35| Neuropsychology 3.0: Commentary on the Future of Neuropsychology

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NAVIGATING NEUROPSYCHOLOGY

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Speakers: Ryan Van Patten, John Bellone

Intro Music 00:00

Ryan Van Patten 00:17
Welcome, everyone, to Navigating Neuropsychology: A voyage into the depths of the brain and behavior. I'm Ryan Van Patten…

John Bellone 00:24

…and I'm John Bellone. Welcome, everyone, to a new year and new decade. We can't think of a better way to start off this new decade than to discuss the future of neuropsychology and the opportunity to make some very exciting updates that would help us better serve our patients.

Ryan Van Patten 00:39

We have a lot of content to get into today. But, before that, another great way to start off a new decade is for John and I to thank those people who are instrumental in making NavNeuro possible. We will start with Charles Moreno and Leslie Gaynor, who do really great work behind the scenes. We really appreciate that they've been with us for quite some time now. So, thank you to Charles and Leslie. We also want to thank our Advisory Board, which consists of Steve Correia, Tanya Nguyen, and Beth Slomine. They have been with us for not quite as long but they have also been super helpful in answering questions that we've had when we're making decisions about moving NavNeuro forward. So, thanks to you all.

Today's episode is a commentary, a follow up on our episode that was released one month ago today with Bob Bilder on Neuropsychology 3.0. During our conversation with Bob, we touched on a number of new and interesting topics that we think warrant further conversation. There was quite a bit that was left out just due to time last time around and we'd like to go into more depth. We're going to start by explaining why we're using this term Neuropsychology 3.0 and where neuropsychology 1.0 and 2.0 went and what those mean. We didn't really explain that last time, so people...

John Bellone 02:06

[laughs] Ryan dropped the ball. I'm sorry.

Ryan Van Patten 02:08

[laughs] So even though this is Part 2, we're going to circle back and explain Neuropsych 1.0 and 2.0. John, get us started.

John Bellone 02:17

Neuropsychology 1.0 - this is all from Dr. Bilder. He published a paper in 2011 in the Journal of the International Neuropsychological Society, JINS. Neuropsychology 1.0, kind of the OG neuropsychology, [laughs] was from the 19th century, really got started. This was a systematic study of brain-behavior relationships. Early practitioners of clinical neuropsychology tended to work in neurology clinics. They

focused more on functional impairments that were associated with discrete brain lesions. So someone would have a stroke and neuropsychologists of the time would try to localize where in the brain that stroke had happened based on the symptoms. They did that up until the advent of widespread neuroimaging, which happened in the 1980s - like MRI, CT, where we were able to look much more directly at the brain of a living person and we could see where the lesion was. We can see that, “Oh, yeah, this person has a stroke in the left hemisphere and that's why they're having these problems speaking.”

Ryan Van Patten 02:17
So that's where the 2.0 comes in, right?

John Bellone 02:30
Precisely.

Ryan Van Patten 02:32
The hard line in the sand between 1.0 and 2.0 is when neuroimaging comes on board.

John Bellone 03:31
Right. Again, there's not a hard line, but this is just to conceptually split these apart. Lesion localization up until about the 1980s when we have these neuroimaging techniques. Dr. Builder theorized that this was the 2.0, the updated version of neuropsychology. Now we're more focused on assessing cognitive strengths and weaknesses. We do some differential diagnosis - so, not just where the lesion is, but based on where the lesion is and some of the underlying pathology, what might be the cause of the problem? What might be some recommendations that we can give to patients? What's the prognosis? Those kinds of questions really came to be much more relevant in this Neuropsychology 2.0 phase since the ‘80s.

Ryan Van Patten 04:17
That has brought us to where we are today. We're no longer seeing patients and giving them cognitive tests in order to determine where the lesion is because we can take "pictures" of the lesion. We can image where it is, which is better. Neuroimaging is better at determining where a lesion is than our cognitive tests. We have found things that we do that neuroimaging and no other area of neurology or psychology can do, such as characterizing cognitive strengths and weaknesses.

John Bellone 04:49
We should say we still do some lesion localization sometimes for presurgical epilepsy cases. I mean, not to the extent that imaging looks at the lesions.

Ryan Van Patten 04:57
Right. In that case, it's more about convergence between neuropsych results and MRI [and] EEG. If there's convergence and all the different tools give the same story, in the epilepsy case, then we have more confidence on where it hangs.

John Bellone 05:13
Right.

Ryan Van Patten 05:13
But, by and large, we're not localizing lesions anymore. I think Bob would say that we have been, and maybe still are, in the late phases of Neuropsychology 2.0. We're talking about Neuropsychology 3.0, which we think is the future. In his 2011 paper, he talks about a few forces promoting change in neuropsychology. These are phenomena or influences that may carry us to the 3.0 stage of our field. We've mentioned neuroimaging, another one would be the human genome project that has huge implications for neuropsychology as we understand how our genes are laid out and we can start to put together these polygenic contributions from genes to Parkinson's or autism. We're understanding the underlying conditions that we study much better. The tech is much better. We can map someone's human genome, whereas we couldn't before. A third force promoting change would be information science and informatics, which we'll get into more later in this episode. And, last but not least, is the healthcare revolution, which, whether we like it or not… [laughs]

John Bellone 06:27
It's here.

