WEBVTT

NOTE duration:"01:00:32"

NOTE recognizability:0.796

NOTE language:en-us

NOTE Confidence: 0.5696312

00:00:00.000 --> 00:00:03.798 Okeydoke. Let's see.

NOTE Confidence: 0.5696312

00:00:03.798 --> 00:00:05.580 Good afternoon, everybody.

NOTE Confidence: 0.5696312

00:00:05.580 --> 00:00:09.256 Can you guys hear me? Oh, excellent.

NOTE Confidence: 0.5696312

00:00:09.256 --> 00:00:12.777 Nice to see all the familiar faces.

NOTE Confidence: 0.5696312

00:00:12.780 --> 00:00:15.456 Welcome back from the spring break

NOTE Confidence: 0.5696312

00:00:15.460 --> 00:00:17.833 and my name is Andrea Zinchuk and

NOTE Confidence: 0.5696312

00:00:17.833 --> 00:00:20.572 I wanted to welcome all of you

NOTE Confidence: 0.5696312

00:00:20.572 --> 00:00:22.622 to our Joint Sleep Conference,

NOTE Confidence: 0.5696312

00:00:22.630 --> 00:00:24.688 which is a seminar that's held

NOTE Confidence: 0.5696312

00:00:24.688 --> 00:00:26.769 between the Yale Beth Israel,

NOTE Confidence: 0.5696312

00:00:26.769 --> 00:00:29.468 Brigham Women's MGH, BMC Tough sleep centers.

NOTE Confidence: 0.5696312

00:00:29.468 --> 00:00:32.486 And so we have grown over the last couple

NOTE Confidence: 0.5696312

00:00:32.486 --> 00:00:35.440 of years and they will continue to grow and.

NOTE Confidence: 0.5696312

00:00:35.440 --> 00:00:39.796 Excited to talk to you guys today about our.

NOTE Confidence: 0.5696312

00:00:39.800 --> 00:00:41.280 Great Speaker Doctor Robert Thomas.

NOTE Confidence: 0.5696312

00:00:41.280 --> 00:00:42.889 But before I do that, I just want

NOTE Confidence: 0.5696312

00:00:42.889 --> 00:00:44.347 to make a couple of announcements.

NOTE Confidence: 0.5696312

00:00:44.350 --> 00:00:46.150 1st, Please take a moment to

NOTE Confidence: 0.5696312

00:00:46.150 --> 00:00:47.770 make sure that you're muted.

NOTE Confidence: 0.5696312

00:00:47.770 --> 00:00:49.970 And to receive CME credit,

NOTE Confidence: 0.5696312

00:00:49.970 --> 00:00:52.364 please see the chat room for instructions.

NOTE Confidence: 0.5696312

00:00:52.370 --> 00:00:53.740 And if you're not already

NOTE Confidence: 0.5696312

00:00:53.740 --> 00:00:54.836 registered with the CME,

NOTE Confidence: 0.5696312

00:00:54.840 --> 00:00:56.940 you will need to do that first.

NOTE Confidence: 0.5696312

00:00:56.940 --> 00:00:59.524 That there will be a code in there

NOTE Confidence: 0.5696312

00:00:59.524 --> 00:01:01.862 that you can text to the phone

NOTE Confidence: 0.5696312

00:01:01.862 --> 00:01:04.080 number for CME to get credit.

NOTE Confidence: 0.5696312

00:01:04.080 --> 00:01:06.054 And so the recording of the session

NOTE Confidence: 0.5696312

00:01:06.054 --> 00:01:07.685 will usually be available online

NOTE Confidence: 0.5696312

00:01:07.685 --> 00:01:09.680 within two weeks and there will be a

NOTE Confidence: 0.5696312

00:01:09.680 --> 00:01:10.980 link provided in the chat for that.

NOTE Confidence: 0.5696312

00:01:10.980 --> 00:01:13.116 And if you have questions during the talk,

NOTE Confidence: 0.5696312

00:01:13.120 --> 00:01:16.816 please make sure to make use of the

NOTE Confidence: 0.5696312

00:01:16.816 --> 00:01:18.480 chat chat room throughout the hour.

NOTE Confidence: 0.5696312

00:01:18.480 --> 00:01:20.766 I will moderate it as well.

NOTE Confidence: 0.5696312

00:01:20.770 --> 00:01:24.386 And so it is a without further ado,

NOTE Confidence: 0.5696312

00:01:24.390 --> 00:01:25.860 it is a great pleasure for me

NOTE Confidence: 0.5696312

00:01:25.860 --> 00:01:27.130 to introduce our next speaker,

NOTE Confidence: 0.5696312

00:01:27.130 --> 00:01:30.388 which is Doctor Robert Thomas from

NOTE Confidence: 0.5696312

00:01:30.388 --> 00:01:33.240 Beth Israel Deaconess Medical Center.

NOTE Confidence: 0.5696312

00:01:33.240 --> 00:01:35.640 And Harvard School of Medicine.

NOTE Confidence: 0.5696312

00:01:35.640 --> 00:01:39.567 And it's a real pleasure to have

NOTE Confidence: 0.5696312

00:01:39.567 --> 00:01:41.250 Robert speak here.

NOTE Confidence: 0.5696312

00:01:41.250 --> 00:01:42.804 Because Robert is turns out to be

NOTE Confidence: 0.5696312

00:01:42.804 --> 00:01:44.824 a mentor of mine and he is the one

NOTE Confidence: 0.5696312

00:01:44.824 --> 00:01:46.189 who got me interested in sleep,

NOTE Confidence: 0.5696312

00:01:46.190 --> 00:01:47.212 medicine and.

NOTE Confidence: 0.5696312

00:01:47.212 --> 00:01:49.767 Kept encouraging me to stay

NOTE Confidence: 0.5696312

00:01:49.767 --> 00:01:51.396 and stick with research,

NOTE Confidence: 0.5696312

00:01:51.396 --> 00:01:53.628 which has been a wonderful endeavor

NOTE Confidence: 0.5696312

00:01:53.628 --> 00:01:55.739 for me and I've collaborated with

NOTE Confidence: 0.5696312

00:01:55.739 --> 00:01:58.220 Robert over the last ten years or so.

NOTE Confidence: 0.5696312

00:01:58.220 --> 00:02:00.860 And so Robert is one of the foremost

NOTE Confidence: 0.5696312

00:02:00.860 --> 00:02:03.387 experts in sleep to sort of breathing

NOTE Confidence: 0.5696312

00:02:03.387 --> 00:02:05.960 in the United States and worldwide.

NOTE Confidence: 0.5696312

00:02:05.960 --> 00:02:08.654 And he had coined the term

NOTE Confidence: 0.5696312

00:02:08.654 --> 00:02:10.450 treatment emergent central sleep

NOTE Confidence: 0.5696312

00:02:10.526 --> 00:02:12.944 apnea or complex sleep apnea and

NOTE Confidence: 0.5696312

00:02:12.944 --> 00:02:15.700 describe it first in the mid 2000s.

NOTE Confidence: 0.5696312

00:02:15.700 --> 00:02:17.026 He has published.

NOTE Confidence: 0.5696312

00:02:17.026 --> 00:02:19.678 You know nearly 100 articles and

NOTE Confidence: 0.5696312

00:02:19.678 --> 00:02:22.523 many books and is editor of the.

NOTE Confidence: 0.5696312

00:02:22.523 --> 00:02:26.394 Landmarks book by Doctor Krieger and others

NOTE Confidence: 0.5696312

00:02:26.394 --> 00:02:29.968 principles and practice of Sleep Medicine.

NOTE Confidence: 0.5696312

00:02:29.970 --> 00:02:32.495 He's edited sleep disorder breathing

NOTE Confidence: 0.5696312

00:02:32.495 --> 00:02:34.320 section and is a recipient of

NOTE Confidence: 0.5696312

00:02:34.320 --> 00:02:36.142 many grants over the past several

NOTE Confidence: 0.5696312

00:02:36.142 --> 00:02:37.898 years from various foundations,

NOTE Confidence: 0.5696312

00:02:37.900 --> 00:02:39.745 including the NIH.

NOTE Confidence: 0.5696312

00:02:39.745 --> 00:02:42.820 And so without further ado,

NOTE Confidence: 0.5696312

00:02:42.820 --> 00:02:44.188 I'm going to let Robert take

NOTE Confidence: 0.5696312

00:02:44.188 --> 00:02:45.713 over since he has some very

NOTE Confidence: 0.5696312

00:02:45.713 --> 00:02:47.108 fascinating things to share with

NOTE Confidence: 0.5696312

00:02:47.108 --> 00:02:49.530 us on his thoughts about network

NOTE Confidence: 0.5696312

00:02:49.530 --> 00:02:51.670 Physiology and pathology of sleep.

NOTE Confidence: 0.5696312

00:02:51.670 --> 00:02:54.344 So thank you again everyone for attending.

NOTE Confidence: 0.5696312

00:02:54.350 --> 00:02:55.594 Welcome Robert and looking

NOTE Confidence: 0.5696312

00:02:55.594 --> 00:02:57.149 forward to this wonderful talk.

NOTE Confidence: 0.894616308421053

00:02:58.670 --> 00:02:59.885 Thank you, Andre.

NOTE Confidence: 0.894616308421053

00:02:59.885 --> 00:03:03.141 And I'm of course very happy to be

NOTE Confidence: 0.894616308421053

00:03:03.141 --> 00:03:05.853 here to share with you some of my.

NOTE Confidence: 0.894616308421053

00:03:05.860 --> 00:03:09.970 More recent thinking and learning.

NOTE Confidence: 0.894616308421053

00:03:09.970 --> 00:03:12.770 In the area of sleep

NOTE Confidence: 0.894616308421053

00:03:12.770 --> 00:03:14.450 Physiology and pathology.

NOTE Confidence: 0.894616308421053

00:03:14.450 --> 00:03:17.376 So it turns out that anybody

NOTE Confidence: 0.894616308421053

00:03:17.376 --> 00:03:19.906 who deals with sleep signs,

NOTE Confidence: 0.894616308421053

00:03:19.910 --> 00:03:22.682 Sleep Medicine, sleep pathology,

NOTE Confidence: 0.894616308421053

00:03:22.682 --> 00:03:24.068 sleep treatments,

NOTE Confidence: 0.894616308421053

00:03:24.070 --> 00:03:28.100 we are actually network scientists,

NOTE Confidence: 0.894616308421053

00:03:28.100 --> 00:03:29.310 physiologists, therapists,

NOTE Confidence: 0.894616308421053

00:03:29.310 --> 00:03:32.940 whether we like it or not.

NOTE Confidence: 0.894616308421053

00:03:32.940 --> 00:03:36.455 Of all these specialties of

NOTE Confidence: 0.894616308421053

00:03:36.455 --> 00:03:38.564 specialties of healthcare.

NOTE Confidence: 0.894616308421053

00:03:38.570 --> 00:03:42.274 Sleep is the closest which comes to almost

NOTE Confidence: 0.894616308421053

00:03:42.274 --> 00:03:44.630 automatically being a network science.

NOTE Confidence: 0.894616308421053

00:03:44.630 --> 00:03:46.335 Much of network science and

NOTE Confidence: 0.894616308421053

00:03:46.335 --> 00:03:48.040 network medicine has focused on

NOTE Confidence: 0.894616308421053

00:03:48.098 --> 00:03:49.890 things like metabolic networks,

NOTE Confidence: 0.894616308421053

00:03:49.890 --> 00:03:52.038 gene networks, epigenetic networks,

NOTE Confidence: 0.894616308421053

00:03:52.038 --> 00:03:54.626 seemingly things which are far

NOTE Confidence: 0.894616308421053

00:03:54.626 --> 00:03:56.806 away from touching the patient.

NOTE Confidence: 0.894616308421053

00:03:56.810 --> 00:03:59.562 But it turns out that we have been

NOTE Confidence: 0.894616308421053

00:03:59.562 --> 00:04:01.580 touching the network of sleep.

NOTE Confidence: 0.894616308421053

00:04:01.580 --> 00:04:05.370 All along. When we look at sleep.

NOTE Confidence: 0.894616308421053

00:04:05.370 --> 00:04:07.770 From the network point of view,

NOTE Confidence: 0.894616308421053

00:04:07.770 --> 00:04:09.586 it becomes actually quite

NOTE Confidence: 0.894616308421053

00:04:09.586 --> 00:04:10.948 interesting and fascinating,

NOTE Confidence: 0.894616308421053

00:04:10.950 --> 00:04:13.518 and I hope I can share

NOTE Confidence: 0.894616308421053

00:04:13.518 --> 00:04:15.230 that excitement with you.

NOTE Confidence: 0.894616308421053

00:04:15.230 --> 00:04:17.426 And let me move my slide.

NOTE Confidence: 0.894616308421053

00:04:17.430 --> 00:04:18.864 Here we go.

NOTE Confidence: 0.894616308421053

00:04:18.864 --> 00:04:22.610 So my main disclosure really for this is.

NOTE Confidence: 0.894616308421053

00:04:22.610 --> 00:04:24.157 I'll be showing you a few slides,

NOTE Confidence: 0.894616308421053

00:04:24.160 --> 00:04:24.615 uh,

NOTE Confidence: 0.894616308421053

00:04:24.615 --> 00:04:26.890 using technology I was involved

NOTE Confidence: 0.894616308421053

00:04:26.890 --> 00:04:28.710 in developing cardio pulmonary

NOTE Confidence: 0.894616308421053

00:04:28.787 --> 00:04:30.029 coupling to track.

NOTE Confidence: 0.894616308421053

00:04:30.030 --> 00:04:31.830 In an ambulatory way,

NOTE Confidence: 0.894616308421053

00:04:31.830 --> 00:04:34.080 the network biology of sleep.

NOTE Confidence: 0.894616308421053

00:04:34.080 --> 00:04:37.869 But other than that, much of this is just.

NOTE Confidence: 0.894616308421053

00:04:37.870 --> 00:04:40.720 Good stuff. OK.

NOTE Confidence: 0.894616308421053

00:04:40.720 --> 00:04:43.344 So I will start off by saying that

NOTE Confidence: 0.894616308421053

00:04:43.344 --> 00:04:45.828 sleep is a unique network state.

NOTE Confidence: 0.894616308421053

00:04:45.830 --> 00:04:48.026 Just think of the.

NOTE Confidence: 0.894616308421053

00:04:48.026 --> 00:04:51.700 Number of different functions which have to.

NOTE Confidence: 0.894616308421053

00:04:51.700 --> 00:04:53.610 Function.

NOTE Confidence: 0.894616308421053

00:04:53.610 --> 00:04:55.600 Together with some degree of

NOTE Confidence: 0.894616308421053

00:04:55.600 --> 00:04:58.080 tolerance and harmony of each other.

NOTE Confidence: 0.894616308421053

00:04:58.080 --> 00:05:01.140 To give us what is sleep?

NOTE Confidence: 0.894616308421053

00:05:01.140 --> 00:05:03.575 Network activity may be intrinsic

NOTE Confidence: 0.894616308421053

00:05:03.575 --> 00:05:05.036 to a subsystem.

NOTE Confidence: 0.894616308421053

00:05:05.040 --> 00:05:06.774 Integrated or communicator?

NOTE Confidence: 0.894616308421053

00:05:06.774 --> 00:05:09.664 In the context of sleep.

NOTE Confidence: 0.894616308421053

00:05:09.670 --> 00:05:11.466 So as an example,

NOTE Confidence: 0.894616308421053

00:05:11.466 --> 00:05:13.262 the respiratory network is

NOTE Confidence: 0.894616308421053

00:05:13.262 --> 00:05:14.969 a subsystem of sleep.

NOTE Confidence: 0.894616308421053

00:05:14.970 --> 00:05:17.496 Integrated networks are seen when you

NOTE Confidence: 0.894616308421053

00:05:17.496 --> 00:05:20.236 have say sinus arrhythmia where you

NOTE Confidence: 0.894616308421053

00:05:20.236 --> 00:05:22.200 have cardio pulmonary integration.

NOTE Confidence: 0.894616308421053

00:05:22.200 --> 00:05:24.410 There can be wide scale

NOTE Confidence: 0.894616308421053

00:05:24.410 --> 00:05:25.736 communication with spindles.

NOTE Confidence: 0.894616308421053

00:05:25.740 --> 00:05:27.504 Long range communication from

NOTE Confidence: 0.894616308421053

00:05:27.504 --> 00:05:29.709 the cortex to the brainstem.

NOTE Confidence: 0.894616308421053

00:05:29.710 --> 00:05:31.960 The non R.E.M slow oscillation

NOTE Confidence: 0.894616308421053

00:05:31.960 --> 00:05:32.860 which permeates.

NOTE Confidence: 0.894616308421053

00:05:32.860 --> 00:05:35.740 Pretty much the whole brain.

NOTE Confidence: 0.894616308421053

00:05:35.740 --> 00:05:38.090 These are all forms of

NOTE Confidence: 0.894616308421053

00:05:38.090 --> 00:05:39.970 network and coupling activity.

NOTE Confidence: 0.894616308421053

00:05:39.970 --> 00:05:41.850 Now couple Physiologies are,

NOTE Confidence: 0.894616308421053

00:05:41.850 --> 00:05:42.790 of course,

NOTE Confidence: 0.894616308421053

00:05:42.790 --> 00:05:43.371 networked.

NOTE Confidence: 0.894616308421053

00:05:43.371 --> 00:05:46.857 So one could to some extent

NOTE Confidence: 0.894616308421053

00:05:46.857 --> 00:05:49.729 interchangeably use coupling and network,

NOTE Confidence: 0.894616308421053

00:05:49.730 --> 00:05:51.795 but networks go far beyond just coupling.

NOTE Confidence: 0.745538702

00:05:54.810 --> 00:05:56.862 There are minimal.

NOTE Confidence: 0.745538702

00:05:56.862 --> 00:05:58.914 Overlaps between fundamental

NOTE Confidence: 0.745538702

00:05:58.914 --> 00:06:01.650 oscillatory outputs of sleep.

NOTE Confidence: 0.745538702

00:06:01.650 --> 00:06:04.380 So you take the spindle frequency.

NOTE Confidence: 0.745538702

00:06:04.380 --> 00:06:06.288 You take heart rate,

NOTE Confidence: 0.745538702

00:06:06.288 --> 00:06:08.196 you take slow oscillation,

NOTE Confidence: 0.745538702

00:06:08.200 --> 00:06:10.990 you take the cyclic alternating pattern.

NOTE Confidence: 0.745538702

00:06:10.990 --> 00:06:13.302 You have oscillations in

NOTE Confidence: 0.745538702

00:06:13.302 --> 00:06:16.192 the range of subsecond to.

NOTE Confidence: 0.745538702

00:06:16.200 --> 00:06:18.783 30 to 40 seconds and all of these have

NOTE Confidence: 0.745538702

00:06:18.783 --> 00:06:22.076 to actually occur in some coordinated

NOTE Confidence: 0.745538702

00:06:22.076 --> 00:06:24.684 interactive way during sleep.

NOTE Confidence: 0.745538702

00:06:24.690 --> 00:06:26.258 The components of course

NOTE Confidence: 0.745538702

00:06:26.258 --> 00:06:27.826 in sleep are dispersed.

NOTE Confidence: 0.745538702

00:06:27.830 --> 00:06:29.654 In biological space, right,

NOTE Confidence: 0.745538702

00:06:29.654 --> 00:06:31.478 the brainstem is somewhat

NOTE Confidence: 0.745538702

00:06:31.478 --> 00:06:33.260 away from the cortex.

NOTE Confidence: 0.745538702

00:06:33.260 --> 00:06:36.188 There is a necessity to travel in time.

NOTE Confidence: 0.745538702

00:06:36.190 --> 00:06:38.778 We sleep over time.

NOTE Confidence: 0.745538702

00:06:38.780 --> 00:06:41.596 And individual subsystems have

NOTE Confidence: 0.745538702

00:06:41.596 --> 00:06:43.708 different driving mechanisms.

NOTE Confidence: 0.745538702

00:06:43.710 --> 00:06:46.506 So the respiratory driver is different,

NOTE Confidence: 0.745538702

00:06:46.510 --> 00:06:48.390 the homeostatic driver is different,

NOTE Confidence: 0.745538702

00:06:48.390 --> 00:06:50.402 the circadian driver is

NOTE Confidence: 0.745538702

00:06:50.402 --> 00:06:51.408 substantially different,

NOTE Confidence: 0.745538702

00:06:51.410 --> 00:06:53.307 but all of these somehow had to

NOTE Confidence: 0.745538702

00:06:53.307 --> 00:06:54.989 work together like a happy family.

NOTE Confidence: 0.905799914285714

00:06:58.200 --> 00:07:00.356 One of the most important components of

NOTE Confidence: 0.905799914285714

00:07:00.356 --> 00:07:02.739 the brain which enables networks to work,

NOTE Confidence: 0.905799914285714

00:07:02.740 --> 00:07:06.516 of course, is the white matter tracks which.

NOTE Confidence: 0.905799914285714

00:07:06.520 --> 00:07:07.464 Essentially connect.

NOTE Confidence: 0.905799914285714

00:07:07.464 --> 00:07:10.296 Everything which requires to be connected.

NOTE Confidence: 0.905799914285714

00:07:10.300 --> 00:07:12.865 So this is just a DTI fibre track just

NOTE Confidence: 0.905799914285714

00:07:12.865 --> 00:07:15.358 to just to remind you that without

NOTE Confidence: 0.905799914285714

00:07:15.358 --> 00:07:17.749 a good white matter connectivity we

NOTE Confidence: 0.905799914285714

00:07:17.749 --> 00:07:20.715 can't do networking for nuts. OK.

NOTE Confidence: 0.905799914285714

00:07:20.715 --> 00:07:24.340 Just listing some sleep networks.

NOTE Confidence: 0.905799914285714

00:07:24.340 --> 00:07:26.140 You know the cortical network,

NOTE Confidence: 0.905799914285714

00:07:26.140 --> 00:07:28.000 there are more cortical loops.

NOTE Confidence: 0.905799914285714

00:07:28.000 --> 00:07:29.582 Interthalamic network,

NOTE Confidence: 0.905799914285714

00:07:29.582 --> 00:07:32.746 brainstem has numerous networks.

