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Provost Presents Faculty Research Series: "The Structure of Working Memory: A Review and New View of Psychometric Models"

Kevin Rosales

Provost Presents Faculty Research Series

"The Structure of Working Memory: A Review and New View of Psychometric Models" by Kevin Rosales (March 28, 2024)

Working memory, defined as the ability to maintain and process information in the face of complex cognition, has been linked to important cognitive abilities like intelligence and academic outcomes. In this presentation, Dr. Kevin Rosales, Assistant Professor in the Department of Child Development at CSUSB, will discuss the findings and implications of his research on the structure of working memory.

START – 00:00:00

Speaker: Alright. Good afternoon, everyone. Hi! I'm filling in for our Dean, who is on a well deserved vacation right now. So I just wanted to say, welcome and thank you for attending. Our Provost presents highlighting faculty research. Thank you, guys all for coming on your lunch hour. I know sometimes it's a little tricky, but thank you for bringing lunch. Now I'm hungry. Should have probably. Alright, I think we're ready to get started, and without further ado our Provost Rafik Mohammed.

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Speaker: Then

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Speaker: usually I met with booze, so I or sometimes booze. But that's just when you

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Speaker: but

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Speaker: hi! Everybody! I I I'm happy to be here. I'm happy Kevin's here. Otherwise we it'd just be me talking about like psychometry or something, and things I don't know about but I'm I'm happy to be here and and happy. You all joined us today. This is one of my favorite things on on a campus like ours is to learn

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Speaker: from or showcase the research that that our faculty do cause. I say all the time that we have faculty at Cs, USB, who could work anywhere

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Speaker: they are excellent teachers, exceptional researchers. But they come here to Csb, and they stay here. You're not going anywhere. Right? This is your first year. So you'll be back next year.

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Speaker: Okay, good. They they.

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Speaker: They. Yeah. Christine is like. We'll give you whatever you need. You can have Eugene Wong's office he says, offering up his car, whatever but but they they choose to be at Csb, because they they believe in our mission, believe in our students and want to serve in that capacity. So I'm always pleased to be here for events like this to hear from and learn from

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Speaker: our faculty here on campus. I have formal notes that that we're gonna talk about what got you here and what you do you ready for this? Okay, okay, it's a good afternoon.

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Speaker: Okay. First step. As I already said, I'm delighted to introduce today's presenter, Dr. Kevin Rosales, an assistant professor in the Department of Child Development. When I got here there was no self-standing department of child development. Now there is, and it's booming

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Speaker: all right. So in the department of child Development.

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Speaker: Dr. Gross joined the tenure ranks at Cs. USB. As an assistant professor this academic year, as you all heard witnesses. He promised us to be back next year. So that's good. He has been, though, a part of the Coyote family for quite some time for more than 10 years, first, as a student who earned his bachelor's degree in psychology and child and child development in 2,016, which

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Speaker: my meeting right before this, which was why I'm late. I'm gonna blame, Kelly Campbell I was with Dr. Campbell, and she's like. Oh, she's running late, she said. Oh, that she's like Kevin's wonderful. He was a student. He was an honor student all this other kind of stuff, and he was just amazing. So so she she vouched for you. So I was like, Alright, he must be okay. Yeah. And and Eugene, not to slight you, Dr. Wong.

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Speaker: but apparently you had a hand in this, as dr. Gzalice was mentored by our own esteemed it says it here. So it must be true. Esteemed colleague Eugene Wong, and was also an honor student in Sbs psychology honors program. All an undergraduate most recently until, joining the the tenure line ranks, he served as a lecturer in both departments psychology and child development from January 20 ninth to May 2023.

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Speaker: He has taught several courses at Csu, USB, including cognitive development introduction to data analysis, applied research methods, language development and others.

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Speaker: He and I have a lot in common, including the exact same research areas. His areas of specialization include individual difference in working memory, executive functions and cognitive control, psychometric modeling of cognitive abilities, network analysis and latent, variable modeling interventions designed to improve cognitive abilities among adolescents.

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Speaker: cognitive and cognitive abilities and academic performance. I understand why you work closely with Dr. Wong.

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Speaker: I was gonna wear my bfast jacket on the way over here, but it's a little, but it was a little warm.

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Speaker: He has authored approximately half dozen publications in the last few years, and has multiple manuscripts currently under review or in progress. He is also a member of the Psychonomic Society, the American Psychological Association, and the Western Psychological Association, and the Society for Applied Research in memory and Cognition.

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Speaker: In his in his presentation today titled The Structure of Working Memory, a review and new view of psychometric Models. Dr. Gonzales will discuss the findings and implications of his research on the structure of working memory. Please join me in welcoming Dr. Kevin.

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Speaker: Appreciate that introduction

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Speaker: to work.

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Speaker: We're good. Okay, awesome. Well, thank you. Guys for being here. I really appreciate it.

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Speaker: think it's a wonderful opportunity to, just.

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Speaker: you know, tell you a little bit about the work that I've been doing, but also the work that I hope to continue doing

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Speaker: here for many years to come. So there's, you know, should be no worry about that at all.