Ryan Van Patten 06:27
It's here and has a huge influence on how we practice neuropsychology. In that paper, he also mentions an agenda, or he outlines an agenda for Neuropsychology 3.0. But lest we steal his thunder, we are going to simply refer you to that paper. There's some great content in there. So if you want to know what the agenda is, then go read Bob's 2011 paper.

John Bellone 06:50

We'll link to it in the show notes. One of the major driving forces that will bring us to Neuropsychology 3.0 is going to be computerized testing. It's really an essential component of that 3.0 upgrade. We thought we should talk about computerized testing a little more specifically, how it differs from paper pencil tests. We want to address some potential downsides or concerns that clinicians have had about computerized testing because the vast majority of neuropsychologists today aren't doing a whole lot of computerized testing. And, really, the paper-pencil, the old way of doing things, is still very much how we do things today. But we think that it's really essential that we eventually, hopefully sooner rather than later, but eventually, we're going to have to transition to fully computerized based testing. We want to talk through some of the possible concerns that people have up front and also get into some of the real benefits of computerized testing.

Ryan Van Patten 07:52

We talked with Bob in Part 1 for quite some time about computerized versus paper-pencil. We want to linger here for a bit longer because, as John said, I think it's important for us to give voice to concerns or reasons for what Bob called inertia. Just because a test is given on a computer does not inherently mean it is better than a test given on a piece of paper. I want to be clear about that. John and I are millennials, [laughs] but that doesn't mean…

John Bellone 08:22

[laughs] We're at the edge of the millennial timeline, I think.

Ryan Van Patten 08:28

Nonetheless, I don't want to paint the picture that we think that just because something uses bits and transistors and is fancy and new that it is necessarily better. We think there are very solid empirically-based and important reasons why computerized testing is overall, all else being equal, a better model than paper-pencil testing. So let's start with some of the concerns people may have about transitioning from paper-pencil to computerized testing.

John Bellone 08:57

I have a question for you, Ryan. Isn't privacy an issue? I mean, if we put everything online, we put the patient's data on our computers online, isn't privacy problematic, potentially?

Ryan Van Patten 09:09

Great question, John. Not really. [laughs] Well, I would start by saying, first, that just because data are in a computer do not mean they're online. Data that are stored in hard copies can be compromised, just like electronic data can be compromised. I could put a patient file in a locked filing cabinet, in a locked office, that doesn't 100% guarantee that it'll be kept confidential. I could be carrying around a file and a piece of paper could drop out of that file and someone else could pick it up, right? There are an uncountable number of ways.

John Bellone 09:47

We're discarding it eventually.

Ryan Van Patten 09:49

Right. Maybe I'm not thinking and I don't shred it. I just throw it in the trash can. Hard copies are not impervious. On the other hand, of course, electronic data are not impervious but there are really good protections - firewalls, password protections, good ways to store. We can de-identify data that's electronic.

John Bellone 10:09

You don't have to keep any patient information actually electronically if you don't want to.

Ryan Van Patten 10:14

Right. I feel like privacy can be enhanced, actually, if we use electronic versus hardcopy files. John, let me play devil's advocate now and say, I am a pretty cheap guy. That's actually you.

John Bellone 10:33

[laughs]

Ryan Van Patten 10:33

But for the role [laughs] for the role that I'm playing right now, I don't want to spend any more money than I have to do. I'm afraid that these electronic computerized neuropsych tests are going to drain my whole budget versus the tests I've been ordering for a long time. What can you tell me about the cost?

John Bellone 10:50
Sure. Yeah. So would you rather spend a lot of money on these manuals and paper records, the record forms and protocols and all the kits and everything…

Ryan Van Patten 11:01
I like to chop down as many trees as I can.

John Bellone 11:03
[laughs] So, obviously, sure, it is more expensive right now, on average, I think, electronically. With more people buying into this and using the electronic versions, I think it will get cheaper. We won't have to buy protocols. You won't even have to spend buying paper and ink. There's lots of little things that we don't think of that if you don't have paper and pencil tests, you wouldn't have all those expenses. So, anyway, I think the cost is really negligible. And especially with certain programs - like we talked to Julie Hook of the NIH Toolbox. For $500 for the year, you can have unlimited access for anyone in your office. So compared to what you spend on kits and things like that. Again, that's two debts and that's only going to get cheaper over time.

Ryan Van Patten 11:52
Yeah. I'm sold.