NOTE Confidence: 0.905799914285714

00:07:32.750 --> 00:07:34.856 The respiratory network,

NOTE Confidence: 0.905799914285714

00:07:34.856 --> 00:07:38.366 the blood pressure regulatory network,

NOTE Confidence: 0.905799914285714

00:07:38.370 --> 00:07:41.410 the cardiac output and autonomic

NOTE Confidence: 0.905799914285714

00:07:41.410 --> 00:07:44.950 Dr Networks you have networks for.

NOTE Confidence: 0.905799914285714

00:07:44.950 --> 00:07:46.750 Feeding control, of course, right?

NOTE Confidence: 0.905799914285714

00:07:46.750 --> 00:07:49.640 Extraordinary network.

NOTE Confidence: 0.905799914285714

00:07:49.640 --> 00:07:52.356 Which is involved in sleep regulation too.

NOTE Confidence: 0.905799914285714

00:07:52.360 --> 00:07:54.565 You have the better reflects the chemo

NOTE Confidence: 0.905799914285714

00:07:54.565 --> 00:07:56.380 reflex, the central autonomic network.

NOTE Confidence: 0.905799914285714

00:07:56.380 --> 00:07:59.220 You are the R.E.M non R.E.M network.

NOTE Confidence: 0.905799914285714

00:07:59.220 --> 00:08:00.884 Sleep. To weight transition,

NOTE Confidence: 0.905799914285714

00:08:00.884 --> 00:08:02.548 how does that occur?

NOTE Confidence: 0.905799914285714

00:08:02.550 --> 00:08:03.890 Clearly it's a network change.

NOTE Confidence: 0.905799914285714

00:08:03.890 --> 00:08:05.270 You have the arousal network,

NOTE Confidence: 0.905799914285714

00:08:05.270 --> 00:08:06.701 you have respiratory,

NOTE Confidence: 0.905799914285714

00:08:06.701 --> 00:08:09.086 generative and respiratory control networks.

NOTE Confidence: 0.905799914285714

00:08:09.090 --> 00:08:11.906 Of course you have the motor network which

NOTE Confidence: 0.905799914285714

00:08:11.906 --> 00:08:14.780 can cause periodic and aperiodic outputs.

NOTE Confidence: 0.905799914285714

00:08:14.780 --> 00:08:15.720 Yeah, cardio,

NOTE Confidence: 0.905799914285714

00:08:15.720 --> 00:08:16.660 autonomic interactions.

NOTE Confidence: 0.905799914285714

00:08:16.660 --> 00:08:18.540 They're probably more networks,

NOTE Confidence: 0.905799914285714

00:08:18.540 --> 00:08:19.780 but you get the point.

NOTE Confidence: 0.905799914285714

00:08:19.780 --> 00:08:24.260 Sleep is 1 big networked family of subnets.

NOTE Confidence: 0.899816324666667

00:08:27.860 --> 00:08:30.709 Just a very quick reminder of the

NOTE Confidence: 0.899816324666667

00:08:30.709 --> 00:08:32.844 classic networks which we normally

NOTE Confidence: 0.899816324666667

00:08:32.844 --> 00:08:35.193 think about when. Talk about sleep.

NOTE Confidence: 0.899816324666667

00:08:35.193 --> 00:08:39.148 So you have. The wake network.

NOTE Confidence: 0.899816324666667

00:08:39.150 --> 00:08:43.730 You have the orexin which is. Sort of.

NOTE Confidence: 0.773142962727273

00:08:45.840 --> 00:08:48.036 A kind of orchestrator of sorts

NOTE Confidence: 0.773142962727273

00:08:48.036 --> 00:08:50.200 of how these networks interact.

NOTE Confidence: 0.773142962727273

00:08:50.200 --> 00:08:53.238 You have the non R.E.M network and

NOTE Confidence: 0.773142962727273

00:08:53.238 --> 00:08:56.047 every several months there is some new.

NOTE Confidence: 0.773142962727273

00:08:56.050 --> 00:08:59.248 Cell group which has been discovered

NOTE Confidence: 0.773142962727273

00:08:59.248 --> 00:09:02.010 which regulates non REM sleep.

NOTE Confidence: 0.773142962727273

00:09:02.010 --> 00:09:04.980 Ohh, you have the R.E.M network.

NOTE Confidence: 0.773142962727273

00:09:04.980 --> 00:09:06.500 So you get a point.

NOTE Confidence: 0.773142962727273

00:09:06.500 --> 00:09:07.391 Now, these networks,

NOTE Confidence: 0.773142962727273

00:09:07.391 --> 00:09:08.876 of course you're familiar with.

NOTE Confidence: 0.773142962727273

00:09:08.880 --> 00:09:11.220 This audience is reasonably familiar with.

NOTE Confidence: 0.773142962727273

00:09:11.220 --> 00:09:13.068 But if you're not?

NOTE Confidence: 0.773142962727273

00:09:13.070 --> 00:09:15.430 The movement between Wake R.E.M

NOTE Confidence: 0.773142962727273

00:09:15.430 --> 00:09:18.463 and non R.E.M is dependent on

NOTE Confidence: 0.773142962727273

00:09:18.463 --> 00:09:20.807 very different network behaviors.

NOTE Confidence: 0.773142962727273

00:09:20.810 --> 00:09:23.682 And different networks which

NOTE Confidence: 0.773142962727273

00:09:23.682 --> 00:09:26.554 are mostly non overlapping.

NOTE Confidence: 0.773142962727273

00:09:26.560 --> 00:09:28.825 A quick word about the

NOTE Confidence: 0.773142962727273

00:09:28.825 --> 00:09:30.184 central autonomic network.

NOTE Confidence: 0.773142962727273

00:09:30.190 --> 00:09:32.620 It's all the way to the top of the

NOTE Confidence: 0.773142962727273

00:09:32.620 --> 00:09:34.409 neuraxis with the entry singlet,

NOTE Confidence: 0.773142962727273

00:09:34.410 --> 00:09:36.750 insular cortex, amygdala, hypothalamus,

NOTE Confidence: 0.773142962727273

00:09:36.750 --> 00:09:39.090 the periaqueductal Gray matter,

NOTE Confidence: 0.773142962727273

00:09:39.090 --> 00:09:40.716 the parabrachial complex,

NOTE Confidence: 0.773142962727273

00:09:40.716 --> 00:09:42.884 the nucleus tractus solitarius,

NOTE Confidence: 0.773142962727273

00:09:42.890 --> 00:09:44.102 the ventrolateral medulla.

NOTE Confidence: 0.773142962727273

00:09:44.102 --> 00:09:46.930 These are all part of the central

NOTE Confidence: 0.773142962727273

00:09:47.004 --> 00:09:49.188 autonomic network and it's

NOTE Confidence: 0.773142962727273

00:09:49.188 --> 00:09:51.783 deeply engaged in numerous sleep

NOTE Confidence: 0.773142962727273

00:09:51.783 --> 00:09:53.340 physiologies and pathologies.

NOTE Confidence: 0.773142962727273

00:09:53.340 --> 00:09:57.250 There are multiple inputs including.

NOTE Confidence: 0.773142962727273

00:09:57.250 --> 00:10:00.002 A visceral information which

NOTE Confidence: 0.773142962727273

00:10:00.002 --> 00:10:02.066 is topographically arranged.

NOTE Confidence: 0.773142962727273

00:10:02.070 --> 00:10:03.502 In the tractor Solitarius,

NOTE Confidence: 0.773142962727273

00:10:03.502 --> 00:10:05.650 as well as chemo reflex and

NOTE Confidence: 0.773142962727273

00:10:05.719 --> 00:10:07.707 bioflex inflammation going in,

NOTE Confidence: 0.773142962727273

00:10:07.710 --> 00:10:10.698 as well as humoral inputs through

NOTE Confidence: 0.773142962727273

00:10:10.698 --> 00:10:12.192 the circumventricular organs.

NOTE Confidence: 0.773142962727273

00:10:12.200 --> 00:10:14.740 The insula and the amygdala

NOTE Confidence: 0.773142962727273

00:10:14.740 --> 00:10:16.544 are quite high order.

NOTE Confidence: 0.773142962727273

00:10:16.544 --> 00:10:18.799 Also the ventromedial prefrontal cortex,

NOTE Confidence: 0.773142962727273

00:10:18.800 --> 00:10:20.960 and of course these paraventricular nucleus

NOTE Confidence: 0.773142962727273

00:10:20.960 --> 00:10:23.160 controls specific subsets of preganglionic,

NOTE Confidence: 0.773142962727273

00:10:23.160 --> 00:10:25.216 sympathetic and parasympathetic neurons.

NOTE Confidence: 0.773142962727273

00:10:25.216 --> 00:10:27.786 So central Autonomic network is

NOTE Confidence: 0.773142962727273

00:10:27.786 --> 00:10:29.749 something which doesn't get much

NOTE Confidence: 0.773142962727273

00:10:29.750 --> 00:10:32.006 attention in clinical medicine,

NOTE Confidence: 0.773142962727273

00:10:32.006 --> 00:10:34.826 but it's clearly extremely important

NOTE Confidence: 0.773142962727273

00:10:34.826 --> 00:10:38.054 and certainly those who deal with

NOTE Confidence: 0.773142962727273

00:10:38.054 --> 00:10:40.639 pain and psychotic disorders clearly

NOTE Confidence: 0.773142962727273

00:10:40.718 --> 00:10:43.460 have more interest in this network.

NOTE Confidence: 0.72664094625

00:10:46.980 --> 00:10:50.300 I think I'll model it said this OK.

NOTE Confidence: 0.72664094625

00:10:50.300 --> 00:10:52.868 Just a quick shout out to

NOTE Confidence: 0.72664094625

00:10:52.868 --> 00:10:54.152 the respiratory network.

NOTE Confidence: 0.72664094625

00:10:54.160 --> 00:10:56.563 Today will not be a talk on the respiratory

NOTE Confidence: 0.72664094625

00:10:56.563 --> 00:10:58.400 network that probably deserves an entire

NOTE Confidence: 0.72664094625

00:10:58.400 --> 00:11:00.500 half day symposium in its own right.

NOTE Confidence: 0.72664094625

00:11:00.500 --> 00:11:02.450 But you have central pattern generators,

NOTE Confidence: 0.72664094625

00:11:02.450 --> 00:11:03.590 you have the motor output,

NOTE Confidence: 0.72664094625

00:11:03.590 --> 00:11:05.380 you have the breathing plant.

NOTE Confidence: 0.72664094625

00:11:05.380 --> 00:11:08.648 You have. Very specific.

NOTE Confidence: 0.72664094625

00:11:08.648 --> 00:11:11.099 Neuronal firing patterns,

NOTE Confidence: 0.72664094625

00:11:11.100 --> 00:11:14.365 inspiratory neuron post inspiratory firing

NOTE Confidence: 0.72664094625

00:11:14.365 --> 00:11:17.630 during inspiration and active expiration.

NOTE Confidence: 0.72664094625

00:11:17.630 --> 00:11:21.740 Post inspiration and activist exploration.

NOTE Confidence: 0.72664094625

00:11:21.740 --> 00:11:23.650 And of course you have

NOTE Confidence: 0.72664094625

00:11:23.650 --> 00:11:25.178 the read reploid nucleus,

NOTE Confidence: 0.72664094625

00:11:25.180 --> 00:11:29.748 the paraphasias nuclear complex,

NOTE Confidence: 0.72664094625

00:11:29.750 --> 00:11:31.518 the new ataxic center.

NOTE Confidence: 0.72664094625

00:11:31.518 --> 00:11:34.660 Again, all of these have to work as a very

NOTE Confidence: 0.72664094625

00:11:34.660 --> 00:11:37.660 fine network while awake and wirelessly.

NOTE Confidence: 0.72664094625

00:11:37.660 --> 00:11:39.620 A good example of a respiratory network

NOTE Confidence: 0.72664094625

00:11:39.620 --> 00:11:41.168 gone bad, of course, is opiates.

NOTE Confidence: 0.72664094625

00:11:41.168 --> 00:11:43.338 The opiates are not the only one you know.

NOTE Confidence: 0.72664094625

00:11:43.340 --> 00:11:45.620 Opiates, Baclofen, all types of

NOTE Confidence: 0.72664094625

00:11:45.620 --> 00:11:47.900 pathologies in the brainstem area,

NOTE Confidence: 0.72664094625

00:11:47.900 --> 00:11:51.272 whether to stroke, degeneration,

NOTE Confidence: 0.72664094625

00:11:51.272 --> 00:11:52.958 multiple sclerosis.

NOTE Confidence: 0.72664094625

00:11:52.960 --> 00:11:55.636 Sitting balbia and such will of

NOTE Confidence: 0.72664094625

00:11:55.636 --> 00:11:57.420 course disrupt the respiratory

NOTE Confidence: 0.72664094625

00:11:57.496 --> 00:11:59.940 network with direct impact. AI.

NOTE Confidence: 0.72664094625

00:11:59.940 --> 00:12:01.940 Traffic, little sclerosis, polio.

NOTE Confidence: 0.72664094625

00:12:01.940 --> 00:12:03.120 We don't see polio much.

NOTE Confidence: 0.72664094625

00:12:03.120 --> 00:12:04.716 Hopefully we will not,

NOTE Confidence: 0.72664094625

00:12:04.716 --> 00:12:07.110 even though there are some murmurs.

NOTE Confidence: 0.72664094625

00:12:07.110 --> 00:12:10.130 Now one very interesting.

NOTE Confidence: 0.72664094625

00:12:10.130 --> 00:12:13.700 Kind of relearned the feature is that.

NOTE Confidence: 0.72664094625

00:12:13.700 --> 00:12:16.420 The respiratory signal actually

NOTE Confidence: 0.72664094625

00:12:16.420 --> 00:12:19.140 permeates the whole brain.

NOTE Confidence: 0.72664094625

00:12:19.140 --> 00:12:21.436 So it turns out you can find the

NOTE Confidence: 0.72664094625

00:12:21.436 --> 00:12:24.730 as you breathe in and out you can

NOTE Confidence: 0.72664094625

00:12:24.730 --> 00:12:26.494 find the respiratory oscillation.

NOTE Confidence: 0.72664094625

00:12:26.500 --> 00:12:29.032 Encoded in hippocampal oscillations

NOTE Confidence: 0.72664094625

00:12:29.032 --> 00:12:31.564 in the olfactory bulb.

NOTE Confidence: 0.72664094625

00:12:31.570 --> 00:12:35.638 In the no forget what VMS.

NOTE Confidence: 0.72664094625

00:12:35.640 --> 00:12:38.200 In fact, I don't forget what PC is,

NOTE Confidence: 0.72664094625

00:12:38.200 --> 00:12:40.970 but this is the dentate.

NOTE Confidence: 0.72664094625

00:12:40.970 --> 00:12:41.772 Dentate nucleus.

NOTE Confidence: 0.72664094625

00:12:41.772 --> 00:12:44.178 So essentially when you breathe in

NOTE Confidence: 0.72664094625

00:12:44.178 --> 00:12:46.686 and out and the ancient side it,

NOTE Confidence: 0.72664094625

00:12:46.690 --> 00:12:48.590 right?

NOTE Confidence: 0.72664094625

00:12:48.590 --> 00:12:50.180 You can control and influence

NOTE Confidence: 0.72664094625

00:12:50.180 --> 00:12:51.134 the entire brain,

NOTE Confidence: 0.72664094625

00:12:51.140 --> 00:12:52.660 which of course influenced than

NOTE Confidence: 0.72664094625

00:12:52.660 --> 00:12:55.790 the body by paste breathing.

NOTE Confidence: 0.72664094625

00:12:55.790 --> 00:12:58.401 It would make sense that evolution decided

NOTE Confidence: 0.72664094625

00:12:58.401 --> 00:13:01.889 to Co opt signal as strong as respiration,

NOTE Confidence: 0.72664094625

00:13:01.890 --> 00:13:03.858 as fundamental as respiration

NOTE Confidence: 0.72664094625

00:13:03.858 --> 00:13:05.334 for other functions.

NOTE Confidence: 0.72664094625

00:13:05.340 --> 00:13:07.074 So respiration actually

NOTE Confidence: 0.72664094625

00:13:07.074 --> 00:13:09.416 provides a network signal,

NOTE Confidence: 0.72664094625

00:13:09.416 --> 00:13:11.234 a network coordination

NOTE Confidence: 0.72664094625

00:13:11.234 --> 00:13:13.658 signal throughout the brain.

NOTE Confidence: 0.72664094625

00:13:13.660 --> 00:13:15.120 As to sleep spindles,

NOTE Confidence: 0.72664094625

00:13:15.120 --> 00:13:16.945 as an example it provides.

NOTE Confidence: 0.72664094625

00:13:16.950 --> 00:13:18.490 A fast oscillatory network

NOTE Confidence: 0.72664094625

00:13:18.490 --> 00:13:20.030 information throughout the brain.

NOTE Confidence: 0.74088845

00:13:22.060 --> 00:13:24.956 Hypercapnia has somewhat specific

NOTE Confidence: 0.74088845

00:13:24.956 --> 00:13:27.356 network going through the lateral

NOTE Confidence: 0.74088845

00:13:27.356 --> 00:13:29.451 parabrachial nucleus and this was

NOTE Confidence: 0.74088845

00:13:29.451 --> 00:13:33.275 worked out by Cliff Zapus group and.

NOTE Confidence: 0.74088845

00:13:33.275 --> 00:13:36.302 Uh. Directly targeting it,

NOTE Confidence: 0.74088845

00:13:36.302 --> 00:13:39.475 you know, may have a role in

NOTE Confidence: 0.74088845

00:13:39.475 --> 00:13:41.367 reducing arousals during sleep,

NOTE Confidence: 0.74088845

00:13:41.370 --> 00:13:43.102 but nevertheless the hypercapnia

NOTE Confidence: 0.74088845

00:13:43.102 --> 00:13:45.267 network seems to be separate

NOTE Confidence: 0.74088845

00:13:45.267 --> 00:13:47.899 from the hypoxic network and the

NOTE Confidence: 0.74088845

00:13:47.899 --> 00:13:50.380 respiratory mechanoreceptor network.

NOTE Confidence: 0.673648732857143

00:13:52.990 --> 00:13:56.784 The Telemo cortical network, of course we.

NOTE Confidence: 0.673648732857143

00:13:56.790 --> 00:14:00.075 No. Well, there's not need much need to spend

NOTE Confidence: 0.673648732857143

00:14:00.075 --> 00:14:03.224 time on this in a Sleep Medicine audience.

NOTE Confidence: 0.673648732857143

00:14:03.230 --> 00:14:07.310 But it's a very complex interaction of.

NOTE Confidence: 0.673648732857143

00:14:07.310 --> 00:14:10.960 Tell him cortical cell conductance.

NOTE Confidence: 0.673648732857143

00:14:10.960 --> 00:14:13.844 The hyperpolarization activated spike

NOTE Confidence: 0.673648732857143

00:14:13.844 --> 00:14:16.728 theoretical thymic nucleus spindles,

NOTE Confidence: 0.673648732857143

00:14:16.730 --> 00:14:19.138 as well as interaction with the one

NOTE Confidence: 0.673648732857143

00:14:19.138 --> 00:14:21.942 to four Hertz Delta. You can think of

NOTE Confidence: 0.673648732857143

00:14:21.942 --> 00:14:24.540 the spindles as a 5G cell network.

NOTE Confidence: 0.673648732857143

00:14:24.540 --> 00:14:26.845 It's a carrier wave which

NOTE Confidence: 0.673648732857143

00:14:26.845 --> 00:14:28.689 allows information to travel.

NOTE Confidence: 0.673648732857143

00:14:28.690 --> 00:14:32.904 And allows way to see scale short

NOTE Confidence: 0.673648732857143

00:14:32.910 --> 00:14:35.950 short time range synchronization.

NOTE Confidence: 0.673648732857143

00:14:35.950 --> 00:14:42.200 The solation. To describe hysteria in 1991.

NOTE Confidence: 0.673648732857143

00:14:42.200 --> 00:14:43.802 It's less than one Hertz and

NOTE Confidence: 0.673648732857143

00:14:43.802 --> 00:14:45.738 it's on off state of the cortex,

NOTE Confidence: 0.673648732857143

00:14:45.740 --> 00:14:48.568 which I will briefly mention later on.

NOTE Confidence: 0.673648732857143

00:14:48.570 --> 00:14:51.230 It enables large rail, large,

NOTE Confidence: 0.673648732857143

00:14:51.230 --> 00:14:54.450 large range synchrony of.

NOTE Confidence: 0.673648732857143

00:14:54.450 --> 00:14:57.670 Cortical activity subcortical activity.

NOTE Confidence: 0.673648732857143

00:14:57.670 --> 00:14:59.440 It aggregates spindles.

NOTE Confidence: 0.673648732857143

00:14:59.440 --> 00:15:03.060 And spindles, almost certainly.

NOTE Confidence: 0.673648732857143

00:15:03.060 --> 00:15:06.084 It's part of the biological glue of sleep.

NOTE Confidence: 0.673648732857143

00:15:06.090 --> 00:15:08.778 So just think of the effect of a

NOTE Confidence: 0.673648732857143

00:15:08.778 --> 00:15:10.846 benzodiazepine on sleep. Fragmented sleep.

NOTE Confidence: 0.673648732857143

00:15:10.846 --> 00:15:12.698 You take a benzodiazepine,

NOTE Confidence: 0.673648732857143

00:15:12.700 --> 00:15:15.080 your enormous amount of spindling,

NOTE Confidence: 0.673648732857143

00:15:15.080 --> 00:15:19.945 but you also have. Almost a bland.

NOTE Confidence: 0.673648732857143

00:15:19.950 --> 00:15:21.903 Uh. Cortical architecture.

NOTE Confidence: 0.673648732857143

00:15:21.903 --> 00:15:24.507 You have ample spindling.

NOTE Confidence: 0.673648732857143

00:15:24.510 --> 00:15:27.079 You have reduction in slow wave sleep.

NOTE Confidence: 0.673648732857143

00:15:27.080 --> 00:15:30.580 Every epic moralist looks like the other.

