ADVANCES IN MODELING NEUTRAL CORRELATES
OF TREATMENT-RELATED RECOVERY AND CONTROVERSIES
IN APHASIA REHABILITATION
PANEL DISCUSSION WITH ALL RESEARCH SYMPOSIUM SPEAKERS

Q: Thank you for your talk Julius. I wanted to ask about if you have; so you presented a lot of different, um, regression analyses, and I'm wondering if you've ever put the demographic and the, um, behavioral and the imaging all together in one model. Do you think that would help explain more of the variance in your data? And do you have a sense of; is that your next step? I'm curious what you think you would find.

(Inaudible comment and several people laugh)

JULIUS FRIDRIKSSON: Yeah, it's a great question. So I did. I did take the factors from the other previous models, the first two models and added them to the last one, the one that was predicting almost 42%. (Um-hm) They did not improve beyond the prediction beyond those 42%. Yeah. I was thinkin' exactly the same. Because then you really should have the best model, but there was no statistically significant in, in, uh, reduction in R squared.

Q: Okay, thank you.

Q: Thank you for a wonderful seminar. It's been really, really great mixture of ideas. I have a general question and whoever would like to answer it should answer it. (Laugh) it's about impairment based treatment and what we really mean by that. And I think it's very important to differentiate a task to, from a treatment. Also a temporary performance versus, uh, a permanent change in the nerves, uh, nervous system. And so when I come—when I think about aphasia therapy, I think about, um, changes that are permanent. So we might have a certain learning task to get there, but eventually, um, the, it's, um, a behavior that the person changes. Um, and so far we haven't really talked about generalization to communication and speech, and, um, indiv—and, per—more permanent changes. But it seems like that would be the most opportune way to look at changes in, but with functional and structural changes in the nervous system in the brain. So, have, is there any talk about how to, how to do model based predictions in terms of what connectivity might, um, might change after, mm, those more permanent changes? Does that make sense? That's a big question. It's a future question. But, what can we do.

SWATHI KIRAN: Okay, give us a chance to think about who wants to answer. The mic will be ready. I'll try, let me talk about it.

SWATHI KIRAN: Wait, I'm just getting the mic.
(They get the mic set up.

JULIUS FRIDRIKSSON: Yeah, great question Katrina. So, um… is this still working? Yup. So there was a lot to unpack about what you asked. The first thing that came to my mind was what Cindy talked about earlier with regards to what we can learn from the animal literature and recovery. I think we focused a lot, lately a lot more on sorta what we call functional approaches as a pr—as a, instead of impairment based approaches. I think the main reason why people have

gone away from the impairment based approach; I will get back to your question for sure; but the reason why people have focused more on it, is because the dosage that we use in our aphasia treatment studies, is probably always underpowered. I suspect that is always under power. So if we're wanting to see real life changes in aphasia *with* impairment based treatment, I think we need to probably do a lot more of it. Whether that's gonna lead to changes in functional connectivity, which would be great, but ultimately structural connectivity, I think it would. But, the study that we have done so far, including my own, I suspect that they're always underpowered. And people have been disappointed with the results, and therefore have gone to these functional approaches. Now, you take that to clinical care, where maybe 3 weeks of treatment may not even be possible. I think that people have gone to functional approaches basically because the impairment best—based treatment are not given in the same dosage that we would like see for example in the animal literature. If you're looking at anything from (sounds like Brandy Noodle) for example, if you look at the number of training sessions that an animal is put through to improve limb function following a stroke, you may be talkin' 150 to 200 sessions. How many patients in clinical care realistically get that? That gets very unusual. That just doesn't happen.

(Inaudible question)

JULIUS FRIDRIKSSON: Yeah, absolutely. I think that's what we should do. I, I would love to do that.

(Inaudible question)

CYNTHIA THOMPSON: I think I just agree with you for once. (Several people laugh)

MARGARET: Okay, we have another question.

SWATHI KIRAN: Well I just wanna add, of course agree with Julius. But I, I, uh, last week I was at a conference that was talking about motor recovery, and the keynote speaker there was making the exact same point that Julius is making for speech and language, but he was doing it in the context of motor recovery. So we're not… And it was exactly the same comparison with animal studies, saying we're not getting enough repetitions in motor recovery as well.

Q: Alright, so I think I have what is a related question. Originally targeted at Julius, but anyone can take it up. So… I'm over here. (Oh) Hi. (Laugh) So I was thinking about the slide that you put up when you were describing the treatment task. And you said sort of offhandedly, that's not what you would do in treatment normally. So I was wondering for that task, and, and for the other where you're trying to predict outcomes, if, if you can speculate about how likely you think that those outcomes would be similar if you picked a different treatment task, um, or a variety of treatment tasks.

JULIUS FRIDRIKSSON: Yeah, it's, that's a very good question. Um, I thought about it a lot. So, I think what we're doing with the TDCS is sort of, sort of like attending to the garden. I think we're improving the environment, of whether that's gonna be language therapy specific, it might be the location where you stimulate, might be important for the type of treatment that you

give. But, I would think that a more potent aphasia therapy than what we did would give you even better results. So if we can sort of scale up, that hopefully we would see comparable improvement with the anodal TDCS compared to the sham, if the behavioral treatment was better. But I, I have no data to tell you whether that would play out right now. Thank you though.

Q: Hey. Thank you all so much. This has been wonderful. Um, so I had a question for Dr. Thompson actually. I was wondering if you could talk a little bit about the training that you discussed. You talked about its effectiveness. Um, and I, also would just, uh, like to say I think it's been wonderful to think about the clinical implications for all of the crazy in depth science you all are doing, which I so appreciate. I think it's gonna, um, it's, it's gonna give us impetus to advocate with insurance companies for therapy done a lot. I just, I love seeing especially Dr. Thompson's model from where we are, where we say and where we're going. Um, so yeah, if you could just talk a little bit about the training. Um, and if there are aspects of that that you think are clinically relevant now that we could be using with our, with our patients clinically.

CYNTHIA THOMPSON: Yeah, sure. Um, it's treatment of underlying form. I don't know if you've heard of it or not. But I've published numbers of papers about it. Lew Shapiro and I, um, developed it in the '90s. Um, and we've done numbers of studies showing how it works. But here's, here's the idea. It exploits, um, verbs and verb argument structure. Um, we're gonna go back to linguistics now. (Some people laugh) No, and in any case, um, (Laughs) um, you know, verbs are, are coded in a lexicon with their argument structure. And so, and I've always said, and this is same thing as training complex sentences, that you train a complex sentence, you get the simpler sentences for free. The same can be true, said for verbs and nouns. If you train verbs, you potentially get the nouns for free, because the verbs, um, come out of lexicon coded for the noun structures that go around them, such as "the boy ate the sandwich" or something like that. Um, so, the, the treatment essentially exploits the verb, the semantic rules around the verb, in a simple sentence. And then we have the now linguistic strategies that we train patients to essentially move the, the sentence constituents, to occupy slots for noncanonical form. And then they again, again identify the semantic roles in the noncanonical form. So that's, that's how the treatment works. And it's online by the way, if you, on my website. Um, if you're interested in it, you can look it up or contact me and I can give it, send it to you. Mkay.

