

04| Neuroimaging and Neuropsychology, Friends or Foes? (Part 2) – With Dr. Steve Correia

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Speakers: Steve Correia, 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. And we're back with the second half of our discussion with Dr. Steve Correia, a board certified neuropsychologist with extensive clinical and research experience in neuroimaging. If you haven't heard Part 1 yet, then I'd encourage you to go back and listen to that first, especially if you'd like an overview of imaging techniques and terminology. This second part is much more of a conceptual discussion of the interplay between neuroimaging and neuropsychology, such as what training neuropsychologists should get in neuroimaging, resources to improve knowledge in this area, how to interact professionally with radiologists, what to do if the imaging doesn't line up quite nicely with the cognitive findings, when to recommend imaging in neuropsych reports, and several other topics. So we're just gonna jump right back into the discussion. Hope you enjoy it.



Transition Music 01:18

Ryan Van Patten 01:28



I think we can transition now and start talking a little bit about training in imaging and something that's relevant to all of us. So, as a trainee, I've noticed a lot of variability in my supervisors' comfort in directly interpreting images. Where some supervisors will do that - they'll look at the image, and, obviously, there's a radiological report which we can simply read and go off of, but some feel comfortable with that. Others don't feel comfortable and are relying on the radiologist's interpretations. I'm seeing this large degree of variability in supervisors and it's made me think about our training as neuropsychology trainees. As a field, how should we think about providing instruction in neuroimaging? There are a lot of different potential models, right? We could take a required course in graduate school on this, or several. We could use more of a "fake it till you make it", sort of pick it up during internship or postdoc. There could be no training and we simply always just rely on radiologists. Do you have an opinion on a model we could use as a field to train our students?

Steve Correia 02:39



Right. So I am not going to pontificate and tell the field what to do about imaging and imaging training. However, I do have some thoughts about this. First of all, before we get to the training, just from a scope of practice perspective, I think it's important to recognize that we are not radiologists. We didn't go to medical school and we don't have that level of training and expertise. There's a whole field devoted to that, and that's their job. If you look at the Houston Conference Guidelines, in

their knowledge base guidelines, it says that neuropsychologists ought to have knowledge of neurodiagnostic techniques, one of which is neuroimaging. There's also EEG and other techniques. It doesn't say that one should be expert in those. Also, the guidelines recommend that those can be acquired through formal training, as in graduate coursework, or in other documentable didactics. I think just in terms of my role here in training at Brown, we get a lot of trainees who have come through, I've seen many over the years, and the range of knowledge is really quite broad. I mean, people come in very comfortable looking at images and having had some clinical training that they've either picked up in their practicum experiences or rarely, I think, coursework, but sometimes. Especially if they've come from a neuroscience background. Maybe as an undergrad, they might have had that. To folks who really have had very little experience looking at the actual images, but have encountered radiology reports. From my perspective, I think the spirit of those Houston Conference Guidelines, and I wasn't one of the authors, for sure, but I think the issue is that I think we need to be informed consumers of these techniques. So we should be able to look at a radiology report, maybe not understand every single technical detail in it, but understand the bottom line and have a sense of what the terminology is. The same for EEG. Just speaking for myself, I don't have formal training in EEG. I certainly understand the technique and I can appreciate an EEG report. I know what the terms mean. But I couldn't - if somebody just threw an EEG print out in front of me, I couldn't do it. That doesn't make me a bad neuropsychologist. It doesn't present a need, in my view, for me to have a course in EEG. I think neuropsychologists should have some background knowledge in understanding neuroimaging. I don't think they need to become experts in it.



Ryan Van Patten 05:36

Yeah.



John Bellone 05:38

Do you think that we are at liberty to disagree with the radiologist or neurologist? And, if we are, at what level of training? What's the threshold that we need to pass to be at that level?



Steve Correia 05:55

What's your chutzpah threshold? [laughs]



Ryan Van Patten 05:56

[laughs]

Steve Correia 05:59

No, you know, I think challenging or pushing back on what a radiologist or neurologist says, I'm not sure that that's a fruitful approach. I think what we're doing - I mean, why are we looking at the images anyway? Why are we reading the report anyway? It all has to do with patient care, right? I mean, that's what we're doing. Clinically, we're trying to do what's right for the patient. And why are you asking a question? You're asking a question, presumably, because you're reading something that you don't understand. Or you're seeing something that you think might be significant but wasn't mentioned, right? Or you're seeing something that was characterized in a different way than you think. So now you're going to the expert in the field, to ask them that. Well, my approach to those situations, and I would advise trainees that this would be the approach, would be collaborative not confrontational. So, "Can you tell me about this?" Or, "I noticed this. Is this anything that I should be concerned about?" You know, "I noticed," for example, "there's higher signal in the posterior part of the brain than the anterior part of the brain in general. Is that a problem?" And the radiologist may say, "No, it's just an artifact. Don't worry about it." I think asking for clarification and for education is the way to go.



