the discussion was is there movement across these area or blurriness? So maybe Dean, what is theorem to say or start to explore with representations emerging like almost precipitating or crystallizing out of something non representational and then the reverse process of something that is more representational submerging back into something that's less? Well, one of the things the authors did talk quite a bit about in terms of the functional aspect of this was the vicarious nature.

06:12 Dean:
And then they also talked quite a bit about whether or not somebody who's story of moving in that radical enactivism space still has to be able to differentiate and get some include some of the temporal aspects of what might pop up and become something that we can stabilize in model representation form. But then it has to also be able to disappear. Right. It also has to not necessarily consume everything in terms of our attentional field. So I'm not really sure exactly how that works itself through.

06:55 But I would think that it's difficult to say that even if we're in a flow state that there isn't some moment when we do reflect in that mirror. So that's kind of where I'm at. I don't have any answers per se, but I don't want to get stuck in the idea that it's just an on off switch. I think that there's a bit of a moment of dimming and then rerelighting.

07:29 Daniel:
That makes me think about certain paths that our thought takes over these eight cells. Like when we're in the representational side, when we're dealing with the representation, how do we take that tetrahedra and look at the four different sides? And then how do we stay within a column looking at just the organizational aspects of a system and then move north and south on that?

08:02 Do these kinds of knowledge or cognitive transitions happen all the time? Do they have other names that might be more familiar than using some of this philosophical language? Like what is it? Are there any times in our days where we're dealing with something representationally and we shift to a non representational version within one of these categories or across categories.

08:39 Bleu:
So I was just thinking of that actually.

08:43 What does variational an organizational representation look like? That is like a map, like a structural representation, a content related representation and a functional representation. And like what do internal representation look like and how are they different? I was thinking about that.

09:08 Daniel:
Let's go to the definition of the organizational representation just to kind of remember the fact that FEP requires internal states, states that encode the recognition model that are statistically separated from the external reality. So the organizational area is about how variables inside of systems are separated from variables outside of the system. The pro representation take is there's an evidentiary boundary, the Markov blanket and there's something on the inside that is doing something like a representation on what's outside. So that's the internal representation take. Then the internal representation take is where we get into the biological and the inactivist perturbation.

10:22 And that's where the authors say that some have approached this Markov blanket structure formalism, even though we're talking about it in the organizational, not the structural facet in a manner that suggests a representational view.

10:39 And they argue that just partitioning two coupled systems like agent and environment with a Markov blanket doesn't imply that the behavior of the agent is explained by anything related to an internal model that's doing anything like capturing the structure of the outside world.

11:05 Bleu:
So you just use organizational and structure in this big hot knob. My question was really what does an organizational representation look like? And so I'm hearing that you answered that there are clearly defined boundaries in organizational representation or partitions between internal and external states. So like I have a clearly when I have a representation in my mind that's organizational it is like your boundary different from like is it only your own boundary or is it like the boundaries of each individual agent? Are organizationally represented in your mind or is it just the boundary between you and the outside world?

11:50 And how might that differ from structure and content related? Like what do these different representations look like? That's what I'm trying to see. Would they be mass and how would the math be different?

12:04 Daniel:
The structure which does come up several times in the organizational definition, so we see structure coming up, the structure of the system in how it's organized. But what is the structural specifically? Okay, internal representation vehicles that are structurally similar to the state of affairs in the world that they stand for.

12:37 The internal representation structural side is kind of like the good regulator theorem of cybernetics. So the organizational side is highlighting that there is some sort of informational encapsulation, we might even say like our previous discussions, but some sort of organization of variables such that there's an inside and an outside that area separated. And the structural side is saying that it's like if there's three things that are connected in the outside world then not just that there are variables that area organizationally separated in the internal states, but that the structure of those isolated variables is going to do something like recapitulate or have a structural resemblance to the generative process. Generative process, that's like the niche, that's what's outside generative model, that's what the agent has on board. And so if it's to be useful for control purposes,
then it may have to have some sort of structure resemblance to the actual connectivity of the generative process.

13:50 So generative model and generative process being separated is what's captured in the organizational side. Them having similar resemblances or similar structures is what the structural side is. The structural non representationalism are suggesting. This is I think, tail of two densities with Ramsette at all or modeling ourself. The authors suggests that generative model do not meet the requirements of internal representation because the process of exploitable structural representations so posterior beliefs in the entity is enacted and so it doesn't necessarily have to recapitulate the force of the generative process.

14:42 So maybe one could be skilled in the performance of driving without having variable connected in the way that a car pieces are connected.

15:07 It comes back to a theme that active presents to us perhaps more as a question than an answer, which is how much do we have to know in order to act? Do we have to have an internal model that is very similar to the process, uncorrelated in how similar it is, anticorrelated in how similar it is? And can we have a framework as researchers that helps us compare the structure and organization of generative processing processing and generative models of those process?

15:52 Noise go 14. So I'll put this out there and then people push back or say it doesn't make any sense

from what I read in the paper now because I had to go back over and look at it again. If I were to try to draw a simple comparison between organization and structure organization, you could see it as being something, as being either in or out. So you could be inside a cell or outside of a cell. Then in our mind we can tell.

16:26 Dean:
We will draw those partitions and then we'll decide what's in or out. Structural I think takes on more of the entailing questions. Something that's all brought up in the That. Which is so once you've decided whether something is in or not. Is there something else that now can be seen as being superordinate to that from the perspective of sort of what's wrapped around now the thing that's in or what can sit upon theoretically the thing That you've now decided is foundational to whatever it is you're looking at and what can be set aside as not being important to what you're looking at.

17:08 So again, pull that apart and say that that's wrong, but that's kind of what I try to read into what the readers or what the writers were saying. So it's just my interpretation. Thanks Bleu. So I just wonder in this organizational representation is if you draw a distinction between I mean, clearly there's one between what's internal and external to yourself. But are you also trying to draw distinctions between what's internal and external to your computer or your refrigerator or your best friend or your child?

17:46 Bleu:
Are you making a representation of everything that's internal and external to every other thing or is it only with respect to your own self versus environment? I would think it's when you do that, I don't know that it's implied that you do it all the time, but if you choose to do that, I think that that's something that's pretty easy to tell the difference around. So again, I'm not sure that they were saying that we do this, we do always constantly doing this. But I think what they were trying to do is show the difference between knowing when something's in or out versus knowing when something's first or second from a structural standpoint. Again, I don't want to put words in the office truth, but I did hear that in the words that they were doing to try to parse those two things and give each their due as opposed to saying they're just the same thing overlapping.

18:51 Daniel:
Let's try one little thought loop. So let's start switch blue's question of what does an variational representation look like? So we'll start in that very top left cell and then shift the focus towards the structural components and then challenge the structural representation but stay within the structural domain and then see if that can result to us making it back to a internal representation organizational framing. So what's something that is classic vanilla organizational representation? Well, that's something that is well separated in terms of variables inside and outside the system.