Q: Hello. I'm over here. I feel like (Laugh) this part of the question asking is waving. Um, my question is for Dr. Turkeltaub. I was curious to know more about the functional anomaly, um, mapping I think you called it. This new method that you are using with resting state data. Um, I just wanted to hear more, um, about it, what potential applications, um, that it might have. Um, I'm interested in indi—individual differences in traumatic brain injury, and so, um, a lot of your framework was really interesting to me, and I just wanted to hear more about that method in particular.

PETER TURKELTAUB: Uh, yeah, thanks. So we're, um, we're pretty excited about this. This is something that we've been working on for the past several, uh, months. Um, we just posted the preprint on bio archive, um, last week I think. Um, so the, the method is pretty straightforward. We take the, the 4 dimensional resting state data, so these are the brain volumes over time, and there's 200 something of them per person, and then we feed them into a machine

learning algorithm, and compare them to control subjects. And then, we combine the weightings, we collapse the weightings over time, and there's a little bit of normalization procedure that goes into it, and then we get these maps out of 'em. And, what we've shown so far, what we've found so far with the maps, is that they do a nice job of finding the area of the sort of obvious anatomical, uh, lesion. Uh, although there are some people with the subcortical lesions that I showed, who show different, uh, patterns, which I think is what we expect to find there. It doesn't find the entire anatomical lesion in every person, so I think it's not… it's certainly not capturing everything that's abnormal about the person yet. And then we, um, so then we look at test retest reliability, and we show, um, regardless of how we look at it, we, we show really high reliability. So like the dice coefficient is I forget, but it's something like .7 or .8 between time points. And we have people with as many as 8 time points over years in this. And it replicates over years. Um, and then, uh, and then it explains behavior at least as well as our regular anatomical lesions, uh, do. So this is all in stroke so far. We're, uh, we're talking about, uh, trying this in other processes also, like epilepsy and nerve generative disorders, and, um, and other things that, uh, as well. And then also looking at whether… we do see some changes over time, especially in the areas that are outside the area of the anatomical lesion. So we're gonna be looking at, um, whether those relate to behavioral changes, uh, over time. I think, I hope they will, but, but we'll see.

Q: Hi, yes, so my question is for Dr. Wilson. Um, one of the few questions I don't think I've asked you about this. (A few people laugh) But, um, for your adaptive semantic matching paradigm, um, when you talked about the few individuals who cannot do the task, do you have any, um, idea of whether that's due to just a global language deficit, or do you suspect there's more cognitive involvement for those individuals?

STEPHEN WILSON: No, the, the only people that can't do the task, are people who have like really, really serious comprehension deficit.

Q: Okay.

STEPHEN WILSON: Yeah, that's, and, literally we've probably run it on… I don't know, 50 people, and I think there's probably only been like one or two that couldn't do the task.

Q: Okay. And then do you, when that happens, would you just exclude that person, or would they still be included?

STEPHEN WILSON: Um, we'd still do structural imaging on them. (Yeah) Uh, but there's not much we can do. Uh, you know, we don't, we don't run the task having them not be able to do it. (Yeah) Like if they can't do it in training, we don't try and do it in the scanner.

Q: Okay.

STEPHEN WILSON: Thanks.

SWATHI KIRAN: Can I ask a follow-up question of that (inaudible words) Swathi? (Inaudible words).

MARGARET: In, in the mic please.

SWATHI KIRAN: Just wanted to ask a follow-up question to that. So when you, Stephen, when you scan them at multiple times, are these people, presumably at different adaptive points, and you still see the consistency? That's pretty cool.

STEPHEN WILSON: Yeah, I mean some of them are definitely, uh, recovered to some extent. Um, but I, we haven't looked at test retest reliability across time points where we actually think recovery is happening, because we wouldn't have any way of interpreting that. 'Cause, like it should be checking.

Q: Can I ask a broader question ideally to each of you, but perhaps to more than one of you? Which is, when I have Master students who don't particularly wanna learn the new neuro anatomy and wanna go with the old, uh… Geschwind, well, do it in order, Wernicke Lichtheim Geschwind. How can; what do I tell them will make them a better speech-language pathologist today, in their practice, to know the greater sophistication of what we know and, and, are on route to knowing about how the brain is organized for language?

PETER TURKELTAUB: Uh, well, I think from my perspective, so I'm a neurologist, so I was trained on the Wernicke Gesththeim, Gesch, uh, Geschwind, (Several people say the names and laugh) Lichtheim, thank you. Lichtheim, um, model. Uh, and, uh, you know I think that model is just so drastically; are you talkin' about the anatomical model, or the, or the cognitive? Uh . . .

Q: the anatomical.

PETER TURKELTAUB: the anatomical, okay. So I mean I think it's so grossly oversimplified, that it explains just very little about what we see, uh, in, in patients. It explains nothing about grammar, it, there's nothing about, there's really very little in that model that actually explains the phenomena that we see in patients. And, and the, the phenomena that I think, uh, are, are likely to explain the kinds of problems that they have, the phonology, versus the semantic problems, and, and grammar problems and, and everything else. And so I think understanding, uh, the, the cognitive architecture and the, and the neuroanatomical architecture to some degree, uh, better will help us understand who our patients are, uh, better, and then provide appropriate treatments for them, I think.