The radiologists often don't have the clinical background, they don't know. You have the clinical background, you have the patient's history, and you may see something and say, "Gee, the history says that this person was a very heavy drinker for a long time." And you're looking at the sagittal T1s and you're saying, "Gee that mammillary body looks a little small." [laughs] You might want to go to the radiologist and say, "Gee, do you think this mammillary body is a little small? I mean, am I seeing brain effects of alcohol?" That's an interesting academic question. Of course, yeah. Maybe informative. But what's the threshold to do that? I think some basic knowledge and understanding of the terminology, and having a good relationship with the other providers that you work with is enough to go and ask questions.

Ryan Van Patten 08:25

I like your characterization of this as collaborative as opposed to confrontational. I don't think about it as necessarily disagreeing and pushing back but more seeking them out - seeking out radiologists, neuroradiologists, for our own learning, right? It sounds like maybe a good approach for early career professionals if you're situated in maybe a medical center is to develop these interdisciplinary relationships with radiologists early on which will then facilitate - go to their rounds, give them a call, introduce yourself. Early on, establish a relationship and then you can have this back and forth.



Steve Correia 09:02



Oh, I totally agree. I've attended rounds during my training at various locations - radiology rounds, neuroradiology rounds. And my experience has been that radiologists presenting are generally eager to collaborate, eager to educate, and audiences are eager to learn and so forth. I think that that's the right approach. Not confront, that doesn't get you anywhere, with any discipline. [laughs]

Ryan Van Patten 09:36



[laughs]

John Bellone 09:37



Yeah, yeah. Not just the radiologist, but the neurologist and other specialties, too, seem very willing to collaborate.

Steve Correia 09:42



Yeah, I mean, think about yourself. Do you like it when somebody is confrontational about your neuropsychological report? Kind of puts you off. They might be right, right? [laughs]

John Bellone 09:51



[laughs]

Steve Correia 09:51



They might be right. They might have a good point. But it sort of makes you defensive. Whereas the person who comes to you and says, "Gee, I noticed you said X about patient Y, but what do you think about this other thing? How come you didn't comment on this?" And they may have a point. Or you may be able to educate them about why that's not something.

Ryan Van Patten 10:12



That's good for interprofessional work in any setting.

Steve Correia 10:15



Exactly. In my view, the reason we consult other providers and other professionals ought to be twofold. Number one is for patient care, and number two is for your own personal education. And not keeping score.



Ryan Van Patten 10:36

Yeah.



John Bellone 10:36

Now what if you don't have access to the radiologist? You get this record from some other hospital and let's say you do disagree with the findings and you need to finalize this report. How do you work through that in the report? Do you include your interpretation or a caveat there? I guess part of this question is, do the radiologists always comment on pathology? Or do they just respond to the referral question and potentially leave out other things? Like, not talk about encephalomalacia from a childhood TBI because the emergent question was whether or not that person had a stroke. I've wondered that sometimes. Does that factor into your reading of that?



Steve Correia 11:25

Yeah. This is a tricky question. I think neuropsychologists are going to vary in terms of how - so that's kind of a two part question there. So the first part of your question is, what do you do when you don't have access to the radiologist to clarify something? And you've seen something that you think is diagnostically relevant or relevant to your case formulation. Right? I think that's what you're asking.



John Bellone 11:59

Exactly.



Steve Correia 12:00

So in cases like that - and it comes up, I mean, we sometimes get images from non-VA facilities or other VAs and we can't call the radiologist. So there have been times when I've consulted our radiology team to ask them the question. And then if not available, I'll ask someone else - maybe a neurologist who I know has good imaging skills. So, I mean, I've done this for a while. I'm sometimes comfortable, depending on what it is, I'm comfortable saying, "On imaging I noticed an area of hypodense signal on the CT in the right hemisphere, but I have not confirmed that with radiology." I may say that. Or I might be silent on it. If I think it's really relevant, I may comment on it with the caveat that this has not been ruled out and just sort of describe what I see and not try to attribute it to an underlying pathology. Now there are plenty of neuropsychologists who would disagree with that. Because I think you're at the edge of your scope of practice and training when you do that. Your other question was about - I don't know if that answers the first part of your question?