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Speaker: And so

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Speaker: representing the Department of Child Development today, and will, as

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Speaker: Provost mentioned.

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Speaker: talking about the structure of working memory.

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Speaker: a review new view of psychometric models. So just starting off.

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Speaker: no, it's not clicking through.

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Speaker: there's just a roadmap that we'll follow one talking about. Well, what is working memory right? How do we think about it?

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Speaker: Then, transitioning into well, how has our field

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Speaker: tested working memory both within the area of cognition and then psychometrics more specific.

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Speaker: and then transitioning into well network modeling. What role can it play in addressing some of these thoughts and contributing to the field in some

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Speaker: different but meaningful way? And then, of course, the current work that I

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Speaker: will be doing and am doing, and then have done as well, and then future directions in terms of well, where do we go now? Right? How do we continue to progress? And

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Speaker: in these areas.

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Speaker: so working memory,

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Speaker: can be defined in many different ways as my lab.

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Speaker: But it's the ability to simultaneously process and store information. So in this current moment, hopefully, you guys are processing what you're seeing up on the screen, listening to what I'm saying. All of that is kind of being jumbled up in some way, trying to make meaning right of of what is going on.

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Speaker: as you're, you know, processing, connecting those ideas to other thoughts, etc. Right? So without a working memory, we wouldn't be able to do

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Speaker: complex cognition, right? And so sometimes complexity can be defined in different ways. But it could come down to writing an email or attending a meeting, or, you know just doing well in school, right conducting research, etc.

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Speaker: There are numerous concepts in the field of working memory.

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Speaker: but really the

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Speaker: definitions that I kind of subscribe to given the data are, first of all, the multi-component working memory. So this definition describes working memory as a

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Speaker: ensemble of different components. That kind of work together to be able to help us navigate our way through different tasks.

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Speaker: Also

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Speaker: the attention control

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Speaker: definition of working memory which is really

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Speaker: looking at working memory as primarily being driven to through attention.

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Speaker: Right? So attention is this very core piece of working memory. And it's, you know, one that we usually always account for in our models, and of course.

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Speaker: also the inclusive working memory here that I'm not highlighting, which also highlights, you know, working memory as being a

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Speaker: repertoire of numerous abilities that you know, work together in that way as well.

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Speaker: So what do cognitive models say

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Speaker: about working memory? What do we know so far from background research. Well, one, the purpose of these cognitive models is to understand mechanisms. So one thing is conceptually understanding what working memory is. But another thing is to know well what is under the hood of this thing that we call working memory. Right? What are the different pieces that move

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Speaker: that make working memory work.

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Speaker: Erm.

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Speaker: And so there are 2 models that really motivate my work. So, as I mentioned before, Badly's multi-component model, so the name badly tends to be pretty popular in the field right? And then the other model here is over hours cognitive process model, which is a bit newer and is really contributing a lot of what we know modern in modern times today.

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Speaker: So just a quick recap of Battley's model so badly, you know, proposed this first model and

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Speaker: 74, then revamped it in 2,010. But really we have the central executive component here that I like to call it in class like the big boss, right? So this component really drives performance on every other component below it.

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Speaker: And we can just think of this as the attentional piece right? If we have good attention, engaging and good attention than the rest of the

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Speaker: Erm model will will work.

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Speaker: and so we can break it down to things like the phonological loop, which is what we're hearing processing. That auditory information.

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Speaker: visual spatial sketch pad is what we're seeing, right? So there's domains that are being integrated into working memory. And of course, things like long-term memory. So using what we have learned before bringing it to the now. And how can we, you know, put these pieces together to then move forward in some meaning.

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Speaker: Now, so just things that we know

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Speaker: from this model is that there is evidence, right that if any one of these components

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Speaker: kind of fails, the working memory system no longer works as it should.

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Speaker: especially that domain, general attentional piece, right? The

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Speaker: the big boss components.

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Speaker: We know that individuals, you know, process verbal information, spatial information.

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Speaker: But one of the shortcomings of this model is that we don't really know what this

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Speaker: piece really is in terms of

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Speaker: more nuanced

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Speaker: information. Right? All we know that it's it's attention. But really, what happens there. Why is it so crucial?

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Speaker: And so that's one of the shortcomings of this model.

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Speaker: So later, Klaus Oberhour and

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Speaker: friends and colleagues said, Well, we need to work on that we need to be more specific about what working memory is.

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Speaker: So

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Speaker: this image here just kind of depicts how working memory works at a conceptual level. So there are thoughts that are kind of floating around in our working memory.

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Speaker: Shaded regions here that are lettered are maybe pieces that we're thinking about now. Right? So I'm hungry. I wanna you know, get over the sock and go to lunch right as you may be thinking, or you know the information that you may be processing at this given moment. So all of these things get connected and brought into the focus of attention here, right? And that's that one thing that we're thinking about now.

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Speaker: Right? So information moves in and out through the model here. And you know it changes, depending on what the demands are, etc.

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Speaker: Now.

