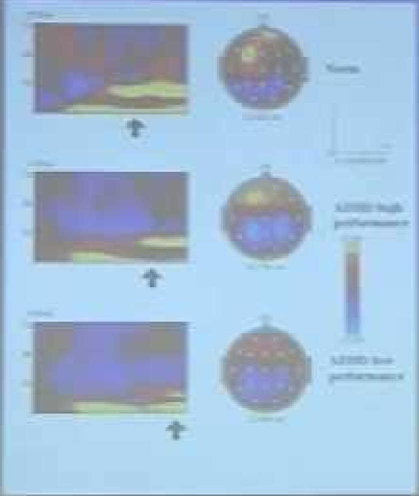
Decrease of nested Gamma with less attention



- Tested with a Go/No-Go task
- "Go" stimuli evoked activity in beta (14-28 Hz) band
- The Gamma differences are apparent with less nested gamma with performance decreases
- Note the modulated "nesting" of Gamma in normal cortical function

Data from J.Kropotov, 2006

1
00:00:08,179 --> 00:00:05,480
we're still waiting well I'm going to be

2
00:00:10,730 --> 00:00:08,189
talking about nested rhythms and and

3
00:00:13,700 --> 00:00:10,740
nested rhythms are a bit of a different

4
00:00:15,470 --> 00:00:13,710
approach to thinking of EEG instead of

5
00:00:17,300 --> 00:00:15,480
looking at one peak and where it's going

6
00:00:19,130 --> 00:00:17,310
or another peak and where it's going

7
00:00:21,800 --> 00:00:19,140
we're literally looking across the

8
00:00:25,670 --> 00:00:21,810
frequency spectrum for coupling between

9
00:00:27,710 --> 00:00:25,680
rhythms and and this can be viewed in a

10
00:00:31,659 --> 00:00:27,720
couple of different ways one is called a

11
00:00:33,740 --> 00:00:31,669
joint time-frequency analysis or jtf a

12
00:00:35,750 --> 00:00:33,750
and we'll show you some of that data

13
00:00:39,229 --> 00:00:35,760

assuming the computer comes back on and

14
00:00:42,610 --> 00:00:39,239
the other one is looking at it with the

15
00:00:46,970 --> 00:00:42,620
by spectral index and the by spectrum

16
00:00:50,600 --> 00:00:46,980
literally is a the x axis as a frequency

17
00:00:52,700 --> 00:00:50,610
from DC to 100 Hertz and the y-axis is

18
00:00:54,770 --> 00:00:52,710
the frequencies from zero to entered

19
00:00:57,260 --> 00:00:54,780
hurts and anything that's off the

20
00:00:59,720 --> 00:00:57,270
45-degree angle or not immediately on

21
00:01:03,070 --> 00:00:59,730
the axis ends up being across spectral

22
00:01:07,910 --> 00:01:03,080
coupling so if 10 and 20 are interacting

23
00:01:10,580 --> 00:01:07,920
you end up seeing off angle dots that

24
00:01:12,469 --> 00:01:10,590
correspond with with 10 on one axis and

25
00:01:15,080 --> 00:01:12,479
20 on the other so you'll end up seeing

26
00:01:18,200 --> 00:01:15,090
mirror image flares coming off the 45

27
00:01:20,749 --> 00:01:18,210
degree angle line this is important

28
00:01:25,789 --> 00:01:20,759
because we literally can predict

29
00:01:28,310 --> 00:01:25,799
consciousness based on this the DC field

30
00:01:31,190 --> 00:01:28,320
potentials since I've used the term

31
00:01:33,530 --> 00:01:31,200
nested rhythms the DC field potentials

32
00:01:36,230 --> 00:01:33,540
when they go negative which in EEG terms

33
00:01:39,679 --> 00:01:36,240
is up all of you that are electronic

34
00:01:42,080 --> 00:01:39,689
engineers go well that's wrong negative

35
00:01:44,120 --> 00:01:42,090
is down on the oscilloscope isn't it but

36
00:01:47,149 --> 00:01:44,130
eg people are upside down and backwards

37
00:01:49,429 --> 00:01:47,159
anyway so that this not that that

38
00:01:54,560 --> 00:01:49,439

difficult to understand let's look at

39
00:01:57,170 --> 00:01:54,570
nesting this is a set of recordings in

40
00:01:59,690 --> 00:01:57,180
the brain you see the spike train up at

41
00:02:03,230 --> 00:01:59,700
the top this is in the limbic system and

42
00:02:04,850 --> 00:02:03,240
it's generating a proximate ly six cycle

43
00:02:07,010 --> 00:02:04,860
per second excuse me about a five cycle

44
00:02:10,880 --> 00:02:07,020
per second wave a 200 millisecond

45
00:02:13,700 --> 00:02:10,890
periodicity and the other frequency is

46
00:02:16,370 --> 00:02:13,710
at a hundred cycles a second it's gamma

47
00:02:18,410 --> 00:02:16,380
and you'll notice that the gamma is

48
00:02:22,310 --> 00:02:18,420
literally as a wave shape being

49
00:02:25,100 --> 00:02:22,320
modulated by the theta the gamma sits in

50
00:02:26,990 --> 00:02:25,110
the theta nest when theta goes negative

51
00:02:30,560 --> 00:02:27,000
gamma can happen when theta goes

52
00:02:33,650 --> 00:02:30,570
positive gamma can't interestingly your

53
00:02:35,470 --> 00:02:33,660
digit span how many numbers you can

54
00:02:38,450 --> 00:02:35,480
remember in a number string is

55
00:02:41,480 --> 00:02:38,460
determined by how many gamma wavelets

56
00:02:43,670 --> 00:02:41,490
fit in a theta nest it's like a register

57
00:02:46,250 --> 00:02:43,680
on a computer how many little numbers

58
00:02:51,470 --> 00:02:46,260
can you hold in this register well if

59