John Bellone 13:18

Perfect. It will be variable depending on the neuropsychologist.

Steve Correia 13:20

Right. I think the other part of your question is, do the radiologists - might they not comment on some pathology? So the question is, really, are they going to be comprehensive in their reads, right? I've seen a lot of variability on that. I think it has to do with the nature of the question that they receive and the setting in which the question is rendered. So, to take your example, a person comes in and they seem to be having an ischemic stroke. Come into the ED and MR is done because you want to look at those diffusion weighted images to see if there's an area of restricted diffusion that might describe an ischemic event. And oh, by the way, the ordering physician from the ED might ask for perfusion imaging. Even if they didn't, the radiologist might say, "Let's do perfusion imaging to see what the blood flow is like as well." The emergent question is, "Is this person a candidate for thrombolysis or clot removal?" Right? This is an emergent question. They might not comment on the old pathology to the cerebellum in that situation. Whereas, if you've got a general question, sort of a baseline question, "Please rule out structural abnormality in patient with late life memory problems" or "New onset seizures" or something like that, then they might be a little bit more comprehensive in a less emergent situation. So I think the referral question and the setting might have a lot to do with that. It's a good question for radiologists. Yeah, have a radiologist here and ask them that question. [laughs]



John Bellone 13:43

We plan to.



Ryan Van Patten 14:44

Yeah.



Steve Correia 15:09

Yeah. Yeah.



Ryan Van Patten 15:12

So I'd like to transition a little bit and talk about training. I'd like to ask for your recommendations for people, neuropsychology trainees or professionals, who are looking to increase their knowledge in this area. So maybe so far in their training they have simply only relied on the radiologist's report, but they're looking to

become someone who is more proficient in interpreting scans themselves. How do you recommend someone go about starting that? Specific books? Or simply looking at images? Any other resources? How did you do it and how do you recommend others do it?

Steve Correia 15:48

All the above. There's plenty of resources out there. There's online resources, different learning institutions. When I was learning, I often visited one of the Harvard sites, that was helpful. But there were lots of others. I think Lake Forest has a site. There's many out there that will help you walk through images. I think there's books out there that are very helpful. From my perspective and, again, other neuropsychologists might disagree, but if a neuropsychologist has an interest in gaining expertise in MR or in imaging - I focus on MR mainly, but CT, MRI - look at images. That's the main thing. What I found helpful and still find helpful, I still do this, is to look at the images first and then look at the radiology report. [laughs] To see, "How did I do?" You know, "What did I miss?" And then go back and see, "Oh, that's what that was." Or, "Gee, I missed that." Right? And more often than not, I find that I miss things more than I catch things.



I think that it's important to have some basic knowledge of the physics. You don't have to know the math and you don't have to know the details, but a little bit of knowledge because it helps you to understand what the source of signals are in the images. That's my opinion. That can be done from reading and also looking at images. But I don't think you need to read physics books, right? I mean, those will be over the heads of most people. They're over my head, for sure. I get to those pages that are full of equations and I turn the page. [laughs] There are books that are designed for clinicians. I particularly like Paul Leiby's book. I think that's a very good one. It's accessible.



Ryan Van Patten 15:48

Yeah.



John Bellone 16:07

Yeah. We'll link to all of these in the show notes as well - the resources that you mentioned.



Steve Correia 18:05

Another thing to do is take advantage of what's out there. If you're going to a conference and there's an imaging colloquium, go to it. Attend your local

neuroradiology rounds. If you happen to be in a medical center that has imaging, there may be radiology rounds, go to them. You know, even if it's spinal cord, go to them. I mean, at neuroimaging rounds at the VA sometimes we're looking at the spine through the abdomen and I'm kind of lost. [laughs]



Ryan Van Patten 18:37

[laughs]



Steve Correia 18:37

But, it's useful to go. You've helped form collaborative relationships between the people who are there, who then you can ask questions to.



Ryan Van Patten 18:46

Right, back to our earlier point.



Steve Correia 18:47

Yeah.