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Speaker: psychometric models are now different from cognitive models. Cognitive models explain mechanisms.

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Speaker: psychometric models explain well, how do we measure

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Speaker: these abilities. And what is their underlying structure? How are they correlated.

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Speaker: Erm?

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Speaker: And so there are 3 psychometric models that also motivate some of my work. So executive attention theory, the cane et all model. And then on Zrf model, which we'll talk about

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Speaker: in just a second.

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Speaker: And so executive attention.

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Speaker: This theory simply states working memory is driven completely by attention. So this was really pioneered by Randy Engel.

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Speaker: and has stuck around for a long time.

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Speaker: Some evidence for this model simply showing that so and who's heard of the street task before?

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Speaker: A few of you? Okay? So the stroop task is a task where you're presented with words on a screen.

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Speaker: and your job is to pay attention to the font color of the words. And so some words will be things like red and red ink. Right? So you name the color.

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Speaker: And so if it's red and red ink, that's easy, right? It's it's it matches right. However, other trials the word red will come up, but in blue ink

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Speaker: right now it's a little bit more difficult because you have to override the need or the temptation to read the word, but focus on the color itself. So then the correct answer, there would be blue

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Speaker: studies show that folks who have higher levels of working memory are able to resolve or resist that interference much better, right? So they are more accurate in the soup tasks. In those conditions where the color, and the word itself don't really match

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Speaker: Adam.

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Speaker: all right. And so.

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Speaker: keeping forward here.

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Speaker: a lot of this work has been done using latent variable models. So for those of us who are familiar with this, we know generally what these are, but for those of us that are not.

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Speaker: Basically these boxes here represent actual tasks that we administer in the lab setting.

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Speaker: But from these tasks we kind of suck up the

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Speaker: common variants, and we produce what's called a latent factor. And so now this bubble here represents fluid intelligence

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Speaker: as measured by these 3 individual tasks. And so that's true for every other latent factor here. And so in line with the angle or executive attention theory.

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Speaker: It's really this, ef right, that attention, ability that drives performance on working memory and things like intelligence or fluid

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Speaker: intelligence here. And so it's just kind of a snapshot of where does that evidence come from? What does it speak to?

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Speaker: All right, then.

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Speaker: Second psychometric model

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Speaker: that motivates my work is this cane at all model where

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Speaker: you know comes along and says, Well, I don't think that it's just attention. We should account for other things as well. So how about verbal storage and spatial storage?

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Speaker: And so we find that working memory is not just attention driven.

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Speaker: But there are also domain specific

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Speaker: storages that we rely on. So storage is for verbal information. Storage is for spatial information.

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Speaker: And so graphically, right. There's, you know, try not to get, too, you know, into the weeds of these things graphically here. What we're looking at is well, we have storage, spatial

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Speaker: storage, verbal attention in the middle. All of these have a say in predicting things like fluid intelligence. So this

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Speaker: outcome here tends to be very common

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Speaker: as an index of well, what does working memory predict? It's kind of like a sanity check. We have to make sure that it's able to predict other things. And so often it does. Okay. But adding these

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Speaker: separate components as well.

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Speaker: all right.

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Speaker: And finally, the Unsworth model. So Unsworth comes along and says, Okay, great attention works, you know, verbal spatial storage also works. But

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Speaker: we're not taking into account

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Speaker: secondary memory, which is equivalent to long-term memory.

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Speaker: And so this is where that additional piece comes into play where we are. Here, for example.

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Speaker: looking at how working memory can explain the relationship with fluid intelligence.

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Speaker: but as mediated by capacity which is

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Speaker: similar to short-term memory, attention, control, or attention, and then, of course, long-term memory. And so we get a full mediation here where

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Speaker: fully explained. So these factors tend to be

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Speaker: important in explaining relationships with

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Speaker: fluid intelligence. So

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Speaker: as a sum.

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Speaker: where are we currently right? So so far, we know from numerous models

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Speaker: that attention is important. So each of the models kind of gets at that

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Speaker: verbal storage is accounted for by the Canadel model.

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Speaker: Spatial storage, also by the cane at all model

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Speaker: that most recent model that we saw

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Speaker: kind of covers, verbal and spatial. But it doesn't really break it down by contents. That's why the X is kind of in the middle here. So that was that one capacity

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Speaker: factor, and then episodic memory by Unsworth as well.

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Speaker: however, what you notice is that there is no one model that covers or checks all of the boxes.

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Speaker: and that's where there's a gap in the literature, where, you know, we don't have a comprehensive model of working memory. Right? So

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Speaker: that's where my work

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Speaker: really comes into play. Okay? So no psychometric model accounts for all of these components.

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Speaker: Alright. So now a lot of the work has been done using latent, variable modeling.

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Speaker: But here we propose an alternative which is network modeling. So how did how do they compare and contrast?

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Speaker: So one of the issues associated with latent, variable modeling is that

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Speaker: it supposes an assumption called the principle of local, and

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Speaker: and so we'll see what that means. And and in just a second.