19:41 So we're not worried about the structure of the variables inside or outside, just that they are separated. So computers seem like pretty clear cases where within a program you could have variables that by design are separated through an intermediate variable. Or computers and hardware like two computer systems could be totally separated except for an interface like a USB port or something. But of course this paper is about that strange loop when it's a cognizing agent, an adaptive active inference agent doing that representing not necessarily a mere active agent, but should we use a computational example or some sort of active human example? You got a good example right here on the page.

20:46 Dean:
So how would we shift across the y axis between organizational representational? Because I'm assuming we're going clockwise from two representational structure. That's not a hard example to make. Yes.

21:07 Daniel:
So in the human case, this would be like two humans in a conversation. They are in a conversation. Yes. Perfect. Outside of the conversation.

21:23 Yes. When two humans are in conversation there is separation in terms of their sensory motor system. So we have check the box for organizational representational starting in the top left cell. Alright.

Now the question would be is there structure representation?

21:48 So that would be like maybe if one person thought of a sentence and then said it and then the other person thought of that sentence too, would that qualify as a structural representation because there's a structural resemblance in the model of the two conversions.

22:11 Dean:
Yeah, we could also find out if both of us were talking at the same time and suddenly stopped turntaking that the structure of that model would now fundamentally change it's internal representation and two people arguing over top of one another to the third party isn't necessarily something comprehendible, never mind to the two people that area inside the conversation. Right.

22:41 Daniel:
Bleu. So when I think about conversation, something comes to mind recently, like really you need to have like the order of the language specified. Like my son is reading now and he's five, he's taken the book like pop on top, the doctor sees book and he'll turn it upside down and he'll say dodge no doe and Cell read it that way. And then he wants to read every sentence backwards, like from the end to the beginning. Which I'm like, I don't care as long as you're reading because Bit gets a practicing reading.

23:10 Bleu:
But it's completely the context is completely different when you're reading each word in the opposite order. So when you're talking about a structure representation of a conversation, I think that there needs to be a literal representation or at least like a course grained representation of in what order things are said in order to glean some kind of learning. But then are we bleeding into the content related?

23:37 That's why I really feel like what are these different maps look like? And trying to maybe elucidate what the representations are is valuable because I think when you have organization inside, outside, like this is the sentence or he said this and she said that or whatever and then you story to put structure on it, that gives it them content or context and so on and so forth.

24:03 Dean:
Dean no, I don't have much to add to that other than I just don't think that this loop that we've just selected, this we said there was going to be a certain amount of randomness in the last livestream and we've chosen this. Now let's walk, let's walk through it. I don't see it being difficult to follow that path and find examples. So we have a superordinate right now structurally we want to carry out this directionality from the representational side of things to the internal representation side. And Bleu if your kid wants to turn the book upside down, that's actually a feature, right?

24:48 Because they're not already stuck in this only one way of doing it thing. Yeah. Let'S complete the red loop and then the green and orange will come to play. Okay, so we started with two people in conversation that's organizational separation of cognition. This brings us to the structural facet which is where there's a structural resemblance action, action, action oriented representation conversants.

25:19 Daniel:
So maybe it is the case where they're both thinking about a similar topology of variables. So there's some structural representation but now let's stay within the structure column, go from B to C. Okay, so the two people are in a conversation, it's kind of like a dance. So what if those two people's representation is so different that it's actually not structurally resembling. So maybe one person is the more experienced in the discipline and the other is less emergence.

25:56 Like one person is super good at fixing motors, the other person just has no idea. So the representationalism take would be like cell they're both thinking about the motor. But then when we start to see a cognitive asymmetry all of a sudden we fall out of internal representation between these two system because their cognitive models don't necessarily have similar structure. Yes, Danielle unmute then go for it. So I might be missing something here but I thought that we can only start to talk about the structural dimension here once.

26:40 Danielle:
In this example the two people in the conversation are representing
the same thing and then the question is how much information or how does each of internal representation do each of internal representation have to look similar to one another but like parse of it has to be that they area representing the same thing. Is that sort of necessary component? If they're not representing the same thing then we're having a different conversation.

27:09 Daniel:
Well, that may come to the functional, that might come to the content related like the novice and the expert, the representations are both about the online but they're so structurally different in their representation of the engine. So that although the content in the aboutness of the representation is similar so still qualifying as a representation in that sense there is a structural non resemblance such that by that criteria in that saturation value fallen out of the representational cell B into something internal representation potentially Bleu. What do you think? So I think two people in this conversation can be trying to represent the same thing. Yes, they both need to be trying to represent have the same representation.

28:11 Bleu:
Like they're trying to converge on a conversation, a meaningful conversation presumably, but they don't always converge and then that's where you get like understanding or we both think that we think the same, we both agree that we're thinking that we have the same structural representation but perhaps they're different and then the communication breaks down.

28:36 Daniel:
Okay, so the structures are so different that we're recognizing it as a continuum from total overlap of structural resemblance to total nonoverlap. But it would be important to specify that null hypothesis. So we've kind of scooted into C how do we stay in that space of, like, the novice and the expert who have different cognitive representations and then use that to challenge even organizational representationalism first and then Bleu go ahead. All right. I want to just go back to Daniel's point.

29:22 Dean:
So if we're structure a conversation, normally we turntake, but if we're playing in a band, we're all playing at once and then we stopped playing. So I think we can start with structure, too. It's just deciding how we want to signal. Right. So I don't think there's necessarily an order that we have to start with organization first.

29:46 We can actually start with structure first as well. Yeah. And I think a conversation is a particularly challenging example because we're representing two things. Bit we're representing what the other person is trying to say and then presumably what the conversation is about is something else in the world. That we could be representing.

30:03 Exactly. Yeah. Bleu so I think we're representations a degree of information sharing, and I think that this is going to lump into autopolysis, which I've been really wanting to kind of get into. Bit when we have, like, I'm my own person and I'm communicating with Daniel from 50 0 mile away, we both feel like we're getting on the same page. When we actually do get on the same page, like, do we form some kind of, like, separate cognitive unit?

30:36 Bleu:
At what degree of model overlap? Is the degree of information sharing so high that then we are worthy of our own? Markov like it we're sure that we understand that we are the same unit. Right. And I think that this idea of self ensemble and information sharing and model overlap, I think that there's an important path to traverse down this way.

31:02 Because if you don't have full overlap of the model or do you need full overlap to form a self assembling system to form a higher level? It's just an interesting thought.

31:16 Daniel:

That'S kind of where the C to D transition takes us, which would be like so we have the drummers waiting for this and has a model resembling this, and then the singer has a totally different structure. And then when we think about the whole cognitive system, it doesn't deny what we recognize in A that there still is, like, the sensory motor separation, but we've teacher that point by those people or roles being part of a larger, nonseparable extended cognitive system. So almost by recognizing the interactions. So here we focused on the separation in A, and that's what granted us the representational cell, but we've returned to seeing that partial information encapsulation within some type of broader structure where none of the entities have, like, the band levels representation. So hopefully other people can think of other, like, ABCD examples, but when we were at B, we kind of started branching off into, like, about the content related things.