John Bellone 11:53
So, how about behavioral observations? If your patient is using the computer, you're not interacting with them one on one. You're not going to be able to tell if they're frustrated or qualitatively if they do something in the tests. You're not going to be able to make note of any of that. You're going to get less data overall from them, right?

Ryan Van Patten 12:12
Wrong. [laughs]

John Bellone 12:12
[laughs]

Ryan Van Patten 12:13
No, good question. But what Bob said when I asked him this is that the computer is just a tool. And I think that's the case. So I have a few thoughts. I guess to start,

computers can make some behavioral observations. As technology improves, computers can make more and more precise behavioral obs that we can't make. Bob mentioned detecting how oxygenated your face is. I don't know how advanced that technology is, to my knowledge that's not something we can do right now. But there are things we can do right now, like eye tracking. We can measure effort via pupil dilation. Those are technologies that we can do with at least fair accuracy right now. So your computer could be a tool that assists with behavioral observations. Everything I just said is not incompatible with having a neuropsychologist or a psychometrist in the room with a patient while they are using the computer or tool, observing their behavior. If someone is completing the Wisconsin Card Sorting Task on a computer instead of on cards, they can still receive negative feedback, they can still get frustrated, they can pound their fist on the table, right? Hopefully they don't break any of your electronics, but you get my point. There's nothing preventing us from administering computerized tests in our office while still observing behavior in a clinically meaningful way.

John Bellone 13:38

There could even potentially be a flag that we get on our [end], when we're scoring or we're writing reports in the same room as they're testing, let's say, or in the side room. You can maybe get flagged that, “Oh, this person is starting the Wisconsin now. Pay more attention to them.” We can have those kinds of markers throughout the testing as well.

Ryan Van Patten 13:55

Yeah, it's a good idea. So, to be clear, my general idea about how computerized testing would work is that, at least for a substantial proportion of the examination period, the psychometrist or neuropsychologist is in the room with the patient. The patient's working on the computer, I'm sitting over to the side scoring, writing, doing something else productive that's helping increase my efficiency, but every so often looking up and observing that behavior, too.

John Bellone 14:22

Maybe we should do maybe one more.

Ryan Van Patten 14:26

So, John, we know that many of our patients as adult neuropsychologists are older. We have the silver tsunami on the horizon, we want to provide good care for older adults. Many of them are less comfortable with technology. So what if they don't want to use a computer?

John Bellone 14:44

Well, I think number one, that's possible. There's some older adults, especially [in their] 70s 80s 90s, who are not going to be as familiar with the technology. I have a few things to say. Number one is that that's just going to be less and less common over the years and decades. People in their 60s now are regularly using technology. Even people in their 70s and 80s and 90s are using technology to some degree. So people are just going to get more and more familiar with it. It's not going to be such a contrast when they come in versus the paper and pencil testing. The other thing I'll say is that we can make it very simple to follow instructions on the computer. They don't have to have any computer literacy before walking in potentially. The instructions can be right there, they tell them exactly what to do on the computer, it could be very easy to follow.

Ryan Van Patten 15:29

"Press the spacebar" or "press these arrows", and that's all you need to do.

John Bellone 15:32

Exactly. Yep.

Ryan Van Patten 15:33

There's some ecological validity in there to using computers, right? More than some, there's a lot. Because even older adults, unless they're very isolated, are required to go to use the ATM, or, if they use a credit card, they might be interacting with electronic devices at the supermarket. So from that perspective, if they use a computer in our office, that's an ecologically valid representation of how they're interacting with their world.

John Bellone 16:00

Think about it. Ten years from now, everything's going to be [on] the computer much more than it is today.

Ryan Van Patten 16:04

Yeah, we should be thinking ahead.

John Bellone 16:06

Exactly. So, yeah, I really don't think that's a major sticking point. So, again, keep in mind, there are some others that we didn't get into. The point of this is not to go in depth on every concern. We're not saying that current computerized tests are

perfect or that everyone should be using them right now. We believe that with some tweaks and some advancements in this area, which we'll talk about in depth for the rest of this episode, this is absolutely the future of the field.Over the next few years to hopefully by the turn of the next decade, neuropsychology should look different than it does right now in terms of our day to day administration and scoring, report writing. Some neuropsychologists have been trying to make this happen since the '80s, since the personal computer came on board, so it's definitely a long time coming. I think now with the technological advances, with internet speed, with computer analytics and processing, I think we are in the sweet spot for making these changes.

Ryan Van Patten 17:06
There's so much benefit that is out there just waiting for us to grab it, as we touched on with Bob. The technology we need to vastly improve our field is there and so it's on us to start to move towards making some of these changes.

John Bellone 17:22
Better not be another 40 years. [laughs]

Ryan Van Patten 17:23
[laughs] By the time you and I are in the geriatric stage, It'll be quite the futuristic neuropsych eval.