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Speaker: So the principle of local independence. So remember, when I was talking about these tasks right? Representing a construct

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Speaker: right. All of their commonalities are taken up, and that represents the construct.

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Speaker: But once that has happened. So once the variance has been explained.

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Speaker: these tasks are no longer allowed to be related to tasks and

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Speaker: other

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Speaker: constructs.

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Speaker: And so that's problematic. Theoretically.

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Speaker: because if you think about cognition? That's not how cognition works.

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Speaker: All of our abilities collaborate all the time. And so if we're looking at cognition in such a sense that everything is kind of

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Speaker: separated and segregated. Then our models are not doing the field any justice in terms of accurately thinking about how we think how humans think.

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Speaker: And so to overcome this statistical disadvantage.

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Speaker: We have network modeling. So on the right.

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Speaker: we have a network model of this traditional higher order, latent, variable model.

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Speaker: And so what the network model

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Speaker: or how you read this.

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Speaker: So each color represents a construct so green here would represent visual spatial ability.

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Speaker: pink processing speed, yellow working memory, etc.

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Speaker: The lines that connect each bubble, so the bubbles represent the

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Speaker: we call them nodes

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Speaker: those lines that represent the correlations between the tasks.

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Speaker: so the thicker the correlation right or the stronger the correlation, the thicker

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Speaker: the edge here or the line right? And so we'll see that there's differences in how all of these may be related to one another.

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Speaker: But, importantly, we allow all of these abilities to correlate with one another. If the correlations exist.

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Speaker: Right? So I don't tell the system. You know. Plot lines between, you know this variable and processing speed. Right? It's a data driven approach to understanding. Well, what's the reality of these abilities? How are they really structured and related? And so the data tells us. Well, you know, we have a strong cluster here for crystallized

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Speaker: and that's related to working memory and working memory predicts fluid reasoning, and and so on. So

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Speaker: this is just a general way of how we

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Speaker: can think about network models and why they surpass late invariable models and

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Speaker: and a couple of ways.

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Speaker: So up to this point one, there's no comprehensive model. That accounts for all of the abilities.

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Speaker: And 2, this really hasn't been explored through network modeling.

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Speaker: So we're trying to bridge the gap here between what we know and what we could know right? If we had adopt different

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Speaker: methodologies.

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Speaker: All right. So

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Speaker: has been heavily underutilized

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Speaker: network modeling actually came out of clinical psychology.

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Speaker: Okay, so a lot of clinical work uses network models to understand things like depression, for example.

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Speaker: and things of that sort. And it's not until the last 5, 6 years that it's been slowly

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Speaker: making its way into cognition. And so, you know, for the clinical folks in here, you know, we borrowed some of some of that knowledge for

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Speaker: for the cognitive work that we do.

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Speaker: All right. So a couple of studies here, so study one. What we wanted to understand is if we have data that speaks to all of the components of working memory.

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Speaker: how does that look like in a network model? And so the purpose was to

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Speaker: determine whether the network model of working memory is comparable at least to the latent, variable model of working.

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Speaker: And then there was a. There is a study, too. Where, then, we compare the predictive validity? So one thing is understanding

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Speaker: what is working memory but 2? Is it useful? Can we use it to predict other things.

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Speaker: So now

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Speaker: study one. So this is a secondary data analysis. So that's kind of popular in my lab.

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Speaker: But we use the Wilhelm at all. 2013 data. And this data set really had most of the variables that we were looking at or wanting to look at.

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Speaker: And so then we

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Speaker: implemented network modeling procedures. I'll spare you some of the details here. But

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Speaker: what we really were wanting to get at is, can we analyze attention.

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Speaker: verbal storage, spatial storage and episodic memory, retrieval, right? Those are the 4 components that

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Speaker: are lacking together in one unified model. We were able to get indices of all 4 in this study.

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Speaker: And so first, we had to make sure that at least the latent, variable, latent, variable model was good. The one way to evaluate, that is, through model fit indices. So that actually worked out really well, which is not really a surprise.

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Speaker: But remember, theoretically.

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Speaker: not allowing some of these tasks to be correlated with others in a model is problematic.

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Speaker: So we looked at the network model version. And so

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Speaker: here we find that model fit was as good

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Speaker: as the latent, variable model. Okay, so if we compare the model fit indices here

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Speaker: to those of this other model.

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Speaker: We're okay. So they are comparable. So there's

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Speaker: sometimes they hesitant in the field to move away from what we're used to

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Speaker: doing right. But this was a good check in terms of that where we can say, Hey, you know what network models still do, what they, you know, are meant to do, and that's comparable to the invariable model. So.

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Speaker: but that's good. Right. What we then wanted to know in

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Speaker: Study 2, which we'll get there in just a moment.

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Speaker: the network model. Really, what it shows is that it does corroborate work from

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Speaker: the working memory field. So one

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Speaker: we see here.

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Speaker: the attentional piece, right is connected to other tasks in this model in a domain general way. So what does that mean

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Speaker: that it connects to things like

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Speaker: spatial storage and also verbal storage, right? That maps onto what we know so far and so theoretically and network modeling. At least this network model does corroborate what we know already right? So that's good as well that we're able to preserve some of that theoretical accuracy there with with

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Speaker: this model.