NOTE Confidence: 0.673648732857143

00:15:30.580 --> 00:15:32.610 And almost certainly it has glued the

NOTE Confidence: 0.673648732857143

00:15:32.610 --> 00:15:35.562 sleep in a way which is fairly unique

NOTE Confidence: 0.673648732857143

00:15:35.562 --> 00:15:37.174 through the spindling mechanisms.

NOTE Confidence: 0.673648732857143

00:15:37.180 --> 00:15:39.378 Now if you take a sodium oxybate,

NOTE Confidence: 0.673648732857143

00:15:39.380 --> 00:15:41.705 you're gluing it through non

NOTE Confidence: 0.673648732857143

00:15:41.705 --> 00:15:42.635 spindling mechanisms,

NOTE Confidence: 0.673648732857143

00:15:42.640 --> 00:15:47.640 probably direct cortical network mechanisms.

NOTE Confidence: 0.673648732857143

00:15:47.640 --> 00:15:49.680 Oh, a spindling is not necessary

NOTE Confidence: 0.673648732857143

00:15:49.680 --> 00:15:50.700 to increase cohesion,

NOTE Confidence: 0.673648732857143

00:15:50.700 --> 00:15:53.204 as we know from anyone who uses an

NOTE Confidence: 0.673648732857143

00:15:53.204 --> 00:15:55.579 oxybate or atypical antipsychotics,

NOTE Confidence: 0.673648732857143

00:15:55.580 --> 00:15:57.560 because.

NOTE Confidence: 0.673648732857143

00:15:57.560 --> 00:15:59.810 Network strengthening at the cortical level.

NOTE Confidence: 0.865192114736842

00:16:03.440 --> 00:16:05.512 I will be spending a bit of time

NOTE Confidence: 0.865192114736842

00:16:05.512 --> 00:16:07.038 on restless legs and periodic

NOTE Confidence: 0.865192114736842

00:16:07.038 --> 00:16:08.922 limb movements as we go along.

NOTE Confidence: 0.865192114736842

00:16:08.930 --> 00:16:11.958 It's the ultimate networked

NOTE Confidence: 0.865192114736842

00:16:11.958 --> 00:16:14.229 Physiology and pathology.

NOTE Confidence: 0.865192114736842

00:16:14.230 --> 00:16:16.870 And there's this really

NOTE Confidence: 0.865192114736842

00:16:16.870 --> 00:16:20.170 elegant paper from John Liu.

NOTE Confidence: 0.865192114736842

00:16:20.170 --> 00:16:22.947 And Patrick Fuller's group here where

NOTE Confidence: 0.865192114736842

00:16:22.947 --> 00:16:27.849 they targeted multiple sites of ablation.

NOTE Confidence: 0.865192114736842

00:16:27.850 --> 00:16:31.670 Across the striatum, globus pallidus.

NOTE Confidence: 0.865192114736842

00:16:31.670 --> 00:16:33.142 And even the cortex,

NOTE Confidence: 0.865192114736842

00:16:33.142 --> 00:16:35.760 motor cortex and showed that at all

NOTE Confidence: 0.865192114736842

00:16:35.760 --> 00:16:38.264 of these levels you actually had.

NOTE Confidence: 0.865192114736842

00:16:38.264 --> 00:16:40.754 The induction of theoretical movements,

NOTE Confidence: 0.865192114736842

00:16:40.760 --> 00:16:43.696 the kind which you see with restless legs,

NOTE Confidence: 0.865192114736842

00:16:43.700 --> 00:16:49.116 as well as as iron deficiency in rodents.

NOTE Confidence: 0.865192114736842

00:16:49.120 --> 00:16:52.708 A classic example of a network

NOTE Confidence: 0.865192114736842

00:16:52.708 --> 00:16:53.904 regulatory dysfunction.

NOTE Confidence: 0.8974574

00:16:57.230 --> 00:17:00.456 Now the. Periodically movement network.

NOTE Confidence: 0.8974574

00:17:00.456 --> 00:17:02.416 The restless legs periodic limb

NOTE Confidence: 0.8974574

00:17:02.416 --> 00:17:03.948 movement network is tightly

NOTE Confidence: 0.8974574

00:17:03.948 --> 00:17:05.336 linked to autonomic activation.

NOTE Confidence: 0.8974574

00:17:05.340 --> 00:17:07.160 You all know that.

NOTE Confidence: 0.8974574

00:17:07.160 --> 00:17:10.706 Whenever there is a periodical improvement.

NOTE Confidence: 0.8974574

00:17:10.710 --> 00:17:12.894 Usually there is at least a

NOTE Confidence: 0.8974574

00:17:12.894 --> 00:17:15.260 little bit of cardio activation.

NOTE Confidence: 0.8974574

00:17:15.260 --> 00:17:16.568 Sometimes they're truly blind.

NOTE Confidence: 0.8974574

00:17:16.568 --> 00:17:17.876 You see nothing happening.

NOTE Confidence: 0.8974574

00:17:17.880 --> 00:17:21.070 But more often than not, you see.

NOTE Confidence: 0.8974574

00:17:21.070 --> 00:17:22.618 Blood pressure surges.

NOTE Confidence: 0.8974574

00:17:22.618 --> 00:17:24.166 You see arousals,

NOTE Confidence: 0.8974574

00:17:24.170 --> 00:17:26.050 and the degree of arousal

NOTE Confidence: 0.8974574

00:17:26.050 --> 00:17:27.930 correlates reasonably well with the

NOTE Confidence: 0.8974574

00:17:27.997 --> 00:17:29.907 amount of blood pressure surge.

NOTE Confidence: 0.8974574

00:17:29.910 --> 00:17:32.289 There's increasing evidence.

NOTE Confidence: 0.8974574

00:17:32.290 --> 00:17:34.442 Suggestive evidence that adverse

NOTE Confidence: 0.8974574

00:17:34.442 --> 00:17:36.056 cardiovascular outcomes are

NOTE Confidence: 0.8974574

00:17:36.056 --> 00:17:38.590 epidemiologically linked to restless legs.

NOTE Confidence: 0.8974574

00:17:38.590 --> 00:17:38.881 Periodically,

NOTE Confidence: 0.8974574

00:17:38.881 --> 00:17:40.336 movements are really quite severe

NOTE Confidence: 0.8974574

00:17:40.336 --> 00:17:42.193 in heart failure and renal failure

NOTE Confidence: 0.8974574

00:17:42.193 --> 00:17:43.798 patients and likely contributes to

NOTE Confidence: 0.8974574

00:17:43.798 --> 00:17:45.370 pathological and nocturnal hemodynamics.

NOTE Confidence: 0.8974574

00:17:45.370 --> 00:17:47.250 Because these people really kick.

NOTE Confidence: 0.8974574

00:17:47.250 --> 00:17:48.098 I mean they kick.

NOTE Confidence: 0.8974574

00:17:48.098 --> 00:17:49.158 You can even without measuring

NOTE Confidence: 0.8974574

00:17:49.158 --> 00:17:49.770 blood pressure,

NOTE Confidence: 0.8974574

00:17:49.770 --> 00:17:52.440 you can see the applet signal,

NOTE Confidence: 0.8974574

00:17:52.440 --> 00:17:53.238 you know, squeeze,

NOTE Confidence: 0.8974574

00:17:53.238 --> 00:17:54.834 you can see the heart rate

NOTE Confidence: 0.8974574

00:17:54.834 --> 00:17:56.067 bump up and and so on.

NOTE Confidence: 0.8974574

00:17:56.070 --> 00:17:58.950 That can't be a good thing.

NOTE Confidence: 0.8974574

00:17:58.950 --> 00:18:01.272 So let's spend a little bit of time on.

NOTE Confidence: 0.832929

00:18:03.860 --> 00:18:07.530 PLM's. Just a bit now, but more to come.

NOTE Confidence: 0.832929

00:18:07.530 --> 00:18:09.274 So this is this of course is an

NOTE Confidence: 0.832929

00:18:09.274 --> 00:18:11.008 example of periodic limb movements,

NOTE Confidence: 0.832929

00:18:11.010 --> 00:18:12.995 but notice how there's really

NOTE Confidence: 0.832929

00:18:12.995 --> 00:18:14.583 not much autonomic activation.

NOTE Confidence: 0.832929

00:18:14.590 --> 00:18:19.098 There's very little change in cardiac rate.

NOTE Confidence: 0.832929

00:18:19.100 --> 00:18:23.216 In fact, any change in RR.

NOTE Confidence: 0.832929

00:18:23.220 --> 00:18:26.285 Is not related to the

NOTE Confidence: 0.832929

00:18:26.285 --> 00:18:28.124 leg movements themselves.

NOTE Confidence: 0.832929

00:18:28.130 --> 00:18:31.526 You can see the plate signal

NOTE Confidence: 0.832929

00:18:31.526 --> 00:18:33.780 showing essentially very. What?

NOTE Confidence: 0.832929

00:18:33.780 --> 00:18:36.530 Actually no reduction in amplitude,

NOTE Confidence: 0.832929

00:18:36.530 --> 00:18:38.735 suggesting there is not recurrent

NOTE Confidence: 0.832929

00:18:38.735 --> 00:18:40.058 sympathetic activation with

NOTE Confidence: 0.832929

00:18:40.058 --> 00:18:41.869 these periodic limb movements.

NOTE Confidence: 0.832929

00:18:41.870 --> 00:18:44.068 So these are what I call dumb

NOTE Confidence: 0.832929

00:18:44.068 --> 00:18:45.010 periodic limb movements.

NOTE Confidence: 0.832929

00:18:45.010 --> 00:18:47.710 Dumb meaning they don't do anything.

NOTE Confidence: 0.832929

00:18:47.710 --> 00:18:49.750 I will show you later on not very

NOTE Confidence: 0.832929

00:18:49.750 --> 00:18:50.990 dumb periodical improvements.

NOTE Confidence: 0.884338239473684

00:18:54.240 --> 00:18:55.950 This is the only classic slide

NOTE Confidence: 0.884338239473684

00:18:55.950 --> 00:18:58.062 I will show you and this of

NOTE Confidence: 0.884338239473684

00:18:58.062 --> 00:18:59.880 course is the two process model.

NOTE Confidence: 0.884338239473684

00:18:59.880 --> 00:19:01.920 If that is not the ultimate

NOTE Confidence: 0.884338239473684

00:19:01.920 --> 00:19:03.398 network interaction, what is right,

NOTE Confidence: 0.884338239473684

00:19:03.398 --> 00:19:05.260 you have the whole sleep system now

NOTE Confidence: 0.884338239473684

00:19:05.320 --> 00:19:06.920 interacting with the circadian system

NOTE Confidence: 0.884338239473684

00:19:06.920 --> 00:19:09.000 which has its own down network.

NOTE Confidence: 0.884338239473684

00:19:09.000 --> 00:19:11.584 I'm not going to be talking much about

NOTE Confidence: 0.884338239473684

00:19:11.584 --> 00:19:12.922 circadian networks today because

NOTE Confidence: 0.884338239473684

00:19:12.922 --> 00:19:15.141 obviously I'm not the best person for

NOTE Confidence: 0.884338239473684

00:19:15.141 --> 00:19:17.388 that and we will not have enough time.

NOTE Confidence: 0.884338239473684

00:19:17.390 --> 00:19:19.706 But the circadian network of course

NOTE Confidence: 0.884338239473684

00:19:19.706 --> 00:19:21.925 interacts with the sleep network and

NOTE Confidence: 0.884338239473684

00:19:21.925 --> 00:19:24.341 is its own entity in its own right,

NOTE Confidence: 0.884338239473684

00:19:24.350 --> 00:19:26.542 having his own networks.

NOTE Confidence: 0.884338239473684

00:19:26.542 --> 00:19:29.028 Uh, in the brain, in the liver,

NOTE Confidence: 0.884338239473684

00:19:29.030 --> 00:19:30.428 in the body, you name it.

NOTE Confidence: 0.884338239473684

00:19:30.430 --> 00:19:33.130 The circadian system is probably.

NOTE Confidence: 0.884338239473684

00:19:33.130 --> 00:19:35.070 And even more impressive network

NOTE Confidence: 0.884338239473684

00:19:35.070 --> 00:19:36.622 than the Sleep network.

NOTE Confidence: 0.884338239473684

00:19:36.630 --> 00:19:38.838 But this is remind you that everybody has

NOTE Confidence: 0.884338239473684

00:19:38.838 --> 00:19:41.150 a sleep system and a circadian system,

NOTE Confidence: 0.884338239473684

00:19:41.150 --> 00:19:43.130 and both these network states

NOTE Confidence: 0.884338239473684

00:19:43.130 --> 00:19:44.318 do interact immensely.

NOTE Confidence: 0.866714414

00:19:46.750 --> 00:19:48.172 So how can you measure the

NOTE Confidence: 0.866714414

00:19:48.172 --> 00:19:49.120 network health of sleep?

NOTE Confidence: 0.893508503571429

00:19:51.480 --> 00:19:53.489 So it turns out that we are

NOTE Confidence: 0.893508503571429

00:19:53.489 --> 00:19:55.570 doing this a lot of the time.

NOTE Confidence: 0.893508503571429

00:19:55.570 --> 00:19:59.640 Classic polysomnography of course measures.

NOTE Confidence: 0.893508503571429

00:19:59.640 --> 00:20:00.615 The Sleep network,

NOTE Confidence: 0.893508503571429

00:20:00.615 --> 00:20:02.240 but the scoring of course,

NOTE Confidence: 0.893508503571429

00:20:02.240 --> 00:20:04.988 does not think network.

NOTE Confidence: 0.893508503571429

00:20:04.990 --> 00:20:09.574 The closest to network would be arousal after

NOTE Confidence: 0.893508503571429

00:20:09.574 --> 00:20:13.178 respiratory event or desaturation linked to.

NOTE Confidence: 0.893508503571429

00:20:13.180 --> 00:20:15.592 A respiratory event, perhaps?

NOTE Confidence: 0.893508503571429

00:20:15.592 --> 00:20:19.010 But the standard manual very very

NOTE Confidence: 0.893508503571429

00:20:19.010 --> 00:20:22.510 precisely tries to steer us away from

NOTE Confidence: 0.893508503571429

00:20:22.510 --> 00:20:25.777 thinking of the brain and sleep as

NOTE Confidence: 0.893508503571429

00:20:25.777 --> 00:20:28.370 a large scale integrated network.

NOTE Confidence: 0.893508503571429

00:20:28.370 --> 00:20:30.002 But from classic polysomnography

NOTE Confidence: 0.893508503571429

00:20:30.002 --> 00:20:32.042 you can certainly extract all

NOTE Confidence: 0.893508503571429

00:20:32.042 --> 00:20:33.770 kinds of network behaviors.

NOTE Confidence: 0.893508503571429

00:20:33.770 --> 00:20:36.398 Functional MRI or sleep very clearly

NOTE Confidence: 0.893508503571429

00:20:36.398 --> 00:20:38.850 shows the network behavior of sleep.

NOTE Confidence: 0.893508503571429

00:20:38.850 --> 00:20:40.398 And I'll give you a small

NOTE Confidence: 0.893508503571429

00:20:40.398 --> 00:20:41.172 sample high density,

NOTE Confidence: 0.893508503571429

00:20:41.180 --> 00:20:45.680 EG it's superficial cortical networks.

NOTE Confidence: 0.893508503571429

00:20:45.680 --> 00:20:48.508 But you can do high density EEG

NOTE Confidence: 0.893508503571429

00:20:48.508 --> 00:20:49.720 polysomnography with including,

NOTE Confidence: 0.893508503571429

00:20:49.720 --> 00:20:51.974 you know, autonomic Dr and so on,

NOTE Confidence: 0.893508503571429

00:20:51.980 --> 00:20:54.632 and map out how the cortical

NOTE Confidence: 0.893508503571429

00:20:54.632 --> 00:20:57.300 activity changes with the breathing,

NOTE Confidence: 0.893508503571429

00:20:57.300 --> 00:20:59.272 with arousals, with muscle,

NOTE Confidence: 0.893508503571429

00:20:59.272 --> 00:21:02.230 sympathetic nerve activity and so on.

NOTE Confidence: 0.893508503571429

00:21:02.230 --> 00:21:03.616 Death recordings, uh,

NOTE Confidence: 0.893508503571429

00:21:03.616 --> 00:21:05.926 where they also is hemodynamics,

NOTE Confidence: 0.893508503571429

00:21:05.930 --> 00:21:09.878 respiration, ECG can again map out.

NOTE Confidence: 0.893508503571429

00:21:09.880 --> 00:21:10.315 Networks,

NOTE Confidence: 0.893508503571429

00:21:10.315 --> 00:21:13.360 I'm not going to be killing you

NOTE Confidence: 0.893508503571429

00:21:13.360 --> 00:21:15.464 with intensely mathematical.

NOTE Confidence: 0.893508503571429

00:21:15.464 --> 00:21:19.624 Uh, displays on this talk.

NOTE Confidence: 0.893508503571429

00:21:19.630 --> 00:21:21.583 I'm trying to keep it as user

NOTE Confidence: 0.893508503571429

00:21:21.583 --> 00:21:23.164 friendly as possible, but there are.

NOTE Confidence: 0.893508503571429

00:21:23.164 --> 00:21:25.318 If you go to pub Med and put

NOTE Confidence: 0.893508503571429

00:21:25.318 --> 00:21:26.368 these keywords in,

NOTE Confidence: 0.893508503571429

00:21:26.370 --> 00:21:29.850 you will get ample sophisticated papers,

NOTE Confidence: 0.893508503571429

00:21:29.850 --> 00:21:33.657 which honestly many of them are over my head.

NOTE Confidence: 0.893508503571429

00:21:33.660 --> 00:21:34.928 Analysis of coupled oscillations.

NOTE Confidence: 0.893508503571429

00:21:34.928 --> 00:21:37.490 I will talk a little bit about that.

NOTE Confidence: 0.893508503571429

00:21:37.490 --> 00:21:38.738 I will talk a little bit

NOTE Confidence: 0.893508503571429

00:21:38.738 --> 00:21:39.570 about time delay stability,

NOTE Confidence: 0.893508503571429

00:21:39.570 --> 00:21:40.970 because this is a method.

NOTE Confidence: 0.7172953865

00:21:43.350 --> 00:21:45.734 Described by Plaman Ave.

NOTE Confidence: 0.7172953865

00:21:45.734 --> 00:21:49.310 And his group from Boston University.

NOTE Confidence: 0.7172953865

00:21:49.310 --> 00:21:52.230 Which talks about the kind.

NOTE Confidence: 0.7172953865

00:21:52.230 --> 00:21:55.688 It's a measure of network strength and.

NOTE Confidence: 0.7172953865

00:21:55.690 --> 00:21:57.860 We look at sleep studies where there's

NOTE Confidence: 0.7172953865

00:21:57.860 --> 00:21:59.230 pathology across multiple systems.

NOTE Confidence: 0.7172953865

00:21:59.230 --> 00:22:01.696 So as an example you have.

NOTE Confidence: 0.7172953865

00:22:01.700 --> 00:22:03.892 Periodically movement coinciding with

NOTE Confidence: 0.7172953865

00:22:03.892 --> 00:22:06.632 the respiratory arousal coinciding with.

NOTE Confidence: 0.7172953865

00:22:06.640 --> 00:22:08.240 Cardio acceleration coinciding with

NOTE Confidence: 0.7172953865

00:22:08.240 --> 00:22:09.840 the cortical arousal coinciding

NOTE Confidence: 0.7172953865

00:22:09.840 --> 00:22:11.749 with the whole body movement.

NOTE Confidence: 0.879060223636363

00:22:13.900 --> 00:22:16.035 The strength of that connectivity

NOTE Confidence: 0.879060223636363

00:22:16.035 --> 00:22:18.580 can be described in different ways,

NOTE Confidence: 0.879060223636363

00:22:18.580 --> 00:22:20.938 but one of them is called

NOTE Confidence: 0.879060223636363

00:22:20.938 --> 00:22:22.510 the time delay stability.

NOTE Confidence: 0.879060223636363

00:22:22.510 --> 00:22:24.926 Of course there is a graph based analysis,

NOTE Confidence: 0.879060223636363

00:22:24.930 --> 00:22:27.426 network strength measures like path length,

NOTE Confidence: 0.879060223636363

00:22:27.430 --> 00:22:30.318 etcetera. I will not be going into that.

NOTE Confidence: 0.879060223636363

00:22:30.320 --> 00:22:32.435 Similarly, the integrated analytics such

NOTE Confidence: 0.879060223636363

00:22:32.435 --> 00:22:35.239 as I'm just loosely calling the sense,

NOTE Confidence: 0.879060223636363

00:22:35.240 --> 00:22:37.928 Wellman, Azerbaijan, Scotty,

NOTE Confidence: 0.879060223636363

00:22:37.928 --> 00:22:41.484 Andrew and Alice computations and algorithms,

NOTE Confidence: 0.879060223636363

00:22:41.484 --> 00:22:43.500 I will not be discussing that today,

NOTE Confidence: 0.879060223636363

00:22:43.500 --> 00:22:45.950 but they are very dependent

NOTE Confidence: 0.879060223636363

00:22:45.950 --> 00:22:47.420 on network connectivity.

NOTE Confidence: 0.879060223636363

00:22:47.420 --> 00:22:49.800 The heart rate response to arousal is

NOTE Confidence: 0.879060223636363

00:22:49.800 --> 00:22:52.244 an example that's a good example of.

NOTE Confidence: 0.879060223636363

00:22:52.244 --> 00:22:53.668 Not calling it network,

NOTE Confidence: 0.879060223636363

00:22:53.670 --> 00:22:55.770 but believe me it is as network as they come.

NOTE Confidence: 0.88575803

00:22:59.260 --> 00:23:02.116 Just to remind you that we of course

NOTE Confidence: 0.88575803

00:23:02.116 --> 00:23:04.478 measure the network all the time.

NOTE Confidence: 0.912080342

00:23:08.230 --> 00:23:10.540 This is an example of.

NOTE Confidence: 0.912080342

00:23:10.540 --> 00:23:12.676 The network of sleep at work.