32:44 The aboutness. So here two people do have a structure resemblance in their internal model and it's about the same thing. But then what if one person sees the about us in such a different way that again we fall out of the content related representation and then how would we move from there back to C where all of a sudden the recognition model in a sense don't have structural representations resemblance because they're about different things now.

33:32 Danielle. So would this be like in the case of two things that are so analogous that they share a lot of structural similarities and things of like dedicator's work that you can actually draw lines between the individual aspects of the concepts but they could be about totally different things. But two people talking about these things can form some sort of structural similarity in the representation and it's just like an entry point into being able to think about all other things. But the about this really has nothing to do with it.

34:12 Dean I might want to ask me on that. Yeah, I don't know if this answers that, Daniel, but from my space I'm thinking active inference between, say, a distracted driver who's looking down at their phone between the seats and somebody who's got that information in a HeadsUp display on their windshield, right? So content twice, but structurally presented one as one as a distracted state and one as a contiguous state. So I don't know if that answers your point, but I think we know the difference, right, in terms of where the content is structure and how we're trying to contextualize each matter.

35:02 Again, staying with a sort of educational setting, what is it important to see a transference or a new emergence of is it that the structural model of the learner is moving into more resemblance with the teacher? Is it that the aboutness of the learner is moving towards the same aboutness of the teacher? Or let's just remind about what the functional is supporting vicarious use before or in the absence of external events. So does the teaching conversation. Will it be a functional representation when vicariously without the teacher, the student can carry out what the teacher could do, which might be having aboutness or not.

36:09 It might be with a structure cocktail of resemblance or not. It might involve total informational isolation putting a squarely in a or it might involve some type of challenging of that in D.

36:31 The reason why there's not going to be, I think, a precise answer because as the paper lays out, even for the same scenario, people do have different perspective. So it's not like we're trying to take a scenario then classify it into cell that one's like an abeg or an ace. That is probably not what one of the outcomes could be. But these are all perspectives that we could take on a given scenario and they do reveal interesting things about the systems of studies.

37:11 Anything else to add on this? Sort of like looping around the cells or should we push on?

37:25 Dean:
Push, push. Okay, Bleu. What were you thinking here? I was just taking notes. So maybe we should talk about concept related and function.

37:41 Bleu:
So I was just taking notes on what the organizational, like, how are the representations and I was trying to draw a picture. So I will draw my picture if you will talk about maybe functional representation, what does the functional representation look like or content related, what's inside of those? And then I will draw my

picture and then you can show it. I'll draw bit while you area talking. Sure.

38:05 Daniel:
So the content related is whether the generative model need to explicitly model the ways external states produce operations, environmental models, or the ways actions produce sensations. Is it really important that internal states resemble external states or is it sufficient that they afford accurate action control?

38:42 So let's just say there's a spotlight that's shining photons onto the eye. The content of the cognition representation would put us more we'd be more internal representation camp if the recognition model were truly explicitly modeling the ways in which the photons hit the retina. Maybe, but this ore is a bit challenging because the ways actions produce sensations, that could be a model of like well, if I blink it becomes darker and when I open my eyes it's lighter. But that's a totally disjoint question from understanding how a spotlight works.

39:39 But those two scenarios of the spotlight's, cognitive explicit modeling, the environmental model or the sensory motor model of blinking and becoming darker, those are both content related and Dean cell. I don't know if this helps or not, but one of the things that I used to bring up around this idea was the puzzle concept. So you got a box and it says 1000 piece puzzle and when you open up the box is internal representation or is it not representational until you figure out whether all thousand pieces have now been duly assembled. Right. So from a content perspective, do you have what you need in order to be able to tell the difference between something which internal representation and that which is not?

40:44 Dean:
So again, I don't
know if that's helpful in terms of sort of trying to see a difference between that, say, instructor like where it's placed relative to the context or not. But that was the way I tried to surface. It. One evolution or handshake that hinges on that or of the environmental models and the sensory motor models, they do unpack a little bit. So one approach consists in starting from the sensory motor models.

41:21 Daniel:
So that would be when I blink it becomes darker. When my eyes are open, it's lighter, but progressively extends them to incorporate extra variables that describe external causes of sensation. So like if there's a light on one side but not on the other side, then it can be the case that that blinking is true no matter how. You're turned. But then that could be enriched or augmented with a model of parameters that describes external causes of sensation.

41:55 Like there's a light over there and not over there. And so actually that little loop that we just took was from the sensory motor B, the sensory motor model in B moving to internal representation model of the content. Like there's a light over there and then does That cell at least that was the BTE move, but then maybe that could do something else. So maybe cell clarify there. But let's go back to just review functional, like what is the functional and it's good to revisit these in the 01234 five because it's the contribution of the paper and maybe there are other facets, other columns to add and there's just a lot of complexity even as this is so the functional one is about supporting vicarious use before or in the absence of external events.

43:05 So in that story with the lights and the blinking, that model only has to be instantiated while in that room with the photons hitting the eye and the blinking happening. However, we can imagine a situation that's vicariously detached or before That setting like what would happen if there were a light over here and a light over here and it was the case that blinking made it darker.

43:39 And this is where they trace back to PSA that representations should vicariously stand for something external in their absence and afford vicarious operations.

43:56 So there's a light over on the left side, you reach over and you unscrew it. What is in your hands now that is seeming to be in the functional facet? Because we're talking about the role the representation is playing and the fact that it is standing for something external in the absence. There's no physical light that we're talking about. It's not like we're unscrewing it and then verifying that it's in our hands who's for and

against that?

44:49 What functional roles do internal model models play during free energy minimization? And does minimization require the internal manipulation of variable in ways that resemble vicarious operating point? The classical PSA account of representation?

45:13 Yes, Bleu. So this might be like, I don't know, maybe it's the easiest and also like the hardest to get a grip on. So I think about if we have a representation of internal variables that are functional, like a functional representation of a functional internal representation, is this like doing like you manipulate the variables internally and then manipulate them externally. Like you plan to reach for the cup to take a drink of water and then you reach for the cup to take a drink of water. But you have to have like the internal expectation prior to or maybe simultaneous with the external expectation.

45:59 Bleu:
Is that like functional representation? Like do you plan the action and do the action maybe separate or maybe together? Is that what functional representation looks like? Let's go with a reaching for the cup because as Daniel noted, like conversation, improvised, spontaneous conversation of reflexive entities is one of the hardest cases but it's the one that we have. So that's awesome.

46:31 Daniel:
But we're going to be talking about an adaptive active inference agent reaching for a mere active inference agent. So in the Sims other paper we discussed now we're talking about the case of unidirectional integration rather than the multi scale reciprocal integration. So the person is separated from the cup. There's a separation of the cognitive model of the agent from the cup. The structural side, if the internal model is cuplike or it features a cup variable touching a table variable and then another edge that is engaged of the hand touching the cup for example, that might be a structure similarity.

47:16 But I think that's part of the debate is how could there be a structural similarity when it's not a cup in your brain which we mind of talked about last time? Like how could you have something that structurally resembles a car if it's your brain and body? The concepts related encoding, environmental contingencies or sensory motor contingencies. So it could be the case that a certain sensory motor action will result in picking up and grasping the cup whereas another sensory motor action is going to result in the shattering of the cup. And that could be analyzed in terms of correctness.