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Speaker: But we will.

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Speaker: So now study 2.

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Speaker: So what is the predictive power? Okay, so we've been able to model network

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Speaker: of working memory. But does it predict things like we want it to.

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Speaker: And so that was the main goal of study. 2.

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Speaker: And so

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Speaker: we first had to again, just like in study, one

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Speaker: plot, a latent, variable model. And so here we see typical to what we find

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Speaker: a relationship of about point 7 7,

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Speaker: which means that about 59% of the variance in fluid reasoning is explained by working.

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Speaker: So that's typical

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Speaker: right? But what is?

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Speaker: How does the network model kind of

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Speaker: far with or fair with

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Speaker: the lane variable model. So

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Speaker: what we did is we plotted

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Speaker: what we call factor scores. So you may look at this and say, Wait, isn't this the Latin variable? So it's not

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Speaker: really. What we did is we took the average of all the different connections here, and we plotted it in this way, so it's a bit easier to just graphically present.

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Speaker: And so what we find is that when we take the sum of all of these here so verbal storage, spatial storage, long-term memory and attention. Right? We explain about 51% of the variance, right? So we have 59%

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Speaker: versus 51%, right? Not necessarily what we were predicting.

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Speaker: but at least right. Half of the variance is explained, so at least we get close enough.

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Speaker: And so for a long time my thinking was well, maybe the network model, right? Something is lacking.

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Speaker: But the alternative could be well, maybe late and but late in variable models, overestimate

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Speaker: right that relationship. And maybe network models

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Speaker: get closer at what the true relationship actually is.

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Speaker: Right? And so that's still some of the work that I'm

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Speaker: planning on doing here, so

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Speaker: will.

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Speaker: we'll see right where we go.

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Speaker: Okay.

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Speaker: So, contrary to our prediction, right? We didn't match the amount of variance explained.

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Speaker: But you know, like I was mentioning, maybe that's due to the overestimation of the

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Speaker: Latin variable model.

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Speaker: So study, one shows that network models fit

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Speaker: the data just as well

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Speaker: as Lane. Variable models do.

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Speaker: But what we go ahead and move forward with is that the network model is the chosen model because it's theoretically accurate.

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Speaker: and that's something that happens often in cognitive work where you know the statistics kind of let you make the conclusion.

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Speaker: But we don't go back and think well, is this theoretically accurate? And so the network model does allow you to think in that way, because, as I explained before.

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Speaker: right, the latent, variable models

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Speaker: have

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Speaker: certain assumptions that are not compatible with how cognition actually works.

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Speaker: So it's kind of taking the model that represents

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Speaker: cognitive abilities

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Speaker: best

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Speaker: right? And then studies, too, of course, shows that the network components of working memory at least explain about half the variance.

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Speaker: All right. So some limitations for that secondary data analysis. So

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Speaker: attention wasn't really measured. Well.

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Speaker: and so to overcome some of that, we have someone from Rhymer's lab representing us here today, we're going to run this full scale, collect our own data. And so at this moment we have about 16 tasks right in the lab. So we have people coming in and completing 2, 1 h sessions of.

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Speaker: you know, cognitive tasks back to back. So

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Speaker: not fun necessarily for participants. But hopefully, once it's all done, we're able to speak to this model a bit better

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Speaker: and getting better measures of that.

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Speaker: Erm.

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Speaker: And so

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Speaker: I want to transition now from, you know, working memory and how that's impacted by network modeling to what are other areas that network modeling can really get into.

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Speaker: And so we've

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Speaker: published the paper recently

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Speaker: where we were able to show that network modeling reveals

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Speaker: certain truths about executive function.

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Speaker: And so

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Speaker: title this paper, right, psychometric structure of executive functions.

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Speaker: a satisfactory measurement model. Right? Is it really? And examining Meta now using a meta analysis and network model?

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Speaker: So

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Speaker: if you guys don't know this

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Speaker: Miyaki model is, I think the gold standard really of how we think about executive functions.

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Speaker: that one paper that came out in 2,000.

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Speaker: I think now it's even more has been cited over 17,194 times.

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Speaker: right? So the impact that it's had in the field

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Speaker: is huge.

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Speaker: However, nobody has ever questioned, well, is this a good model for us to keep using or thinking about?

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Speaker: And so this paper looked at exactly. That. Is that the best way to think about executive.

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Speaker: all right.

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Speaker: And so the model in that 2,000 paper

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Speaker: looks like this.

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Speaker: where we have shifting, updating and inhibition.

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Speaker: those are 3 common executive functions.

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Speaker: Shifting is the ability to, you know, switch between different tasks or rules that you may be engaging in.

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Speaker: I like to use the drive-through examples. Right? So you may be preparing an order right while maybe cashing somebody out and then taking in the next order, etc. Right? Takes a lot of multitasking

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Speaker: updating is just, you know. Are you refreshing the contents in your current

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Speaker: space of thinking? Right as you're getting incoming information?