NOTE Confidence: 0.912080342

00:23:12.680 --> 00:23:15.101 So you have air flow and then you have

NOTE Confidence: 0.912080342

00:23:15.101 --> 00:23:17.439 the peripheral arterial tonometry signal

NOTE Confidence: 0.912080342

00:23:17.439 --> 00:23:19.934 and your arterial blood pressure.

NOTE Confidence: 0.912080342

00:23:19.940 --> 00:23:21.920 Typically, when any individual

NOTE Confidence: 0.912080342

00:23:21.920 --> 00:23:24.395 signal shows a major deviation,

NOTE Confidence: 0.912080342

00:23:24.400 --> 00:23:27.418 a major perturbation, a major transient,

NOTE Confidence: 0.912080342

00:23:27.420 --> 00:23:29.268 these others will have it at

NOTE Confidence: 0.912080342

00:23:29.268 --> 00:23:31.119 the same time because they are.

NOTE Confidence: 0.912080342

00:23:31.120 --> 00:23:32.620 Tightly linked. And network.

NOTE Confidence: 0.912080342

00:23:32.620 --> 00:23:35.246 Now whether you call them coupled or

NOTE Confidence: 0.912080342

00:23:35.246 --> 00:23:37.416 network is the same thing here anyway.

NOTE Confidence: 0.912080342

00:23:37.420 --> 00:23:39.373 But what it tells you is that you can

NOTE Confidence: 0.912080342

00:23:39.380 --> 00:23:41.557 use any of these individual signals in

NOTE Confidence: 0.912080342

00:23:41.557 --> 00:23:43.720 the right context to predict the other.

NOTE Confidence: 0.912080342

00:23:43.720 --> 00:23:45.218 So if you're sleeping and your blood

NOTE Confidence: 0.912080342

00:23:45.218 --> 00:23:46.359 pressure is showing the profile,

NOTE Confidence: 0.912080342

00:23:46.360 --> 00:23:47.608 which is seen here.

NOTE Confidence: 0.912080342

00:23:47.608 --> 00:23:49.480 Either you have sleep apnea or

NOTE Confidence: 0.912080342

00:23:49.549 --> 00:23:51.549 you have periodically movements,

NOTE Confidence: 0.912080342

00:23:51.550 --> 00:23:54.238 or or someone has slapped headphones on

NOTE Confidence: 0.912080342

00:23:54.238 --> 00:23:57.646 you and I'm beeping you every 35 seconds.

NOTE Confidence: 0.912080342

00:23:57.650 --> 00:24:00.149 If respiration of course looks like that,

NOTE Confidence: 0.912080342

00:24:00.150 --> 00:24:02.678 you know there is apnea and you

NOTE Confidence: 0.912080342

00:24:02.678 --> 00:24:04.848 will almost certainly have blood

NOTE Confidence: 0.912080342

00:24:04.848 --> 00:24:06.760 pressure tracking along with it.

NOTE Confidence: 0.711551057777778

00:24:08.910 --> 00:24:12.090 A cyclic alternating pattern or

NOTE Confidence: 0.711551057777778

00:24:12.090 --> 00:24:15.207 cap is the best. Day-to-day.

NOTE Confidence: 0.711551057777778

00:24:15.207 --> 00:24:18.042 Example of the cortical network

NOTE Confidence: 0.711551057777778

00:24:18.042 --> 00:24:19.743 stability or instability.

NOTE Confidence: 0.711551057777778

00:24:19.750 --> 00:24:21.730 Remember networks can be vertical.

NOTE Confidence: 0.711551057777778

00:24:21.730 --> 00:24:23.140 You know across different levels

NOTE Confidence: 0.711551057777778

00:24:23.140 --> 00:24:25.658 of the brain it can be horizontal.

NOTE Confidence: 0.711551057777778

00:24:25.658 --> 00:24:27.326 Across the same level.

NOTE Confidence: 0.711551057777778

00:24:27.330 --> 00:24:29.390 So the slow oscillation is

NOTE Confidence: 0.711551057777778

00:24:29.390 --> 00:24:31.038 a cortical network thing.

NOTE Confidence: 0.7739187625

00:24:33.220 --> 00:24:35.284 Cyclic alternating pattern is

NOTE Confidence: 0.7739187625

00:24:35.284 --> 00:24:37.348 both horizontally integrated as

NOTE Confidence: 0.7739187625

00:24:37.348 --> 00:24:40.099 well as vertically integrated.

NOTE Confidence: 0.7739187625

00:24:40.100 --> 00:24:42.944 So when you have. The A phase and B

NOTE Confidence: 0.7739187625

00:24:42.944 --> 00:24:45.426 phase alternating you have immense

NOTE Confidence: 0.7739187625

00:24:45.426 --> 00:24:48.036 changes in the cortical network.

NOTE Confidence: 0.7739187625

00:24:48.040 --> 00:24:50.658 Uh activity, and this is a period

NOTE Confidence: 0.7739187625

00:24:50.658 --> 00:24:54.130 of cap of cyclical training pattern.

NOTE Confidence: 0.7739187625

00:24:54.130 --> 00:24:55.730 Which is markedly amplified by

NOTE Confidence: 0.7739187625

00:24:55.730 --> 00:24:58.075 disease and here you have non cap

NOTE Confidence: 0.7739187625

00:24:58.075 --> 00:24:59.790 or non cyclic alternating pattern.

NOTE Confidence: 0.7739187625

00:24:59.790 --> 00:25:01.974 You will notice that I'm sort of

NOTE Confidence: 0.7739187625

00:25:01.974 --> 00:25:03.894 repackaging a lot of things that

NOTE Confidence: 0.7739187625

00:25:03.894 --> 00:25:05.724 you already know in a network

NOTE Confidence: 0.7739187625

00:25:05.730 --> 00:25:09.380 in kind of network thing.

NOTE Confidence: 0.7739187625

00:25:09.380 --> 00:25:10.962 Now, it's very important to note that

NOTE Confidence: 0.7739187625

00:25:10.962 --> 00:25:12.758 when there is a cortical perturbation,

NOTE Confidence: 0.7739187625

00:25:12.760 --> 00:25:15.178 there is usually a downstream perturbation.

NOTE Confidence: 0.7739187625

00:25:15.180 --> 00:25:17.676 So it turns out whenever you have K

NOTE Confidence: 0.7739187625

00:25:17.676 --> 00:25:19.638 complexes and phasic egg activity,

NOTE Confidence: 0.7739187625

00:25:19.640 --> 00:25:21.296 you will have an increase in blood pressure,

NOTE Confidence: 0.7739187625

00:25:21.300 --> 00:25:22.988 increase in heart rate,

NOTE Confidence: 0.7739187625

00:25:22.988 --> 00:25:24.676 increase in tidal volume,

NOTE Confidence: 0.7739187625

00:25:24.680 --> 00:25:27.506 the flat signal amplitude will drop.

NOTE Confidence: 0.7739187625

00:25:27.510 --> 00:25:31.374 You will have a blood pressure surge.

NOTE Confidence: 0.7739187625

00:25:31.380 --> 00:25:32.688 Maybe a little blimp,

NOTE Confidence: 0.7739187625

00:25:32.688 --> 00:25:34.323 maybe not necessarily a surge,

NOTE Confidence: 0.7739187625

00:25:34.330 --> 00:25:37.754 but these will occur very reliably as the

NOTE Confidence: 0.7739187625

00:25:37.754 --> 00:25:40.488 reflection of the integrated network.

NOTE Confidence: 0.7739187625

00:25:40.490 --> 00:25:42.065 Just to remind you that you may

NOTE Confidence: 0.7739187625

00:25:42.065 --> 00:25:43.649 have deep sleep which is unstable.

NOTE Confidence: 0.7739187625

00:25:43.650 --> 00:25:46.994 So this is M3 showing a lot of

NOTE Confidence: 0.7739187625

00:25:46.994 --> 00:25:48.670 intermittent phasic activity.

NOTE Confidence: 0.7739187625

00:25:48.670 --> 00:25:50.854 So deep and stable is now this is

NOTE Confidence: 0.7739187625

00:25:50.854 --> 00:25:53.046 so you can be deep and stable,

NOTE Confidence: 0.7739187625

00:25:53.050 --> 00:25:55.850 deep and light, light and stable and such.

NOTE Confidence: 0.7739187625

00:25:55.850 --> 00:25:58.454 So all all the combinations are actually

NOTE Confidence: 0.7739187625

00:25:58.454 --> 00:26:01.188 possible. And this is an example of.

NOTE Confidence: 0.7739187625

00:26:01.190 --> 00:26:03.514 The network of sleep being the cortical

NOTE Confidence: 0.7739187625

00:26:03.514 --> 00:26:05.348 network at least at a minimum,

NOTE Confidence: 0.7739187625

00:26:05.350 --> 00:26:06.798 being unstable despite sleep

NOTE Confidence: 0.7739187625

00:26:06.798 --> 00:26:07.884 being quite deep.

NOTE Confidence: 0.75307355375

00:26:09.950 --> 00:26:10.732 Network switching.

NOTE Confidence: 0.75307355375

00:26:10.732 --> 00:26:13.078 We see this on every polysomnogram.

NOTE Confidence: 0.75307355375

00:26:13.080 --> 00:26:14.074 If you choose to look at it,

NOTE Confidence: 0.75307355375

00:26:14.080 --> 00:26:15.040 well, almost every.

NOTE Confidence: 0.75307355375

00:26:15.040 --> 00:26:17.280 So on the top left you have

NOTE Confidence: 0.75307355375

00:26:17.357 --> 00:26:19.199 ongoing respiratory events,

NOTE Confidence: 0.75307355375

00:26:19.200 --> 00:26:20.230 fragmented sleep.

NOTE Confidence: 0.75307355375

00:26:20.230 --> 00:26:24.350 In the middle you see the abrupt switch.

NOTE Confidence: 0.75307355375

00:26:24.350 --> 00:26:25.939 Ohh there's no change in body position.

NOTE Confidence: 0.75307355375

00:26:25.940 --> 00:26:27.518 This is not a therapy study.

NOTE Confidence: 0.75307355375

00:26:27.520 --> 00:26:29.108 We did nothing spontaneous

NOTE Confidence: 0.75307355375

00:26:29.108 --> 00:26:30.696 switched to stable state.

NOTE Confidence: 0.75307355375

00:26:30.700 --> 00:26:32.779 This is how non REM sleep works.

NOTE Confidence: 0.75307355375

00:26:32.780 --> 00:26:35.106 Not N 1, N 2, N 3, N 4, N 5, N 6.

NOTE Confidence: 0.75307355375

00:26:35.106 --> 00:26:36.527 This is how non REM sleep works.

NOTE Confidence: 0.75307355375

00:26:36.530 --> 00:26:40.340 You have two fundamental network behaviors,

NOTE Confidence: 0.75307355375

00:26:40.340 --> 00:26:43.250 one where you have low frequency

NOTE Confidence: 0.75307355375

00:26:43.250 --> 00:26:44.220 oscillations dominating.

NOTE Confidence: 0.75307355375

00:26:44.220 --> 00:26:47.706 The other way you have essentially everything

NOTE Confidence: 0.75307355375

00:26:47.706 --> 00:26:49.651 synchronized around respiratory frequency,

NOTE Confidence: 0.75307355375

00:26:49.651 --> 00:26:51.004 individual breath frequency.

NOTE Confidence: 0.75307355375

00:26:51.004 --> 00:26:55.049 So this is an example of network switching.

NOTE Confidence: 0.75307355375

00:26:55.050 --> 00:26:56.450 Sleep onset is another great

NOTE Confidence: 0.75307355375

00:26:56.450 --> 00:26:57.570 example of network switching,

NOTE Confidence: 0.75307355375

00:26:57.570 --> 00:27:00.504 which we'll go into a little bit of detail.

NOTE Confidence: 0.75307355375

00:27:00.510 --> 00:27:03.390 So delving a little bit more into the,

NOTE Confidence: 0.75307355375

00:27:03.390 --> 00:27:04.084 you know,

NOTE Confidence: 0.75307355375

00:27:04.084 --> 00:27:06.166 horizontal network of non REM sleep,

NOTE Confidence: 0.75307355375

00:27:06.170 --> 00:27:08.888 the glue of non REM sleep.

NOTE Confidence: 0.75307355375

00:27:08.890 --> 00:27:12.826 Up here you have cortical network.

NOTE Confidence: 0.75307355375

00:27:12.830 --> 00:27:13.694 Local field potentials.

NOTE Confidence: 0.75307355375

00:27:13.694 --> 00:27:16.120 This is what we see on the brain.

NOTE Confidence: 0.75307355375

00:27:16.120 --> 00:27:18.016 You know a slow oscillations but

NOTE Confidence: 0.75307355375

00:27:18.016 --> 00:27:20.075 if you measure multi unit activity

NOTE Confidence: 0.75307355375

00:27:20.075 --> 00:27:21.905 you will find firing silence,

NOTE Confidence: 0.75307355375

00:27:21.910 --> 00:27:22.638 firing silence.

NOTE Confidence: 0.75307355375

00:27:22.638 --> 00:27:26.270 So this is the on off state of non REM

NOTE Confidence: 0.75307355375

00:27:26.270 --> 00:27:28.430 sleep which is a fundamental building

NOTE Confidence: 0.75307355375

00:27:28.430 --> 00:27:31.880 block of non REM sleep on top of which

NOTE Confidence: 0.75307355375

00:27:31.880 --> 00:27:33.490 everything else essentially rides.

NOTE Confidence: 0.75307355375

00:27:33.490 --> 00:27:34.730 And there's some examples

NOTE Confidence: 0.75307355375

00:27:34.730 --> 00:27:35.970 where the cortical network,

NOTE Confidence: 0.75307355375

00:27:35.970 --> 00:27:39.246 the non R.E.M slow oscillation breaks down.

NOTE Confidence: 0.75307355375

00:27:39.250 --> 00:27:41.446 And the best example would be

NOTE Confidence: 0.75307355375

00:27:41.446 --> 00:27:42.544 perhaps Alzheimer's disease.

NOTE Confidence: 0.75307355375

00:27:42.550 --> 00:27:44.188 You know, as your cortex breaks down,

NOTE Confidence: 0.75307355375

00:27:44.190 --> 00:27:47.154 your slow oscillation will also start

NOTE Confidence: 0.75307355375

00:27:47.154 --> 00:27:49.130 disappearing and start fragmenting.

NOTE Confidence: 0.786633272666667

00:27:51.280 --> 00:27:53.515 The small isolation builds up

NOTE Confidence: 0.786633272666667

00:27:53.515 --> 00:27:55.750 in frequency and spatial extent

NOTE Confidence: 0.786633272666667

00:27:55.827 --> 00:27:57.877 as sleep starts and deepens.

NOTE Confidence: 0.786633272666667

00:27:57.880 --> 00:28:01.372 And essentially, as we fall asleep, we have.

NOTE Confidence: 0.786633272666667

00:28:01.372 --> 00:28:03.590 The network, uh, is.

NOTE Confidence: 0.786633272666667

00:28:03.590 --> 00:28:06.170 The Sleep network is quite unstable,

NOTE Confidence: 0.786633272666667

00:28:06.170 --> 00:28:07.110 so we have microsleeps.

NOTE Confidence: 0.786633272666667

00:28:07.110 --> 00:28:08.850 You have a little bursts of sleep,

NOTE Confidence: 0.786633272666667

00:28:08.850 --> 00:28:11.690 K complexes, some spindles alpha in and out.

NOTE Confidence: 0.786633272666667

00:28:11.690 --> 00:28:13.748 And as we go further and further

NOTE Confidence: 0.786633272666667

00:28:13.748 --> 00:28:15.458 and further you have coalescence

NOTE Confidence: 0.786633272666667

00:28:15.458 --> 00:28:17.358 of the slow oscillation resulting

NOTE Confidence: 0.786633272666667

00:28:17.358 --> 00:28:19.717 in you know in three or stage

NOTE Confidence: 0.786633272666667

00:28:19.717 --> 00:28:21.445 four or stable non REM sleep.

NOTE Confidence: 0.786633272666667

00:28:21.450 --> 00:28:23.382 And if you count the number

NOTE Confidence: 0.786633272666667

00:28:23.382 --> 00:28:25.183 of slow oscillations per unit

NOTE Confidence: 0.786633272666667

00:28:25.183 --> 00:28:26.967 time it progressively increase.

NOTE Confidence: 0.786633272666667

00:28:26.970 --> 00:28:30.175 So essentially the cortical network can

NOTE Confidence: 0.786633272666667

00:28:30.175 --> 00:28:32.590 be vulnerable when the cycles per minute

NOTE Confidence: 0.786633272666667

00:28:32.590 --> 00:28:35.477 of slow oscillation is at the lower end.

NOTE Confidence: 0.786633272666667

00:28:35.480 --> 00:28:36.740 And it becomes very stable.

NOTE Confidence: 0.786633272666667

00:28:36.740 --> 00:28:40.300 It's like a very good self sealing tire.

NOTE Confidence: 0.786633272666667

00:28:40.300 --> 00:28:43.678 You book the the sleeping brain.

NOTE Confidence: 0.786633272666667

00:28:43.680 --> 00:28:46.179 When the slow oscillation density is high,

NOTE Confidence: 0.786633272666667

00:28:46.180 --> 00:28:48.420 the network is very stable,

NOTE Confidence: 0.786633272666667

00:28:48.420 --> 00:28:50.607 while if you poke it when it is not

NOTE Confidence: 0.786633272666667

00:28:50.607 --> 00:28:52.843 so stable you will have an awakening

NOTE Confidence: 0.786633272666667

00:28:52.843 --> 00:28:55.604 or you will have a arousal with

NOTE Confidence: 0.786633272666667

00:28:55.604 --> 00:28:58.964 respiratory transient and so on.

NOTE Confidence: 0.786633272666667

00:28:58.970 --> 00:28:59.327 OK.

NOTE Confidence: 0.786633272666667

00:28:59.327 --> 00:29:01.112 So the slow oscillation and

NOTE Confidence: 0.786633272666667

00:29:01.112 --> 00:29:02.970 and slow waves you know,

NOTE Confidence: 0.786633272666667

00:29:02.970 --> 00:29:04.447 for for a while it was thought

NOTE Confidence: 0.786633272666667

00:29:04.447 --> 00:29:05.869 to be fairly passive things,

NOTE Confidence: 0.786633272666667

00:29:05.870 --> 00:29:07.879 but it turns out they're not passive.

NOTE Confidence: 0.786633272666667

00:29:07.880 --> 00:29:11.306 And using simultaneous EEG and fMRI.

NOTE Confidence: 0.786633272666667

00:29:11.310 --> 00:29:11.662 Uh,

NOTE Confidence: 0.786633272666667

00:29:11.662 --> 00:29:15.121 this is very elegant paper in PNAS in 2008

NOTE Confidence: 0.786633272666667

00:29:15.121 --> 00:29:18.967 actually showing that many cortical areas,

NOTE Confidence: 0.786633272666667

00:29:18.970 --> 00:29:20.689 including inferior frontal,

NOTE Confidence: 0.786633272666667

00:29:20.689 --> 00:29:22.408 middle prefrontal precuneus,

NOTE Confidence: 0.786633272666667

00:29:22.410 --> 00:29:25.175 the posterior singlet, all actually

NOTE Confidence: 0.786633272666667

00:29:25.175 --> 00:29:27.387 activate during slow oscillation.

NOTE Confidence: 0.786633272666667

00:29:27.390 --> 00:29:28.326 So slow oscillation.

NOTE Confidence: 0.786633272666667

00:29:28.326 --> 00:29:30.198 What you see on the surface,

NOTE Confidence: 0.786633272666667

00:29:30.200 --> 00:29:32.128 there's a slow wave, it's an inhibitory wave.

NOTE Confidence: 0.786633272666667

00:29:32.130 --> 00:29:33.096 That is true.

NOTE Confidence: 0.786633272666667

00:29:33.096 --> 00:29:34.384 That's the off state.

NOTE Confidence: 0.786633272666667

00:29:34.390 --> 00:29:36.268 And then you have the on

NOTE Confidence: 0.786633272666667

00:29:36.268 --> 00:29:37.207 state with activation.

NOTE Confidence: 0.786633272666667

00:29:37.210 --> 00:29:39.180 So it turns out that.

NOTE Confidence: 0.786633272666667

00:29:39.180 --> 00:29:40.500 The driver of this on,

NOTE Confidence: 0.786633272666667

00:29:40.500 --> 00:29:41.094 off, on,

NOTE Confidence: 0.786633272666667

00:29:41.094 --> 00:29:42.876 off is not some passive Zen

NOTE Confidence: 0.786633272666667

00:29:42.876 --> 00:29:44.818 kind of state of the brain,

NOTE Confidence: 0.786633272666667

00:29:44.820 --> 00:29:46.660 but very active engagement by

NOTE Confidence: 0.786633272666667

00:29:46.660 --> 00:29:48.500 a fairly widespread network of

NOTE Confidence: 0.786633272666667

00:29:48.571 --> 00:29:50.599 very specific areas in the brain.

NOTE Confidence: 0.786633272666667

00:29:50.600 --> 00:29:53.428 And this is just the pictorial representation

NOTE Confidence: 0.786633272666667

00:29:53.428 --> 00:29:56.390 of the areas which I laid out to you.

NOTE Confidence: 0.786633272666667

00:29:56.390 --> 00:29:57.506 And of course,

NOTE Confidence: 0.786633272666667

00:29:57.506 --> 00:30:00.110 this breaks down when you have insomnia.

NOTE Confidence: 0.786633272666667

00:30:00.110 --> 00:30:02.060 Uh, you know, Parkinson's disease.

NOTE Confidence: 0.786633272666667

00:30:02.060 --> 00:30:03.320 Uh, I think of other,

NOTE Confidence: 0.786633272666667

00:30:03.320 --> 00:30:04.500 you know, bad brain states,

NOTE Confidence: 0.786633272666667

00:30:04.500 --> 00:30:07.290 traumatic brain injury.

NOTE Confidence: 0.786633272666667

00:30:07.290 --> 00:30:08.625 A word on time delay, stability.