47:55 The functional representational question would be like the vicarious detachments of the sensory motor loop from the cognition. So then it would be like if you were to pick up that cup, then you dumped it, what would happen? And then someone says like water would fall out. So in that case it is like there's a functional representation whether or not it resembles the structure of the cup. There's a functional representation because That idea of grasping the cup it's able to be operated on internally vicariously in the salience of direct stimuli related to the cup.

48:42 Dean. Do you mind if I just read right from the paper for a second because I think it helps in terms of this difference between the sort of the automaticity and reflective aspects of this action. Okay. One important implication falling out of this diagnosis is that when considering functional rural aspects it's often how the details of our chosen process theory are fleshed out and contextualized by the kinds of cognitive phenomena that we are attention to account for that skew our interpretation of FEP in one direction or another. For examples.

49:30 Dean:
1 may consider that there are core aspects of FEP such as the possession of a Markov blanket and more ancillary acts aspects and I think ancillary is the key here. Such as the possibility but not the necessity to engage in counterfactual inference which is only required for planning and it is only the latter more ancillary aspects that call for internal representation interpretation under a given process theory. This would imply that when using functional role as the sole criterion for representational processes. Only some FEP agents, namely those that can engage in counterfactuals forms of inference, would meet the criteria for representation. It is only this subset of FEP agents that would be equated to fullfledged predictive

processing agents.

50:20 So there is an automaticity part to this where it's really not a Markov blanket. You just do it almost subconsciously. And that's again, the authors are trying to point this out. Yes, if we fail, I dropped the cup and now I reflect on that. That's the representational piece.

50:39 But prior to That, I was just going through the motions. I didn't need a set of interactions telling me to reach out for the cue. So that's just in the author's words. Thanks a lot for clarifying that. It's like, yes, if one is reflexively grasping at it or accidentally then grasping the cup, like if you're groping around in a dark room and then you Kappel to graph the cup, it doesn't have to internal representation because there isn't a counterfactuals.

51:25 Daniel:
And that's very interesting how they say that it is ancillary. So that's kind of like a secondary or not essential to it because we can imagine an active inference entity that's taking insensary observation updating its generative model, engaging in policy selection and then resulting in some action output impacting the niche, and the cycle begins again, that can be just like a single layer model that doesn't engage in counterfactuals. But they raise that notion that it's only the counterfactuals in cognition that actually give us the space to have a functional representation. It's like if the shell just represents the shell can't be anything else. But then there's another kind of entity who can see the shell as financial or can see it in a different way.

52:28 And then it's those counterfactuals that enable the shell to play a functional representational role in that it stands for something else. Bleu. What is this imagery on the bottom? So I just was like trying to really look at or try to visualize what would these different representations really look like? If we take the idea of two, a person and a cup, even right on the first one, we have variational.

53:02 Bleu:
So, like, I am a thirsty body. I'm contained within me there is a cup that contains water over there. Like, I know my boundary. I know the boundary of the cue. And the representation looks like this.

53:15 And then a structural representation is just me and the cup and my relationship between me and the cup. So do I have to also have my real question here is do these perhaps build on one another? So here you have the structural and then the next one would be content related. Do I also have to have this connecting line in the content related? Is that required?

53:47 Like, do I have to have an idea of the structure to understand the content? And then in the functional, like, do you need to know the content and the structure and the organizational to have to have an understanding of the function, do I need to know like the content related? Like I know that there's water in the cup, right?
I assume that there's water in the cup. To find out, I have to realize that there's an inside of me and outside of me and inside of the cup and outside of the cup I have to realize my relationship between me and the cup.

54:19 And then to find out the content. Like I have to go sample the cup to see what's inside of bit and I just know what's inside of me and then the function. I wonder if there's water in that cup and then if I go to drink it and there's like whiskey in it or something. Like I'm not going to understand the function until I have all those things layered on top of each other. And so that's kind of really my question here and Daniel's drawing all my drawings.

54:45 But really I just wonder if there's levels of increasing complexity between these different kinds internal representation or if it's just merely the structure, the organizational and I don't need these boundaries between self and cup in these other models. Maybe it's just the line without the circles in the structure or the no external circles and content related. So I just want to know like what you guys maybe think of that, if there is a layering here because I was kind of layering them up, but I don't know if that's really the right mental representation. Thanks, Bleu. Dean.

55:28 Dean:
I'm not muted good. A few I think there's two parts to this. One is that we are able to differentiate which is what the table allows for. And I think That, the second part is the curved arrow that Daniel drew which essentially represents boundary crossing number one. So the difference between something that's static and something that is translatable and then the second part of it, I think without going back down the rabbit hole that we almost fell into in the .1 of this when we started talking about free will and can and will and the orthogonal piece of that.

56:09 I think what it speaks to maybe is that it's not a question of free or encapsulated, it's a degree of independent question when you throw that curved online on this sort of tiled representation and start moving across a boundary. So I don't want to call it degrees of dependency will up to a point of passing through zero. But I'd like to because I think there is an aspect of that and that's why I think it's kind of crazy if we just focus on the static things instead of the moving around the moving through four squares is what I really think gives our minds a good workout. Yes. So here's another little workout.

57:02 Daniel:
So Bleu had two circles in relationship. So here the circle is going to reflect in adaptive active inference agents or the fullfledged predictive processing agent, one that can engage in counterfactuals. So the top is two adaptive entities in relationship and the triangle is going to reflect a active reference distinctions like a cup or just something that doesn't engage in counterfactuals. So organizational is the separation of the systems. So that's very similar because it's just describing there being a Markov blanket separating the systems.

57:42 The structural representation is having vehicles that area structurally similar. So it's simple. Er in the lower case triangle out there in the world, is there a structural resemblance that would be very representational, whereas if they were cognitively imagining something different than a triangle, that would have less resemblance. But that gets challenging with adaptive, adaptive because we're modeling ourselves, modeling each other, blah, blah, blah. So here's them modeling the conversation and that's where there's sort of like very complex dynamics, which is how can we have a structural similarity about a conversation with another person.

58:24 But it's simpler. In the adaptive mirror case, the action oriented representation encode environmental contingencies or sensory motor contingencies. So like in this case, the triangle, it is the case that it can rotate clockwise. And so this entity does have a good content related representation if it can actually turn the dial to that way. And again, that's a little bit more complex in the reciprocal case.

58:58 But in the unidirectional case, this red arrow is a contentrelated representation of the actual motion in the world. And then this last case is the functional representation and here it could be more structural. So like more about the actual structure of a cognitive model or it could be more about the encoding of the contingencies. But the key piece is this isolation, which isn't a Markov isolation. This is actually the true vicarious separation of so here the person or the entity is able to engage in either structural pondering of the triangle or functional pondering of the triangle in the absence of seeing the triangle or grasping the triangle.

59:50 And again, though that's a little bit complex when you have multiple counterfactual cognizers asking each other questions. I decided to counterfactuals.