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Speaker: And then, of course inhibition, which is your ability to resist distractions. I always like to tell

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Speaker: a story that happens to me pretty often, so I pull up to a red light right.

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Speaker: and then the lane next to me is waiting for a green light to turn left

306

Speaker: right. So if I get distracted right and I see green. I want to go.

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Speaker: but then my inhibition thankfully kicks in. And so then I don't right stop, because that's not my green light. So it's an important ability, right? Could get you in trouble if you don't use it. That much. All right. So

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Speaker: what we find here is that

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Speaker: these loadings right that can range from negative one to one

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Speaker: tend to not be as high as we think that they are

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Speaker: right. So point 3 3. Is not

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Speaker: that impressive right. But yet the field really loves the model and uses it in other areas of psychology.

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Speaker: And so

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Speaker: the variance explained, really ranges from poor to just really moderate that best.

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Speaker: And so so why is it

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Speaker: that this model continues to be used when psychometrically, the evidence really isn't there?

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Speaker: And so

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Speaker: there's more error, really, than than anything.

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Speaker: So in our paper there we have numerous findings where, if we take a network modeling approach

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Speaker: and we apply it to the Miyaki data

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Speaker: that exact same data set. This is what you find.

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Speaker: right? So compared to the other pretty network model where there was connections.

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Speaker: there's nothing here

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Speaker: right? There's so little

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Speaker: covariance between the tasks

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Speaker: that ultimately what the network model is saying is.

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Speaker: this is not a good way of thinking about executive function

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Speaker: right? The tasks themselves are just not good enough, right? And so that's

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Speaker: worrisome where people, you know, pick this model, and they just kind of fly with it. It's the best model we have.

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Speaker: but not considering, you know.

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Speaker: whether it actually is or not.

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Speaker: So

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Speaker: there's many more in that article. But network modeling allows us to evaluate

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Speaker: the psychometric accuracy of executive functions, and, as you saw before, working in memory.

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Speaker: it pushes us to really consider alternative models

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Speaker: right? Can we at least think about other models that may be equally good or potentially better.

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Speaker: Erm.

338

Speaker: And it does reveal the urgency. And I think what's going on here. It's not necessarily that conceptually the model is wrong.

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Speaker: but statistically it hasn't been analyzed. The best

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Speaker: and 2, we just need better measures.

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Speaker: Right? There's a lot of inconsistency between how one lab may measure inhibition

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Speaker: and another lab across the country may be measuring inhibition.

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Speaker: Then, when you want to talk about the same thing, but use different measures, you're not really, you know, on the same plane.

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Speaker: So

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Speaker: the

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Speaker: cognitive theoretical work really does or is complemented by my more applied work. And so a lot of

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Speaker: my goal. And really, what my work represents is the bridging

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Speaker: between traditional, cognitive, theoretical work and applied

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Speaker: work. And so through the Bfast lab, I always like to call myself a product of the beef fast lab.

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Speaker: I've been able to keep 2 like these 2 lines working together. So really, I know we have

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Speaker: crowded here. But really, what we do is we go out to the schools. And we implement computers cognitive training.

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Speaker: We want to know if targeting certain abilities leads to improvements in those abilities and hopefully, ultimately, improvements in academic performance.

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Speaker: And so we'll do that using game-based adaptive program so essentially ipads.

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Speaker: And they'll engage in these activities on a daily basis.

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Speaker: And they total anywhere in between 6 to 12 h.

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Speaker: And so what we find constantly.

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Speaker: and we've shown that in some of our recent pubs is that we do find effects. So from pre-to-post we'll see improvements in things like working memory, processing, speed, cognitive flexibility.

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Speaker: right? But an interesting question to add to the mix right, bringing back what I was just talking about before is, can we detect changes using network models?

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Speaker: Right? Are we able to kind of

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Speaker: push that frontier

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Speaker: and look at the effects of these training programs in children or adolescents

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Speaker: using that workflow.

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Speaker: And so we can.

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Speaker: And so this is data that hasn't been published yet.

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Speaker: But please don't take a picture of it. I'm kidding. Okay. But so we have 3 models here. This first one here.

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Speaker: I don't know if you can get rid of the bar down here.

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Speaker: I think it's covering some of the text, but if not, it's okay. I can just walk

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Speaker: folks through it.

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Speaker: I think.

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Speaker: No, I think you can go back to the other one

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Speaker: cause I think there's still text on it. But it's it's fine. I can

372

Speaker: cover it through. Yeah, no worries.

373

Speaker: Okay, so

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Speaker: this first model here would be a pretest model. And so this is without any training.

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Speaker: And so

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Speaker: students or kids have come in

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Speaker: have taken the assessments right? And so we plot a network model of these data.

378

Speaker: So there are a few connections, right? So we can see so yellow. Here would be working memory.

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Speaker: A blue would be cognitive flexibility or task switching

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Speaker: and green would be processing speed. Okay, so we see connections. Right? That's good.

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Speaker: But then post 6 h of training.