John Bellone 17:32
I'm hoping, yeah. Just very quickly, some other quick benefits of these computerized assessments. Obviously, there'll be more consistent standardization of how people administer things. There will be automatic data collection and storage.

Ryan Van Patten 17:49
Scoring.

John Bellone 17:50
Scoring, obviously, that would save a ton of time scoring and norming. Transferring into an excel sheet and all that. The automatic scoring and norming really eliminates human scoring errors. There's definitely a possibility that, while we're hand scoring, we're making calculation errors or missing a line here and there. That would be completely eliminated with computerized testing.

Ryan Van Patten 18:09

I'm aware of at least one clinic that has every file scored by two different people, which I remember thinking that's a good idea. It's very conscientious and detail oriented. That is a lot of manpower for each file. The fact that that's happening is also acknowledging what we know is the truth, that we are liable to make errors whereas a computer would not make those errors. Computers also allow for greater manipulation of presentation of stimuli. A quick example of this would be many of us are familiar with the Stroop task, which can be presented in a card reading format. There's a version of the computerized Stroop task, which just allows you, without getting into detail, it allows you to play around with when a stimulus is presented, maybe I'll give you a cue before the stimulus to tell you how to respond. I can add a delay between a cue and a stimulus that taxes your working memory and attentional control. I can make the test a lot more sensitive. I can improve its psychometric properties because on the screen I can control what you're seeing every second. Then I can measure your responses with millisecond accuracy. I can look at within person variability in reaction times. It's a Pandora's box of data that can be very helpful that we can get from these computerized tests.

John Bellone 19:31

Think about like the TOMM where you have to show a stimulus for three seconds exactly, right? We don't have to flip around with the pages or worry about pages sticking or skipping a page. It just automatically shows you exactly three seconds. Reaction times, like you mentioned, could be just more precise.

Ryan Van Patten 19:48

Just really briefly, there are some sophisticated statistical ways to analyze reaction times that are possible if we use computers. Something called Ex-Gaussian analyses. I mentioned intra-individual variability, the coefficient of variation, I'm just naming these to say that this is a world of research in cognitive neuroscience that has a lot of validity to it that we miss if I'm sitting there clicking a stopwatch as opposed to recording reaction times on a computer.

John Bellone 20:17

I think we've thoroughly explained the benefits and dealt with some of the main concerns.

Ryan Van Patten 20:24

In case people are wondering on which side we fall and what our opinions are… [laughs]

John Bellone 20:29
[laughs]

Ryan Van Patten 20:29
We like computerized tests. Just to quickly piggyback off what you said, John, my approach would be incrementalism. If you're in a clinic and you give a fully paper-pencil battery and you'd like to move into a computerized battery, you don't have to go cold turkey and make 100% change in the course of a day. You can slowly move towards incorporating more and more computerized tests that you have vetted, that have good data backing them up into your battery. Over time, you will have a more computerized battery.

John Bellone 21:05
I don't want this to sound like we're preaching or shaming anyone who uses paper and pencil testing. We still do. And Dr. Bilder admitted that he does, too. We're just not there yet. The purpose of this conversation is to help the field move towards that future that we can envision, where we're all using computerized tests.

Ryan Van Patten 21:25
Let's now move on. A distinction that Bob made in our conversation that I find really helpful that pertains specifically to neuropsych tests is this difference between physiological and ecological validity. Many of us who have been in the field of neuropsych for a while have heard the term “ecological validity”, meaning the extent to which a test or a score or an outcome generalizes to real world behavior. What we mean by physiological validity is going in the opposite direction. Rather than taking, in this case, a neuropsych test and predicting vocational outcomes or driving. We're taking a neuropsych test and going back into the brain to say how well does performance on this test relate to specific neural circuitry and its functioning? So, John, you mentioned earlier that we still sometimes do contribute - I wouldn't, myself, call it lesion localization, but I would say it's more like lateralization of language functioning in epilepsy. That's physiological validity. Another area would be when patients have strokes. You touched on this earlier. Where they may have more problems with comprehension or expression or repetition and the profile and cognitive testing helps us solidify what their lesion looks like in their brain. This is physiological validity. The question is when we're choosing tests. Test selection is a really important topic in neuropsych. In the clinic, we do it all the time. We do it for research batteries, too. There's a lot of different test options for us to select from. So many that it can be paralyzing. Then we just go to our Rabin 2015 favorites and choose the WAIS and CVLT and WMS. But I

think that we should consider these two related but distinct types of validity. Think about who the patient is sitting across from us and try to choose neuropsych tests that are best at answering that type of question. Because tests that are very good with physiological validity aren't always great with ecological validity, and vice versa. The distinction Bob made that's very helpful is that our neuropsych tests tend to be multifactorial. There tends to be test impurity, meaning that one test such as verbal fluency does not just measure language functioning. It measures many different cognitive constructs - processing speed, executive functioning, attention, language at the same time. These messy neuropsych tests, although their physiological validity isn't as good as we would like it to be - we can't localize the one brain circuit or the brain area that really lights up when someone is performing that task. But, because they're messy, they tend to generalize to real world behavior better than a very precise test in cognitive neuroscience that is meant to discriminate, say, between semantic versus episodic memory. So maybe you hit that one circuit versus the other. I'm saying all this for us to be aware of the difference between physiological and ecological validity and then to design tests that do one or the other and choose tests in our batteries that serve the function that we are trying to accomplish with each patient.