(Inaudible comment)

PETER TURKELTAUB: Oh. Yeah. Well I think that's a fair statement. I think you know if you, uh, if you do a thorough aphasia exam on your, uh, uh, on your patient, uh, and you have a good picture of, of who they are, and you're aiming for, uh, for sort of conventional, uh, speech therapy treatments, then, um, I'm not sure that the brain really adds that much, uh, at this point. I think we're very, very close. I think we're really within a few years now of, of… of being able to predict things that are important for people. And that work is coming from, from the people at this, this table, and also from Cathy Price's, uh, group and, and others as well. So I think it will become more important very, very soon. Um, but I agree at this moment maybe it's not perfectly

critical. But you know, if your student wants to have a career (Several people laugh) in the next 30 years, yeah. (People continue to laugh)

STEPHEN WILSON: I, I have a bit of a different perspective on it, um, in, in several ways. I mean for one, I'm a big fan of the Wernicke, Lichtheim Geshwind model. (Laugh) think I, I, uh, I am. I, I think it explains a lot a fundamental things. And it, it needs an enormous amount of tweaking, but I, I still think it gives us a backbone for thinking about the neuroanatomy of language. And, you know, I know that Hickok and Poeppel feel the same way. So no, I feel like we're, what we're doing is amending and improving and not replacing. That said, um, I, I do think that, you know, we know a lot more than the model suggests, and, and it is clinically relevant right now. We had a patient last week who had a heart issue and also had aphasia from a, a stroke. Looking at, uh, in kind of Wernicke's area of affinity, looking at the lesion, um, the SLP's in my lab and I were certain that this person will recover just fine. Um, but the neurologists were advising them not to bother with the heart surgery on this 78 year old lady because she's gonna have like, you know, intractable aphasia anyway, and quality of life's just not, it's not worth it. And you know, we, basically we, we said to them hey, this is aphasia is not gonna be the problem for this lady. Like make your decision on other, on other bases. So I, I do think that, I mean I can't tell you how many frontal patients we had where the neurologists are just like, oh, you know, they're not gonna speak again. I look at the lesion, and I'm like no, you know, this broca's area, well you missed the critical area by, you know, a centimeter or two, don't be (inaudible words). So, yeah, I, I think for prognosis, for accuracy of prognosis, I think we can offer a lot more than the, than the classical model.

CYNTHIA THOMPSON: I don't have too much to add to that, except for that I don't like the model. I mean I think it is very well, very much underspecified, I, I agree with Peter. And the, and the kinds of things that are coming out. For example the role of the anterior temporal lobe, in word knowledge and so on, it, you know, 5 years ago, that wasn't even part of the language network. Um, and the more we're seeing patients with degenerative disease like PPA, they have much different manifestations in terms of the rate, the… regions that are atrophied, than we do with sort of vascular disease, it just affects different tissue. So I, I think it's important. That said, I think that it's not going to me, uh, the behavioral, um, performance profiles. And using sophisticated psycholinguistic tests to examine the language function is equally, if not more important right now. But, another thing I agree with about pe—what Peter said, is that we are on the cusp. I don't know if it's gonna be 3 years, but we are on the cusp of being able to understand a little bit more about things for sure, relation between lesion and recovery. And if we can learn more about white matter and recovery, these kinds of things, profusion. I think that it is important for students to recognize that this field is moving forward very quickly, and that it has potential to, to greatly inform clinical practice.

JULIUS FRIDRIKSSON: I just wanna say that if I have to go in for heart surgery, I hope Stephen Wilson is on call. (Everyone laughs) Uh, with regards to the Wernicke Lichtheim model, I tend to go more with Stephen. So I talked to Greg Hickok about this many times. That if you took the Wernicke Lichtheim model, added about 5 or 6 more boxes, you basically have the dual stream model. So, yes, I know there's a lot more to it, but I think it's a good baseline. I think it's a, it's a good baseline. I think that you can add more to it. But it certainly, it has some explanatory power, and it, you know, I think if you look at you know, uh… Joe Rauschecker

and, and Scott's model, that's another dual stream model, it has a flavor of the Wernicke Lichtheim model. But it, yeah, the Wernicke Lichtheim, it's, you know, these newer models certainly have, have a lot more explanatory power.

Q: Explanatory for how great language (inaudible words).

JULIUS FRIDRIKSSON: Yes.

Q: But, explanatory for what it, what (inaudible words) you're saying?

JULIUS FRIDRIKSSON: No. Nope. And may—maybe we will get there. And maybe at some point, we will do better, and everybody here will do better, in that, coming up with maybe the amount of, you know, functional resting state dysfunction, or leukoaraiosis, or, you know, any of these measures. Perhaps at some point they will help us better predict who's gonna recover. We're always under pressure as speech pathologists in who should give, where we should put our resources. Perhaps the, that's where these models could be used. But at this point, I think promising, but not ready for prime time. Swathi?

SWATHI KIRAN: I was gonna say I thought I would have to cast a tie breaker vote, but I don't have to, so let's go on to the next question. (Several people laugh)

(Several people say "you too.")

Q: Come on Swathi.

SWATHI KIRAN: Um, I'm always in the; I'm always in the middle of this, and I think, (Everyone laughs) um…

JULIUS FRIDRIKSSON: Yeah, be careful . . .

SWATHI KIRAN: Be careful, uh, know. Um . . .

(Inaudible comments)

SWATHI KIRAN: The… I don't… I actually do think that, um, actually I'm gonna go with what, what Peter and Stephen said. I think the, the model is a great . . .

(Several people react and laugh)

SWATHI KIRAN: The model is a great starting point. Um, there's nothing about this that's proven wrong, but it's grossly under, underspecified, so.

JULIUS FRIDRIKSSON: I just said that. (Everyone laughs)

PETER TURKELTAUB: Yeah. Can I? I, I just wanna, I just wanna add the point that the mod, the model, wh—it's from 1885 for Christ's sake. I mean. . ..

(Several people laugh and react to that.)

PETER TURKELTAUB: It's okay. Like, it's okay that it was amazing at the time, and lasted for a hundred years. That's great! I mean it's amazing. I still teach my medical students the model because it's so historically important, and it's still useful I think in a way, right. I Mean considering that there's like 3 little boxes on, on it and 5 arrows, like that's amazing how much it can do. But, it's, it's, I mean come on, it's, it's 2018. I mean we don't, we don't need to use it anymore.

SWATHI KIRAN: Well actually Julius's point here was nobody's gonna be talking about us 118 years from now, (Several people laugh) so that's a good place to be. (She and several audience members laugh)

Q: We could change that (inaudible words).

CYNTHIA THOMPSON: Well I just; can I just make one more comment about that too? (A few people continue to react.) The old models are all cortex. Okay, except for this little flip between you know, Broca's and Wernicke's area. We know so much more now about the white matter tract, and how important they are, and how impaired they are in stroke, in particular, and . . .

Q: And differently as a result of how (inaudible words) . . .

CYNTHIA THOMPSON: Um, I agree with that completely, but yet I think, you already heard what I said. I think it's really important to be informed so we can move forward.

Q: Hi. First off, thank you guys all for today, I really enjoyed it. Um, I actually wanted to circle back to the functioning, or the functional resting state dysfunction. Um, I was just curious if there's any way to like determine that or something in the future that moving forward, that what they're thinking or doing independently in that scanner time, or how that might influence.

CYNTHIA THOMPSON: Well if all this… the, that's one of the reasons that we are looking at resting state. Because… of all of the neuroimaging tasks that we do, we do multi model ing—imaging, you know, it doesn't require the patient to do anything, they're just lying there. Um, so I think it's possible, you know, if we had a situation, which we don't have now, that clinicians have access to, uh, MRI, um, that doing this you know functional ta—or na—nonfunctional task is something that could be done. So, what was the other part of the question?