NOTE Confidence: 0.786633272666667

00:30:08.625 --> 00:30:11.640 So basically what it means is that you have,

NOTE Confidence: 0.786633272666667

00:30:11.640 --> 00:30:13.638 you know, your EKG, heart rate,

NOTE Confidence: 0.786633272666667

00:30:13.640 --> 00:30:14.993 respiration, eye movements.

NOTE Confidence: 0.786633272666667

00:30:14.993 --> 00:30:19.220 If all of them are very tightly synchronized,

NOTE Confidence: 0.786633272666667

00:30:19.220 --> 00:30:23.060 it means you have short time delay stability.

NOTE Confidence: 0.786633272666667

00:30:23.060 --> 00:30:25.120 The DPO sleep the less

NOTE Confidence: 0.786633272666667

00:30:25.120 --> 00:30:26.356 synchronized these are.

NOTE Confidence: 0.786633272666667

00:30:26.360 --> 00:30:27.940 So the lighter your sleep,

NOTE Confidence: 0.786633272666667

00:30:27.940 --> 00:30:30.032 the more synchronized in

NOTE Confidence: 0.786633272666667

00:30:30.032 --> 00:30:32.124 time these signals are.

NOTE Confidence: 0.786633272666667

00:30:32.130 --> 00:30:33.850 And the deeper you sleep,

NOTE Confidence: 0.786633272666667

00:30:33.850 --> 00:30:34.729 the more apart.

NOTE Confidence: 0.786633272666667

00:30:34.729 --> 00:30:36.487 So it becomes a way to

NOTE Confidence: 0.786633272666667

00:30:36.487 --> 00:30:38.130 measure the integrated step,

NOTE Confidence: 0.786633272666667

00:30:38.130 --> 00:30:39.004 the integrated.

NOTE Confidence: 0.786633272666667

00:30:39.004 --> 00:30:42.063 A network behavior of sleep and if

NOTE Confidence: 0.786633272666667

00:30:42.063 --> 00:30:45.112 you spend all your night being in

NOTE Confidence: 0.786633272666667

00:30:45.112 --> 00:30:47.690 short range time delay stability,

NOTE Confidence: 0.786633272666667

00:30:47.690 --> 00:30:49.364 it means that you have these

NOTE Confidence: 0.786633272666667

00:30:49.364 --> 00:30:50.780 ongoing transients all night long,

NOTE Confidence: 0.786633272666667

00:30:50.780 --> 00:30:54.020 which of course would be a bad thing.

NOTE Confidence: 0.786633272666667

00:30:54.020 --> 00:31:00.847 OK. Why bother? Well, it turns out that.

NOTE Confidence: 0.786633272666667

00:31:00.850 --> 00:31:03.890 The Sleep network is dysfunctional

NOTE Confidence: 0.786633272666667

00:31:03.890 --> 00:31:06.462 in epilepsy, dementia, stroke,

NOTE Confidence: 0.786633272666667

00:31:06.462 --> 00:31:09.166 itel fibrillation, heart failure,

NOTE Confidence: 0.9415437

00:31:09.170 --> 00:31:11.550 neuromuscular disorders.

NOTE Confidence: 0.9415437

00:31:11.550 --> 00:31:12.694 Parkinson's disease?

NOTE Confidence: 0.9415437

00:31:12.694 --> 00:31:13.838 Disneya syndromes.

NOTE Confidence: 0.9415437

00:31:13.838 --> 00:31:16.936 That should be reason enough, right?

NOTE Confidence: 0.9415437

00:31:16.936 --> 00:31:18.352 But it turns out that a

NOTE Confidence: 0.9415437

00:31:18.352 --> 00:31:20.050 lot of our sleep disorders,

NOTE Confidence: 0.9415437

00:31:20.050 --> 00:31:21.796 things which bother us a lot,

NOTE Confidence: 0.9415437

00:31:21.800 --> 00:31:23.292 are classic network disorders.

NOTE Confidence: 0.9415437

00:31:23.292 --> 00:31:25.157 Insomnia is a network disorder.

NOTE Confidence: 0.9415437

00:31:25.160 --> 00:31:27.170 I think hypersomnia is also

NOTE Confidence: 0.9415437

00:31:27.170 --> 00:31:28.807 a network disorder. Now.

NOTE Confidence: 0.9415437

00:31:28.807 --> 00:31:31.796 Eclipse, of course, is a network disorder.

NOTE Confidence: 0.9415437

00:31:31.800 --> 00:31:34.000 Brain injury and sleep apnea

NOTE Confidence: 0.9415437

00:31:34.000 --> 00:31:36.200 certainly affects the white matter.

NOTE Confidence: 0.9415437

00:31:36.200 --> 00:31:38.517 So it should make the network weaker.

NOTE Confidence: 0.9415437

00:31:38.520 --> 00:31:40.818 Of course we have enormous resilience.

NOTE Confidence: 0.9415437

00:31:40.820 --> 00:31:42.308 We have lots of white matter

NOTE Confidence: 0.9415437

00:31:42.308 --> 00:31:43.300 and lots of redundancy,

NOTE Confidence: 0.9415437

00:31:43.300 --> 00:31:46.378 but still white matter injury is,

NOTE Confidence: 0.9415437

00:31:46.380 --> 00:31:47.262 you know,

NOTE Confidence: 0.9415437

00:31:47.262 --> 00:31:49.467 the most tightly linked brain

NOTE Confidence: 0.9415437

00:31:49.467 --> 00:31:51.330 pathology to sleep apnea.

NOTE Confidence: 0.858221985

00:31:53.780 --> 00:31:56.360 Just checking my time.

NOTE Confidence: 0.858221985

00:31:56.360 --> 00:31:58.208 So what can network Physiology do for

NOTE Confidence: 0.858221985

00:31:58.208 --> 00:31:59.779 sleep science and Sleep Medicine?

NOTE Confidence: 0.858221985

00:31:59.780 --> 00:32:00.828 If you think network,

NOTE Confidence: 0.858221985

00:32:00.828 --> 00:32:02.138 remember we only do network,

NOTE Confidence: 0.858221985

00:32:02.140 --> 00:32:05.130 but we don't think network.

NOTE Confidence: 0.858221985

00:32:05.130 --> 00:32:08.498 What is this glue of sleep which holds?

NOTE Confidence: 0.858221985

00:32:08.500 --> 00:32:10.984 Disparate oscillations and synchrony.

NOTE Confidence: 0.858221985

00:32:10.984 --> 00:32:14.242 You know, wakeful cognition has always

NOTE Confidence: 0.858221985

00:32:14.242 --> 00:32:17.634 had this, you know, binding problem.

NOTE Confidence: 0.858221985

00:32:17.634 --> 00:32:19.895 How does? Different parts of

NOTE Confidence: 0.858221985

00:32:19.895 --> 00:32:21.670 the brain hold things together.

NOTE Confidence: 0.858221985

00:32:21.670 --> 00:32:24.126 The gamma Oscillation is one of the binders,

NOTE Confidence: 0.858221985

00:32:24.130 --> 00:32:26.190 but. It's always been, uh,

NOTE Confidence: 0.858221985

00:32:26.190 --> 00:32:27.218 the issue of consciousness.

NOTE Confidence: 0.858221985

00:32:27.218 --> 00:32:31.038 When we are conscious, how do we bind?

NOTE Confidence: 0.858221985

00:32:31.040 --> 00:32:33.040 Brain information networks together.

NOTE Confidence: 0.858221985

00:32:33.040 --> 00:32:35.540 So let's flip to sleep.

NOTE Confidence: 0.858221985

00:32:35.540 --> 00:32:38.150 Clearly there is a glue of sleep which holds

NOTE Confidence: 0.858221985

00:32:38.150 --> 00:32:40.868 all these crazy oscillations and synchrony.

NOTE Confidence: 0.858221985

00:32:40.870 --> 00:32:43.182 So we have a binding problem in sleep

NOTE Confidence: 0.858221985

00:32:43.182 --> 00:32:45.819 and how does this inform consciousness?

NOTE Confidence: 0.858221985

00:32:45.820 --> 00:32:48.208 What is the minimum unit of

NOTE Confidence: 0.858221985

00:32:48.208 --> 00:32:49.800 sleep to perform function?

NOTE Confidence: 0.858221985

00:32:49.800 --> 00:32:51.310 There must be some universal

NOTE Confidence: 0.858221985

00:32:51.310 --> 00:32:52.820 law of tolerance of sleep,

NOTE Confidence: 0.858221985

00:32:52.820 --> 00:32:54.200 fragmentation and arousals.

NOTE Confidence: 0.858221985

00:32:54.200 --> 00:32:57.990 A few decades ago there was a paper.

NOTE Confidence: 0.858221985

00:32:57.990 --> 00:33:00.770 I think it's Mark Bonnet.

NOTE Confidence: 0.858221985

00:33:00.770 --> 00:33:03.194 Ohh, where they woke up healthy

NOTE Confidence: 0.858221985

00:33:03.194 --> 00:33:04.810 volunteers every so often,

NOTE Confidence: 0.858221985

00:33:04.810 --> 00:33:06.210 starting at once an hour,

NOTE Confidence: 0.858221985

00:33:06.210 --> 00:33:07.810 every half an hour, etcetera,

NOTE Confidence: 0.858221985

00:33:07.810 --> 00:33:09.466 to see the effect the next day on,

NOTE Confidence: 0.858221985

00:33:09.470 --> 00:33:10.610 I believe there were MSLT,

NOTE Confidence: 0.858221985

00:33:10.610 --> 00:33:13.966 so at least there was, you know,

NOTE Confidence: 0.858221985

00:33:13.966 --> 00:33:15.563 some measurement of alertness.

NOTE Confidence: 0.858221985

00:33:15.563 --> 00:33:17.081 So it turned out that once

NOTE Confidence: 0.858221985

00:33:17.081 --> 00:33:18.470 you came to 10 minutes,

NOTE Confidence: 0.858221985

00:33:18.470 --> 00:33:21.030 all hell broke loose at about 30 minutes.

NOTE Confidence: 0.858221985

00:33:21.030 --> 00:33:22.790 You had an irritated person,

NOTE Confidence: 0.858221985

00:33:22.790 --> 00:33:24.365 but their data and performance

NOTE Confidence: 0.858221985

00:33:24.365 --> 00:33:25.940 the next day was reasonable.

NOTE Confidence: 0.858221985

00:33:25.940 --> 00:33:28.500 So that's an example of trying to figure

NOTE Confidence: 0.858221985

00:33:28.500 --> 00:33:31.108 out what is the minimum unit of sleep.

NOTE Confidence: 0.858221985

00:33:31.110 --> 00:33:33.918 Has to be left alone to do his thing.

NOTE Confidence: 0.858221985

00:33:33.920 --> 00:33:35.492 And of course, how many such

NOTE Confidence: 0.858221985

00:33:35.492 --> 00:33:37.528 units do we need to string along?

NOTE Confidence: 0.858221985

00:33:37.530 --> 00:33:39.858 To figure out what is adequate

NOTE Confidence: 0.858221985

00:33:39.858 --> 00:33:41.022 sleep versus not,

NOTE Confidence: 0.858221985

00:33:41.030 --> 00:33:43.470 why are certain individuals

NOTE Confidence: 0.858221985

00:33:43.470 --> 00:33:45.300 incredibly fragmented sleep?

NOTE Confidence: 0.858221985

00:33:45.300 --> 00:33:48.330 Who seem asymptomatic and vice versa.

NOTE Confidence: 0.858221985

00:33:48.330 --> 00:33:50.448 Of sleep apnea is an example.

NOTE Confidence: 0.858221985

00:33:50.450 --> 00:33:52.076 All of you know that substantial

NOTE Confidence: 0.858221985

00:33:52.076 --> 00:33:53.650 minority of sleep apnea patients,

NOTE Confidence: 0.858221985

00:33:53.650 --> 00:33:57.298 especially in epidemiological studies.

NOTE Confidence: 0.858221985

00:33:57.298 --> 00:33:59.590 Really. They said they feel fine.

NOTE Confidence: 0.858221985

00:33:59.590 --> 00:34:00.421 Don't bother me.

NOTE Confidence: 0.858221985

00:34:00.421 --> 00:34:02.360 If they brought to the sleep link,

NOTE Confidence: 0.858221985

00:34:02.360 --> 00:34:04.466 they're sulking there while they're partners,

NOTE Confidence: 0.858221985

00:34:04.470 --> 00:34:06.280 you know?

NOTE Confidence: 0.858221985

00:34:06.280 --> 00:34:07.416 Snitching on them about

NOTE Confidence: 0.858221985

00:34:07.416 --> 00:34:09.120 snoring and gasping and so on.

NOTE Confidence: 0.858221985

00:34:09.120 --> 00:34:11.318 Do a sleep study. They look terrible.

NOTE Confidence: 0.858221985

00:34:11.320 --> 00:34:13.180 They say they feel fine.

NOTE Confidence: 0.858221985

00:34:13.180 --> 00:34:15.378 You convince them to somehow try CPAP.

NOTE Confidence: 0.858221985

00:34:15.380 --> 00:34:16.358 They're using it.

NOTE Confidence: 0.858221985

00:34:16.358 --> 00:34:17.988 They don't feel any different.

NOTE Confidence: 0.858221985

00:34:17.990 --> 00:34:20.880 How do you explain that?

NOTE Confidence: 0.858221985

00:34:20.880 --> 00:34:23.545 Can the disruption grade of

NOTE Confidence: 0.858221985

00:34:23.545 --> 00:34:25.619 pathology be quantified better

NOTE Confidence: 0.858221985

00:34:25.619 --> 00:34:28.184 than just counting arousals or

NOTE Confidence: 0.858221985

00:34:28.184 --> 00:34:30.150 counting brief transience?

NOTE Confidence: 0.858221985

00:34:30.150 --> 00:34:32.230 And is a kind of network map of

NOTE Confidence: 0.858221985

00:34:32.230 --> 00:34:34.048 sleep useful in clinical practice?

NOTE Confidence: 0.847463106

00:34:36.480 --> 00:34:38.710 Some examples of of course.

NOTE Confidence: 0.847463106

00:34:38.710 --> 00:34:41.298 You know breakdown syndromes?

NOTE Confidence: 0.847463106

00:34:41.300 --> 00:34:43.380 Heart failure? It will.

NOTE Confidence: 0.847463106

00:34:43.380 --> 00:34:45.580 Fibrillation, severe TBI treatment,

NOTE Confidence: 0.847463106

00:34:45.580 --> 00:34:46.700 resistant depression,

NOTE Confidence: 0.847463106

00:34:46.700 --> 00:34:47.956 mania, neurodegeneration.

NOTE Confidence: 0.847463106

00:34:47.956 --> 00:34:51.096 The Sleep network breaks down.

NOTE Confidence: 0.847463106

00:34:51.100 --> 00:34:52.388 There's no shortage of

NOTE Confidence: 0.847463106

00:34:52.388 --> 00:34:53.998 evidence that it breaks down.

NOTE Confidence: 0.847463106

00:34:54.000 --> 00:34:55.552 And the binding mechanisms

NOTE Confidence: 0.847463106

00:34:55.552 --> 00:34:57.104 like the slow oscillation,

NOTE Confidence: 0.847463106

00:34:57.110 --> 00:34:58.930 the cyclic alternating pattern,

NOTE Confidence: 0.847463106

00:34:58.930 --> 00:35:00.295 the PGO waves,

NOTE Confidence: 0.847463106

00:35:00.300 --> 00:35:01.880 these are all vulnerable as

NOTE Confidence: 0.847463106

00:35:01.880 --> 00:35:03.460 the brain starts breaking down.

NOTE Confidence: 0.847463106

00:35:03.460 --> 00:35:04.800 The worst degrees of sleep

NOTE Confidence: 0.847463106

00:35:04.800 --> 00:35:06.475 fragmentation we will see in the

NOTE Confidence: 0.847463106

00:35:06.475 --> 00:35:07.860 sleep clinic is heart failure.

NOTE Confidence: 0.847463106

00:35:07.860 --> 00:35:11.109 Parkinson's, it'll fibrillation.

NOTE Confidence: 0.847463106

00:35:11.110 --> 00:35:12.211 Probably the worst,

NOTE Confidence: 0.847463106

00:35:12.211 --> 00:35:13.679 and sometimes patients with

NOTE Confidence: 0.847463106

00:35:13.679 --> 00:35:15.228 irregular sleep wake cycle

NOTE Confidence: 0.847463106

00:35:15.228 --> 00:35:17.562 disorder or very severe kind of

NOTE Confidence: 0.847463106

00:35:17.562 --> 00:35:18.729 complex psychiatric comorbidities,

NOTE Confidence: 0.847463106

00:35:18.730 --> 00:35:21.670 PTSD plus psychosis and such.

NOTE Confidence: 0.847463106

00:35:21.670 --> 00:35:22.950 You can have incredibly fragmented

NOTE Confidence: 0.847463106

00:35:22.950 --> 00:35:24.490 sleep where they look like rats,

NOTE Confidence: 0.847463106

00:35:24.490 --> 00:35:25.778 and I'll show you a sample anyway.

NOTE Confidence: 0.79734390875

00:35:30.210 --> 00:35:32.079 Network breakdown so.

NOTE Confidence: 0.79734390875

00:35:32.079 --> 00:35:35.194 Look at the cortical level.

NOTE Confidence: 0.79734390875

00:35:35.200 --> 00:35:38.056 It's normally fairly resilient and redundant.

NOTE Confidence: 0.79734390875

00:35:38.060 --> 00:35:41.231 As an example, there is virtually no

NOTE Confidence: 0.79734390875

00:35:41.231 --> 00:35:44.359 description of loss of sleep with a whole

NOTE Confidence: 0.79734390875

00:35:44.359 --> 00:35:47.877 range of strokes of any kind of any severity.

NOTE Confidence: 0.79734390875

00:35:47.880 --> 00:35:50.230 And distribution.

NOTE Confidence: 0.79734390875

00:35:50.230 --> 00:35:51.710 Traumatic brain injury, of course,

NOTE Confidence: 0.79734390875

00:35:51.710 --> 00:35:53.930 badly affects the sleep network.

NOTE Confidence: 0.79734390875

00:35:53.930 --> 00:35:55.904 But a stroke is another good example

NOTE Confidence: 0.79734390875

00:35:55.904 --> 00:35:57.925 where the sleep network starts getting

NOTE Confidence: 0.79734390875

00:35:57.925 --> 00:35:59.790 unstable but does not disappear.

NOTE Confidence: 0.79734390875

00:35:59.790 --> 00:36:01.654 As almost Parkinson's epilepsy,

NOTE Confidence: 0.79734390875

00:36:01.654 --> 00:36:04.808 not your typical you know, average epilepsy.

NOTE Confidence: 0.79734390875

00:36:04.808 --> 00:36:07.671 But once you go to epilepsy needing

NOTE Confidence: 0.79734390875

00:36:07.671 --> 00:36:09.809 multidrug therapy treatment resistant

NOTE Confidence: 0.79734390875

00:36:09.809 --> 00:36:12.564 by whatever definition, thinking about,

NOTE Confidence: 0.79734390875

00:36:12.564 --> 00:36:15.846 you know, epilepsy surgery and such,

NOTE Confidence: 0.79734390875

00:36:15.850 --> 00:36:17.740 there's ample data there that sleep

NOTE Confidence: 0.79734390875

00:36:17.740 --> 00:36:20.370 is poor even by conventional metrics.

NOTE Confidence: 0.79734390875

00:36:20.370 --> 00:36:22.122 You know, in one and two, etcetera.

NOTE Confidence: 0.79734390875

00:36:22.122 --> 00:36:23.930 Sleep is more fragmented,

NOTE Confidence: 0.79734390875

00:36:23.930 --> 00:36:26.168 never mind going deeper into it.

NOTE Confidence: 0.79734390875

00:36:26.170 --> 00:36:27.698 The Thermo Cortical network

NOTE Confidence: 0.79734390875

00:36:27.698 --> 00:36:29.226 of course is disabled.

NOTE Confidence: 0.79734390875

00:36:29.230 --> 00:36:31.286 Terribly by fatal familial

NOTE Confidence: 0.79734390875

00:36:31.286 --> 00:36:33.856 insomnia and other prion disorders.

NOTE Confidence: 0.79734390875

00:36:33.860 --> 00:36:36.386 That immediate till I make stroke

NOTE Confidence: 0.79734390875

00:36:36.386 --> 00:36:39.320 has hypersomnia as a network output.

NOTE Confidence: 0.79734390875

00:36:39.320 --> 00:36:41.553 And of course, the tumors in the

NOTE Confidence: 0.79734390875

00:36:41.553 --> 00:36:43.360 area can disrupt sleep state.

NOTE Confidence: 0.79734390875

00:36:43.360 --> 00:36:44.865 The sleep Wake Transition Network

NOTE Confidence: 0.79734390875

00:36:44.865 --> 00:36:46.496 is an amazing network, isn't.

NOTE Confidence: 0.79734390875

00:36:46.496 --> 00:36:48.200 Just think of it.

NOTE Confidence: 0.79734390875

00:36:48.200 --> 00:36:50.400 We are moving from this.

NOTE Confidence: 0.79734390875

00:36:50.400 --> 00:36:50.966 You know,

NOTE Confidence: 0.79734390875

00:36:50.966 --> 00:36:53.230 hopefully most of us on this call are,

NOTE Confidence: 0.79734390875

00:36:53.230 --> 00:36:53.908 you know,

NOTE Confidence: 0.79734390875

00:36:53.908 --> 00:36:55.942 pretty good sleepers and we just

NOTE Confidence: 0.79734390875

00:36:55.942 --> 00:36:58.445 switch on the system and switch off

NOTE Confidence: 0.79734390875

00:36:58.445 --> 00:37:00.693 the system and these systems are

NOTE Confidence: 0.79734390875

00:37:00.693 --> 00:37:02.808 completely different and we make

NOTE Confidence: 0.79734390875

00:37:02.808 --> 00:37:04.890 this transition almost effortlessly.

NOTE Confidence: 0.736462111428571

00:37:07.120 --> 00:37:09.437 But those who don't make it effortlessly,

NOTE Confidence: 0.736462111428571

00:37:09.440 --> 00:37:12.770 of course, have insomnia with

NOTE Confidence: 0.736462111428571

00:37:12.770 --> 00:37:14.768 various driver mechanisms.