John Bellone 25:04
Some computerized tests are more ecologically valid, such as the VRFCAT that we discussed with Bob. Others are more physiologically valid, like certain cognitive neuroscience tests of memory that you mentioned. Now I want to go back to our computerized testing discussion because it fits very nicely with the NNN, the National Neuropsychology Network that we talked with Bob about.

Ryan Van Patten 25:29
By the way, what kind of acronym is NNN? Right? Isn't the acronym supposed to create some sort of word that you can say? I thought Bob was a creative guy. [laughs]

John Bellone 25:41
[laughs] We could call it the New Net.

Ryan Van Patten 25:43
[laughs] We could call it like the Triple N or the N-cubed. Would that be a little more…?

John Bellone 25:51
You can say that, Ryan? [laughs]

Ryan Van Patten 25:52
We'll send Bob our ideas. [laughs]

John Bellone 25:53
You can call it N-cubed.

Ryan Van Patten 25:55
[laughs]

John Bellone 25:55
It's NNN. [laughs] So, it's right now a four site program - the University of Florida, UCLA, Emory, Medical College of Wisconsin, they got together and thought about a way to create this data archive. They are aggregating this data for some of the most widely used neuropsych assessment measures. Even more than just aggregating data on the subtest level, they're actually looking at the item level. So they're collecting data for every item that's given on that test and compiling that over, hopefully, hundreds, maybe thousands of patients so that we can really start getting some pretty big sample sizes. We can look at how people answer these specific items for these subtests.

Ryan Van Patten 26:42
Right. The item level data is what sets the NNN apart from any other data repository. Because, as you heard in our first conversation with Bob, in order for IRT to work, we must have item level data. What's unique about IRT relative to classical test theory is that IRT ties a construct to performance on each item, as opposed to tying a construct to performance on a subtest, a composite, or an entire test.

John Bellone 27:12
Right. That's item response theory, IRT.

Ryan Van Patten 27:15
Right. John and I both truly think that the National Neuropsych Network is a great initiative. So we're promoting it not because of a partnership or sponsorship but because we think that it is a great way. We're talking about computerized

assessment and Neuropsychology 3.0 and how we might move into the future. We can do that at an abstract level, in a very conceptual way, and it's helpful. But the NNN is the instantiation of that. It's the best way that I've seen. The initiative that's happening right now, that's starting to move us into the future. To me, I think about it similar to the AACN Relevance 2050 and other initiatives in neuropsychology that are really important that I want to promote. We want to promote it on NavNeuro as much as possible.

John Bellone 28:05
It's really necessary for the 3.0 upgrade that we're talking about.

Ryan Van Patten 28:08
Yeah.

John Bellone 28:09
We need to collect this item level data because then we can manipulate the tests. We can use computerized adaptive testing to limit the number of items that we need to give people which would substantially cut the amount of time that we need for these assessments. Imagine if rather than giving a subtest that takes 20 minutes, if you can get the same amount of information from three items that could take less than a minute. Imagine that across the whole neuropsych battery. We're talking about substantial increases in efficiency here.

Ryan Van Patten 28:43
Yeah. I like what you just said. A specific example of that is referenced in Bilder and Rice 2019, showing that potentially in people with schizophrenia, it's possible to differentiate them from healthy controls after the first four Wisconsin cards. That's actually - that's crazy, right? It's actually one of the non-IRT computerized methods, but we can just think about - there's IRT and then there's these other computerized adaptive, sophisticated psychometric methods of taking a small amount of data and extracting a lot of information from it. So, to your point, we could really shorten our batteries, become more efficient while not losing any information.

John Bellone 29:29
Right. We can have different algorithms that people come up with to best hone in on certain constructs and certain factors.

Ryan Van Patten 29:38

Before we move into a few of the weeds, I want to say about the NNN that you may be wondering how you can contribute and or how you can be part of this. Right now they're in the early phase. They just have the four sites, but they do have a website which we will link to in our show notes and we encourage everyone to go there. On their website, you can click register on the top ribbon to the right, and just put in your contact info. It will take 30 seconds, and they will send you updates on the NNN and let you know when you can contribute and what's going on with it. Right now, what we can do is stay abreast and then when the NNN is ready and starts expanding into additional institutions, we can maybe contribute data. We can all do something to move this forward.

John Bellone 30:28

We talked about some of the benefits with Dr. Bilder, but you can update norms - we can have such a large normative sample, we can have so many different populations that we have specific norms for. So Ryan, maybe we should talk about CAT more in detail and talk about some of the specifics.