Q: I thought just kind of if there's any way for you guys, or any way we could differentiate or monitor between like. 'Cause obviously we have no idea what they're thinking. If they're, (Yeah) functioning out the rest of their day, or if they got stuck in traffic on the way there. Just like that independent free thinking I guess.

CYNTHIA THOMPSON: I agree with that too, and I was really skeptical at first, and I still am slightly, as in a, all the work that I do, I've just been not always, really… that, well, I'm not,

um… married to the outcome, let's just put it that way. You know, I'm not hide bound by previous ideas. And one of my ideas in the beginning was, what does this resting state actually really mean. Like they could be doing their shopping list while they're lying there. But, these recent findings are encouraging. I mean it's just all encouraging. We're not making any, you know, hard and fast statements here about what can, should be done, or, or not. Um, but they're very encouraging that we're actually finding these fALFF values are associated with you know lesion, which is no surprise, it's no surprise. Um, but they do reflect something about the stroke. And that we are seeing these particular regions within the brain that show this… um… decrease in fALFF activity, which is activity, of the brain, you know, the extent to which it's gonna be replicable, whether or not we're gonna actually really be able to use it, I don't know. But, um, I'm… I think it holds promise.

STEPHEN WILSON: I, I agree it's really promising, like your, your stuff that you presented, as well as the stuff that you're doing with Andrew Demarco is like very exciting stuff. Um, I think we can actually investigate this pretty easily. I mean I think most of these fluctuations are, mm, probably not that sensitive to task, and so it's probably fine if the person's thinking about their grocery list or not. Um, but it's not a difficult matter to compare the fluctuations under different conditions and, and see what, whether it's an issue or not. So I, I think we can deal with it in the next; any, anybody can deal with it with data they already have.

PETER TURKELTAUB: I just wanna make one point about the, the resting state with people with aphasia. So, um, the reason we started using it originally was this issue of the task effort confound with, with task related FMRI. But we've also been studying inner speech, uh, in, in the people with aphasia, and that's got me thinking more about what people do in the scanner, uh, during a resting state scan. And what they do is they talk to themselves. And so that means that people with aphasia will talk to themselves differently than people without aphasia. Yeah. And so I think there are some possible behavioral effects. Uh, although, and there is a little bit of work looking at people in different mental states, in, uh, you know, it, free mental state. So things like thinking about grocery lists versus, you know, thinking about, uh, you know, what they, you know, where they went for their prom, or something like that, and showing differences in the, in the connectivity at least in those different, uh, states. Um, there, they're small differences compared to the overall pattern of, of networks that you see, uh, regardless. But I do think there's a potential that the aphasia could impact the resting state mediated by a difference in, in what people do in the scanner.

STEPHEN WILSON: I thought about that too. But you know, you, you guys are looking at differences in fluctuations rather than differences in connectivity. So I thought it might be less of a problem.

PETER TURKELTAUB: right, well, yeah. So I think it, it; the degree to which it's a problem varies on what you do with the data. And, and I think it's not a big problem in our case, but I, I can't strictly, uh, rule that, rule that out.

(Inaudible comment)

SWATHI KIRAN: So I, I do actually think that resting state probably has the most promise for what will eventually get translated to clinical practice. 'Cause once all these issues are sorted out, and you've done it 4 times, using Stephen's analysis paradigm, and you look at it being consistently different, that's the one thing that I think clinicians, neurologists could do in a, in a regular scan. All this task based stuff that we're all doing is helping us understand what's going on in the brain. Um, but at the end of the day, if we were, after all this work, able to point out what's actually different, and be consistent with that, that might actually have some practical clinical promise in the long run.

STEPHEN WILSON: I don't see any reason why a task based fMRI couldn't be integrated into clinical practice in principle.

CYNTHIA THOMPSON: Well it takes time. That's one thing. It takes a lot of, um, clinician energy and, and knowledge, to evaluate the scans and so on. And, 'course in resting state you have to do that as well. That's the main reason I think it might not work clinically. Maybe. At your shop. (A few people laugh)

Q: thank you all. Um, oh. This may be a good follow-up question. So it's originally for Dr. Kiran. So you di—discuss the fact that those with better organization demonstrate better recovery. But now do we tap into that on a clinical level? Is it looking at specific domains, or is there something else we can look at bigger picture to tap into that?

SWATHI KIRAN: Okay, what do you mean by domain? You mean domain in the--?

Q: Like cognitive domains. Or is there some; is there a better way to look at organization behaviorally?

SWATHI KIRAN: Um, so, I'm glad I was in the middle of the these presentations today, 'cause you heard how much individual differences there are in just the same tasks, and in the way Stephen presented the data. And then you heard Cindy's talk about just across domains. And I was talking about people differences. And then Julius was talking about BDNF differences. So, I think that we're all sitting at the tip of the iceberg of what might actually be a really long, but hopefully, uh, you know, fruitful journey on what these, these… brain difference, these differences might be. Um, it could be cognitive, uh, but I suspect it's something much more than that. Um, and what's really, uh, you know, I started the panel, uh, the symposium this morning by saying that we're beyond the basic questions of the (inaudible words) and we're asking more sophisticated questions. And what you heard today was just sort of the scratching the surface of what these questions might be. I don't think we know the answer to the, the question yet, but I'll let the others answer.

(Inaudible comment and several people laugh)

Q: Okay. Hi. I, uh, I study motor speech. And so we—right here. (Laughs) sorry. (Laugh) And so we're always interested in how language influences our motor speech outcomes. And so, I guess I have the exact opposite question for you guys. (Laugh) In how, maybe you could talk a little bit about how you consider motor speech impairments in your patients, or, or in your, uh,

participants sorry. And, in particular for the production tasks, how do you, do you control for that? Do you, how, how much do you think about that?

STEPHEN WILSON: I think about it every day and every night. (Several people laugh)

Q: Me to, it's okay. (Several people laugh)

STEPHEN WILSON: Um, you know, in the acute setting we see every, everything. I mean we see dysarthria in most people even. And, disentangling apraxia speech from aphasia is very challenging. Um, and some; I don't really have a good answer. Just to say that I, I think, I actually kind of have in the end come around to seeing apraxia speech as part of aphasia. Um, because it is left lateralized. Um, and so like the brain is telling us something; it's telling us like that's part of that. Um, and it's separate from dysarthria. So, I, I sort of integrate it into my thinking of like, what is an aphasia. And I, and I don't actually really see a sharp dividing line. I think that there's like, you know, there's kinda like parietal types of apraxia speech that are a little bit closer to aphasia, an there's more frontal types that get clo—you know, more purely motor. Um, but I kinda see it as all part of the same problem. That's not an answer, but, (inaudible words).