John Bellone 18:48

I know it's incredibly helpful to have a good understanding of neuroanatomy also when you're looking at these scans. Do you have any separate recommendations for how trainees might begin to learn about the geography of the brain? How'd you go about it?



Steve Correia 19:08

Yeah. It's been something that's been interesting to me. I don't claim to be an expert at it. But, I think when you're looking at the images, having a good basic anatomic knowledge is really important. Especially because radiology reports refer to the anatomy and I think you should be able to - I think it's helpful to know that when they say there's such-and-such a lesion in such-and-such an area that, in your mind, you have a sense of where that is. You can pull up at least a rough image in your mind's eye of where that lesion is because you may not have access to the actual images to go look to see where it is. So I think having some good basic neuroanatomy knowledge is really helpful.

Now, that said, you know, what I struggled with and I see most trainees struggle with is anatomy. The brain is a three dimensional structure, and our images are in 2D. [laughs] Even if they're acquired in 3D, they're often rendered on the screen as

a plane. So I think it's important to understand, when you're looking at structures, what the trajectory of structures are through the different slices. Having an understanding of that. A structure that you see or a lesion that you see having a certain shape and location on the axial images - let's say in the axial FLAIR images, we get an area of high signal on the gray white matter boundary in the right hemisphere. I think it will help you develop anatomy to then go through the sagittal T1s to see if you can find that as an area of hypointensity, so you get a sense of where you are in 3D. I think that that's really helpful. That's helped me a lot, kind of developing that. I didn't have that when I first started getting into images, and you develop it over time. So looking at anatomy, going to brain cuttings, all of that helps, I think. Looking at anatomical books, as well as real brains, as well as images and trying to correlate those all together.

Ryan Van Patten 21:49



Our listeners will really appreciate your perspective on that. Because, of course, there are multiple avenues to learning about something, to developing expertise in imaging. But, yeah, thanks for sharing yours.

Steve Correia 22:01



Yeah. I think one challenge in terms of anatomy, and, again, other people might disagree with me, but the patient sitting in the scanner doesn't always have their head straight up. [laughs]

Ryan Van Patten 22:16



Good point.

Steve Correia 22:16



And so, you know, where a slice goes through the anatomy, you might be catching different parts of the anatomy on the left side or the right side of the brain, or as you move anteriorly to posteriorly in a sagittal image depending on how their head is oriented. And that can really throw you off. So having a good sense of anatomy can help ground you as to what you're looking at.

Ryan Van Patten 22:41



Right. You have your own mental map, 3D mental map of what the brain looks like. So if it's a little off, you can sort of self-correct as opposed to only strictly learning how to interpret the 2D images and not fully appreciating the three dimensional structure.



Steve Correia 22:56

I think I can do that to some extent, but it's a challenge and it's a skill that you just continue to need to [develop]. I enjoy it. You continue to grow with that.



Ryan Van Patten 23:09

Yeah. So let's move a little bit into daily clinical practice and how we can use imaging. So maybe an obvious question is how do we integrate neuroimaging data with neurocognitive data? And, specifically, what happens if they don't match?



Steve Correia 23:25

Yeah. So, how do you integrate? I think the imaging will help you in a couple of ways. If you know that a person has a pretty extensive lesion in a particular part of the brain, and you have good knowledge of your neurocircuitry, knowing the imaging findings might help you guide your assessment in terms of test selection and how you approach the interview. A person with a large, anterior MCA stroke, you're going to expect an expressive aphasia in that person and so you need to think about that before the person comes in. So I think the imaging helps from that perspective. I think it also can help you in interpreting the test results. And I think that it can also help you in terms of your treatment recommendations, even sometimes for things that don't have to do directly with our testing. So, for example, the person with a large orbital-frontal encephalomalacia from a head injury. Neuropsychologists often, but not always, test for olfactions - that person might have safety issues related to that. You want to think about that in terms of your treatment recommendations. I think having that knowledge is really helpful in terms of formulating the assessment, formulating your diagnostic impressions, and the treatment recommendations. At least to the point where you appreciate what the report says if you're not looking at the images.



John Bellone 25:01

So what do you do if you have this beautiful brain but they're completely impaired on testing? Or vice versa? If they perform really well on testing, but then, you know, they've got this peanut-sized brain? [laughs] You know, they have a ton of atrophy.



Steve Correia 25:20

Or it doesn't line up.



John Bellone 25:21

Right. What do you do with that? I always have difficulty.