Ryan Van Patten 30:47

Right. So we discussed CAT with Bob without describing it very much. I'll take a stab at this pretty briefly. CAT, computerized adaptive testing. If you've ever taken the GRE or the SAT computerized, you're familiar with the idea that you may take a test in a computer that all of the items you're going to get are not decided a priori. The computer, based on your performance, selects items that give it the most information about your ability. So if you get a question right, you're likely to get a harder item next. But it isn't necessarily just the next hardest item. It's not like a typical neuropsych test where there's 1, 2, 3, 4, you just go in that order. You jump around. It depends on the amount of the construct that you are determined to have. The construct might be math ability, right? Or might be depression. Depending on how much of that construct that computer hypothesizes you to have, it will select the item that gives it the most information each time. So this allows us after sometimes just a few items, 4 or 5, 6, 7, to know person X is somewhere between the 7th and 11th percentile in terms of their language performance. We can do that because we are not just drones who are going in numerical order one item after another. We're always administering that item that gives us the most information. So it's a very powerful technique. That's CAT. That's one of the advantages of IRT embedded in computerized testing. Another that we talked about is the nominal response model, which takes advantage of multiple choice items that are more wrong and less wrong. So we don't just score these tests dichotomously.

John Bellone 32:45

Right. So, if you have a multiple choice [item] with four choices, two of them are clearly wrong, one of them's pretty close to the right answer, one of them is the right answer. If you get the one that's pretty close, that tells us that you have some knowledge on that topic. It's not like you were completely guessing and you guess one that was completely out of the blue. So we can use some of that data. Maybe you get a half credit on that one. where it's much harder to do that with the paper and pencil [test].

Ryan Van Patten 33:13

Right. If I were to ask you, “How many planets are in our solar system?” And you said 9, or you said 5000.

John Bellone 33:19

[laughs] Sure.

Ryan Van Patten 33:21

They're both wrong. But if you said 9, I might think, “Oh, maybe you're a little bit older. Maybe you initially learned that Pluto was a planet.”

John Bellone 33:28

I was going to say, “Are you counting Pluto, Ryan?” [laughs]

Ryan Van Patten 33:32

No, Pluto gets excluded. [laughs] You get my point. That the second answer is much more wrong than the first one. Right now we're throwing away information by counting them both as equally wrong. So this is how the nominal response model can benefit us.

John Bellone 33:48

The other is person fit statistics. So, over time, when you're taking these tests, the computer learns how you're performing and your profile. Then if you answer a question that's different, that's aberrant from your typical profile that it's set for you, it's going to flag that. Maybe that's a sign that you're not trying as hard as you should be, or you're tired, or some other problem. It's just a fluke performance. Where it's hard for us now to do that on the item level, especially. The computers will be really adept at picking out those small aberrations.

Ryan Van Patten 34:27

Let's linger on person fit statistics for a minute. This is where, in our conversation with Bob, we touched on the idea of these embedded effort indices. Where, as someone is taking a test, the computer or the algorithm can be learning something about their level of engagement. So let's step back and imagine a futuristic neuropsych battery that's based off of IRT and has all these advantages that we're talking about. Let's just brainstorm, John, what this could look like. So, first off, the person might be testing for a way shorter period of time than they are now - maybe an hour to get all the information we need from a current four hour long battery. Maybe 20 minutes into that hour, we receive a notification saying that, "They're not converging".

John Bellone 35:21

[laughs]

Ryan Van Patten 35:22

Meaning, in terms of in person fit statistics language, that there are inconsistencies in how they're performing. This might mean that they're getting hard questions right and easy questions wrong. Maybe easy questions are taking a really long time to answer when the correct answer is very obvious. There's certain patterns to human cognition that we know after decades and hundreds of years of study. Someone may break the pattern and that could tell us that there's likely something else going on. The obvious one is performance validity and effort.

John Bellone 36:00

We wouldn't need a standalone measure like we do now. It would just be throughout the entire battery.

Ryan Van Patten 36:06

Right, which saves more time.

John Bellone 36:08

And it's better. A better measure than our standalone ones.

Ryan Van Patten 36:11

Effort is low hanging fruit that comes to mind for me. John, you've talked to me off air about anxiety and impulsivity, as well. What do you think this might look like?

John Bellone 36:22

They're a couple of things. I think I brought this up with our conversation with Bob, but the impulsivity, if someone is responding quicker than would be necessary for that item. Let's say if we know that that item takes even someone who is very smart, who gets an answer right, it takes them 10 seconds to get that and this person answers in three seconds. That's an impulsive response, potentially. Or they might be anxious. We could be able to parse that out a little bit. Or maybe someone answers some easy questions wrong upfront and then later on, when they get to the harder questions, they actually do better. Maybe that's a measure of anxiety. Maybe at the beginning, they were a little anxious, or maybe you can split up the first 15 minutes from the last 15 minutes and you can see how they perform. Maybe you can have a Digit Span test, you can have part of the Digit Span test in the first 10 minutes, part of it in the middle of the battery, and then part of it at the end and you can see.