CYNTHIA THOMPSON: Um, we rule it out (Laugh) pretty much. I mean it's most of the patients that I see have agramma—a, uh, well they have agrammatic aphasia. And, some of them have a mild motor speech impairment. But we don't study anybody who has a significant motor speech impairment, because, it might preclude their ability to be able to produce the sentences that we want them to produce. So… you know, that said, I don't really, I don't have an opinion on that. (Several people laugh)

JULIUS FRIDRIKSSON: No I mean we don't exclude people in our large treatment study based on apraxia speech. We look at it as an aoutco— as a predictor of outcome, but you know, it's an issue that we've looked at quite a bit actually, looking at the neuroana—so the lesion location that is associated with apraxia speech. But it's very common in our participants. And, you know, people with very severe apraxia speech we've shown in a couple of our treatment studies that those patients tended to show the least, uh, treatment response. Probably because they're apraxia speech is so profound.

(Inaudible comment)

JULIUS FRIDRIKSSON: Well, and the speech and treatment stuff too. So that, um… yeah, it's, it's a very, it's a negative predictor of improvement in speech production, even if the lang—the problem is language based.

MARGARET: So before we move to the next question, I'm gonna insert one for you Julius. Um, which is, on the hea—tail, tail of that. If I heard you correct, while the severity of naming was a indicator for worse response, the severity of phonolo— or the frequency of phonologic errors was actually a predictor of better response. I'm puzzled.

JULIUS FRIDRIKSSON: Yeah. So I think that goes to this, it's almost like taking a sledgehammer to the data. I mean, by coming up with this overall outcome. I like it, because I think that for a patient, if you could ask somebody at baseline to look at that graph and say would you rather be like the people that showed the overall treatment response that was good, or the ones that didn't improve at all, I think everybody would select the overall good outcome. But there's a lot a nuisance that we have not take—ha—just haven't looked at. So why is it that somebody has an overall better outcome? Because perhaps, um, it's phonology that is improving, and therefore, if you ha—make a lot of phonological errors in discourse at baseline, perhaps that is what is getting better.

MARGARET: Or perhaps their, their lesion and network is disturbed in a different way that is less overall disruptive.

JULIUS FRIDRIKSSON: Yeah. You know, I tend not to take this jump so quickly into the neuroanatomy. I, I really wanna focus on the language. I; obviously, we do a lot a neuroimaging work, but right now we, unless, until we look at our neuroimaging data in greater detail, I just, it's just a speculation really.

Q: I have another kind of discussion question. I think they're pretty fun, at least from the audience perspective. (Laughs) Um, so kind of across (Several people react) um, across all of your talks, um, something that I noticed is that there are differing opinions amongst all of you, um, about the importance, or even the presence of compensatory right hemisphere, um, activation in aphasia recovery. Um, so I want you to do 2 things. Uh, the first thing is to (Several people laugh) yes, please, if you would. (Some people laugh) Um, would be to, to tell us what your perspective on that is, uh, more explicitly, 'cause I feel like there were a lot of kind of side comments about that. Um, and then, um, I'm curious to know what data would convince you of the opposite opinion, um, if it were to come out. So, so what, what would your be, opinion on that be, and then, and, and what would change your mind about that opinion?

JULIUS FRIDRIKSSON: So I don't have a particularly strong feelings about this. Other than to say that to preface everything by saying if we were doing, we're sort of right now with understanding brain reorganization associated with aphasia recovery, where we were with regards to geography in the year thousand. There's a long way to go. I think that… we, when we're looking at differences in brain activation across studies, well some studies to T tests. Other studies run regression. It really matters. When you just throwing out there, oh this was left hemisphere, this was right hemisphere, this is both hemispheres, I mean it really matters how you do the analyses. So I think that there's no reason to think that the recovery anomia, and I said this earlier, is if we are looking at some kind of a reorganization of that pattern, is gonna look the same as if we're looking at the recovery from agrammatism. I just don't see why it would. That there would be some, like this golden pattern that would emerge that would explain all the variance. I just don't think that's gonna happen. So I think that… um… the tasks matter. I think it would be nice if we were doing things that were more similar. I think we are gonna adopt some a the things that Stephen is doing. I've, took me a long time to get to that point, but, um… (A few people laugh) I think that the more we're doing the same tasks, we can compare across studies. And the more that we're looking at same, some of the same outcome measures, if we're looking at the same predictors. We use, uh, you know, multiple tests at baseline to predict

outcome. Like, like Cindy's navs, was, one of her subtitles was the best predictor of neuropsych testing at baseline. I think we need a lot more coordination across these neuroimaging studies, to be able to answer questions like the ones you have.

SWATHI KIRAN: I'm gonna take, I'll take a more contentious view, 'cause I thought you were being very neutral there. I actually think, um, for the longest time I thought everything was happening in the left hemisphere after stroke. I thought that that was really where all the action was. And, and, as Stephen started the talk this morning, he sort of said, you know, that's the one thing we seem to know from these studies. But I don't think that's true anymore. I do think that the right hemisphere, this whole, there's so many regions in the right hemisphere that play a role. To what extent they're helpful or not, I don't think we know the answer to that yet. And there's a lot of ideas about maladaptive, and TDCS, and what that can tell us. But that's a bit of a long way off for me. I, I would have to see a lot of data like that, to be convinced that what we're actually seeing is maladaptive. Um, in the absence of that kind of data, I hope to believe that everything that's working in the brain is working for the good cause of recovery.

JULIUS FRIDRIKSSON: Yeah, and I think that, um, when we, we're thinkin' about brain changes, we assume everything that happens, all the brain changes that we're seeing, somehow have something to do with the outcomes that we're looking at. There's no reason to think that. If you look at the effect of stroke on both structure and function, not all of that is gonna be related to how the patient does. So there are changes. For example, I think Cindy showed changes in perfusion that were not related to performance. Is that correct? There's no re . . .

CYNTHIA THOMPSON: Much, uh, yeah, hypo (inaudible words).

JULIUS FRIDRIKSSON: Yeah, yeah. So, when we see neurophysiological changes, it may just be the effect of the stroke itself, but it may not translate into behavior, and if we take the next step, into predicting outcomes, or be related to outcomes.

CYNTHIA THOMPSON: Yeah, so I'd like to put another plug in for the right hemisphere. I've always loved the right hemisphere.

