

1
00:00:00,410 --> 00:00:08,189
we're still waiting well I'm going to be

2
00:00:05,490 --> 00:00:10,740
talking about nested rhythms and and

3
00:00:08,189 --> 00:00:13,710
nested rhythms are a bit of a different

4
00:00:10,740 --> 00:00:15,480
approach to thinking of EEG instead of

5
00:00:13,710 --> 00:00:17,310
looking at one peak and where it's going

6
00:00:15,480 --> 00:00:19,140
or another peak and where it's going

7
00:00:17,309 --> 00:00:21,809
we're literally looking across the

8
00:00:19,140 --> 00:00:25,679
frequency spectrum for coupling between

9
00:00:21,809 --> 00:00:27,719
rhythms and and this can be viewed in a

10
00:00:25,679 --> 00:00:31,669
couple of different ways one is called a

11
00:00:27,719 --> 00:00:33,750
joint time-frequency analysis or jtf a

12
00:00:31,669 --> 00:00:35,759
and we'll show you some of that data

13
00:00:33,750 --> 00:00:39,238
assuming the computer comes back on and

14
00:00:35,759 --> 00:00:42,619
the other one is looking at it with the

15
00:00:39,238 --> 00:00:46,979
by spectral index and the by spectrum

16
00:00:42,619 --> 00:00:50,609
literally is a the x axis as a frequency

17
00:00:46,979 --> 00:00:52,709
from DC to 100 Hertz and the y-axis is

18
00:00:50,609 --> 00:00:54,780
the frequencies from zero to entered

19
00:00:52,710 --> 00:00:57,270
hurts and anything that's off the

20
00:00:54,780 --> 00:00:59,730
45-degree angle or not immediately on

21
00:00:57,270 --> 00:01:03,080
the axis ends up being across spectral

22
00:00:59,729 --> 00:01:07,920
coupling so if 10 and 20 are interacting

23
00:01:03,079 --> 00:01:10,590
you end up seeing off angle dots that

24
00:01:07,920 --> 00:01:12,478
correspond with with 10 on one axis and

25
00:01:10,590 --> 00:01:15,090
20 on the other so you'll end up seeing

26
00:01:12,478 --> 00:01:18,209
mirror image flares coming off the 45

27
00:01:15,090 --> 00:01:20,759
degree angle line this is important

28
00:01:18,209 --> 00:01:25,798
because we literally can predict

29

00:01:20,759 --> 00:01:28,319
consciousness based on this the DC field

30
00:01:25,799 --> 00:01:31,200
potentials since I've used the term

31
00:01:28,319 --> 00:01:33,539
nested rhythms the DC field potentials

32
00:01:31,200 --> 00:01:36,240
when they go negative which in EEG terms

33
00:01:33,540 --> 00:01:39,689
is up all of you that are electronic

34
00:01:36,239 --> 00:01:42,089
engineers go well that's wrong negative

35
00:01:39,688 --> 00:01:44,129
is down on the oscilloscope isn't it but

36
00:01:42,090 --> 00:01:47,159
eg people are upside down and backwards

37
00:01:44,129 --> 00:01:49,438
anyway so that this not that that

38
00:01:47,159 --> 00:01:54,570
difficult to understand let's look at

39
00:01:49,438 --> 00:01:57,179
nesting this is a set of recordings in

40
00:01:54,569 --> 00:01:59,699
the brain you see the spike train up at

41
00:01:57,180 --> 00:02:03,240
the top this is in the limbic system and

42
00:01:59,700 --> 00:02:04,859
it's generating a proximate ly six cycle

43
00:02:03,239 --> 00:02:07,019

per second excuse me about a five cycle

44

00:02:04,859 --> 00:02:10,889

per second wave a 200 millisecond

45

00:02:07,019 --> 00:02:13,710

periodicity and the other frequency is

46

00:02:10,889 --> 00:02:16,379

at a hundred cycles a second it's gamma

47

00:02:13,710 --> 00:02:18,420

and you'll notice that the gamma is

48

00:02:16,379 --> 00:02:22,319

literally as a wave shape being

49

00:02:18,419 --> 00:02:25,109

modulated by the theta the gamma sits in

50

00:02:22,319 --> 00:02:27,000

the theta nest when theta goes negative