Steve Correia 25:24



The image is not the function. That gets back to a question you asked earlier, right? That's why you need us, right? Because people do have this wide variability in terms of - I mean, listen, the hippocampi are where they are, right? I mean, they're not going to be someplace else. But there's wide variability in terms of what our skills are and individual variability in how cognitive skills are networked in the brain to some degree.

Ryan Van Patten 25:57



So I'm wondering about, as a clinician and neuropsychologist who receives a referral, I've actually had variability in my supervisors in terms of when they would look at the imaging. I had one supervisor I could think of who would specifically wait to look at imaging until after the clinical interview and he had done test selection in order, he would say, to prevent himself from biasing his thought process and then integrate imaging on the back end. Clearly there's no right or wrong answer with this. So I'm just curious about your personal perspective.

Steve Correia 26:32



Yeah. It's a great perspective to take. I don't know, I'm variable on it. Sometimes you don't get the images until afterward anyway. Until after or you just don't have time to look at them. Maybe you looked at the report - hopefully you've looked at a report if there is one. You've done that ahead of time. And the reason I say that - again, there's a potential biasing effect with that but I think it's helpful to know in terms of thinking about your assessment so that you don't overlook something in your assessment or give somebody a test that you know they're going to fail because they've whopping damage in that area. It may be useful to quantify that, but you should have some expectations about what you're going to see, I think. Yeah, I think you're right. There's no right answer, but I think looking afterward is sometimes very helpful. It depends on the referral question. The patient I saw today who had an old, right thalamic stroke and I didn't get to look at the images. That's what the report said - right thalamic stroke. So I get the test results now. And now I'm going to go back to look at those images because the thalamus is a small structure, but it's not that small. And if there's a lacunar infarct in the thalamus I want to get a sense - the patient's complaint is memory problems, so I want to know is this in the mediodorsal nucleus area? Because it may have implications about the person's memory problems, about the results. But I didn't have that information ahead of time. I don't know if that's helpful. I think you're right. There's no right or wrong answer to that, in my view.

John Bellone 28:19



I've noticed that radiologists don't seem to regularly state whether or not they're correcting for age in their interpretations. So, you know, an interpretation of a brain MRI in an 83-year old might say "mild atrophy". And I always wonder what their comparison is. Is it "mild" compared to a healthy 22-year old brain or "mild" compared to a healthy 83-year old brain? That's what we do when we use age norms in our interpretation, and that has real consequences for how we interpret the atrophy. Is there a way of knowing if the interpretation is age corrected or not?

Steve Correia 29:16



Ask the radiologist. Yeah, I think there's probably wide variability. I've actually talked to radiologists about this and the answer I got was, "Well, that's a good question." Right, right, right. You know, I'm being facetious. But no, I think that there's wide variability about that. Are they judging the normal age related atrophy that you see in a 75-year old, and they call that mild atrophy? Well, that's maybe true. I mean, there's going to be atrophy compared to the big juicy tomato brain of a 22-year old, right? There's going to be differences. So are they speaking in absolute terms relative to the biggest healthy brain? Or are they saying mild to moderate atrophy for a 75-year old? I really appreciate the radiologist who says in their report "age appropriate atrophy" or "mild atrophy for age", then you know. Otherwise, I think it's hard to know. I think radiologists who deal with different populations may view those differently. I mean, the person who is looking at mostly younger people might call normal age related atrophy in an older person "moderate". Who knows? I think you need to ask the radiologist what they do. And I think you do develop new norms after looking at some for a while.

Ryan Van Patten 30:44



When should we recommend neuroimaging in our reports? What considerations should go into us saying, "This patient would benefit from neuroimaging"? I know that's a loaded question. There are a lot of different things to consider. Maybe just boilerplate?

Steve Correia 30:56



Yeah. We touched upon this a little bit earlier. I think I've never really thought about the explicit guidelines. But, when I do it, it's usually because I think it would help me with a differential diagnosis and would impact care of the patient. It's interesting to know, sometimes, right? But it may not have any bearing on the person's care. And when we think about the patient's care and the differential diagnosis, I think part of that care is explaining to the patient why they're experiencing what they have. If that

helps you to explain that, then I, personally, think that that's valuable. Others may disagree. [laughs]



John Bellone 31:46

How do you talk to patients about it? About the neuroimaging? Do you show them? Or...