I hate it now. (Several people laugh)

CYNTHIA THOMPSON: No, you know, in early psychology, um… um… boil—biology, all of these… things. You know, in looking at children with hemispherectomies, um, who showed the abilities to learn language. Whe—at the first studies by Fox and others that I, um, read, that were neuroimaging studies, there's a right hemisphere activation. These were healthy people. Continually, there are almost all tasks at some level, you know, depending on how you threshold the data, it will show some right hemisphere activation. I personally believe that the bi—that the right hemisphere is biologically predisposed to process language. Just because of the hemispherectomy studies, because of tumor studies, because of recovery studies, because of am—for many, many reasons. That said, it doesn't necessarily mean that it's better or worse than a left hemisphere activation, but I absolutely disagree with the statement that says we know that the left hemisphere's better, because we really don't. And there's so many factors, in addition to the fact that the right hemisphere tissue likely does have a capacity for, and I know it

does, for processing language at some level, there's all of these other variables. There's perfusion, there's white matter, there's all these other things that, there's the language, um, impairment as well as what treatment is provided. I think these are such crucial variables that are going to tell us more about when the right hemisphere comes into play, um, and when the left hemisphere also comes into play. In some of our series, we have found left hemisphere activation, but we've always found right hemisphere. (Someone hiccups and causes everyone to laugh)

STEPHEN WILSON: Natalie, that's a great question. I'm really glad you asked it. (Several people laugh) Um, and I, and I'm really glad that we, actually having like, some like actual discussion and debate, unlike so, so many, so often these panels are just like oh yeah, I agree with, you know, half of that an 6 of, half a dozen of those in sequence. Okay, so, I mean I, I think, um… it's, I absolutely agree with Cindy that, that, um, for, at birth, the right hemisphere is perfectly capable of acquiring language. And we know this from hemispherectomies and from perina—large left perinatal strokes, which lead to excellent language outcomes and, um, right hemisphere dominance for language. And usually you don't even know that that person had a perinatal stroke, unless there's like a motor problem, or something like that, or it just comes up incidentally. Um, but I, don't think that the adult situation is anything like that at all. And, and I kind of, I, I think there was an allusion to that in the discussion earlier. But I, I just think that, recovery from perinatal stroke is just so vastly different, because it's de—it's, it's unequivocal that those kids acquire language in the right hemisphere and they do just fine. Whereas, what we've seen with adults, is that very rarely do they undergo any kind of pulsar reorganization to the right hemisphere. We've seen it like you know, once or twice out of dozens of patients. So, that's not to dismiss the role of the, the right hemisphere in recovery from aphasia. I absolutely am not going that far at all. And I think your data is, it's very promising about the, you know, the connectivity of the right IFG and what, I think it's very promising. But that's not the same as being like a, a reorganization to the right like happens with kids. That's a totally different thing. And so . . .

CYNTHIA THOMPSON: What I . . .

STEPHEN WILSON: Not you, no, not you. Uh, I didn't say you said that. (Several people laugh) Um, any—so, um… so I think it's like do, do, there's a difference between the dominant hemisphere and the minor hemisphere. And, I think the question is like, does the right hemisphere become the dominant hemisphere after aphasia, probably not. Can the minor hemisphere take on the roles of the dominant hemisphere? To some extent. Depends on the language domain, depends on a whole other things that I think we've discussed today. But like it's, it's a much more subtle question than just the right hemisphere taking over. I'm glad we agree on that.

(Inaudible comments.

It's Peter's turn.

PETER TURKELTAUB: Am, am I giving it back to you, or do I get . . .?

SWATHI KIRAN: No, if, if you, if you are not done, then I'll come back, 'cause I want . . .

PETER TURKELTAUB: I was gonna say, 'cause I get to go last, so that, that means I'm right I think. Right? (Everyone laughs) Uh, so, alright. So I'm having a lot of complicated thoughts and feelings, right. (Everyone laughs)

Q: I'm so sorry about that. (Several people laugh)

Just tell me one. (Several people laugh)

PETER TURKELTAUB: So, uh, so I, I wrote a paper several years ago, uh, that, that I titled, uh, "The Right Hemisphere is Not Unitary in its Role in Language Recovery", or something, or "Aphasia Recovery"; now I forget the title. And, and so . . .

(Inaudible comment)

PETER TURKELTAUB: Yeah. So the, and the point of that is just that it's, you know, I don't know. I think yes, there's a, there's 2 hemispheres, one is on the right, and one is on the left. And, (Everyone laughs) I, I agree. (Everyone continues to laugh) We all agree on that point. (Some people laugh) But it's just not; it, you know, and I do this too in my papers because it's convenient. But it, it, it's, I, I just don't think it's right to just talk about the whole right hemisphere as if it's one thing, and it should have one role, right. Uh, so some parts of the right hemisphere, uh, will help more than others, uh, and they'll help differently in different language processes, and differently in different people depending on the circumstances. And they may help for various reason ns. So some of the regions may be literally taking over synapses and performing, you know, effectively replacing left hemisphere nodes in the, um, in the network. Other ones are just compensating by, you know, paying more attention to prosody and pragmatics. Uh, ye—there's lots of things that could be going on over there that could be helpful, um, to greater or lesser degrees. And maybe there are some that are, uh, that are getting in the way of recovery, maybe, I'm not sure about that. Um, to, to Stephen's point about the, the, uh, the, the perinatal stroke. So I agree, the situation is different in adults. The, the kind of changes that we see in adults, when you look at the group level, have the same patterns in that we see this mirror image right hemisphere networks coming online at the group level. When you look at individual patients… wonder what they're talking about. (Some people laugh) Okay. So they, uh, they, uh, you don't see the same degree of, of shift. When we look at our perinatal stroke kids, this is work, uh, that Elissa Newport's doing here, uh, at Georgetown, um, we just see like the kids are missing their left hemisphere, and the activity in the right hemisphere looks just like the control subjects, and like the kids who have strokes in the right hemisphere. Um, and it's just in the other hemisphere. So that is different than, than we see in adults. But I will say this; so, uh, I hope that in a hundred years we can cure people who have aphasia. Um, that is not just, you know, fiddle around with making them 10% better, uh, uh, or, you know, than, than our behavioral treatments, uh, can provide, but actually cure their aphasia. And to me, the way that we're going to do that, is by taking advantage of the hemisphere that's intact. So there iss—

(Inaudible comment)

PETER TURKELTAUB: What;, say it again?

CYNTHIA THOMPSON: I said any teaching that's (inaudible words) . . .

PETER TURKELTAUB: Well I, I think that if we're gonna do this across people, that there is a hemisphere in most people who have aphasia, where you have a homolog of Wernicke's area, and a homolog of Broca's area, you have the connections largely that are in between. You have all the same connectivity patterns, you have the same side architectonics, and yes, it hasn't been used since they were babies for that purpose. But I don't think that means that in a hundred years we won't have a way to make them use it. Uh, and I think that's how, I think personally that's how we're gonna, that's how we're gonna cure aphasia.