1:00:06 Yeah, exactly. The red one is then there's the Bleu one. It could go a different way and then this is how we know that it's a true cognizer and a true functional representation. Yes, great call. Thanks a lot.

1:00:21 Bleu because it has to do with the vicarious nature, with not directly seeing it, but it also has to do with that representation, whether more structural, triangular or more functional. Red arrow could be different. So there's them having a counterfactuals action contingency and here they're also imagining a counterfactuals structural position.

1:00:51 Okay, I'm going to go to a question from Stephen. In the chat, Steven asked how do we resolve the use of a term functional as used in correlational dynamics? So that's referring to some of our earlier discussions on like functional and effective connectivity in neuroimaging and the term functional in use and the term functional in terms of having cognition counterfactuals. So how is the functional here related to effective and functional connectivity in neuroimaging and time series statistics?

1:01:39 I'll give a first thought. It's not that it can't be linked or connected, but they are different namespaces and they're totally different. The functional connectivity in the time series is about how changes in one variable through active inference, another variable through time, or are associated with changes in the other one through time. So it's not a mechanistic causal relationship per se, but it's just that changes in one variable have an edge reflecting how changes in some other variable change that does not engage either of the pieces that we're highlighting here, which is the vicarious or standing for nature, nor the counterfactuals nature. So it is a different use of the term functional.

1:02:32 Functional is an overloaded word. And so yeah, it's not that you couldn't have a paper that was looking at functional representation and using neuroimaging and using functional and effective connectivity of brain regions while individuals were engaged in functional representation, but that would a little bit be like the star was the star of the movie. It's just using a word in multiple senses in a way that may give some ambiguity to those who don't parse out the different senses extremely clearly. Is that fair to say or does anyone have a different thought?

1:03:18 Functional can also mean teleological, like the function of something, essentially. So there's many uses of function and I think it's interesting that it has come up in these different spaces Bleu. So I do agree that they're disconnected, but I am able to perhaps see a relationship in functional connectivity and also in counterfactuals. So when things are functionally connected, like one drives the other, right? And then the counterfactuals is like when things are not functionally connected, there's no corresponding correlation, right?

1:04:04 Bleu:
So in the exploration of functional connectivity you have to have all of the data points, like over a time series. So you have to like you understand functional connectivity through the exploration of counterfactuals. Does that make sense? Okay, how about this? Functional connectivity, the term it is a function representation that cognitive scientists use because it could be otherwise they're engaging in the Lamme region A and B have functional connectivity because I did the time series statistics in SPM and we got this value and so that functional connectivity value is able to be used in subsequent internal cognitive representations.

1:04:56 Daniel:
It stands for something and it can be engaged with in a counterfactuals way. Like what if it would have been stronger, then what would our conclusion have been? Or what if it would have been weaker? What would it have been?

1:05:09 And then Steven wrote these are definitions and ways to name could be where the ontology Working group could have a future role. Yes, ontology development in active inference and how will we even make the decisions of what terms to use and what senses disambiguate the uses and the different corpuses that we are looking at? So pretty interesting, this graphic actually. I hope any of the authors or anyone who is like interested in this topic, what do you think about these doodles? Do you agree?

1:05:49 Disagree?

1:05:52 Let's go to Blue's question about autopuices. What is interesting or that about.

1:06:03 Bleu:
Just really where it comes in. And I think we kind of brought it up earlier in the sharing of a model. So is sharing of a generative model necessary for self assembly or even the attempt to share a generative model? Is that a necessary component of auto poetics? And at what levels?

1:06:28 Like organizationally, structurally, content related, functionally at all the levels. I just wonder how these things are related. And when we were talking earlier about having a conversation and trying to make your
models align with one another through information sharing and like we saw with the computational boundary of itself about selfassembly and autopilotis via Mike Levin, just about the informational sharing between subunits leads to the formation of a larger cognitive unit. And so I was just wondering about model relationships and forming a larger cognitive unit like we're talking about the conversation and then we form switch complete overlap of yes, we get it, we group, we're there and then we form a larger cognitive unit. And is that on all aspects?

1:07:21 Is it just related to content structure, organization or function or all of the above? Just that anybody thinks about that? Alright.

1:07:33 And we saw this actually in Matt Sims earlier paper, the Biological Symbiosis, right? Yes.

1:07:43 Daniel:
The autopilotic system is capable of producing and maintaining itself by creating its own parts. So it's kind of like the ship of theseus plus crew. They're able to be modifying and reconstructing the material basis of the system.

1:08:04 On one hand that maintains an organizational separation of like the cell and the surrounding in terms of the realist interpretation of a Markov blanket. At the same time, the autopoetic process does not need to have it involves ingressing and outgrassing material. So that does blur the boundary and structurally bit doesn't need to be the case that the autopoetic process of the cell has like a blueprint or a structural resemblance of the cell. It could just be subunits that are non representational theory cannot engage.

1:08:54 It doesn't even make sense to ask whether the cognitive model has structural similarity with the target because it's a non cognition entity. And similarly on the function side, the enzymes can't engage in counterfactuals that, you know, synthesize the lipids and add them to the membrane. So is information a representation?

1:09:31 Bleu:
I don't know. I mean, we're getting into the quantum now.

1:09:39 Daniel:
Where's information in this it comes up in the paper 1817 times based on local information. Information comprises the generative model. Past and present information, future information, information gain no additional information about internal states that's the Markov definition high mutual information can be in the context of a non representational generalized synchrony like the pendulums that synchronize. Where is information in this eight volt distinction? So the author talks about here.

1:10:25 Bleu:
If I can read a quote quickly if one only appeals to the organizational aspect of representation the presence of environment or sensory motor or complex or frugal model does not matter insofar as the internal variables of the model are understood to be separated from external reality by a markup blanket and the generative model is leveraged to infer the causal structure of external reality via selfevident. However, these differences matter if one considers structural aspects and the degree of resemblance between hidden variables and environmental dynamics as opposed to action or information gathering dynamics. So I don't know here the content of representations is used to draw a further distinctions within internal representation view between an internalist, sometimes called intellectualist or encoding versus an action oriented perspective.

1:11:23 Daniel:
Probably one of the most thrilling academic debates. Dean.

1:11:31 Dean:
Please don't judge what I'm about to say next. Just bear with me. Be kind. So in this representation. For example.

1:11:40 Where we've got this table if we were to look at those lines. Each one of those horizontal lines because there's three IC and each one of those vertical ines because there's four IC and we realized. And we realized them as a standard XY graph we know that there's a relationship between X and Y. That every one of those horizontal lines relative to Y has a zero component to it. And we know that every one of those vertical lines relative to X has a zero component to it.

1:12:17 So most people will look at the blackness of that relative to the white background and they'll just see something material separating. But if we actually look at it graphically and we take Daniel's idea of the tetrahedron every time we round an edge and change direction on that tetrahedron there is a zero element that allows for that boundary crossing that we again don't pay as much attention to. And so from an autopoetic standpoint you can actually see where something like a Markov blanket both separates and levels the potential open for that transfer or that process theory, that transition. So when we're model ourselves the last paragraph of the section five of the paper they wrote arriving at an FPP as synthesis so some nonzero number and zero view depends upon which representational criterion we are assuming when either considering FPP's central constructs or considering specific cognitive phenomena through the lens of a process theory. Under FP, do we include the zero piece of this or not, tentatively, fully?