Steve Correia 31:53

I don't. No, I don't. That's the realm of the radiologists or the person who ordered the scan. I think there are pitfalls in doing that. And I think that should be done somewhat carefully. I usually don't disclose the results. If the patient tells me, "Oh, I had that MRI last week, I don't know what the results are." If I know the results and it's all good, I might say, "It's all good. You should talk to the radiologist." But usually, I'll say, "Well, you need to talk to Dr. So-and-so who sent you for the images."



John Bellone 32:32

Fair enough. One thing that comes to mind when we think about considerations for recommending neuroimaging is a difference in funding based on the setting. I've been in a number of different settings, and I was told by one of my supervisors when I was working in a setting with very minimal resources that I should be really selective about who I referred for imaging, only requesting it if it would substantially increase diagnostic accuracy or improve prognosis. The reason being that there just weren't enough resources to send people for an MRI and it would look bad for the clinician who referred the patient for testing if we requested imaging and then they couldn't do that for financial reasons. It would look like that clinician wasn't following through on our recommendation. So that's something I've been mindful of and I just wanted to get your perspective.



Steve Correia 33:27

I think if you're in medical centers that are well-equipped with MRI and have the capacity, there's a tendency to want to do the imaging, right? So, yeah. I spoke about this earlier. I think the clinical need and the clinical indication should drive that decision. I also think that this is just stylistic, right? Your concern is important, especially if there's limited resources and you tell the referring provider, you're saying, "I, neuropsychologist expert, recommend imaging on this person." You're not the one ordering the imaging, right, the other provider is. You're putting it back on the other provider, that sort of pigeonholes that provider and constrains them. Whereas I think a recommendation about consideration and why you think it may

be useful for that and also framing that there may be reasons not to do it. If you know that there are reasons not to, if you're on the fence, fine. I think you can say that. So I think one shouldn't be cavalier about ordering imaging in any sense, in any setting, even when it's widely available. And be careful when there's limited resources. And try not to pigeonhole your referring providers. I don't think that's a fair thing to do.



John Bellone 35:02

Yeah, I like that a lot. I like the caveat of "consider this."



Steve Correia 35:06

And why.



John Bellone 35:08

Right. But also saying, you know, "We defer to the physician to decide ultimately whether or not this is necessary."



Steve Correia 35:14

Right, because the physician might know more about the patient than you. The clinician may say, "Well, I'm going to treat their hypertension anyway." Right? So what is this adding?



Ryan Van Patten 35:29

The information that they're privy to that we may not be could allow them to make a better decision.



Steve Correia 35:33

Correct.



Ryan Van Patten 35:34

Yeah.



John Bellone 35:35

In terms of safety, is there anything we need to think about here? To what extent is it our responsibility to ensure that the patient is appropriate for imaging? Like, do we need to make sure that they don't have shrapnel? Or should we mention that the person has a pacemaker? What do you do usually?

Steve Correia 35:53



Yeah. So if you're writing back to your referring provider to say, "Consider the MRI, consider imaging," and you know that the patient has a whopping contraindication, safety indication, I think you're ethically responsible for mentioning that. So if you know the patient has a pacemaker and if you're going to say, "Consider neuroimaging to help differentiate blah, blah, blah," you might state, "It is noteworthy, the patient has a pacemaker. CT might be more appropriate than MR." Or "MR is not appropriate." Well, although some pacemakers are now MR compatible. Then that's the realm of the radiologist and the MRI techs and CT techs to make sure of that. I think if you're referring somebody who has whopping claustrophobia, that's another issue, too.

Ryan Van Patten 35:59



Right. Another safety issue that we may be more knowledgeable about - there are certain anxieties related to having an MRI scan, being closed in, that sort of thing.

Steve Correia 37:12



Yeah. A lot of people can't tolerate it.

Ryan Van Patten 37:14



Yeah. So as we're moving towards the end of the episode, I thought it would be helpful and it makes sense to step back and talk a little bit about where the field is going. This is a broad field, obviously, neuroimaging, there's a lot to it. So I'm not asking you to tell us all the cutting edge technologies in all of neuroimaging.

Steve Correia 37:36



I can't. [laughs]

Ryan Van Patten 37:39



But, instead, what's on your mind? Maybe it's DTI or anything that you're familiar with. New things that are coming down the pike that will improve neuroimaging.