(Inaudible words) don't say anything.

STEPHEN WILSON: It's go—I, I, well, I agree. And, uh, (Some people laugh) and I think it's gonna involve, uh, some drug that, that, um, changes the plasticity state of the brain to how it is in the critical period in the fir—especially in the first 2 years of life. I, I do—I, if we can… change. 'Cause that's not a struct—uh,. I don't know. That's, I'm hoping that's a neurochemical difference and not a structural difference. 'Cause if it's a neurochemical difference we can adjust it.

(Inaudible comment)

PETER TURKELTAUB: And I, I just wanna add that, uh, in, in case you think we, we are really far off from this, I'm not sure that we are. That, this, we may be. But there are mass models where you can reopen critical periods for plasticity, now, using drugs, and using certain kinds of, of brain stimulation actually. And so I think it's entirely plausible that we can do this in people in the next hundred years. I'm a little worried about what will happen to them when you reopen their… critical periods as adults. (Several people laugh) Uh, but I don't think it's impossible.

CYNTHIA THOMPSON: I agree. Thank you for that.

PETER TURKELTAUB: Sure.

Q: Just one point of clarification. Are any of you saying that language is a left hemisphere function exclusively? And if you are not, um, do you think that there as such a thing as normal language with one hemisphere?

CYNTHIA THOMPSON: I wouldn't say that. I mean, (Laugh) I don't think the le—well, never mind. I don't, wh—yeah. The right hemisphere's involved in most neuroimaging studies. There are many on lang—many language tasks. Um… yeah I don't know about the second question.

PETER TURKELTAUB: Uh, I mean I can, uh, you know, all I can tell you is what, uh, Elissa's finding in her papers in reference to this. So, uh, or in her, in her work so far with

reference to this. Um, so, uh, so I don't think that language ordinarily is a function of just one hemisphere, I think there are some things that involved, uh, uh, many things that involve to some degree both hemispheres. And we use both hemispheres, but just mostly the left for the things that we usually call language. Um, wee, we do have kids in our, in our cohort, um, Elissa's cohort I should really say, who have giant left hemisphere strokes; they have practically no tissue left . . .

Q: Yeah, most a those patients came from our cohort, and they're not normal.

PETER TURKELTAUB: So when we, uh, when, so, the first thing is to say is when we look at their fMRI activity, and it, and granted it's, it's, uh, one main language test that we're using that shows patterns that are roughly similar to what Stephen showed before. So they show a lot of, yeah, areas of language network, but not the entire, you know, not every, every piece that we know that's involved in language. But what we see is that they, they're just activating the same pattern, but in, in the right hemisphere. Um, when we do you know, uh, uh, tests with syntax on them, so passives and actives and, and various, you know complicated manipulations that I don't really understand, um, they do… uh, just as well on those as their siblings. Um, and they do as well as our, as the perinatal stroke patients, kids, sorry, who, well, they're now adults, they had perinatal strokes; whether they were in the right hemisphere or the left hemisphere. Um, and, so now does that mean their language is normal, I don't, I don't know. I mean I don't, I don't think you can really ever say that, uh, I guess. But it's pretty darn close. I mean, these are, you know, some of these kids are honors students, you know, they, they go to college, they have successful careers. Um, so to me, when I say I wanna cure aphasia by making people using the right hemisphere in a hundred years, that would be a satisfactory, that would's what I would consider cured.

Q: Yeah. I don't disagree with most of what you guys have been saying, I just, for pedagogical purposes, I just wanna make a point that language is a bilateral function, requires both hemispheres. And in fact, in these children, many of which came from, uh, the cohort that we have at University of Chicago that we sent down to Elissa, um, language is pretty good. Surprisingly good compared to motor function. But on the other hand, there, there are areas that are better than others and it's not the same. I mean, and, and my personal view of the future of recovery is a combination of, interventions like stem cells or devices or something else, and really very, very import—very strong experience dependent, you know, therapy to, uh, to encourage experience depend on plasticity in a very specific way. I, I don't think it's gonna be uni hemispheric, but that's one, one other person's opinion on this.

PETER TURKELTAUB: Um-hm.

SWATHI KIRAN: So maybe do one last question and then wrap up, if there's one more. One here?

MARGARET: Well while I'm walkin', so a, a little half question while I walk. Um, so, um, you know most of our therapies are focused on aspects of language. Yet given what we've seen with the integrated nodes and the models, um, what, is there anything you might suggest that we consider doing therapeutically? I know this may not be the best question for this group, but I

wanted to pose it. That might, um, help with activation of, um, uh, larger brain regions and interconnected processing, other than what they do in their day to day life of going around and tryin' to communicate with people. But you know I'm thinking attention tasks, I'm thinking sustain and shifting, and, working memory and all of this. And, what do you think?

CYNTHIA THOMPSON: Well I'll just talk first, and then I'll give it to you guys, hate passin' on it. Um… I don't know about all those sustain attention tasks and all those kinds of things. I mean I think that it, you know, they're more domain general, and we do see changes in those networks with, with recovery. Um, so they certainly do come into play in recovery of language. I just don't know if doing that alone is going to drive a, drive a, a language function or not. Um… so I think it's an empirical question and important one. But I also, think though that some of the things that, um, I've ta—I talked about in terms of specificity, that, of the treatment itself, and the kinds of principle, neuro plastic principles that Swathi and I have, are, have talked about a lot, um, and has been shown in the animal literature, I do think that those, if I had aphasia, this is what I would want to have done to me.

JULIUS FRIDRIKSSON: Yeah, so I wanna preface my answer by saying I, I love you Margaret, but, I really dislike the premise of your question. I mean we really should be thinkin' about how can we improve language to improve language. I mean, whatever is happening with, in the brain that's great, but, when was the last time we saw an aphasia treatment that really moved our field forward; a new therapy approach? I mean, we are publishing treatment studies today, of, treatment approaches that were invented in the '60s and '70s. I mean maybe that's the best we can do. But when was the last time you saw an aphasia treatment approach that you thought this is really gonna make a huge difference? I mean there have been some, but there hasn't been the development that I think we need to see. And I sometimes worry that maybe all this focus on the neuro stuff, maybe it's taking away from… (Inaudible comment) Yeah. I mean… whatever it is, I wor— I worry, and I hope it's not the case that we're taking away sorta the thunder from… the, the behavioral approaches. (Some people applaud)

SWATHI KIRAN: Okay. Um, so I wasn't gonna di—disagree with that, but I was gonna say that, that, um,… a different interpretation of your question. Um, and sort of I missed the initial part of Katarina's question. But I do think that maybe where, we're, we are… focusing a little bit too much on the details of which specific language function we're looking at. And that doesn't mean to say we shouldn't at the starting point, but I do think we need to rise up a little bit in terms of what we're trying to treats, and prove that it works, uh, I agree. But, but maybe there's a, a way to move a little bit higher. And, and the way that I think that higher is, is not just people, um, it's not just in the context of functional, it's in the context of making people do more difficult things. And that may be functional. Um, and the reason I say that is because, uh, again at this motor conference that I, this rehab conference I went to, they were showing data where people who were involved in more complex motor function generalize to simpler motor functions. Well where did we hear that? Just in Cindy's talk. Um, so I think we're thinking about this at some level very granularly in terms of what particular measure we're changing. And I appreciate your comment really as why don't we go beyond that. Um, but maybe the way to do that is to focus on something that might be more challenging for the patient, more complex, but functional, a useful thing in their environment, and then see if language all, uh, language is improved.