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Speaker: Right now we see

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Speaker: a difference. Right? So now, not only do we preserve some of the earlier connections.

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Speaker: That's good.

385

Speaker: Yeah, that works. So now post 6 h of training.

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Speaker: We see added edges that were not there before.

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Speaker: and not only that, but there is a strengthening of some of these edges.

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Speaker: So that is initial evidence that network modeling can pick up on

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Speaker: developmental improvements

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Speaker: that happen as a function of interventions right. And so to our knowledge, this is really the first

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Speaker: soon to be paper that shows that

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Speaker: right? So network modeling has been used a lot with well measurement.

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Speaker: but not really with interventions, especially that occur within the school setting.

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Speaker: And then, finally, after 12 h of training.

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Speaker: some of these connections strengthen even more. And so there's actually numerical values here. It's not just like you're looking at art right? But there's objective ways of kind of determining whether these are improving over time. And so they are. So if we connect, if we compare 12 h post training

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Speaker: to no training at all, there's a big difference in how these abilities are now much more cohesive, especially in the population here, that tends to have.

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Speaker: you know.

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Speaker: difficulties with learning right, or are at risk right? So they need a little bit more

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Speaker: sports.

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Speaker: And so we find that the network models can pick up on that.

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Speaker: And so what are some implications from just the work overall.

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Speaker: So first, right, the initial studies show that

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Speaker: network modeling is helpful in understanding working memory psychometrically right, we're able to

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Speaker: take

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Speaker: previous theoretical frameworks and combine them right and provide a more accurate

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Speaker: representation of working memory.

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Speaker: We can utilize network modeling to detect changes and cognitive abilities as a function of computerized cognitive training.

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Speaker: That's really kind of the

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Speaker: the novel piece. And and all of this.

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Speaker: and ultimately bridge the gap between cognitive psychology

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Speaker: psychometrics

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Speaker: and the applied setting right, which really isn't done. So if ever right, there's always 2 distinct camps, right? Applied researchers, basic researchers. But in this work we show that

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Speaker: merging the 2 having the 2 collaborate really is a more fruitful way of kind of pushing science forward. Right?

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Speaker: And of course, that can. This can have important implications for educational settings. We're measuring these abilities often

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Speaker: really important, right? And so what are the best measures that we should be using? And of course, in clinical settings, where we, you know, we're talking about interventions. And how do we improve these interventions in

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Speaker: in the school population?

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Speaker: What are some future directions of of this work. So one like I said in collaboration with Jason Rhymer's lab is really testing at the basic level all of the components of working memory. And of course, then applying network modeling.

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Speaker: Analyze multiple studies right to see if the network models hold across different studies.

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Speaker: Look at the predictive validity. Right? So go beyond the lab right into the real world, setting and test some of that.

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Speaker: And then

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Speaker: importantly, potentially, being able to use network analysis in college samples, right? So computerized cognitive training that can be applied to a different

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Speaker: range of populations and then being able to maybe gain greater insight as to how

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Speaker: you know, network modeling can pinpoint some of the mechanisms that can then lead to college success. Right? So it's usable across many different

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Speaker: settings.

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Speaker: And so

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Speaker: is the end of my time.

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Speaker: Thank you, guys. Thank you.

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Speaker: Question.

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Speaker: Good

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Speaker: second goal.

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Speaker: Thank you so much for for the lecture and for the talks. I have one question, but I'm gonna hold my question, cause we do have a little bit of time for other folks to ask questions, and Dr. Campbell first hand up

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Speaker: hang on so that the people in the zoom world can hear you.

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Speaker: Well, first of all, Kevin.

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Speaker: I knew you as a student. And so it's pretty exciting to see you, not only as a professor, but an amazing professor cause. Look at how you taught us the complex material so effortlessly. It was amazing.

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Speaker: I have to leave like in a minute. So I thought I'd go first for a question. It's it's more of a comment

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Speaker: to commend you for your strategy of taking on the 17,000 plus cited paper through a published paper of your own with the team here. And let's see if this leads to like some arguing through published papers with that author, I think that'll be pretty awesome and is really amazing.

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Speaker: Yeah, I was thinking that was pretty audacious, but I loved it right like that, you know. You took on the cannon, so to speak, any other questions for for Dr. Gross.

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Speaker: So I was just back there. And now I gotta come back there

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Speaker: microphones. So really cool, impressive work took me back to my grad school days when I did more of that. Efa cfa multi.

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Speaker: Well, but I was wondering. So my work deals more with emotion. Right? So like a lot of what I do, the strip test for is stress people out rather than actually for

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Speaker: your type of work. So, wondering what you see, the relationship with emotion being with memory. Right? Because I guess part of it has a cognitive component. Right? So I'm I'm wondering, like, if you see any? Yeah? And I think that's actually a very important avenue to go in, because a lot of cognitive stays with cognitive. But when you start to incorporate emotion, right or other associations

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Speaker: factors into these models.

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Speaker: I think it adds to the accuracy by which we understand people right, because cognition often operates in the context of emotion. Right? So it's driven completely, or most of the time by how we feel or how how we may think.