Steve Correia 37:49



Yeah. So I find as I move along in my career, you know, one of the things that happens - you guys are young in your careers but, hopefully, you'll resist some of the temptations that I haven't - responsibilities tend to, like, glom on like burrs when you're walking through a forest. [laughs]



John Bellone 38:12

[laughs]



Steve Correia 38:12

Like, "Where did this come from?" So I think the more things that you get, the harder it is to keep up with things. It's not uncommon for me to pick up a paper and look at it and go like, "Oh, when did that imaging technique? That's pretty cool."



Ryan Van Patten 38:28

[laughs]



Steve Correia 38:29

There are always advances in scanner hardware. There's always advances in software for rendering the images, analyzing the images. I think you asked about DTI. There's increasing techniques for many more directions of diffusion encoding, which helps us disentangle those areas of fiber crossing and kissing fibers which can help with that. Another advancement - it's not terribly new, but another advancement in DTI is what they call multishell imaging, where diffusion is being encoded at different gradient strengths to allow you to characterize what are diffusion in different tissue compartments - intracellular, extracellular, that sort of thing - to make some judgments about that. In the area of functional imaging, more rapid acquisition of images with higher resolution is coming. One technique that we didn't talk about are advances in MR spectroscopy, looking at metabolic imaging. I think the field, as a whole, is moving - blood brain barrier imaging - is moving toward increased spatial resolution with quicker time, with shorter acquisition times. I think that's where the field is moving generally. But, man, there's a lot of stuff out there. It's hard to keep up with.



Ryan Van Patten 40:12

Yeah.



John Bellone 40:12

Yeah. How do you keep up? How do you suggest we stay on top of it?



Steve Correia 40:18

Well, I think for the neuropsychologist who is a consumer of imaging and doesn't view themselves as wanting to become really fluent in it - I won't say expert, but I will say really fluid in it - I think attending conference seminars, colloquiums, and

things like that from time to time is sufficient. When you see a radiology report that has a technique that you don't know about, ask. Ask the radiologist what it is. Or ask a neurologist who might know what that is and what it's useful for. I think doing that is appropriate. If you really want to get into the weeds, there are certain journals - there are MR physics journals, if you want to get into that level of detail.



John Bellone 41:10

Good. Anything you wanted to add that you feel like would be helpful? We didn't cover yet?



Steve Correia 41:20

No, I mean, we've talked mainly about CT and MRI and within those techniques there's certain things that we didn't look at. We didn't talk about perfusion imaging. We didn't talk about it, either with gadolinium or arterial spin labeling. There's other techniques that we didn't talk about - MR spectroscopy, we didn't talk about magnetoencephalography. We didn't talk about near infrared spectroscopy. There's tons of imaging techniques. And fortunately we didn't talk about those because I don't know that much about them. I know a little bit about perfusion and spectroscopy, but not that much.



Ryan Van Patten 41:57

See, I thought that was you volunteering to be a guest on our show again to talk about those things.



Steve Correia 42:04

[laughs] Those are a little bit out of my camp.



John Bellone 42:07

Before we end, we'd like to reveal a fun fact about our guest Steve here. So in addition to being a board certified neuropsychologist, he's actually also a badass saxophone player. [laughs]



Steve Correia 42:19

Was. [laughs] And marginal.



Ryan Van Patten 42:23

He's so modest. [laughs]



John Bellone 42:25

He used to play in clubs. We tried to get him to create our theme music, but he wanted too much in royalties.



Ryan Van Patten 42:29

[laughs]



Steve Correia 42:32

Right. [laughs]



John Bellone 42:33

He's clearly a man of many, many talents.



Steve Correia 42:36

Well, my music days are long gone.



Ryan Van Patten 42:39

Yeah. So I have a question, Steve, that requires a little self reflection. I know you're a modest guy, but hear me out here. So, in looking at your skills as a neuropsychologist, I think you're well above average in terms of interpreting brain scans. And I've heard you talk a lot about 3D models, mental manipulation - broadly speaking, you know, right hemisphere sort of abilities. Then, you also have this musical prowess that we're referring to.



Steve Correia 43:09

I wouldn't call it prowess. I had some skill at one point.



Ryan Van Patten 43:12

Okay. Okay. Well, I don't want to overstate. So those things can sort of go together, right? Right hemisphere abilities. And the three of us are psychologists. On average, psychologists tend to be more "left hemisphere". That's an oversimplification, but we tend to be more verbal and maybe weaker in some of these spatial and pattern recognition sort of skills. So my question to you is, above and beyond what we've already talked about today in interpreting scans, how do you think those skills that you have help you be a better neuropsychologist?