CYNTHIA THOMPSON: Yeah. I just wanna add one more thing to that. And I think it's really important that we exploit what we know about how normal language is represented and processed. Um, I think that's something that is not emphasized in speech and language pathology, and it's something that's absolutely essential. I think that many people who are speech-language pathologists, haven't even had courses there in, you know, sophisticated linguistics courses and so on. Not to mean that we're gonna do the, draw all these trees and all these things. And I don't believe trees are in our heads, okay. But I do know that when we learn language, we learn it automatically. We, we learn how to parse a sentence, we learn how to know whether or not a verb has certain 3 arguments, or 2 arguments. Our brains know this. Okay, so in treatment it makes sense to me that we would exploit those processes as much as possible so that we can facilitate some sort of perhaps reorganization of a normal process.

Q: Thank you for a great discussion. So, speaking about the behavioral outcomes, and the functional approaches. Can we link quality of life scores to the, uh, neuroimaging? Uh, you, you cannot say that look at quality of life is directly correlated to the WAB score, or like the aphasia quotient. So how can you use, or like incorporate quality of life into predicting the language recovery?

SWATHI KIRAN: I think we should use different outcome measure than just impairment based ones. We, we started to do that, and we'll, um, hopefully have publications on that in the next few years. I really like that the, the treatment trial that Julius talked about earlier used the, the NL as the outcome. I think that's an excellent out, outcome measure, because it kinda gets at like real life . . .

JULIUS FRIDRIKSSON: Inaudible comment)

STEPHEN WILSON: Yeah. I, I mean I just think; and you know, you; I, I don't understand why you put up that other study, um, about whether it's better to do the WAB or the, or the CAD. I mean isn't it just better to do, um, something more?

(Inaudible comment.)

STEPHEN WILSON: Wouldn't, wouldn't we…

(More inaudible comments)

STEPHEN WILSON: I, I don't know. I, I, okay, so I, I do think we should measure real, real life outcomes instead of just impairment based ones. I . . .

(Several people comment at once)

JULIUS FRIDRIKSSON: What are you talkin' about?

STEPHEN WILSON: they recommended different kinds of outcome measure, it wasn't just the WAB.

JULIUS FRIDRIKSSON: What are you talkin' about?

STEPHEN WILSON: there were several different kinds of outcome measure.

Right, that, oh, okay.

SWATHI KIRAN: But just to be fair . . .

STEPHEN WILSON: Yeah . . .

SWATHI KIRAN: 'Cause I was an author on that paper. They're making recommendation. (Laugh)

What paper?

SWATHI KIRAN: They're making recommendations on what might be outcome measures to pick if you had a choice to pick from. And they do say that you should measure the qual— you know, there's a measure of quality of life, there's a measure of functional outcome, and there's a measure of impairment. And, and in the, in the, in… in the best case scenario, you're measuring one of, or some of everything. Uh, but can I just say one? I mean, does it really matter what happens in the brain for somebody to be happy with their life or not? Does it? It does. I, I don't think it does. I mean we're doing the neuroimaging experiments to understand what's going on in the brain, but at the end of the day, we all know, we all work with patients who are just doing fine. They're happy, they love their family, they, they enjoy their vacations, they go to the opera, and I don't wanna, I don't think it's fair to say we have to know what's going on in the brain, otherwise they're not happy. I, I don't wanna go there.

I, I think that's right . . .

JULIUS FRIDRIKSSON: That's it, our work here is done. (Everyone laughs)

CYNTHIA THOMPSON: But I, Swathi, I don't think that's the point that she's making at all.

Q: Yeah. I wasn't making that point . . .

CYNTHIA THOMPSON: You know, I think, you know, opera's great, you know. But yet, (Several people laugh) but we're tryin' to understand how we can push the brain to the extent it can be pushed. You know. And, clearly there should be functional treatments going on together with any impairment treatment. Um… and there should be functional outcome measures as well as impairment based, outcome measures.

Q: But wouldn't it be cool if you could correlate your predictive models to quality a life and improve language? I think, I think that's where we were goin ' is, (Yeah) you know that would be amazing to be able to do that. You could predict quality of life in, related to language recovery.

CYNTHIA THOMPSON: Yeah.

STEPHEN WILSON: Yeah I think, I think we probably all have quality of life measures. Right? (Yeah) And we probably will all try to predict them when we have enough subjects.

JULIUS FRIDRIKSSON: yeah, if you wanna talk about some serious areas, and quality of life outcomes. I mean it's, we do that before and after treatment, rather than with life . ..

CYNTHIA THOMPSON: Right. And I just wanna say one more thing, okay, and then I won't talk anymore, okay. So, um… quality of life doesn't necessarily depend on language. There are a lot of language normal people who have very poor quality of life. Okay. So I don't really think it's our job to make their quality of life better. (Some people laugh) Right? Okay, so clearly it's an issue, it is an issue. But I, and, and I think what you're saying, Swathi, what you're saying about going to the opera and doing all these things, that that doesn't really require, you know, having friends. It doesn't really require language. Lange helps, bit, uh, anyway. So that's, I'm not gonna say anything more. Okay, thank you, bye. (Everyone laughs)

SWATHI KIRAN: I do want us to wrap it up 'cause it's 4:30 and, um, and, um… we should, the next year's conference, if you ha—if you can make a recommendation for what to do next year is maybe have a happy hour with wine and cheese at the end of this meeting, (Some people laugh and agree) so we could keep this conversation going. But we're gonna stop for now. Um, thank you all. (Applause)

MARGARET: I really wanna recognize Swathi Kiran, because she put so much work into this. Thank you so much Swathi. (Applause) And lastly, I want to reiterate our appreciation to NIDCD for funding the research symposium for so many years. Thank you NIDCD.