1:13:44 Or do we willfully ignore it? Hence, in the end, the debate about FEP may reveal more about us, our criteria, whether we want this to be a material thing and not include the zero aspect of it and our interest in particular facets of cognition than does about the representational status of FEP. So I just want to kind of bring that. Again, don't judge me because I could be way wrong here and I may be overfitting, but I think that the autopilotic part of it. We can see both the separation and we can see the portal in a line if we choose to include both.

1:14:26 That's kind of what I wanted to bring up.

1:14:31 Daniel:
Okay. Very interesting, Dean. Thanks.

1:14:36 Here's the unfolded tetrahedra. There's a few shapes of paper that can be folded into a tetrahedra. One looks more like a parallelogram and one looks more like an equilateral triangle. We're just kind of like, folds up like the petals of a flow. So these zero lines so there's the zero point of within a facet representational and non representational.

1:15:07 That's almost like the two sides of the paper. Like, how many triangles are here? Oh, four. How about eight units? How many triangle units of paint do you need to paint this?

1:15:17 Four. No, eight. Two sides. So the zero is like the thickness of the paper. And that's also when you fold it up, that's like inside versus outside of the state.

1:15:26 And then these zero y ines are like the movements from one face to another force, where it's also thin enough as to be imperceptible, especially when it's laid flat. But bit makes all the difference to move from one side to another.

1:15:51 How do we use moving through zero in this eight fold or other recognition model? How do we use that to increase the efficacy or the fluidity or the accessibility of models?

1:16:14 Dean:
Does it help us in explaining that we're not locked out of that self organization loop that we can actually participate in bit? Is that the first thing that it tells us, that we're not locked out of that ability to selfgenerate?

1:16:41 That was a question I wasn't questioning. Bit wasn't like an honest, sincere question.

1:16:51 Daniel:
I think. So one supportive or complexity component would be this is sort of a map. This is like a cognitive map. And someone could say, this side of the paper is better than the other side. And this is my favorite face, but it's presented as part of a larger knowledge structure such that the learner could engage in counterfactuals.

1:17:18 Like, what if we were on the other side of the paper? Or what if we were on a different face? So this allows, for example, individuals to reflect their understanding of the lay of the land, but also communicate their preferences. And as the paper shows, different individuals do have different outcomes in terms of their cognition, conclusions. And that's what reveals the super fascinating thing about us.

1:17:45 And that's why the paper is model ourselves. What the free energy reveals about our implicit notions of representation. Not free energy principle modeling representation. What the free energy principle reveals about representation, which would be a slightly different paper and title. So just the scholarship and the sense making phase that only very few have to engage in, like Samsung, Pazilla have, is to make these maps and then bring the perspectives that were not integrated to be shown as just different locations in a phase space.

1:18:39 Like we put four zeros bit. It's not as simple as just like two numbers, but if it was just two topics being against each other, every perspective could have like a position in that face space. And then what do we do? Switch that?

1:19:02 Yes. I'm thinking about that ourselves, part of modeling ourselves. I'm not really thinking about all humans and the way that our minds work. It's more of the academic conversations that have been happening around the sort of intellectual tradition that's been happening around representation. And so the contribution of this paper, as I see it is that, look, we've got this framework that does a lot of work for us in a lot of different disciplines. Yes, Danielle.

1:19:30 Danielle:
And if we apply it to this conversation, this intellectual debate that's been happening, we can reveal implicit assumptions of the debate itself. And what emergence is that perhaps as an artifact of particular examples that have been used to understand representation, we see one side of the coin or another. We can see these we pull on these different dimensions that are laid out in this paper. So I guess it's just important to think about and disagree. If you disagree, but be ourselves is really just about the way that philosophers and cognitive scientists have been thinking about this.

1:20:10 Nothing
is true. This is not revealing something about cognition per se. It's more about the implicit assumptions that have been kind of unfolding and how we're thinking about the discipline. Thanks for that. Just like there was a sort of hinge on the functional being used in two different ways.

1:20:33 Daniel:
Another sense of representation, one that might be more commonly used outside of cognitive science, would be like representation in terms of different perspectives or identities in a group. And then that made me think of Nothing about us without US which is used in different contexts, but basically has to do with participatory decisionmaking that decisions are not being made in a way removed from the people who it influence. And that has to do with representation. No taxation without representation, for example. And so cognitive science is actually in a nothing about us without US because if there's just an academic discussion.

1:21:22 Especially an unexamined one with a lot of implicit baggage about a hyperintellectualized. Hyperabtracted scenario. Or like we like to study representational organizational cases where it's super clean. These are the ones that we study. These are the model systems.

1:21:39 These are the kind of careers that have been built in academia. For example. But it's about us in the broader sense, like humans and then even us as cognition entities. And so it is the philosophers and the literature that is in this paper as Danielle kind of. Highlighted that's the modeling ourselves, the selves there are the participants in the discussion around representation, which of course has been textual abstract, English speaking, qualitative, other adjectives.

1:22:25 So it's another interesting connection there. Bleu. So definitely the subjectivity that Daniel highlighted is a big part of perhaps why we have these organizational structure, these different viewpoints. But maybe something that I don't think is really emphasized too much in this paper is kind of the realist versus instrumentalist viewpoint of active inference. And so there's a pretty big argument in the literature and I think probably the math is not the territory maybe gets into it the best maybe in the most detail of the papers.

1:23:11 Bleu:
that we've studied here on this stream. But theorem area, people that say like, active inference is a way to model the cognition process or the action perception process that we all undergo. And then there are people who say that this is actually happening in a computational way in the brain. It's not a model of it is how it works. And so there's this ongoing like vision fusion feud happening in the active inference community also.

1:23:44 And I just wanted to highlight that because. You may not thanks a lot. Bleu I pulled out a few quotes because I also noticed that bit was one of the earlier quotes when we were talking about the, I think, organizational element. So look at how often reality comes into play in these discussions. So internal variables of a model, okay, so we're talking about instrumentalism, right?

1:24:16 Daniel:
Like models area understood to be separated from external reality by a Markov blanket wait reality. And the generative model is leveraged to infer the causal structure of material reality. So it flips four times in that sentence from reality from model to reality back to model back to reality.

1:24:55 It's a very it doesn't make it right or wrong. It's just a very interesting epistemic artifact because within the reality of the model, like the reality of the map bit is the case that the internal variables are separated. And if the model is trying to do determination on that level of reality, like maps trying to infer maps, that is reality, but then that's not the sort of layer one external reality in the sense that many people often mean or use it. Dean yeah, I think, Danny, if you take the words reality and model and push them out into even more extreme tales, you could see the model, you could see people who area pushing back against the model idea and they're arguing, you're just too rigid, right? You're just too stock.