NOTE Confidence: 0.736462111428571

00:37:14.770 --> 00:37:15.910 Amygdala Bay syndrome.

NOTE Confidence: 0.736462111428571

00:37:15.910 --> 00:37:18.370 So anxiety, fear, PTSD makes the

NOTE Confidence: 0.736462111428571

00:37:18.370 --> 00:37:20.070 sleepy transition network unstable.

NOTE Confidence: 0.736462111428571

00:37:20.070 --> 00:37:21.045 Of course, pain and stress

NOTE Confidence: 0.736462111428571

00:37:21.045 --> 00:37:22.220 will do the same thing too.

NOTE Confidence: 0.761745166666667

00:37:25.500 --> 00:37:26.984 More on bad networks,

NOTE Confidence: 0.761745166666667

00:37:26.984 --> 00:37:28.839 the REM sleep network breakdown

NOTE Confidence: 0.761745166666667

00:37:28.839 --> 00:37:31.097 and the disorders you know well.

NOTE Confidence: 0.761745166666667

00:37:31.100 --> 00:37:34.138 Non REM sleep network and sleepwalking as

NOTE Confidence: 0.761745166666667

00:37:34.138 --> 00:37:36.886 well as depression, the arousal network.

NOTE Confidence: 0.761745166666667

00:37:36.886 --> 00:37:39.296 It's unstable inclined Levine syndrome

NOTE Confidence: 0.761745166666667

00:37:39.296 --> 00:37:42.518 and bipolar disease on a long on a long

NOTE Confidence: 0.761745166666667

00:37:42.518 --> 00:37:44.817 on an intermediate to long time scale.

NOTE Confidence: 0.761745166666667

00:37:44.820 --> 00:37:46.392 A hypoactive arousal network,

NOTE Confidence: 0.761745166666667

00:37:46.392 --> 00:37:48.938 of course, anesthesia, comma, etcetera.

NOTE Confidence: 0.761745166666667

00:37:48.938 --> 00:37:52.454 And hyperactive arousal network is seen

NOTE Confidence: 0.761745166666667

00:37:52.454 --> 00:37:57.150 in PTSD stress, abnormal respiration.

NOTE Confidence: 0.761745166666667

00:37:57.150 --> 00:37:58.878 So what are the consequences of

NOTE Confidence: 0.761745166666667

00:37:58.878 --> 00:38:00.508 the time of night distribution

NOTE Confidence: 0.761745166666667

00:38:00.508 --> 00:38:02.568 of the slow oscillation glue?

NOTE Confidence: 0.761745166666667

00:38:02.570 --> 00:38:04.794 Our network is more vulnerable later in the

NOTE Confidence: 0.761745166666667

00:38:04.794 --> 00:38:08.130 night than earlier in the night, clearly.

NOTE Confidence: 0.761745166666667

00:38:08.130 --> 00:38:09.234 Uh, and they're usability.

NOTE Confidence: 0.761745166666667

00:38:09.234 --> 00:38:12.418 You know, changes across the night.

NOTE Confidence: 0.761745166666667

00:38:12.420 --> 00:38:14.892 Successful insomnia treatment almost

NOTE Confidence: 0.761745166666667

00:38:14.892 --> 00:38:16.746 certainly improves effective.

NOTE Confidence: 0.761745166666667

00:38:16.750 --> 00:38:18.820 Glumness of the slow oscillation,

NOTE Confidence: 0.761745166666667

00:38:18.820 --> 00:38:21.870 although as far as I know this has not been

NOTE Confidence: 0.761745166666667

00:38:21.941 --> 00:38:26.480 explicitly studied and analyzed and computed.

NOTE Confidence: 0.761745166666667

00:38:26.480 --> 00:38:27.848 I've got sleep goes in cycles,

NOTE Confidence: 0.761745166666667

00:38:27.850 --> 00:38:29.957 so you have critical points of weakness

NOTE Confidence: 0.761745166666667

00:38:29.957 --> 00:38:31.369 occurring regularly across the night.

NOTE Confidence: 0.761745166666667

00:38:31.370 --> 00:38:32.810 We always have light periods,

NOTE Confidence: 0.761745166666667

00:38:32.810 --> 00:38:34.660 we always have unstable periods.

NOTE Confidence: 0.761745166666667

00:38:34.660 --> 00:38:36.920 We always have sleep cycles.

NOTE Confidence: 0.761745166666667

00:38:36.920 --> 00:38:39.596 So if you're a light sleeper,

NOTE Confidence: 0.761745166666667

00:38:39.600 --> 00:38:40.584 genetically predisposed

NOTE Confidence: 0.761745166666667

00:38:40.584 --> 00:38:43.044 to have not great glue.

NOTE Confidence: 0.761745166666667

00:38:43.050 --> 00:38:44.975 These critical points of weakness

NOTE Confidence: 0.761745166666667

00:38:44.975 --> 00:38:47.731 is where you have breakdown of the

NOTE Confidence: 0.761745166666667

00:38:47.731 --> 00:38:49.626 slow oscillation and this blueness.

NOTE Confidence: 0.761745166666667

00:38:49.630 --> 00:38:50.722 And of course,

NOTE Confidence: 0.761745166666667

00:38:50.722 --> 00:38:52.906 then you respond to stressors and

NOTE Confidence: 0.761745166666667

00:38:52.906 --> 00:38:54.270 environmental noise and so on.

NOTE Confidence: 0.761745166666667

00:38:54.270 --> 00:38:56.262 And of course the slow oscillation

NOTE Confidence: 0.761745166666667

00:38:56.262 --> 00:38:59.022 breaks down with a whole range of

NOTE Confidence: 0.761745166666667

00:38:59.022 --> 00:39:00.846 abnormal cortical health conditions.

NOTE Confidence: 0.761745166666667

00:39:00.850 --> 00:39:02.935 Almost certainly genetic factors are

NOTE Confidence: 0.761745166666667

00:39:02.935 --> 00:39:05.020 associated with sleep resilience and

NOTE Confidence: 0.761745166666667

00:39:05.080 --> 00:39:07.080 likely impact the slow oscillation.

NOTE Confidence: 0.761745166666667

00:39:07.080 --> 00:39:08.205 Uh, we don't.

NOTE Confidence: 0.761745166666667

00:39:08.205 --> 00:39:10.455 We don't have great individual genes.

NOTE Confidence: 0.761745166666667

00:39:10.460 --> 00:39:14.530 Um. At the individual level.

NOTE Confidence: 0.761745166666667

00:39:14.530 --> 00:39:17.008 But certainly at the jeevas level you

NOTE Confidence: 0.761745166666667

00:39:17.008 --> 00:39:19.298 have neiss an example which covaries

NOTE Confidence: 0.761745166666667

00:39:19.298 --> 00:39:21.970 with insomnia as well as the restless legs.

NOTE Confidence: 0.761745166666667

00:39:21.970 --> 00:39:24.538 That's probably not just by chance.

NOTE Confidence: 0.761745166666667

00:39:24.540 --> 00:39:26.140 And of course, in insomnia,

NOTE Confidence: 0.761745166666667

00:39:26.140 --> 00:39:27.072 pharmacotherapy is,

NOTE Confidence: 0.761745166666667

00:39:27.072 --> 00:39:28.921 from one view, illogical.

NOTE Confidence: 0.761745166666667

00:39:28.921 --> 00:39:31.627 You need the greatest help in

NOTE Confidence: 0.761745166666667

00:39:31.627 --> 00:39:33.830 the second-half of the night,

NOTE Confidence: 0.761745166666667

00:39:33.830 --> 00:39:36.168 when the slow oscillation is the weakest.

NOTE Confidence: 0.761745166666667

00:39:36.170 --> 00:39:36.767 But guess what?

NOTE Confidence: 0.761745166666667

00:39:36.767 --> 00:39:38.439 We get most of our help in the

NOTE Confidence: 0.761745166666667

00:39:38.439 --> 00:39:39.549 first half of the night.

NOTE Confidence: 0.761745166666667

00:39:39.550 --> 00:39:39.932 Of course,

NOTE Confidence: 0.761745166666667

00:39:39.932 --> 00:39:41.269 if a sleep onset problem is just

NOTE Confidence: 0.761745166666667

00:39:41.269 --> 00:39:42.229 a dominant problem,

NOTE Confidence: 0.761745166666667

00:39:42.230 --> 00:39:43.298 it's probably circadian.

NOTE Confidence: 0.779814194285714

00:39:45.800 --> 00:39:47.425 A quick word on respiratory

NOTE Confidence: 0.779814194285714

00:39:47.425 --> 00:39:48.075 network dysfunction.

NOTE Confidence: 0.779814194285714

00:39:48.080 --> 00:39:48.840 You know, all of this,

NOTE Confidence: 0.779814194285714

00:39:48.840 --> 00:39:49.956 I don't have to, you know,

NOTE Confidence: 0.779814194285714

00:39:49.960 --> 00:39:51.676 really go through any of these.

NOTE Confidence: 0.792110186666667

00:39:54.170 --> 00:39:56.410 OK. Sleep onset. Let's spend a few

NOTE Confidence: 0.792110186666667

00:39:56.410 --> 00:39:58.119 minutes talking about sleep onset,

NOTE Confidence: 0.792110186666667

00:39:58.120 --> 00:40:00.920 because it's a big deal for insomnia.

NOTE Confidence: 0.792110186666667

00:40:00.920 --> 00:40:05.410 For sleep apnea. For vigilance.

NOTE Confidence: 0.792110186666667

00:40:05.410 --> 00:40:07.559 This is probably the best single paper

NOTE Confidence: 0.792110186666667

00:40:07.559 --> 00:40:09.908 I come across looking at sleep onset.

NOTE Confidence: 0.792110186666667

00:40:09.910 --> 00:40:12.205 I don't know if Mike is on this call,

NOTE Confidence: 0.792110186666667

00:40:12.210 --> 00:40:16.342 but if he is shut out, it's a great paper.

NOTE Confidence: 0.792110186666667

00:40:16.342 --> 00:40:18.436 Really worthwhile reading.

NOTE Confidence: 0.792110186666667

00:40:18.440 --> 00:40:19.230 So essentially.

NOTE Confidence: 0.88802378375

00:40:21.240 --> 00:40:23.800 This is a very geeky kind of paper.

NOTE Confidence: 0.88802378375

00:40:23.800 --> 00:40:26.464 So you have this ball which you squeeze.

NOTE Confidence: 0.88802378375

00:40:26.470 --> 00:40:29.299 You're measuring respiration.

NOTE Confidence: 0.88802378375

00:40:29.299 --> 00:40:32.128 You're measuring the.

NOTE Confidence: 0.88802378375

00:40:32.130 --> 00:40:34.371 The long flexor?

NOTE Confidence: 0.88802378375

00:40:34.371 --> 00:40:37.359 The flexor historeum profundus.

NOTE Confidence: 0.88802378375

00:40:37.360 --> 00:40:39.568 You are. Tracking.

NOTE Confidence: 0.80185187

00:40:42.090 --> 00:40:45.724 Responses. This is a breathing.

NOTE Confidence: 0.80185187

00:40:45.724 --> 00:40:47.779 There's a, there's a metronome.

NOTE Confidence: 0.80185187

00:40:47.779 --> 00:40:49.138 Essentially you're breathing

NOTE Confidence: 0.80185187

00:40:49.138 --> 00:40:50.950 in relation to that.

NOTE Confidence: 0.80185187

00:40:50.950 --> 00:40:54.580 And you have the squeeze amplitudes.

NOTE Confidence: 0.80185187

00:40:54.580 --> 00:40:56.088 Dropping overtime as we

NOTE Confidence: 0.80185187

00:40:56.088 --> 00:40:57.219 transition into sleep.

NOTE Confidence: 0.80185187

00:40:57.220 --> 00:41:00.470 OK, so this is just. The base.

NOTE Confidence: 0.80185187

00:41:00.470 --> 00:41:03.585 And how they compute the squeeze amplitude,

NOTE Confidence: 0.80185187

00:41:03.590 --> 00:41:06.670 the alpha power, the Theta and delta power.

NOTE Confidence: 0.80185187

00:41:06.670 --> 00:41:09.124 Behavioral responses gone.

NOTE Confidence: 0.80185187

00:41:09.124 --> 00:41:11.578 Weak probability curves.

NOTE Confidence: 0.80185187

00:41:11.580 --> 00:41:13.260 And of course the ospital spectrogram.

NOTE Confidence: 0.80185187

00:41:13.260 --> 00:41:15.703 You see the alpha dying out and

NOTE Confidence: 0.80185187

00:41:15.703 --> 00:41:17.720 Theta and delta building up.

NOTE Confidence: 0.727139931

00:41:21.630 --> 00:41:23.145 Any further, you have response

NOTE Confidence: 0.727139931

00:41:23.145 --> 00:41:24.660 probability in the squeeze amplitude.

NOTE Confidence: 0.727139931

00:41:24.660 --> 00:41:26.565 Just another depiction of essentially

NOTE Confidence: 0.727139931

00:41:26.565 --> 00:41:28.700 the same thing. But just think,

NOTE Confidence: 0.727139931

00:41:28.700 --> 00:41:30.350 every time you're falling asleep,

NOTE Confidence: 0.727139931

00:41:30.350 --> 00:41:31.926 there's this whole book

NOTE Confidence: 0.727139931

00:41:31.926 --> 00:41:33.896 on sleep onset by Ogilvy.

NOTE Confidence: 0.727139931

00:41:33.900 --> 00:41:38.534 It's yo thick and really great reading.

NOTE Confidence: 0.727139931

00:41:38.540 --> 00:41:41.080 It's. At the end of my fellowship,

NOTE Confidence: 0.727139931

00:41:41.080 --> 00:41:43.060 so it's over 20 years old,

NOTE Confidence: 0.727139931

00:41:43.060 --> 00:41:45.337 but there's a lot of good data there listing

NOTE Confidence: 0.727139931

00:41:45.337 --> 00:41:47.354 all the different kinds of physiological

NOTE Confidence: 0.727139931

00:41:47.354 --> 00:41:49.440 changes which occur at sleep onset,

NOTE Confidence: 0.727139931

00:41:49.440 --> 00:41:51.750 evoke responses, and so on.

NOTE Confidence: 0.727139931

00:41:51.750 --> 00:41:53.934 So just think of the importance of

NOTE Confidence: 0.727139931

00:41:53.934 --> 00:41:56.196 sleep onset and the incredible network

NOTE Confidence: 0.727139931

00:41:56.196 --> 00:41:59.424 change which occurs during sleep onset,

NOTE Confidence: 0.727139931

00:41:59.430 --> 00:42:01.761 respiration, EG behaviors.

NOTE Confidence: 0.727139931

00:42:01.761 --> 00:42:05.646 And even in the brain.

NOTE Confidence: 0.727139931

00:42:05.650 --> 00:42:07.998 Multi level changes which occur and

NOTE Confidence: 0.727139931

00:42:07.998 --> 00:42:09.662 we have to navigate this and we do

NOTE Confidence: 0.727139931

00:42:09.662 --> 00:42:11.369 this effortlessly most of the time,

NOTE Confidence: 0.727139931

00:42:11.370 --> 00:42:12.828 unless of course you have insomnia

NOTE Confidence: 0.727139931

00:42:12.828 --> 00:42:14.070 and heart failure and such.

NOTE Confidence: 0.727139931

00:42:14.070 --> 00:42:17.798 Then of course the sleep onset has to.

NOTE Confidence: 0.727139931

00:42:17.800 --> 00:42:21.216 You have to redo your sleep onset

NOTE Confidence: 0.727139931

00:42:21.220 --> 00:42:24.016 multiple multiple times across the night.

NOTE Confidence: 0.727139931

00:42:24.020 --> 00:42:26.040 Obviously that will be hostile,

NOTE Confidence: 0.727139931

00:42:26.040 --> 00:42:27.965 and blood pressure of course

NOTE Confidence: 0.727139931

00:42:27.965 --> 00:42:30.800 fluctuates up and down and rises if

NOTE Confidence: 0.727139931

00:42:30.800 --> 00:42:32.900 you keep having these transients.

NOTE Confidence: 0.727139931

00:42:32.900 --> 00:42:34.795 Now what's the clinical equivalent

NOTE Confidence: 0.727139931

00:42:34.795 --> 00:42:36.690 of that what I call?

NOTE Confidence: 0.727139931

00:42:36.690 --> 00:42:39.010 Of state amplified wake sleep,

NOTE Confidence: 0.727139931

00:42:39.010 --> 00:42:39.620 transitional instability.

NOTE Confidence: 0.727139931

00:42:39.620 --> 00:42:43.394 If you have a better acronym, send it to me.

NOTE Confidence: 0.727139931

00:42:43.394 --> 00:42:46.310 So this is a 10 minute.

NOTE Confidence: 0.727139931

00:42:46.310 --> 00:42:48.840 Yes, a 10 minute snapshot.

NOTE Confidence: 0.727139931

00:42:48.840 --> 00:42:52.296 And technically scored mostly as weak.

NOTE Confidence: 0.727139931

00:42:52.300 --> 00:42:53.833 I hope I don't have to convince

NOTE Confidence: 0.727139931

00:42:53.833 --> 00:42:55.558 you that this is serious pathology,

NOTE Confidence: 0.727139931

00:42:55.560 --> 00:42:57.210 where you have central apneas,

NOTE Confidence: 0.727139931

00:42:57.210 --> 00:42:59.807 you have some periodical movements and such.

NOTE Confidence: 0.727139931

00:42:59.810 --> 00:43:02.438 This is another example of amplified

NOTE Confidence: 0.727139931

00:43:02.438 --> 00:43:04.190 wake sleep transitional instability.

NOTE Confidence: 0.727139931

00:43:04.190 --> 00:43:05.570 The conventional scoring may

NOTE Confidence: 0.727139931

00:43:05.570 --> 00:43:07.295 exclude a lot of this.

NOTE Confidence: 0.727139931

00:43:07.300 --> 00:43:08.254 Don't do that,

NOTE Confidence: 0.727139931

00:43:08.254 --> 00:43:09.844 because this is clearly very

NOTE Confidence: 0.727139931

00:43:09.844 --> 00:43:11.610 pathological and these patients will

NOTE Confidence: 0.727139931

00:43:11.610 --> 00:43:13.400 always complain of onset insomnia,

NOTE Confidence: 0.727139931

00:43:13.400 --> 00:43:15.116 at least a lot of insomnia.

NOTE Confidence: 0.727139931

00:43:15.120 --> 00:43:17.976 And of course it's more common with heart

NOTE Confidence: 0.727139931

00:43:17.976 --> 00:43:20.650 failure and it'll fibrillation and such.

NOTE Confidence: 0.727139931

00:43:20.650 --> 00:43:24.716 So. Some examples of interesting

NOTE Confidence: 0.727139931

00:43:24.716 --> 00:43:26.708 coupling and networking.

NOTE Confidence: 0.727139931

00:43:26.710 --> 00:43:30.448 Of various physiologies which you see.

NOTE Confidence: 0.727139931

00:43:30.450 --> 00:43:32.448 So periodically movements

NOTE Confidence: 0.727139931

00:43:32.448 --> 00:43:34.446 these are alternating.

NOTE Confidence: 0.727139931

00:43:34.450 --> 00:43:36.510 And.

NOTE Confidence: 0.727139931

00:43:36.510 --> 00:43:38.985 One lot is roughly synchronizing

NOTE Confidence: 0.727139931

00:43:38.985 --> 00:43:40.965 with the respiratory recovery,

NOTE Confidence: 0.727139931

00:43:40.970 --> 00:43:42.870 it seems, but apparently it's

NOTE Confidence: 0.727139931

00:43:42.870 --> 00:43:44.770 just following his own rhythm.

NOTE Confidence: 0.727139931

00:43:44.770 --> 00:43:46.361 Now here it is in the center, respiration.

NOTE Confidence: 0.727139931

00:43:46.361 --> 00:43:47.143 Here it's.

NOTE Confidence: 0.727139931

00:43:47.143 --> 00:43:49.880 You know in the middle of it,

NOTE Confidence: 0.727139931

00:43:49.880 --> 00:43:52.840 while these less frequently

NOTE Confidence: 0.727139931

00:43:52.840 --> 00:43:55.370 occurring periodically movements are

NOTE Confidence: 0.727139931

00:43:55.370 --> 00:43:57.540 right in the middle of the event.

NOTE Confidence: 0.727139931

00:43:57.540 --> 00:44:01.338 So. There is variable coupling.

NOTE Confidence: 0.727139931

00:44:01.338 --> 00:44:04.650 And and sleep is basically slow wave sleep,

NOTE Confidence: 0.727139931

00:44:04.650 --> 00:44:09.069 so each one is pretty much doing his thing.

NOTE Confidence: 0.727139931

00:44:09.070 --> 00:44:10.360 Without really caring too much

NOTE Confidence: 0.727139931

00:44:10.360 --> 00:44:11.392 what the others do.

NOTE Confidence: 0.727139931

00:44:11.400 --> 00:44:12.950 Now there are some fundamental

NOTE Confidence: 0.727139931

00:44:12.950 --> 00:44:14.858 frequencies in sleep which occur and

NOTE Confidence: 0.727139931

00:44:14.858 --> 00:44:17.230 they are expecting that, but overall.

NOTE Confidence: 0.727139931

00:44:17.230 --> 00:44:19.408 The various networks now, uh,

NOTE Confidence: 0.727139931

00:44:19.408 --> 00:44:20.600 you know, somewhat uncoupled.

NOTE Confidence: 0.7261354

00:44:22.700 --> 00:44:24.455 Thinking more about the respiratory

NOTE Confidence: 0.7261354

00:44:24.455 --> 00:44:27.580 motor complex, so here you have.

NOTE Confidence: 0.7261354

00:44:27.580 --> 00:44:28.740 Well, these are not typical

NOTE Confidence: 0.7261354

00:44:28.740 --> 00:44:29.436 periodic limb movements.

NOTE Confidence: 0.7261354

00:44:29.440 --> 00:44:31.650 You will agree. These are.

NOTE Confidence: 0.83871607

00:44:34.400 --> 00:44:38.285 We are having these clusters of limb

NOTE Confidence: 0.83871607

00:44:38.285 --> 00:44:39.950 movements occurring periodically.