51

00:02:25,110 --> 00:02:30,570

gamma can happen when theta goes

52

00:02:27,000 --> 00:02:33,659

positive gamma can't interestingly your

53

00:02:30,569 --> 00:02:35,479

digit span how many numbers you can

54

00:02:33,659 --> 00:02:38,460

remember in a number string is

55

00:02:35,479 --> 00:02:41,489

determined by how many gamma wavelets

56

00:02:38,460 --> 00:02:43,680

fit in a theta nest it's like a register

57

00:02:41,490 --> 00:02:46,260

on a computer how many little numbers

58
00:02:43,680 --> 00:02:51,480
can you hold in this register well if

59
00:02:46,259 --> 00:02:53,729
your gamma is nested well you end up

60
00:02:51,479 --> 00:02:56,840
with approximately 7 gamma wavelets in

61
00:02:53,729 --> 00:03:01,139
your theta frequency nest but the entire

62
00:02:56,840 --> 00:03:03,110
oscillatory EEG is in the DC nest the

63
00:03:01,139 --> 00:03:05,669
direct current field potential nest

64
00:03:03,110 --> 00:03:08,390
modulates on and off the entire

65
00:03:05,669 --> 00:03:11,849
alternating current EEG which is how the

66
00:03:08,389 --> 00:03:15,319
calc ami turned off his somatosensory

67
00:03:11,849 --> 00:03:17,400
strip he pulled the plug on the DC posit

68
00:03:15,319 --> 00:03:19,919
electronegativity it went positive and

69
00:03:17,400 --> 00:03:22,800
the alternating current EEG of the brain

70
00:03:19,919 --> 00:03:26,699
working literally was turned off in a

71
00:03:22,800 --> 00:03:29,219
somatosensory strip so the DC fields are

72
00:03:26,699 --> 00:03:33,329
the base nest which modulates the entire

73
00:03:29,219 --> 00:03:36,900
EEG if you look to the literature this

74
00:03:33,330 --> 00:03:39,300
is called infra slow EEG it's below a

75
00:03:36,900 --> 00:03:41,760
third of a Hertz or a half of hurts so

76
00:03:39,300 --> 00:03:43,920
it's it's extremely slow activity you

77
00:03:41,759 --> 00:03:47,459
might say well DC that's zero not like

78
00:03:43,919 --> 00:03:50,339
point three or point2 yeah but it drifts

79
00:03:47,460 --> 00:03:52,140
up and then down so it has an apparent

80
00:03:50,340 --> 00:03:55,830
frequency but it's really not a

81
00:03:52,139 --> 00:04:02,359
frequency it's simply the on and off of

82
00:03:55,830 --> 00:04:06,510
the DC signal DC and gamma are the basic

83
00:04:02,360 --> 00:04:12,290
heart of the biz index their secret

84
00:04:06,509 --> 00:04:12,289
formula is a oops let's go back

85
00:04:16,279 --> 00:04:21,388
yeah here we are the secret formula here

86

00:04:19,199 --> 00:04:23,550
for the biz index which is the surgical

87
00:04:21,389 --> 00:04:25,710
depth of anesthesia monitor is the

88
00:04:23,550 --> 00:04:27,900
mathematical relationship between point

89
00:04:25,709 --> 00:04:30,719
three eight and thirty eight Hertz well

90
00:04:27,899 --> 00:04:35,609
that's slow cortical potentials in gamma

91
00:04:30,720 --> 00:04:38,310
and that measures from conscious to

92
00:04:35,610 --> 00:04:41,069
unconscious their index has a few other

93
00:04:38,310 --> 00:04:43,319
tricks for measuring the too deep like a

94
00:04:41,069 --> 00:04:44,849
burst suppression detector telling you

95
00:04:43,319 --> 00:04:46,980
that your brain is going flat and then

96
00:04:44,850 --> 00:04:50,400
bursting it's not a good sign you're too

97
00:04:46,980 --> 00:04:53,100
deep and then also a flatline detector

98
00:04:50,399 --> 00:04:55,500
and if the anesthesiologist is created a

99
00:04:53,100 --> 00:05:00,720
flat EEG you're probably a bit too deep

100
00:04:55,500 --> 00:05:02,699

so theta nephs gamma again that controls