1:26:01 Dean:
And you can see people that are taking the non representational sort of reality view, the variance maintained or retained view. You can see the people that are on the model end of the continuum saying that's just chaos. There's nothing about that that we can actually make sense of because the cognitive overload right now is just swamping me right and so I think what these authors were trying to do is say, well, can we move back and forth instead of getting stuck on those really far out positions in terms of this way of being able to see when we have these densities, right? And then out of those densities re set back to some sort of invariance and then rereform, right? So I hope that kind of speaks to what Daniel was saying too, because sure, we can point out the most extreme example at the very end of the continuum or we can actually talk about how we're going to draw these unidirectional or bidirectional lines and boundary cross.

1:27:19 And I think that's what they were trying to open us, our thinking up to. But maybe I'm just being Pollyanna here because I really like the paper. I don't know.

1:27:32 Daniel:
Interesting point. Realism is also used in another way, which is kind of like it's a school of literature or a thread of literature. And so then I found this paper, affect of realism evoke reality beyond representation.

And so this is in the case of literary expression. So that's an activity that cognition entities are engaged in.

1:27:58 And we just see a lot of terms that we talk about in active, like agency, affect, process. And here it's not about reality, realism territory. It's like realization. And realization is an interesting word. And I know verveki and others use it as well because realization, it is about the model.

1:28:26 But when something is realized, it becomes real in the model. But usually we wouldn't say that something is realized like, oh, I just realized that zebras have nine legs. It's like you engaged in a counterfactual. But is it a implication if the model is updated in a way that isn't concordant with reality? And I agree that the paper gives us a lot of nuance to talk about these areas because we can talk about how well the evolution of the variables doesn't change or the structure of the legs and the zebra doesn't change or it can still run, right?

1:29:13 So why not nine legs? Is it still a zebra?

1:29:20 There's a lot of open threads, but the way that they use model and reality in light of a lot of the other discussions we've had is really illustrative Bleu. So one of my favorite things to think about in terms of like the realism versus the instrumentalism is the Markov blanket. So I was looking for the picture about like of the person sleeping under the mark up blanket really as a position for a system. Do systems have Markov blankets or can they be modeled with Markov blanket? And I always just like think of that cute little picture with the little person sleeping under the Markov blanket.

1:30:12 Bleu:
Like, do I have a Markov blanket up around me? Because that's really where it tends to Brea down in my mind. Like, yes, there's a boundary, but I'm not sure that it's karl Friston blanket or a pearl blanket or a markup blanket. Maybe it's just skin.

1:30:34 Daniel:
Yes. Dean?

1:30:38 Dean:
I hate answering a question with another question, but in the conclusion of the paper, the authors speak specifically to the free energy principle can be very heuristic. And so I'm wondering in the instrumentalist versus versus realist debate whether it has to necessarily get up to that abstract level of Markov like it, or whether we can just say that sandwiched between those two are rules that we demarcate, that we lay down and that we have act as a parsing mechanism. I don't know, what do you think, Bleu like our rules area rules, things that we can just get our hands on right today instead of having to go all the way up to figuring out what a Markov like it is under this set of circumstances. No, I can. Definitely rules.

1:31:26 Bleu:
Right. So I mean, we all agree that there are laws in physics. Like if you drop an apple it will fall to the flow. We all abide by these rules. They might not apply at every scale, but I definitely think that a rule based construction or understanding.

1:31:42 Does that then bridge the realism versus instrumentalism debate? Perhaps.

1:31:52 Daniel:
Building on the point that the ourselves in the title is the people reading the paper. So not just like people in the psych department, but it's the ourselves, the people who are in that epistemic commons so using that, but also the content related representations in terms of correctness or truth. So if that if the ourselves are those who are pondering FEP, then the heuristic that they refer to, we conclude by highlighting the heuristic power of the FEP to advance our understanding of the notion of internal representation. It is pretty meta because we're representing the debate about people representing the debate about representation. However, the fact that it has a heuristic utility within the content related aspect, at the very least it does have representational impact.

1:33:09 I'm not sure where that takes us. There's probably other ways to take it, but I think something about the diversity of conclusions that people have and how that shines a light back on us or is a mirror and how the FEP has been applied here in this paper as a heuristic for sense making in this meta debate says something. I hope, Danielle.

1:33:44 Danielle:
I hope I'm addressing what you're saying and not taking this in another direction, but. Stepping back. I'm thinking of FEP as just one of many different tools of thought that we have that
allow us to align our representations. And if it is an effective tool, we all start having a conversation that makes sense to each other, that's mutually intelligible.

1:34:09 In this case it is kind of meta because it's about how the academics, the intellectual conversation about representations have failed to converge on something. There is this debate theorem area, many layers of the debate. And so what it reveals is that we haven't yet converged, the community hasn't converged. And so FEP is this thing that we can use that reveals those things and allows us to then better because it's revealing these things. We can all attend to those things that were implicit and are now made explicit.

1:34:40 We're converging internal representation. So I think That kind of addresses what you're saying. It's about representations, but it's also this tool. Like there are many other types of tools that allow us to realize what we've been taking for granted and action oriented representation. Thanks a lot, Dean.

1:35:01 Dean:
Yeah. Just to add on to that, if you're like me, you think rules and tools, area interchangeable. And the other thing you think is that if it's a heuristic, it speaks mind of to that vicarious function in terms of content. So I just want to throw that on top because I think there's some agreement around that we use the rules to make that next very vicarious play before we make the next move. Anybody that doesn't is kind of kidding themselves, I think, but maybe I'm wrong.

1:35:47 Daniel:
Okay, here's a little bit of FEP in a heuristic case. So we talked about the Helmholtz decomposition of vector fields, like in stream number 32, about how there's this pragmatics or sort of hill climbing or gradient descending component. Whether you take the optimistic biology climbing mountains, improbable, go straight up the mountain of fitness or the physicists gradient descent into the bottom of the well. In either case there's that variational component that's associated with pragmatism and then there's this epistemic component that's associated with the solenoidal isocontour. So we've talked about that Helmholtz decomposition.

1:36:32 So here's one way in which the FEP is being heuristic applied. So Daniel said the academic conversation on representation has not converged and it has not converged and it has also not even coherent. Like there isn't a shared ontology, there's not a shared narrative, there's not shared words or regime of attention or what people are even focused on. And so what the FEP is doing literally like they did here with this distinction, it does a few things. It holds space for not overfitting.

1:37:13 Like, let's just say in 2055, all the people in the world or all the cognitive scientists, they all agreed, oh great, we converged, let's lock that in. But FEP even then will remind us, like, not to overfit and also not to center one side of the tetrahedral. We could say this is the side that has these attributes, or we focus on this side for these reasons and no one goes there to this other side, or there's a reason why we don't go there, or we take a journey, we travel through there, but we don't live there, or something like that. It brings a level of coherence to the discussion that doesn't necessarily have the goal of perfect static conversation. But still, there'll be solenoidal flow and differences in opinion even then, who said the FEP wasn't useful.