NOTE Confidence: 0.83871607

00:44:39.950 --> 00:44:42.270 With the right periodic sequence,

NOTE Confidence: 0.83871607

00:44:42.270 --> 00:44:44.552 except that it's clusters and when you

NOTE Confidence: 0.83871607

00:44:44.552 --> 00:44:47.287 go and take a close look you see that.

NOTE Confidence: 0.83871607

00:44:47.290 --> 00:44:49.918 This oscillatory there's reverberatory

NOTE Confidence: 0.83871607

00:44:49.918 --> 00:44:51.889 interaction between respiratory

NOTE Confidence: 0.83871607

00:44:51.889 --> 00:44:55.568 output and the motor systems output.

NOTE Confidence: 0.83871607

00:44:55.570 --> 00:44:58.558 Is alternating too.

NOTE Confidence: 0.83871607

00:44:58.560 --> 00:44:59.988 Of course, you have huge arousal here.

NOTE Confidence: 0.83871607

00:44:59.990 --> 00:45:00.980 Isn't that fascinating?

NOTE Confidence: 0.86599016

00:45:04.630 --> 00:45:06.050 What drives and what follows

NOTE Confidence: 0.86599016

00:45:06.050 --> 00:45:07.470 is a never ending question.

NOTE Confidence: 0.86599016

00:45:07.470 --> 00:45:09.870 And when someone has periodical

NOTE Confidence: 0.86599016

00:45:09.870 --> 00:45:12.050 movements and has apnea here,

NOTE Confidence: 0.86599016

00:45:12.050 --> 00:45:13.090 it looks like well,

NOTE Confidence: 0.86599016

00:45:13.090 --> 00:45:17.090 maybe the respiration is driving.

NOTE Confidence: 0.86599016

00:45:17.090 --> 00:45:19.340 The periodic elements.

NOTE Confidence: 0.86599016

00:45:19.340 --> 00:45:21.380 The same person slightly later,

NOTE Confidence: 0.86599016

00:45:21.380 --> 00:45:23.520 where the limb movements are

NOTE Confidence: 0.86599016

00:45:23.520 --> 00:45:25.232 occurring with the recovery

NOTE Confidence: 0.86599016

00:45:25.232 --> 00:45:27.496 breath in the middle of an apnea.

NOTE Confidence: 0.86599016

00:45:27.500 --> 00:45:28.490 It's doing his own thing.

NOTE Confidence: 0.795110864444444

00:45:31.370 --> 00:45:33.656 This is an example of dumb

NOTE Confidence: 0.795110864444444

00:45:33.656 --> 00:45:34.799 periodic limb movements.

NOTE Confidence: 0.795110864444444

00:45:34.800 --> 00:45:36.648 And now you have not done

NOTE Confidence: 0.795110864444444

00:45:36.648 --> 00:45:37.572 periodic limb movements.

NOTE Confidence: 0.795110864444444

00:45:37.580 --> 00:45:38.716 This is blood pressure.

NOTE Confidence: 0.795110864444444

00:45:38.716 --> 00:45:40.420 You know here is blood pressure.

NOTE Confidence: 0.795110864444444

00:45:40.420 --> 00:45:42.556 So you have repeated surges of

NOTE Confidence: 0.795110864444444

00:45:42.556 --> 00:45:43.980 blood pressure occurring with

NOTE Confidence: 0.795110864444444

00:45:44.045 --> 00:45:45.589 every single leg movement.

NOTE Confidence: 0.795110864444444

00:45:45.590 --> 00:45:47.202 This is not dumb.

NOTE Confidence: 0.795110864444444

00:45:47.202 --> 00:45:48.008 Periodically movements

NOTE Confidence: 0.795110864444444

00:45:48.008 --> 00:45:50.448 and a great example of a

NOTE Confidence: 0.795110864444444

00:45:50.448 --> 00:45:51.770 pathological sleep network.

NOTE Confidence: 0.786337627894737

00:45:57.210 --> 00:46:00.332 You can. Now there is some scoring

NOTE Confidence: 0.786337627894737

00:46:00.332 --> 00:46:03.050 guidelines say nothing about the chin

NOTE Confidence: 0.786337627894737

00:46:03.050 --> 00:46:05.654 EMG during non REM sleep basically.

NOTE Confidence: 0.786337627894737

00:46:05.660 --> 00:46:07.994 Yeah, it may be low, you know,

NOTE Confidence: 0.786337627894737

00:46:07.994 --> 00:46:09.879 but there's an enormous amount

NOTE Confidence: 0.786337627894737

00:46:09.879 --> 00:46:11.918 of information in the chin EMG.

NOTE Confidence: 0.786337627894737

00:46:11.920 --> 00:46:14.762 You can see how this coupling between

NOTE Confidence: 0.786337627894737

00:46:14.762 --> 00:46:17.119 cortical transients and chin transients,

NOTE Confidence: 0.786337627894737

00:46:17.120 --> 00:46:19.760 cortical chin, cortical chin cortical thin,

NOTE Confidence: 0.786337627894737

00:46:19.760 --> 00:46:22.124 and you can extract the quality

NOTE Confidence: 0.786337627894737

00:46:22.124 --> 00:46:24.540 of sleep by EMG analysis.

NOTE Confidence: 0.786337627894737

00:46:24.540 --> 00:46:26.670 I'm sure not done it yet.

NOTE Confidence: 0.786337627894737

00:46:26.670 --> 00:46:27.123 Hopefully.

NOTE Confidence: 0.786337627894737

00:46:27.123 --> 00:46:29.388 Hopefully you can another example

NOTE Confidence: 0.786337627894737

00:46:29.388 --> 00:46:31.728 of cortical motor network connection

NOTE Confidence: 0.786337627894737

00:46:31.728 --> 00:46:34.368 while breathing is reasonably good.

NOTE Confidence: 0.786337627894737

00:46:34.370 --> 00:46:35.470 Breathing is reasonably good,

NOTE Confidence: 0.786337627894737

00:46:35.470 --> 00:46:37.120 but all hell is breaking loose

NOTE Confidence: 0.786337627894737

00:46:37.168 --> 00:46:38.590 when it comes to sleep quality.

NOTE Confidence: 0.786337627894737

00:46:38.590 --> 00:46:40.627 So now you have a dissociation of.

NOTE Confidence: 0.786337627894737

00:46:40.630 --> 00:46:42.304 So the cortical motor system is

NOTE Confidence: 0.786337627894737

00:46:42.304 --> 00:46:44.368 doing its thing in a different way,

NOTE Confidence: 0.786337627894737

00:46:44.370 --> 00:46:46.526 while respiration says I don't really care,

NOTE Confidence: 0.786337627894737

00:46:46.530 --> 00:46:47.978 I'm going to do my own little thing.

NOTE Confidence: 0.65671418

00:46:50.070 --> 00:46:52.058 This person is on a postulator pressure.

NOTE Confidence: 0.91832468

00:46:54.590 --> 00:46:57.038 On the left, you have network

NOTE Confidence: 0.91832468

00:46:57.038 --> 00:46:59.538 success where you have good

NOTE Confidence: 0.91832468

00:46:59.538 --> 00:47:01.452 behavior while there's some R.E.M,

NOTE Confidence: 0.91832468

00:47:01.452 --> 00:47:02.686 dominant apnea, etcetera.

NOTE Confidence: 0.91832468

00:47:02.686 --> 00:47:06.438 On the right, you have network failure.

NOTE Confidence: 0.91832468

00:47:06.440 --> 00:47:08.939 This looks like a poorly sleeping rat.

NOTE Confidence: 0.91832468

00:47:08.940 --> 00:47:12.360 Not only a good rat, but a poor rat.

NOTE Confidence: 0.91832468

00:47:12.360 --> 00:47:15.002 And below. Essentially the same

NOTE Confidence: 0.91832468

00:47:15.002 --> 00:47:16.898 person getting a titration.

NOTE Confidence: 0.91832468

00:47:16.900 --> 00:47:19.636 Another night and sleep remains very,

NOTE Confidence: 0.91832468

00:47:19.640 --> 00:47:22.220 very poor. It's a network failure.

NOTE Confidence: 0.8181226625

00:47:25.660 --> 00:47:28.860 Let's see. OK, just do three more minutes.

NOTE Confidence: 0.8181226625

00:47:28.860 --> 00:47:32.560 So. Once you start thinking network,

NOTE Confidence: 0.8181226625

00:47:32.560 --> 00:47:34.996 you start seeing a lot of really

NOTE Confidence: 0.8181226625

00:47:34.996 --> 00:47:36.720 interesting kind of features.

NOTE Confidence: 0.8181226625

00:47:36.720 --> 00:47:38.655 So this is a hypnogram

NOTE Confidence: 0.8181226625

00:47:38.655 --> 00:47:40.590 from the home sleep study.

NOTE Confidence: 0.8181226625

00:47:40.590 --> 00:47:45.330 Showing craziness of the heart rate, right?

NOTE Confidence: 0.8181226625

00:47:45.330 --> 00:47:47.090 Going down and then OK,

NOTE Confidence: 0.8181226625

00:47:47.090 --> 00:47:48.258 then down and OK.

NOTE Confidence: 0.8181226625

00:47:48.258 --> 00:47:50.010 And there is some respiratory stuff,

NOTE Confidence: 0.8181226625

00:47:50.010 --> 00:47:53.226 there's some you know oxygenation stuff,

NOTE Confidence: 0.8181226625

00:47:53.230 --> 00:47:55.246 some snoring now take a close up look.

NOTE Confidence: 0.84789922

00:47:57.370 --> 00:48:00.500 So you have stable breathing.

NOTE Confidence: 0.84789922

00:48:00.500 --> 00:48:02.030 Sorry, stable breathing,

NOTE Confidence: 0.84789922

00:48:02.030 --> 00:48:05.600 a little bit of snore and the

NOTE Confidence: 0.84789922

00:48:05.701 --> 00:48:08.157 plate signal behaves well.

NOTE Confidence: 0.84789922

00:48:08.160 --> 00:48:11.319 You have on the other end on the right.

NOTE Confidence: 0.84789922

00:48:11.320 --> 00:48:13.700 You have abnormal respiration.

NOTE Confidence: 0.84789922

00:48:13.700 --> 00:48:18.010 And you have bradycardia return to normal,

NOTE Confidence: 0.84789922

00:48:18.010 --> 00:48:19.318 bradycardia return to normal.

NOTE Confidence: 0.84789922

00:48:19.318 --> 00:48:21.854 And I just put a line around

NOTE Confidence: 0.84789922

00:48:21.854 --> 00:48:23.858 the respiratory recovery starts.

NOTE Confidence: 0.84789922

00:48:23.860 --> 00:48:26.059 It's not synchronized.

NOTE Confidence: 0.84789922

00:48:26.060 --> 00:48:29.630 However, when state is stable.

NOTE Confidence: 0.84789922

00:48:29.630 --> 00:48:32.528 This cardiac arrhythmia is not occurring.

NOTE Confidence: 0.84789922

00:48:32.530 --> 00:48:34.200 So it is not entrained,

NOTE Confidence: 0.84789922

00:48:34.200 --> 00:48:36.084 but perhaps stable,

NOTE Confidence: 0.84789922

00:48:36.084 --> 00:48:38.498 unstable sleep networks enable.

NOTE Confidence: 0.84789922

00:48:38.498 --> 00:48:41.138 Certain pathologies to come through.

NOTE Confidence: 0.84789922

00:48:41.140 --> 00:48:43.135 So this is a transition where breathing

NOTE Confidence: 0.84789922

00:48:43.135 --> 00:48:45.257 is starting to look a little unstable.

NOTE Confidence: 0.84789922

00:48:45.260 --> 00:48:47.036 A little bit of snoring coming

NOTE Confidence: 0.84789922

00:48:47.036 --> 00:48:49.765 in and you can start seeing this

NOTE Confidence: 0.84789922

00:48:49.765 --> 00:48:51.470 intermittent bradyarrhythmia coming.

NOTE Confidence: 0.621259128

00:48:53.920 --> 00:48:55.810 You do better than hypersomnia.

NOTE Confidence: 0.621259128

00:48:55.810 --> 00:48:58.987 Can be thought of as a network of failure.

NOTE Confidence: 0.621259128

00:48:58.990 --> 00:49:00.526 We got to get up in the morning.

NOTE Confidence: 0.621259128

00:49:00.530 --> 00:49:02.679 We need a wake network to take

NOTE Confidence: 0.621259128

00:49:02.679 --> 00:49:04.616 over as an example of a patient

NOTE Confidence: 0.621259128

00:49:04.616 --> 00:49:05.910 who keeps sleeping, sleeping,

NOTE Confidence: 0.621259128

00:49:05.910 --> 00:49:07.830 sleeping, not very fragmented.

NOTE Confidence: 0.621259128

00:49:07.830 --> 00:49:09.288 This one is much more sleep,

NOTE Confidence: 0.621259128

00:49:09.290 --> 00:49:10.595 sleeping, sleeping, sleeping.

NOTE Confidence: 0.621259128

00:49:10.595 --> 00:49:12.770 But it's very fragmented and

NOTE Confidence: 0.621259128

00:49:12.770 --> 00:49:16.390 sleeps I think 22 hours, 22 hours.

NOTE Confidence: 0.84176378

00:49:18.980 --> 00:49:22.900 So it's a speculative hypothesis, but.

NOTE Confidence: 0.84176378

00:49:22.900 --> 00:49:24.436 Perhaps hypersomnia can be

NOTE Confidence: 0.84176378

00:49:24.436 --> 00:49:26.740 considered a failure of a switch

NOTE Confidence: 0.84176378

00:49:26.813 --> 00:49:28.895 from the sleep to awake network.

NOTE Confidence: 0.15332344

00:49:33.390 --> 00:49:38.020 Uh. I should probably stop here.

NOTE Confidence: 0.8745208

00:49:43.070 --> 00:49:45.972 So. Stabilizing networks

NOTE Confidence: 0.8745208

00:49:45.972 --> 00:49:47.756 to target sleep disorders.

NOTE Confidence: 0.8745208

00:49:47.760 --> 00:49:48.750 We do it all the time.

NOTE Confidence: 0.8745208

00:49:48.750 --> 00:49:49.620 Here are examples.

NOTE Confidence: 0.8745208

00:49:49.620 --> 00:49:50.780 We don't think network,

NOTE Confidence: 0.8745208

00:49:50.780 --> 00:49:52.607 but we're doing it all the time.

NOTE Confidence: 0.8745208

00:49:52.610 --> 00:49:54.353 Successful sleep treatment

NOTE Confidence: 0.8745208

00:49:54.353 --> 00:49:56.677 of any kind requires.

NOTE Confidence: 0.8745208

00:49:56.680 --> 00:49:58.699 Stabilizing sleep networks.

NOTE Confidence: 0.875279911

00:50:00.740 --> 00:50:03.780 And I think I will stop with that if there's

NOTE Confidence: 0.875279911

00:50:03.780 --> 00:50:05.960 you know if there's some time I can go back

NOTE Confidence: 0.875279911

00:50:06.017 --> 00:50:07.997 and show you cardio pulmonary coupling,

NOTE Confidence: 0.875279911

00:50:08.000 --> 00:50:10.184 how it can be used to track network

NOTE Confidence: 0.875279911

00:50:10.184 --> 00:50:11.820 stability in an ambulatory way,

NOTE Confidence: 0.875279911

00:50:11.820 --> 00:50:14.116 but it's not necessary to make my point.

NOTE Confidence: 0.875279911

00:50:14.120 --> 00:50:16.129 So in summary, sleep is a unique

NOTE Confidence: 0.875279911

00:50:16.129 --> 00:50:18.180 network state, it's multi Physiology,

NOTE Confidence: 0.875279911

00:50:18.180 --> 00:50:21.120 it has multiple dimensions including time,

NOTE Confidence: 0.875279911

00:50:21.120 --> 00:50:22.084 it's dynamic,

NOTE Confidence: 0.875279911

00:50:22.084 --> 00:50:24.494 it's morphing the phase transitions,

NOTE Confidence: 0.875279911

00:50:24.500 --> 00:50:26.284 predictable changes in disease,

NOTE Confidence: 0.875279911

00:50:26.284 --> 00:50:28.068 predictable effects of treatment

NOTE Confidence: 0.875279911

00:50:28.068 --> 00:50:29.960 which works or doesn't work.

NOTE Confidence: 0.875279911

00:50:29.960 --> 00:50:32.438 And network analysis is severely underused.

NOTE Confidence: 0.875279911

00:50:32.440 --> 00:50:34.088 And sleep research and

NOTE Confidence: 0.875279911

00:50:34.088 --> 00:50:35.736 nonexistent and sleep practice.

NOTE Confidence: 0.875279911

00:50:35.740 --> 00:50:38.848 Network science is alive and well.

NOTE Confidence: 0.875279911

00:50:38.850 --> 00:50:39.546 There are.

NOTE Confidence: 0.875279911

00:50:39.546 --> 00:50:41.982 In so many different metrics which can

NOTE Confidence: 0.875279911

00:50:41.982 --> 00:50:44.302 be generated and potentially useful

NOTE Confidence: 0.875279911

00:50:44.302 --> 00:50:47.152 and track disease and quantify beyond.

NOTE Confidence: 0.875279911

00:50:47.160 --> 00:50:49.239 You know we keep talking beyond the

NOTE Confidence: 0.875279911

00:50:49.239 --> 00:50:51.718 HI beyond the HI yeah this is one of

NOTE Confidence: 0.875279911

00:50:51.718 --> 00:50:53.875 those beyond the HI kinds of things

NOTE Confidence: 0.875279911

00:50:53.875 --> 00:50:56.017 which almost certainly can be useful.

NOTE Confidence: 0.875279911

00:50:56.020 --> 00:50:58.555 A call out for frontiers

NOTE Confidence: 0.875279911

00:50:58.555 --> 00:51:00.076 and network Physiology.

NOTE Confidence: 0.875279911

00:51:00.080 --> 00:51:02.198 It's a new subsection of frontiers.

NOTE Confidence: 0.875279911

00:51:02.200 --> 00:51:04.810 The new journal within Frontiers

NOTE Confidence: 0.875279911

00:51:04.810 --> 00:51:09.276 and Ivanov is the. Is the edit.

NOTE Confidence: 0.875279911

00:51:09.276 --> 00:51:11.586 El France chief overall editor.

NOTE Confidence: 0.875279911

00:51:11.590 --> 00:51:13.480 It has a section on sleep

NOTE Confidence: 0.875279911

00:51:13.480 --> 00:51:14.425 and circadian systems,

NOTE Confidence: 0.875279911

00:51:14.430 --> 00:51:16.986 networks and sleep and circadian systems.

NOTE Confidence: 0.875279911

00:51:16.990 --> 00:51:17.923 And you know,

NOTE Confidence: 0.875279911

00:51:17.923 --> 00:51:20.100 if you have a network key kinds

NOTE Confidence: 0.875279911

00:51:20.174 --> 00:51:22.250 of things you like to publish,

NOTE Confidence: 0.875279911

00:51:22.250 --> 00:51:24.710 we are open and happy.

NOTE Confidence: 0.875279911

00:51:24.710 --> 00:51:27.914 I don't know if Flammen is on this call.

NOTE Confidence: 0.875279911

00:51:27.920 --> 00:51:29.420 I hope he could join,

NOTE Confidence: 0.875279911

00:51:29.420 --> 00:51:32.828 but we're very excited about the

NOTE Confidence: 0.875279911

00:51:32.828 --> 00:51:35.344 potential of rapid translation.

NOTE Confidence: 0.875279911

00:51:35.344 --> 00:51:38.940 Uh, not just uh, you know,

NOTE Confidence: 0.875279911

00:51:38.940 --> 00:51:40.440 interesting theoretical physics,

NOTE Confidence: 0.875279911

00:51:40.440 --> 00:51:42.128 see kind of papers,

NOTE Confidence: 0.875279911

00:51:42.128 --> 00:51:44.238 but really trying to better

NOTE Confidence: 0.875279911

00:51:44.238 --> 00:51:46.004 understand disease and tracking

NOTE Confidence: 0.875279911

00:51:46.004 --> 00:51:47.796 and pathophysiology by looking

NOTE Confidence: 0.875279911

00:51:47.796 --> 00:51:50.322 at multi system integration and

NOTE Confidence: 0.875279911

00:51:50.322 --> 00:51:52.200 breakdown in the sleep state.

NOTE Confidence: 0.875279911

00:51:52.200 --> 00:51:55.113 So with that I shall stop and happy

NOTE Confidence: 0.875279911

00:51:55.113 --> 00:51:57.693 to take questions and similar things.

NOTE Confidence: 0.875279911

00:51:57.700 --> 00:51:58.080 Thank you.

NOTE Confidence: 0.865498784444445

00:51:59.770 --> 00:52:02.170 Great. Well, thank you very much

NOTE Confidence: 0.865498784444445

00:52:02.170 --> 00:52:05.442 Robert for this tour, tour of the.

NOTE Confidence: 0.865498784444445

00:52:05.442 --> 00:52:06.964 Sure. Of the sleep network.

NOTE Confidence: 0.865498784444445

00:52:06.964 --> 00:52:08.470 So I will moderate the questions

NOTE Confidence: 0.865498784444445

00:52:08.522 --> 00:52:09.637 that you guys have them,

NOTE Confidence: 0.865498784444445

00:52:09.640 --> 00:52:10.840 please put them in the chat

NOTE Confidence: 0.865498784444445

00:52:10.840 --> 00:52:12.210 and if you have a question,

NOTE Confidence: 0.865498784444445

00:52:12.210 --> 00:52:15.072 just raise your hand and I will unmute you.

NOTE Confidence: 0.865498784444445

00:52:15.080 --> 00:52:16.950 So that you can go ahead and and do that.

NOTE Confidence: 0.865498784444445

00:52:16.950 --> 00:52:18.756 And so it looks like Mayor Krieger,

NOTE Confidence: 0.865498784444445

00:52:18.760 --> 00:52:19.472 you have a question.