101

00:05:00,720 --> 00:05:06,690

digit span we've mentioned that let's

102

00:05:02,699 --> 00:05:08,550

take an example of a jtf a display here

103

00:05:06,689 --> 00:05:11,219

we have a normal high functioning and

104

00:05:08,550 --> 00:05:14,699

low functioning a DD here you go from

105

00:05:11,220 --> 00:05:17,160

slow to fast this is 74 cycles a second

106

00:05:14,699 --> 00:05:20,550

so gamma occurs in the generally from

107

00:05:17,160 --> 00:05:22,320

about 35 or so up that's the red sheets

108

00:05:20,550 --> 00:05:25,699

that are going up that you see there and

109

00:05:22,319 --> 00:05:28,129

this is a one thousand one hundred

110

00:05:25,699 --> 00:05:30,659

milliseconds this is an event-related

111

00:05:28,129 --> 00:05:32,310

synchronization d synchronization the

112

00:05:30,660 --> 00:05:34,470

first hundred milliseconds our baseline

113

00:05:32,310 --> 00:05:36,780

the next one the next thousand

114

00:05:34,470 --> 00:05:39,390

milliseconds end up being the one second

115
00:05:36,779 --> 00:05:41,339
of the brain responding to us to a

116
00:05:39,389 --> 00:05:43,589
stimulus a go/no-go stimulus and

117
00:05:41,339 --> 00:05:45,119
basically you can see here from the

118
00:05:43,589 --> 00:05:49,288
first center milliseconds you get a

119
00:05:45,120 --> 00:05:53,389
burst of gamma 1 2 3 4 5 just hit 6

120
00:05:49,288 --> 00:05:55,709
gamma is chirping it's nested in theta

121
00:05:53,389 --> 00:05:57,689
you can see in the healthy normal

122
00:05:55,709 --> 00:06:00,779
functioning brain gamma is occurring in

123
00:05:57,689 --> 00:06:03,418
brief bursts called chirps and those

124
00:06:00,779 --> 00:06:06,239
little chirps imagine that a nest and

125
00:06:03,418 --> 00:06:07,949
chirps but they called them chirps

126
00:06:06,240 --> 00:06:12,810
before they thought about nesting it

127
00:06:07,949 --> 00:06:15,149
just happened and now in the high

128
00:06:12,810 --> 00:06:17,519
functioning a DD you can see that we

129
00:06:15,149 --> 00:06:20,009
still have one two three four five six

130
00:06:17,519 --> 00:06:22,579
of them but boy are they weak and in low

131
00:06:20,009 --> 00:06:25,228
functioning a DD he's missing some nests

132
00:06:22,579 --> 00:06:27,008
there's some trooping not going on there

133
00:06:25,228 --> 00:06:29,199
so literally

134
00:06:27,009 --> 00:06:33,879
what we have here is conscious less

135
00:06:29,199 --> 00:06:36,908
conscious less conscious and literally

136
00:06:33,879 --> 00:06:38,999
on the biz index people that have a DD

137
00:06:36,908 --> 00:06:44,319
look like they're in stage one sleep

138
00:06:38,999 --> 00:06:46,270
there they're not fully conscious by the

139
00:06:44,319 --> 00:06:51,278
way a DD is very common to have sleep

140
00:06:46,269 --> 00:06:53,680
disturbances as well so the the actual

141
00:06:51,278 --> 00:06:56,139
original slide was looking only at the

142
00:06:53,680 --> 00:06:57,728
beta synchrony the beta synchrony takes

143

00:06:56,139 --> 00:07:00,728
about five hundred milliseconds although

144
00:06:57,728 --> 00:07:03,338
they called it here at 620 it actually

145
00:07:00,728 --> 00:07:05,348
occurs at about 500 and here in the high

146
00:07:03,338 --> 00:07:07,418
functioning a DD it's at 750

147
00:07:05,348 --> 00:07:09,038
milliseconds and here it just barely

148
00:07:07,418 --> 00:07:11,728
starts to happen at nine hundred

149
00:07:09,038 --> 00:07:14,918
milliseconds so the beta synchronization

150
00:07:11,728 --> 00:07:16,389