1:38:23 Danielle:
Cell, and maybe this is obvious, but is that not what any goods theory does? Like Bleu said, cell gravity is true because if I drop an apple it will fall. Yes. So the theory of gravity does the same thing. It allows us to action oriented representation.

1:38:38 It's just that the theory of gravity is not itself about representation.

1:38:45 Daniel:
Yes, this is like the hall of Mirrors, this paper and conversation because it's the group of people in the hall of Years and they're all wearing mirror suits in a weird way. But it is our gym for building the kind of framework that then can reduce our uncertainty a ton, potentially in similar cases. And the strange loop of reflexive cognitive entities is going to be this open ended bounce for a long time to come. But just like how we started here with a really complex reciprocal case of two adaptive entities but then it was a lot less ambiguous here. And I wonder if active informed system design will frame an increase amount of pieces, especially in a digital world, into this bottom tier offloading some of the repetitive tasks, attention consuming tasks, anxiety producing stimuli into these type of interactions which opens up new spaces for these kinds of interactions with the two adaptive entities.

1:40:20 To return to that having or possessing a Markov blanket, just one quick point, which we already even read the quote, which was a core aspect of FEP such as the possession of a Markov blanket. So is the Markov blanket the system or does it have one? Those are both reality or is it modeled as having? Is it model as being those area instrumentalist ways of similar framings? And how do we know what the force aspects are?

1:40:48 What does that stem from? So there's a ton to learn and discuss there. And then let's look at in just our last few minutes any of the other topics and if anybody wants to highlight one of these or also maybe as we jump off from 36.2 to 37 and beyond when we discuss Free Energy a user's guide, but also we just continue on our paths, like why does it matter? Not all these papers maybe make the argument for why this whole representation debate matters. So what is the pragmatics that make this meaningful, make it important to fund people working on it or the way that influences the technologies that we're developing rather than just a pure infogain prediction of uncertainty question?

1:41:55 So any topics here or any like thoughts on how this will or could or should influence our action selection going forward?

1:42:20 Dean:
I'm comfortable with long silences, but I'm going to throw this out there.

1:42:29 I think people will be able to use this tool to become more creative, not just be able to reduce and minimize their prediction error, but actually have the confidence to come up with new and different ways of looking at problems that we probably didn't have in our toolkit before in terms of being able to come up with something different. And so I think the first thing that it does is bit allows for a boundary crossing that maybe we constructed in our minds before, but we're seeing less and less of it as being a hard stop. And there's now maybe a little bit more say in whether to go or don't go. So that's what I would think that this kind of work is maybe opening up unless somebody comes and shuts it down. And I can't speak to what outside forces would find terribly threatening.

1:43:34 But I'm sure there are some out there.

1:43:39 Daniel:
Outside Bleu. So I'm not sure if this has any pragmatic value, but I'm certainly interested in kind of really exploring like sensory motor engagement and structural representation and maybe like synesthesia. I know Daniel Chaos been to meow, but when you're playing these invisible harp and could you structure a room? Like draw a map in a room and your goal is to like kind of like an scale room, but your goal is to find navigate your way through based on sound, right? Like you ting the things and you have to find the right sound.

1:44:15 Bleu:
You play Mary Had a Little Am and then you get to your prize at the end or you get to get out of the room. So I wonder creatively, like Dean was saying, really, these maps, these representations, can we get literally

out of our own representation and into the feeling of an alternate representation and what would that feel like or be like? And that's also why I brought up like, blindness. If you ever wake up and totally like my power went out the other night. It's like black.

1:44:43 I mean, no moon, nothing. Bit was just like, whoa, total darkness, right? Like no little Bleu light from the plug or nothing. And so in these total darkness situations, you have this representation of what is my house look like? Where's my flashlight?

1:45:00 You phase to be able to navigate yourself in a totally dark situation which is very foreign to go find a flashlight. And so I like these kind of boundary pushing experiences because they really force us to examine our own model and perhaps allow us to explore the kind of models that other people use.

1:45:23 Daniel:
Thinking through other minds is this case with adaptive agent in dialogue. And it's like thinking through other representations. And this paper and discussion opens up not to then simply converge, but opens up and holds ways to think and act through other types of representations. Not just the same type, but in a different cognitive entity.

1:46:03 It comes up a lot. And it would be awesome to see how just as so many other themes that we've had raised by very prescient papers like 14 Math is not the Territory, 20 Emperor's New Markov Blanket and some of the further nuancing about the Markovian assumptions. This representational and non representational and these words like organization, structure, content and function, they will come up again. And maybe they'll be citing this paper, maybe they won't, but like, it's almost like when we see in a future paper just one facet of the set and they'll say, here's how it is, it's this one side. And it's like, well, no, there's other sides and we could be inside or we could be outside and someone could still say, I prefer this one, but we know there's a bigger system that we can at least come to the table around.

1:47:11 Dean.

1:47:15 Dean:
I'm not marketing, but it's going to come up in 37. It's going to come up a bunch of times in 37. So that's just the next paper anyway. Hold
on to your socks because if you think you have to wait for it to come up again, it's going to come up again next week. Don't touch that dial.

1:47:40 Daniel:
Thanks a lot for the awesome sequence. This was a somewhat complex or intellectual paper. I mean, they're all written, but this one was like challenging topics, a lot of different perspectives. And then not only did they hold it open for all of the different perspectives, but then rather than pick a winner, they flipped the table in the end and posed it not as an answered competition for us to then have like domain specific clarity of action within, but really a challenge on multiple levels. For researchers who are familiar with FEP and not, the big question we asked was can the free energy principle help us advance or even resolve the long lasting debate on internal representation in philosophy of mind?

1:48:54 We certainly asked.

1:48:58 So if anybody has any last concepts they want to make on anything, they're welcome to.

1:49:13 Dean:
Last words. So I'll get this in real quick. I think that we're still arguing about whether or not representation and modeling is heavily dependent. Like, that there is a dependency. I think that the more philosophical views that we see come up around FEP and active inference.

1:49:36 The harder and harder it is to make the case that we can remove that dependency or somehow just see the scale three aspects of this tool that there's actually a heavy dependency on what we're going to get out of representation or non representation based on our awareness or our realization that every time

we cross a boundary. That is just an independent act. That's a highly dependent act. So that'll be my last word.

1:50:11 Bleu:
So I just want to give a final comment. You know, we talk about instrumentalism and realism and then there's the third axis of utility. And I really think that this paper was super useful in prompting new questions, in holding up these different views of representation and non representation and in these different categories and allowing us to really kind of view them through a partitioned framework that I think will drive future questions and really be useful in helping researchers formulate their theorem area.

1:50:56 Daniel:
Danielle, you're still here. Thanks for joining for your first stream. Do you have any last comments? This was a wonderful introduction. I'm curious how representative it is of other conversations.

1:51:11 Danielle:
It was super heady in a really pleasant way. It was not representative or representational of other conversations. No. Thanks a lot. Awesome combo.

1:51:23 Daniel:
Everyone's always welcome to join these discussions or other lab activities. So thanks again to the authors and all the participants here. See you.