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Speaker: And so, if we are able to incorporate emotional

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Speaker: data into this. I think it just adds to that. You know, specificity that we're trying to get at. So I think it's a

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Speaker: a great avenue for that. So

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Speaker: potential. If that's a potential collaboration. Yeah, yeah.

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Speaker: All right. Well, then, here's my question.

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Speaker: Alright, you have a

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Speaker: Dr. Wilcox, Dr. Wong, Dr. Campbell in the room who was better? No, that's that's not my! I wouldn't. I wouldn't.

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Speaker: Yeah, I I wouldn't do that to you. But no, no! Who your chair is is all I'm saying so. No, my question is, though related to that which is that you know you're a product of Csb, and and and I don't mean this as as like a pandering question. I'm I'm there are students here, I assume.

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Speaker: and and I wanna know you know how that choice to come here

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Speaker: as an undergraduate student, really, and and the and the work you were able to do here as an undergraduate student kind of drove you

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Speaker: to where you are today and doing this kind of work.

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Speaker: Yeah, I think that's a very

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Speaker: important question. So

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Speaker: I so one would wanted me

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Speaker: that what kept me thinking I need to come back is

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Speaker: just a student body. So I reflect

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Speaker: or identify with the students here, so I do see myself in them, and I often tell them, you know, like that was in your shoes. So I know what it's like to not know anything about research or not, you know, knowing how to navigate spaces.

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Speaker: And so the mentoring that I received, of course, Eugene and

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Speaker: Amanda being some of the primary ones early on. Really, you know, showed hey? You know what? Through mentorship you can get to where you want to be, and as long as your heart and your mind are in the right place, right?

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Speaker: And so I think, having those experiences in

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Speaker: at Csu's be early on, you know, expose me to the research, all of the scholarly skills that I needed to get the exposure to, but also seeing the passion through which people serve our students right, through which our faculty serve our students through, you know, teaching and through research.

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Speaker: And so I was like, you know, I need to go back and be part of that group, because I just feel like it fits well with my philosophy of how I see

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Speaker: student success and

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Speaker: engagement, and all of that

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Speaker: fantastic and and thank you for for that. And then there's one last question, I guess, on my question.

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Speaker: Has such network analysis been used in cognitive function among older adults.

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Speaker: What's the data requirement for conducting network analysis in terms of sample size or items? Yeah, very good question. So there are a couple of studies comparing network models of younger adults

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Speaker: to those of older adults, and there are differences in the abilities that become more central as you get older. But so there, there's data on that

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Speaker: erm

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Speaker: sample size. So I always use kind of the

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Speaker: rule of thumb, which is at least 100. So for a lot of the psychometric work, you need at least 100 people, the more the better. But I think that would be at a minimum and in terms of items that really depends on the constructs that you're wanting to tap into. So you know, I would say that maybe 2 or 3 items per construct. Right? Is kind of a good way to to think about it.

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Speaker: But yeah, it's it's

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Speaker: It's really one more psychometric approach that obviously

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Speaker: requires a lot of people, and

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Speaker: and so on. But

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Speaker: I said one last question, but here's Dr. Hasi. Now go ahead. We have a meeting at one with somebody.

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Speaker: How do I model the Ptsd, and by 5 11,

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Speaker: yeah, so have they done any of.

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Speaker: And I know he's also setting up his population.

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Speaker: Lisa.

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Speaker: yeah. So we actually have. Yes, yes.

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Speaker: yeah. So I know students in here that are, you know, maybe right? Next to you that are interested in that. Yes, Jason, but actually, not not directly off the top of my head. And I think that's why

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Speaker: this approach is very attractive because you can.

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Speaker: you know, integrate different fields of study

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Speaker: to see how these things are collaborating. But not that I know. But I think that that is really

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Speaker: think about. But yeah.

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Speaker: corporate setting.

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Speaker: Yeah, wow.

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Speaker: right?

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Speaker: Right? That's really where we're at. I was like, why are we

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Speaker: right?

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Speaker: And I think that, you know this is a really good vehicle to do that, because then you can look at how symptomology might be changing as a function of these information

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Speaker: and across.

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Speaker: Yes, yeah.

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Speaker: all right. Well, one last round of applause for our distinguished guest, Dr. Rosales. Thank you so much.

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Speaker: and

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Speaker: thank you to the folks in the library, and the and the fce Robbie and Isabelle and Dean Lubass, who was too good to be here with us today. But no, but and thank thank you all for coming for coming most importantly, especially our students. So thanks a lot. Thank you.

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Speaker: Yes, really quick. And while everybody's walking out, I just want to invite you to our next provost, which will be on Wednesday, April 20. Fourth. It's a hemodynamic responses following high intensity exercise and long COVID-19 patients with brain fog wave separation analysis that's going to be by doctor saying, we again that's going to be on Wednesday, April 20, fourth 12 to one Pm. Here in 4 0 0 5, and also on zoom. Alright, thank you. Everybody.

END – 00:49:42