Ryan Van Patten 37:16

Fatigue.

John Bellone 37:17

You can see fatigue effects, right? Or potentially anxiety, if early on they did much worse than later. Maybe that was anxiety early on. There's just so many variables that we could have. We can have all these different scales that we could just color the person so much better and have such a constellation of data for this person.

Ryan Van Patten 37:38

Talking about impulsivity, what came to mind for me is like you're describing an embedded CPT test. We don't need to add 12, 15, 20 minutes extra to our battery doing a boring CPT task because every test could have a CPT component. Reaction times are measured constantly. Impulsivity, like you said, we would know on the hardest matrix reasoning item, that it's just really not humanly possible. It's like no one is taller than 8 feet tall, right? There's like limits to our physical and cognitive abilities. No one thinks in such a way that they could get the right answer to this question and under a certain number of seconds. So if someone answers, then we know they're not really thinking it through.

John Bellone 38:25

Yeah, right, exactly. These could all be embedded, like you said. They don't have to be standalone, which could further increase the efficiency. We don't have to give just this one test when it's just being measured with these other tests that we're

giving. Right now, the only thing we could really do are embedded performance validity tests, but there could be so many more embedded scales in this futuristic, computerized battery that we're talking about.

Ryan Van Patten 38:53

We are squeezing a lot more good data out of less time that we're using. Earlier, we mentioned the healthcare revolution. Many of you probably have some ideas about what we mean by that - managed care, pressure to see more patients in less time, issues with reimbursement. Everything we're talking about now would allow us to do our jobs well, and also meet the needs of these insurance companies, the pressure that they're putting on us. It's a win win. See more patients in less time.

John Bellone 39:25

One other thought that I had was in terms of differential diagnosis. Right now, we have a good sense of patterns of performance, but it's pretty crude. If we have a computerized battery, we can maybe start to really differentiate between different populations. So in a way that the MMPI does - it was empirically keyed, meaning that they didn't care if that question that got included on the test had any face validity. It might not seem like it has anything to do with psychopathology, let's say, or depression, but if it separates those populations, if, based on how you answer that question, we can tell whether someone is more likely to be depressed than not, we include that.

Ryan Van Patten 40:05

It's so powerful.

John Bellone 40:05

If we had this cognitive testing battery, well maybe someone with Alzheimer's disease compared to someone with Lewy body dementia perform differently on certain aspects of the testing. We can start putting together these really sensitive profiles, you can pick up those minor differences.

Ryan Van Patten 40:20

Like you say, it may not be obvious to us why it differentiates AD from Lewy Body. We might not look at and say, "Oh, yeah, that's episodic memory, that's visual spatial." We are limited in ways that AI and machine learning are not. This comes up a lot with machine learning, where this idea of supervised or unsupervised learning, we're pulling out patterns in the data in a human naked eye doesn't put

together what the difference is. But there are regularities in the underlying data structure that truly do differentiate those groups. So, yeah, I think that's great. So what you just said, John, raised a question for me that people might have, which is, how do we know that all these fancy computers aren't going to put us out of a job?

John Bellone 41:11

[laughs] Good. Yes. Right. We didn't deal with this early on. Well, we don't know. Automation could put everyone out of the job. And that's fine. I'd be happy to sit on a desert island, do some reading or something. But I think that I have a couple things to say about that. First of all, I think the administration part of our job is actually the least interesting and we're trained for so much more than just the scoring and administration part. We should really be spending most of our time on the interpretation and actually face to face in the feedback session, talking through the data with the patients. We're talking about brain health and new research and literature. There's so much more that we can do if we are not spending the time scoring and administering these tests.

Ryan Van Patten 41:57

The nuts and bolts. The parts of our job that are uniquely human. As I mentioned with Bob, Max Tegmark in his book Life 3.0 touches on and neuropsychologists fit well within this box of abilities that will not be automated anytime soon. Some things can be automated very well - adding ones and zeros and twos, finding underlying algorithms, pattern recognition, there are some things that computers can do very well. Computers cannot sit down face to face with a human being and explain complex topics in a way that makes sense to that person, that initiates behavior change. Our knowledge of brain-behavior relationships and then the psychology that we learn makes us very unique. I have no concern that we will be replaced. We will just need to be adaptable because our jobs will look different. I'm excited. I think our jobs are going to be better and even more fun.

John Bellone 41:57

It was similar to the transition between Neuropsychology 1.0 and 2.0. We had to adapt. Some clinicians were afraid that neuroimaging was going to completely wipe out their job. But, we're flexible. We're a pretty resilient group, I think. We have very broad knowledge and training. We can fit into so many different areas. This will only open us up to do better things, I think.