Steve Correia 43:47

Oh, gosh. That's a hard question. [laughs] I don't know. I don't know if they do. I mean, music was fun. And neuropsychology is fun. And looking at images is fun. I enjoy it. So does it make me a better neuropsychologist? I don't know. Better than what?



Ryan Van Patten 44:08

Fair enough.



Steve Correia 44:08

Yeah, I don't know. I have the skills that I have and I have the knowledge base that I have and that's that. There are certainly areas of neuropsychology that I could improve on. And I think we all do. I think for our careers, we should be mindful of that.



Ryan Van Patten 44:28

Right. Of course.



John Bellone 44:29

We thought you would be overly modest about that question. [laughs]



Ryan Van Patten 44:32

Yeah. We both predicted that.



John Bellone 44:34

So that's where most interviews would end but we have a couple of bonus questions for you that we're planning on asking all of our future guests. So the first one is if you could improve one thing about the field of neuropsychology, could be related to neuroimaging or it could be something completely different, if you could choose one thing to improve what would it be?



Steve Correia 44:56

Gosh, that's a hard question. I almost want to go away from imaging for this question.



Ryan Van Patten 45:06

Sure.

Steve Correia 45:06



I think there's been great developments in our field in terms of psychometric issues and normative issues. I think continuing on that is really important for our field so that we can, as best as we can, be able to talk about a person's performance on our tests as strengths or weaknesses with an appropriate normative sample. I also think the field needs to continue to work on developing tests and expanding our armamentarium of the kinds of cognitive abilities that we assess. We sort of, most of us, assess a fairly narrow range of abilities. I think that there's a lot of things that we don't typically get at clinically for issues of time and so forth.



John Bellone 45:59

Yeah.



Ryan Van Patten 46:02

If you can give us one bit of advice that you wish you had as a trainee or something you would advise current trainees to do. We're looking for sort of an actionable step that people can do to learn more knowledge and skills and ultimately become a better neuropsychologist.



Steve Correia 46:21

Yeah, so that's another tough question. Well, judging from my experience with trainees and what I think augurs well, is the willingness to ask a question without fear that the question is showing your ignorance, that you don't know something. I think that willingness to do that and to engage in discussion, I think is really important. Always keep your mind on that. That there's always things to learn. And yet, from a research perspective, don't get too diffuse. [laughs] But from a clinical perspective, always being eager to learn. I kind of have this - I don't know if I'm going too far afield, but I have this little mantra that I try to keep in mind and usually have it pinned on my bulletin board above my desk. It says, you know, "Learn something new every day. Do good work. And have fun doing it." I think if you do those three things, you're doing pretty well.



Ryan Van Patten 47:34

Good advice.



John Bellone 47:34

And from working with you, it seems like you do all three of those every day.



Steve Correia 47:37

Try to. [laughs]



John Bellone 47:38

Especially the “have fun” part. [laughs]



Ryan Van Patten 47:41

Well, speaking of, this has been great. Thanks for coming on the podcast, Steve.



Steve Correia 47:45

Thanks for inviting me. Again, I feel honored to be here. I think you could have a lot of guests who know a lot about neuroimaging and a lot more than me.



Ryan Van Patten 47:51

That modesty.



John Bellone 47:53

[laughs]



Steve Correia 47:54

But anyway, so.



Ryan Van Patten 47:55

Thanks.



John Bellone 47:56

Thank you.

John Bellone 47:59

Well, that's it for neuroimaging for now. Let us know if you'd like us to cover other details about imaging at a later date. Or if you have ideas for future topics or suggestions or questions, you can reach us at feedback@navneuro.com or through the contact page on the website. Also on our website are links to several neuroimaging resources. You can go directly to that page by typing navneuro.com/04. We're really grateful to all of you who subscribed to the show and left us a review. It really helps. As a token of our appreciation for this, we'll enter you into a drawing to win one of the AACN Oxford Workshop Series books.



Just remember to send us an email with the name you left the written review under so that we know how to contact you. Then listen in at the end of the October 1st episode to see if you won. You can find step by step instructions on how to leave a review by going to navneuro.com/itunes. On October 1st, we'll have a pediatric neuropsychologist discussing childhood cancer and how it impacts cognition and development. We're really excited to get that out to you. So that's all for now. Thanks for listening, and join us next time as we continue to navigate the brain and behavior.



Exit Music 49:21

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