which is event related to the task it

151
00:07:14,918 --> 00:07:21,728
ends up being delayed further and

152
00:07:16,389 --> 00:07:25,809
further by being less conscious this is

153
00:07:21,728 --> 00:07:29,588
a by spectral index you can see on the

154
00:07:25,809 --> 00:07:32,080
upper right this is a Parkinson's

155
00:07:29,588 --> 00:07:35,620
patient when neural networks are bound

156
00:07:32,079 --> 00:07:38,378
and don't unlock gamma becomes

157
00:07:35,620 --> 00:07:41,680

persistent it doesn't occur in a dynamic

158

00:07:38,379 --> 00:07:43,838

chirp it's on so gamma is not

159

00:07:41,680 --> 00:07:49,408

necessarily a good thing it in fact

160

00:07:43,838 --> 00:07:58,658

occurs in pathology as well the off OOP

161

00:07:49,408 --> 00:08:01,360

let's go back if you go back here the

162

00:07:58,658 --> 00:08:04,709

non 45 degree angle line flares here

163

00:08:01,360 --> 00:08:07,120

this is a control a patient this is a

164

00:08:04,709 --> 00:08:09,579

Parkinson's patient with a bound neural

165

00:08:07,120 --> 00:08:12,579

network that's locked not just bound but

166

00:08:09,579 --> 00:08:15,639

locked and it loses the dynamic gammas

167

00:08:12,579 --> 00:08:20,378

on it just stays on that's pathological

168

00:08:15,639 --> 00:08:23,408

and as you can see if you gather not

169

00:08:20,379 --> 00:08:26,588

with respect to parkinsonism but all

170

00:08:23,408 --> 00:08:29,019

patients and you end up displaying all

171

00:08:26,588 --> 00:08:31,718

patients of all categories here the

172
00:08:29,019 --> 00:08:33,908
average of all patients you get off 45

173
00:08:31,718 --> 00:08:35,610
degree angle line flaring here the

174
00:08:33,908 --> 00:08:40,418
average of all controls you end up

175
00:08:35,610 --> 00:08:44,110
mimicking this display so when you have

176
00:08:40,418 --> 00:08:46,028
pathology it's extraordinarily common to

177
00:08:44,110 --> 00:08:48,909
end up seeing the lack of neural network

178
00:08:46,028 --> 00:08:54,120
dynamic shown as a by spectral index

179
00:08:48,909 --> 00:08:57,309
flare that's not appropriate so

180
00:08:54,120 --> 00:09:02,110
consciousness ends up being spawned by a

181
00:08:57,309 --> 00:09:04,359
cross spectral interaction between the

182
00:09:02,110 --> 00:09:07,449
slow cortical potentials or DC field

183
00:09:04,360 --> 00:09:10,839
potentials and neural network dynamics

184
00:09:07,448 --> 00:09:15,120
of gamma and when those two are related

185
00:09:10,839 --> 00:09:19,690
you're conscious the implication here

186
00:09:15,120 --> 00:09:21,759
for our next speaker is we actually did

187
00:09:19,690 --> 00:09:24,850
a recording on bill doing some healings

188
00:09:21,759 --> 00:09:28,000
and the implication for the model here

189
00:09:24,850 --> 00:09:31,149
is if you're looking for stuff that

190
00:09:28,000 --> 00:09:34,570
might be happening during these trance

191
00:09:31,149 --> 00:09:37,990
personal interactions look for cross

192
00:09:34,570 --> 00:09:40,420
spectral events that are associated with

193
00:09:37,990 --> 00:09:43,480
whatever these changes are that are

194
00:09:40,419 --> 00:09:47,049
happening during the healing and in fact

195
00:09:43,480 --> 00:09:51,730
using the by spectral approach we looked

196
00:09:47,049 --> 00:09:53,799
for harmonics suggesting that the neural

197
00:09:51,730 --> 00:09:56,579
networks were activated in a different

198
00:09:53,799 --> 00:10:01,588
way during the healing than during

199
00:09:56,578 --> 00:10:01,588
resting or normal conscious functioning