NOTE Confidence: 0.865498784444445

00:52:19.472 --> 00:52:20.006 Go ahead Mayor

NOTE Confidence: 0.827144099166667

00:52:20.820 --> 00:52:24.428 Robert, I didn't see oxygen on your slide

NOTE Confidence: 0.827144099166667

00:52:24.428 --> 00:52:27.800 where you talked about potential therapies

NOTE Confidence: 0.827144099166667

00:52:27.800 --> 00:52:30.818 for some of these network problems.

NOTE Confidence: 0.827144099166667

00:52:30.820 --> 00:52:33.392 I found in Canada was it was easy

NOTE Confidence: 0.827144099166667

00:52:33.392 --> 00:52:35.829 to order oxygen for heart failure.

NOTE Confidence: 0.827144099166667

00:52:35.830 --> 00:52:40.900 And some of the patients did incredibly well.

NOTE Confidence: 0.827144099166667

00:52:40.900 --> 00:52:42.115 That is true.

NOTE Confidence: 0.827144099166667

00:52:42.115 --> 00:52:44.140 Oxygen definitely should be there.

NOTE Confidence: 0.827144099166667

00:52:44.140 --> 00:52:47.479 In fact, one of my earliest oxygen

NOTE Confidence: 0.827144099166667

00:52:47.479 --> 00:52:49.484 successes was a patient who had very

NOTE Confidence: 0.827144099166667

00:52:49.484 --> 00:52:51.569 severe he had changed strokes and clinic.

NOTE Confidence: 0.827144099166667

00:52:51.570 --> 00:52:53.110 He was that severe.

NOTE Confidence: 0.827144099166667

00:52:53.110 --> 00:52:54.650 And on oxygen therapy,

NOTE Confidence: 0.827144099166667

00:52:54.650 --> 00:52:55.730 he was back to hunting.

NOTE Confidence: 0.827144099166667

00:52:55.730 --> 00:52:58.346 So you know that is true.

NOTE Confidence: 0.827144099166667

00:52:58.350 --> 00:53:00.716 I just wish it was more predictable.

NOTE Confidence: 0.827144099166667

00:53:00.720 --> 00:53:02.140 But that is true.

NOTE Confidence: 0.827144099166667

00:53:02.140 --> 00:53:03.560 Patients can have really

NOTE Confidence: 0.827144099166667

00:53:03.560 --> 00:53:05.100 great benefit from oxygen,

NOTE Confidence: 0.827144099166667

00:53:05.100 --> 00:53:07.816 but it's just less predictable than ideal.

NOTE Confidence: 0.827144099166667

00:53:07.820 --> 00:53:09.518 Oxygen of course changes the sleep

NOTE Confidence: 0.827144099166667

00:53:09.518 --> 00:53:11.297 network in many ways because the

NOTE Confidence: 0.827144099166667

00:53:11.297 --> 00:53:12.767 current it will suppress curby

NOTE Confidence: 0.827144099166667

00:53:12.767 --> 00:53:14.319 body firing to some extent.

NOTE Confidence: 0.827144099166667

00:53:14.320 --> 00:53:16.684 And the current body of course

NOTE Confidence: 0.827144099166667

00:53:16.684 --> 00:53:18.260 influences the tractor solitarius,

NOTE Confidence: 0.827144099166667

00:53:18.260 --> 00:53:20.969 which then of course influences just about

NOTE Confidence: 0.827144099166667

00:53:20.969 --> 00:53:23.489 everything in the brain and brainstem.

NOTE Confidence: 0.827144099166667

00:53:23.490 --> 00:53:23.951 So.

NOTE Confidence: 0.827144099166667

00:53:23.951 --> 00:53:25.334 Yeah, oxygen, definitely.

NOTE Confidence: 0.827144099166667

00:53:25.334 --> 00:53:27.178 I should add that.

NOTE Confidence: 0.7758289325

00:53:31.230 --> 00:53:33.558 All right, very good.

NOTE Confidence: 0.7758289325

00:53:33.560 --> 00:53:36.374 I have a question Robert and so.

NOTE Confidence: 0.7758289325

00:53:36.380 --> 00:53:39.257 Is very interesting you pointing out the

NOTE Confidence: 0.7758289325

00:53:39.257 --> 00:53:41.152 differences between stable and unstable

NOTE Confidence: 0.7758289325

00:53:41.152 --> 00:53:43.552 and to sleep and in many cases where

NOTE Confidence: 0.7758289325

00:53:43.620 --> 00:53:45.888 it just seems to occur spontaneously.

NOTE Confidence: 0.7758289325

00:53:45.890 --> 00:53:47.834 Do you have an idea or at least

NOTE Confidence: 0.7758289325

00:53:47.834 --> 00:53:49.751 if you have some hypothesis as

NOTE Confidence: 0.7758289325

00:53:49.751 --> 00:53:51.456 to why might that occur?

NOTE Confidence: 0.7758289325

00:53:51.460 --> 00:53:53.876 So we we do see that in PSG's

NOTE Confidence: 0.7758289325

00:53:53.876 --> 00:53:56.156 quite often where you have.

NOTE Confidence: 0.7758289325

00:53:56.160 --> 00:53:57.749 Stage two sleep, but one is stable,

NOTE Confidence: 0.7758289325

00:53:57.750 --> 00:53:58.306 one is not stable.

NOTE Confidence: 0.7758289325

00:53:58.306 --> 00:53:59.889 Do you have a sense of why that might occur?

NOTE Confidence: 0.86344005

00:54:01.390 --> 00:54:05.380 Honestly, no. Some ideas as to why,

NOTE Confidence: 0.86344005

00:54:05.380 --> 00:54:11.038 how, how it could occur? Umm. No.

NOTE Confidence: 0.86344005

00:54:11.038 --> 00:54:15.434 The Telemac cortical system has a membrane

NOTE Confidence: 0.86344005

00:54:15.434 --> 00:54:18.338 oscillations which can change over.

NOTE Confidence: 0.86344005

00:54:18.340 --> 00:54:22.730 You know. Multiple seconds and minutes.

NOTE Confidence: 0.86344005

00:54:22.730 --> 00:54:26.341 And because they are so central in the, you

NOTE Confidence: 0.86344005

00:54:26.341 --> 00:54:28.509 know, between the cortex and the brain stem.

NOTE Confidence: 0.86344005

00:54:28.510 --> 00:54:30.285 It's possible that changes in

NOTE Confidence: 0.86344005

00:54:30.285 --> 00:54:31.350 telemac cortical conductance,

NOTE Confidence: 0.86344005

00:54:31.350 --> 00:54:33.078 especially potassium conductance,

NOTE Confidence: 0.86344005

00:54:33.078 --> 00:54:37.110 could be a switching kind of mechanism.

NOTE Confidence: 0.86344005

00:54:37.110 --> 00:54:40.350 It's possible that in stable state

NOTE Confidence: 0.86344005

00:54:40.350 --> 00:54:43.060 there is mild hypercapnia mild.

NOTE Confidence: 0.86344005

00:54:43.060 --> 00:54:45.390 Even in normal stable state.

NOTE Confidence: 0.86344005

00:54:45.390 --> 00:54:48.930 That it after a certain point

NOTE Confidence: 0.86344005

00:54:48.930 --> 00:54:51.598 it triggers a hyper. Well.

NOTE Confidence: 0.86344005

00:54:51.598 --> 00:54:54.078 Hard to call it hypercapnia,

NOTE Confidence: 0.86344005

00:54:54.080 --> 00:54:56.600 but the CO2 mediated.

NOTE Confidence: 0.86344005

00:54:56.600 --> 00:54:59.910 Arousal, which enables the switch to.

NOTE Confidence: 0.86344005

00:54:59.910 --> 00:55:00.818 Another state.

NOTE Confidence: 0.86344005

00:55:00.818 --> 00:55:03.260 But in reality, I'm just guessing.

NOTE Confidence: 0.86344005

00:55:03.260 --> 00:55:05.060 I simply do not know.

NOTE Confidence: 0.86344005

00:55:05.060 --> 00:55:07.330 I have for many years.

NOTE Confidence: 0.86344005

00:55:07.330 --> 00:55:09.730 I tried to convince Cliff shaper,

NOTE Confidence: 0.86344005

00:55:09.730 --> 00:55:10.560 Jerome Siegel,

NOTE Confidence: 0.86344005

00:55:10.560 --> 00:55:14.949 and a few others to try to study this state.

NOTE Confidence: 0.86344005

00:55:14.950 --> 00:55:18.166 Which of course occurs in rats and mice.

NOTE Confidence: 0.86344005

00:55:18.170 --> 00:55:21.360 Called intermediate sleep I believe.

NOTE Confidence: 0.86344005

00:55:21.360 --> 00:55:23.334 And that's what actually is our enemy.

NOTE Confidence: 0.86344005

00:55:23.340 --> 00:55:25.636 I mean, our enemy is what the

NOTE Confidence: 0.86344005

00:55:25.636 --> 00:55:28.060 neurobiologists kind of, sort of ignore.

NOTE Confidence: 0.86344005

00:55:28.060 --> 00:55:31.700 Uh, we have, uh, less worry about.

NOTE Confidence: 0.86344005

00:55:31.700 --> 00:55:32.734 Nice, good.

NOTE Confidence: 0.86344005

00:55:32.734 --> 00:55:35.836 Delta enhanced sleep in the clinic.

NOTE Confidence: 0.86344005

00:55:35.840 --> 00:55:38.080 Much of what we deal with is unstable,

NOTE Confidence: 0.86344005

00:55:38.080 --> 00:55:40.840 so it is a mystery and I wish.

NOTE Confidence: 0.86344005

00:55:40.840 --> 00:55:41.932 Neurobiologists would actually

NOTE Confidence: 0.86344005

00:55:41.932 --> 00:55:44.116 try to figure it out because

NOTE Confidence: 0.86344005

00:55:44.116 --> 00:55:45.760 that's what we struggle with.

NOTE Confidence: 0.86344005

00:55:45.760 --> 00:55:46.378 That's our enemy.

NOTE Confidence: 0.902255614285714

00:55:48.580 --> 00:55:49.796 But we see it all the time, right?

NOTE Confidence: 0.902255614285714

00:55:49.796 --> 00:55:50.972 I mean, anyone who chooses to

NOTE Confidence: 0.902255614285714

00:55:50.972 --> 00:55:52.616 look for it, you'll see it.

NOTE Confidence: 0.902255614285714

00:55:52.616 --> 00:55:54.024 And stable breathing periods

NOTE Confidence: 0.902255614285714

00:55:54.024 --> 00:55:55.758 have been described, you know,

NOTE Confidence: 0.902255614285714

00:55:55.758 --> 00:55:57.792 so many times over the years

NOTE Confidence: 0.902255614285714

00:55:57.792 --> 00:55:59.629 in sleep apnea patients.

NOTE Confidence: 0.902255614285714

00:55:59.630 --> 00:56:02.270 It's almost certainly a it's not

NOTE Confidence: 0.902255614285714

00:56:02.270 --> 00:56:04.030 just a genioglossus activity,

NOTE Confidence: 0.902255614285714

00:56:04.030 --> 00:56:04.950 or it's not one thing.

NOTE Confidence: 0.902255614285714

00:56:04.950 --> 00:56:07.386 It is the whole state switching.

NOTE Confidence: 0.840297835294118

00:56:11.140 --> 00:56:13.400 Gotcha. OK. Anybody else have

NOTE Confidence: 0.840297835294118

00:56:13.400 --> 00:56:16.099 any other questions I wanted to

NOTE Confidence: 0.840297835294118

00:56:16.099 --> 00:56:18.235 to bring up during this talk?

NOTE Confidence: 0.821953371

00:56:19.720 --> 00:56:21.154 Want to join in and drop

NOTE Confidence: 0.821953371

00:56:21.154 --> 00:56:22.110 some words of wisdom?

NOTE Confidence: 0.80087035

00:56:26.420 --> 00:56:26.790 You too.

NOTE Confidence: 0.695851145

00:56:28.050 --> 00:56:30.048 Try to try to doctor Evanoff.

NOTE Confidence: 0.695851145

00:56:30.050 --> 00:56:30.918 Try to meet yourself.

NOTE Confidence: 0.634668705

00:56:36.850 --> 00:56:37.800 Yes, OK.

NOTE Confidence: 0.795789740869565

00:56:38.950 --> 00:56:40.936 So take your other wonderful presentation

NOTE Confidence: 0.795789740869565

00:56:40.936 --> 00:56:43.745 and so you paint the big picture and I

NOTE Confidence: 0.795789740869565

00:56:43.745 --> 00:56:46.088 think with the big potential for the future,

NOTE Confidence: 0.795789740869565

00:56:46.090 --> 00:56:50.398 but basic science and clinical practice.

NOTE Confidence: 0.795789740869565

00:56:50.400 --> 00:56:53.944 In general, just West of perhaps the question

NOTE Confidence: 0.795789740869565

00:56:53.944 --> 00:56:56.538 about stability and instability and whether

NOTE Confidence: 0.795789740869565

00:56:56.538 --> 00:56:59.709 we have a true human studies in sleep,

NOTE Confidence: 0.795789740869565

00:56:59.710 --> 00:57:02.594 it seems like, at least from a

NOTE Confidence: 0.795789740869565

00:57:02.594 --> 00:57:05.109 certain indication of these dynamics,

NOTE Confidence: 0.795789740869565

00:57:05.110 --> 00:57:07.390 whether of individual systems or from

NOTE Confidence: 0.795789740869565

00:57:07.390 --> 00:57:10.469 point of view of network interactions,

NOTE Confidence: 0.795789740869565

00:57:10.470 --> 00:57:14.390 that sleep has also certain

NOTE Confidence: 0.795789740869565

00:57:14.390 --> 00:57:16.898 characteristics of criticality

NOTE Confidence: 0.795789740869565

00:57:16.898 --> 00:57:19.890 and this system at criticality.

NOTE Confidence: 0.795789740869565

00:57:19.890 --> 00:57:22.530 What this would mean is that

NOTE Confidence: 0.795789740869565

00:57:22.530 --> 00:57:24.958 there is certain not local, but.

NOTE Confidence: 0.77351288

00:57:27.080 --> 00:57:30.700 Global interactions that allow a

NOTE Confidence: 0.77351288

00:57:30.700 --> 00:57:33.596 transition that are spontaneous.

NOTE Confidence: 0.77351288

00:57:33.600 --> 00:57:36.112 If we have a system which is truly

NOTE Confidence: 0.77351288

00:57:36.112 --> 00:57:37.880 in equilibrium then it takes a

NOTE Confidence: 0.77351288

00:57:37.880 --> 00:57:39.906 lot of energy to drive the system

NOTE Confidence: 0.77351288

00:57:39.906 --> 00:57:41.982 Congress sleep stage to another or

NOTE Confidence: 0.77351288

00:57:41.982 --> 00:57:44.968 from one sub state within the sleep

NOTE Confidence: 0.77351288

00:57:44.968 --> 00:57:47.890 stage to another and having you

NOTE Confidence: 0.77351288

00:57:47.989 --> 00:57:51.195 know certain critical features from

NOTE Confidence: 0.77351288

00:57:51.195 --> 00:57:54.165 actually physics point of view of

NOTE Confidence: 0.77351288

00:57:54.165 --> 00:57:56.412 criticality perhaps has a place.

NOTE Confidence: 0.77351288

00:57:56.412 --> 00:57:58.602 To better understand the dynamics

NOTE Confidence: 0.77351288

00:57:58.602 --> 00:58:00.628 and regulation of sleep.

NOTE Confidence: 0.77351288

00:58:00.630 --> 00:58:03.584 So this in relation to the last

NOTE Confidence: 0.77351288

00:58:03.584 --> 00:58:06.065 question that was asked about

NOTE Confidence: 0.77351288

00:58:06.065 --> 00:58:08.305 stable and unstable states.

NOTE Confidence: 0.77351288

00:58:08.310 --> 00:58:10.418 This transitions across spontaneously

NOTE Confidence: 0.77351288

00:58:10.418 --> 00:58:13.580 and there could be facilitated by

NOTE Confidence: 0.77351288

00:58:13.657 --> 00:58:16.252 dynamics which are non equilibrium

NOTE Confidence: 0.77351288

00:58:16.252 --> 00:58:18.847 non homeostatic dynamics that occur

NOTE Confidence: 0.77351288

00:58:18.930 --> 00:58:21.336 at small timescales of seconds up

NOTE Confidence: 0.77351288

00:58:21.336 --> 00:58:24.017 to minutes of course when you speak

NOTE Confidence: 0.77351288

00:58:24.017 --> 00:58:26.530 about the large window of hours or.

NOTE Confidence: 0.77351288

00:58:26.530 --> 00:58:28.819 Well, you know the sleep wake cycle

NOTE Confidence: 0.77351288

00:58:28.819 --> 00:58:32.574 of the 24 hours day then for you have

NOTE Confidence: 0.77351288

00:58:32.574 --> 00:58:34.374 certain homeostatic control there.

NOTE Confidence: 0.77351288

00:58:34.380 --> 00:58:36.956 So it's seems that there is some

NOTE Confidence: 0.77351288

00:58:36.956 --> 00:58:39.470 duality and I think these network

NOTE Confidence: 0.77351288

00:58:39.470 --> 00:58:42.260 approaches also could perhaps will be

NOTE Confidence: 0.77351288

00:58:42.260 --> 00:58:45.490 useful in this direction in the future.

NOTE Confidence: 0.77351288

00:58:45.490 --> 00:58:49.792 But you painted a very really deep and

NOTE Confidence: 0.77351288

00:58:49.792 --> 00:58:53.170 broad picture and a lot to be investigated,

NOTE Confidence: 0.77351288

00:58:53.170 --> 00:58:57.070 so obviously this is a visual

NOTE Confidence: 0.77351288

00:58:57.070 --> 00:59:00.490 one can see traces that.

NOTE Confidence: 0.77351288

00:59:00.490 --> 00:59:02.625 Visually you can see certain

NOTE Confidence: 0.77351288

00:59:02.625 --> 00:59:03.906 correspondence in patterns,

NOTE Confidence: 0.77351288

00:59:03.910 --> 00:59:05.710 but the big challenge is,

NOTE Confidence: 0.77351288

00:59:05.710 --> 00:59:07.290 as you also pointed out,

NOTE Confidence: 0.77351288

00:59:07.290 --> 00:59:10.450 is to find reliable metrics.

NOTE Confidence: 0.77351288

00:59:10.450 --> 00:59:14.514 And in basic science we do not quite

NOTE Confidence: 0.77351288

00:59:14.514 --> 00:59:17.147 have reliable metrics for systems

NOTE Confidence: 0.77351288

00:59:17.147 --> 00:59:19.926 which are diverse in nature and that

NOTE Confidence: 0.77351288

00:59:19.926 --> 00:59:23.093 also work in parallel but work in

NOTE Confidence: 0.77351288

00:59:23.093 --> 00:59:24.925 parallel across multiple scales.

NOTE Confidence: 0.77351288

00:59:24.930 --> 00:59:27.615 So simple cross correlation simple

NOTE Confidence: 0.77351288

00:59:27.615 --> 00:59:30.740 metrics don't quite work or not.

NOTE Confidence: 0.77351288

00:59:30.740 --> 00:59:31.952 Do not work reliably.

NOTE Confidence: 0.77351288

00:59:31.952 --> 00:59:35.160 And so in that sense I just would like to,

NOTE Confidence: 0.77351288

00:59:35.160 --> 00:59:37.140 you know, caution the community.

NOTE Confidence: 0.77351288

00:59:37.140 --> 00:59:39.690 Of course the horizon is there

NOTE Confidence: 0.77351288

00:59:39.690 --> 00:59:40.965 and very exciting,

NOTE Confidence: 0.77351288

00:59:40.970 --> 00:59:43.070 but one also has to be careful

NOTE Confidence: 0.77351288

00:59:43.070 --> 00:59:46.125 of how to how do we technically

NOTE Confidence: 0.77351288

00:59:46.125 --> 00:59:48.715 approach the question of extracting

NOTE Confidence: 0.77351288

00:59:48.715 --> 00:59:51.156 information that is hidden in the

NOTE Confidence: 0.77351288

00:59:51.156 --> 00:59:53.110 dynamics of the signals and in

NOTE Confidence: 0.725491274

00:59:53.120 --> 00:59:55.144 their couple. Very good.

NOTE Confidence: 0.725491274

00:59:55.144 --> 00:59:56.016 Well, thank you.

NOTE Confidence: 0.725491274

00:59:56.016 --> 00:59:57.162 Thank you very much, Doctor Evanoff.

NOTE Confidence: 0.725491274

00:59:57.162 --> 00:59:59.102 Thank you very much, Doctor Thomas.

NOTE Confidence: 0.725491274

00:59:59.102 --> 01:00:02.346 It was a great talk, great conference,

NOTE Confidence: 0.725491274

01:00:02.346 --> 01:00:05.223 lots of stimulation for thought and ideas

NOTE Confidence: 0.725491274

01:00:05.223 --> 01:00:07.448 for future research and collaboration.

NOTE Confidence: 0.725491274

01:00:07.450 --> 01:00:10.117 And thank you all for attending another

NOTE Confidence: 0.725491274

01:00:10.117 --> 01:00:12.529 edition of the joint conference.

NOTE Confidence: 0.725491274

01:00:12.530 --> 01:00:14.394 And we will see you guys back on

NOTE Confidence: 0.725491274

01:00:14.394 --> 01:00:16.073 the 12th of October when Doctor

NOTE Confidence: 0.725491274

01:00:16.073 --> 01:00:18.240 Ali Azar Brazil will join us from

NOTE Confidence: 0.725491274

01:00:18.240 --> 01:00:19.390 pregnant Women's Hospital and talk

NOTE Confidence: 0.725491274

01:00:19.390 --> 01:00:22.678 about his work in examining others,

NOTE Confidence: 0.608789036666667

01:00:22.690 --> 01:00:25.620 by the way will be networking. Yeah.

NOTE Confidence: 0.865433845454546

01:00:27.030 --> 01:00:27.946 Okey Doke, very good.

NOTE Confidence: 0.865433845454546

01:00:27.946 --> 01:00:29.770 So we'll see you guys in October.

NOTE Confidence: 0.865433845454546

01:00:29.770 --> 01:00:31.998 Have a great week.