Ryan Van Patten 43:23

Just really briefly, I think an area that we'll spend more and more time on as time goes on is neuropsychological intervention. People like Beth Twamley and Glenn Smith are doing great work in taking what we know in neuropsychology, the knowledge base we have brain-behavior relationships and applying it to treatment. We are great at assessment and that is incredibly important. I think we will be doing more - we'll continue to do certain pieces of assessment, as well. We're going to get more help with that. Then we can move forward. Instead of just having a few minutes for feedback and recommendations and sending patients on their way, we can spend more of our time following them, following up with them, continuing to provide cog rehab, cog training - be it compensatory or restorative - and help them actually improve their cognitive functioning.

John Bellone 44:16

We'd see more people too, which is, there's such a need. Waiting lists are crazy for neuropsychologists in most parts of the country.

Ryan Van Patten 44:24

So let's transition into something else we talked to Bob about that ties in everything we've already mentioned, which is the standardized neuropsych history form. I want to say that I had initially misunderstood Bob a little bit. I thought he meant standardizing our clinical interview and the history form. But really what they're more focused on in the NNN right now isn't standardizing our interviews, but is in standardizing our history forms. There are some really, really cool and easy benefits to this. First off, I think history forms are a great idea. Not everyone uses them but we send this form to the patient before they come in for their clinical evaluation. They answer a bunch of questions and then we don't have to check all those boxes with them in the room. We have limited time. So a great example, I think, would be family medical history. That's a checking the box sort of thing - like, your mother, how old is she? Is she still living? Did she have any neurodevelopmental conditions? And they're really like yes/no questions. It can take one person 5, 10, 20 minutes.

John Bellone 45:34

[laughs] Right. Especially if they're tangential or verbose.

Ryan Van Patten 45:37

It takes zero minutes if we use a history form. They're taking that a step further and saying, "Why don't we all use very similar history forms with common data

elements?” Then if it's computerized, not only do we just have a paper copy of that form, but it can automatically populate our neuropsych reports. It's mind blowing.

John Bellone 45:57
Right. For the family history section of the report, it'll automatically populate based on that person that said that their mother is 92 years old, and has been having signs of dementia or has memory loss for a year now. Boom. That'll be in your report. Maybe we can even see that before they sit down with us in the interview so that we can have that right there in front of us in the format of our report. That would not only make the interview more efficient, we can focus on the things that we actually really, really need to talk to them about in the interview. Then the report is already partially written. So that's efficiency on both ends, really.

Ryan Van Patten 46:36
So, to be clear, we're not just advocating for this so that we can be lazy and go watch YouTube videos instead of interviewing our patients.

John Bellone 46:44
That would be nice.

Ryan Van Patten 46:44
[laughs] The idea is that it gives us time for other things that are more important. I know I've had this experience many times, you can share yours John, where I only have so much time for the interview because I have another appointment coming up and I have a lot to get through. So I have to find places to cut corners or shave time. I'm talking to this person, I'm connecting with them. It's not causing me to scribble something down right away, it's not checking a box, so I feel pressure to move on to the next thing. It'd be better if I could sit and listen a little more, ask them about their psychosocial history, get more precise timelines, make behavioral observations in a more mindful sort of way because I'm not so concerned about ticking all the boxes. This, I think, would help with all of that.

John Bellone 47:33
Yep, I absolutely agree.

Ryan Van Patten 47:35
Okay, I think that just about wraps up our commentary for the first part of our conversation with Bob. I just want to reiterate how excited we are about the

National Neuropsychology Network. We encourage everyone to go to the website, which you can find by going to our show notes.

John Bellone 47:52
That's at navneuro.com/35 and we'll have the link directly to the NNN.

Ryan Van Patten 48:01
So go to the NNN website and register for updates. That's all that we're suggesting you do right now and then see how you can help going forward.

John Bellone 48:09
We'll keep bringing you updates as we hear them as well.

Ryan Van Patten 48:12
Yeah, for sure. This is one of the areas that we're really excited and interested in. So we want to promote it in our field as much as possible.

Stay tuned, because we're actually still not finished with our conversation with Bob, which is exciting. We will have part three of this mini series of Neuropsychology 3.0, which includes more of Bob and less of John and me, although some of John and me. [laughs]

John Bellone 48:38
[laughs]

Ryan Van Patten 48:38

We'll be talking to Bob about cognitive ontologies and phenomics, which are different topics but related and I found absolutely fascinating. I've been following Bob's work in this area for years and it's really, really interesting.

John Bellone 48:51
Yeah, that's another aspect that's going to move the field forward.

Ryan Van Patten 48:54
Yeah. Agreed.

John Bellone 48:55
We hope you join us next time as we continue to navigate the brain and behavior.

Exit Music 49:02

John Bellone 49:26
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Ryan Van Patten 49:37
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