00:02:53,720 --> 00:02:51,480
your gamma is nested well you end up

60
00:02:56,830 --> 00:02:53,730
with approximately 7 gamma wavelets in

61
00:03:01,130 --> 00:02:56,840
your theta frequency nest but the entire

62
00:03:03,100 --> 00:03:01,140
oscillatory EEG is in the DC nest the

63
00:03:05,660 --> 00:03:03,110

direct current field potential nest

64
00:03:08,380 --> 00:03:05,670
modulates on and off the entire

65
00:03:11,840 --> 00:03:08,390
alternating current EEG which is how the

66
00:03:15,310 --> 00:03:11,850
calc ami turned off his somatosensory

67
00:03:17,390 --> 00:03:15,320
strip he pulled the plug on the DC posit

68
00:03:19,910 --> 00:03:17,400
electronegativity it went positive and

69
00:03:22,790 --> 00:03:19,920
the alternating current EEG of the brain

70
00:03:26,690 --> 00:03:22,800
working literally was turned off in a

71
00:03:29,210 --> 00:03:26,700
somatosensory strip so the DC fields are

72
00:03:33,320 --> 00:03:29,220
the base nest which modulates the entire

73
00:03:36,890 --> 00:03:33,330
EEG if you look to the literature this

74
00:03:39,290 --> 00:03:36,900
is called infra slow EEG it's below a

75
00:03:41,750 --> 00:03:39,300
third of a Hertz or a half of hurts so

76
00:03:43,910 --> 00:03:41,760
it's it's extremely slow activity you

77
00:03:47,450 --> 00:03:43,920
might say well DC that's zero not like

78
00:03:50,330 --> 00:03:47,460
point three or point2 yeah but it drifts

79
00:03:52,130 --> 00:03:50,340
up and then down so it has an apparent

80
00:03:55,820 --> 00:03:52,140
frequency but it's really not a

81
00:04:02,350 --> 00:03:55,830
frequency it's simply the on and off of

82
00:04:06,500 --> 00:04:02,360
the DC signal DC and gamma are the basic

83
00:04:16,270 --> 00:04:06,510
heart of the biz index their secret

84
00:04:21,379 --> 00:04:19,190
yeah here we are the secret formula here

85
00:04:23,540 --> 00:04:21,389
for the biz index which is the surgical

86
00:04:25,700 --> 00:04:23,550
depth of anesthesia monitor is the

87
00:04:27,890 --> 00:04:25,710
mathematical relationship between point

88
00:04:30,710 --> 00:04:27,900

three eight and thirty eight Hertz well

89
00:04:35,600 --> 00:04:30,720
that's slow cortical potentials in gamma

90
00:04:38,300 --> 00:04:35,610
and that measures from conscious to

91
00:04:41,060 --> 00:04:38,310
unconscious their index has a few other

92
00:04:43,310 --> 00:04:41,070
tricks for measuring the too deep like a

93
00:04:44,840 --> 00:04:43,320
burst suppression detector telling you

94
00:04:46,970 --> 00:04:44,850
that your brain is going flat and then

95
00:04:50,390 --> 00:04:46,980
bursting it's not a good sign you're too

96
00:04:53,090 --> 00:04:50,400
deep and then also a flatline detector

97
00:04:55,490 --> 00:04:53,100
and if the anesthesiologist is created a

98
00:05:00,710 --> 00:04:55,500
flat EEG you're probably a bit too deep

99
00:05:02,690 --> 00:05:00,720
so theta nephs gamma again that controls

100
00:05:06,680 --> 00:05:02,700
digit span we've mentioned that let's

101
00:05:08,540 --> 00:05:06,690
take an example of a jtf a display here

102
00:05:11,210 --> 00:05:08,550
we have a normal high functioning and

103
00:05:14,690 --> 00:05:11,220
low functioning a DD here you go from

104
00:05:17,150 --> 00:05:14,700
slow to fast this is 74 cycles a second

105
00:05:20,540 --> 00:05:17,160
so gamma occurs in the generally from

106
00:05:22,310 --> 00:05:20,550
about 35 or so up that's the red sheets

107
00:05:25,690 --> 00:05:22,320
that are going up that you see there and

108
00:05:28,120 --> 00:05:25,700
this is a one thousand one hundred

109
00:05:30,650 --> 00:05:28,130
milliseconds this is an event-related

110
00:05:32,300 --> 00:05:30,660
synchronization d synchronization the

111
00:05:34,460 --> 00:05:32,310
first hundred milliseconds our baseline

112
00:05:36,770 --> 00:05:34,470
the next one the next thousand

113
00:05:39,380 --> 00:05:36,780

milliseconds end up being the one second

114
00:05:41,330 --> 00:05:39,390
of the brain responding to us to a

115
00:05:43,580 --> 00:05:41,340
stimulus a go/no-go stimulus and

116
00:05:45,110 --> 00:05:43,590
basically you can see here from the

117
00:05:49,279 --> 00:05:45,120
first center milliseconds you get a

118
00:05:53,380 --> 00:05:49,289
burst of gamma 1 2 3 4 5 just hit 6

119
00:05:55,700 --> 00:05:53,390
gamma is chirping it's nested in theta

120
00:05:57,680 --> 00:05:55,710
you can see in the healthy normal

121
00:06:00,770 --> 00:05:57,690
functioning brain gamma is occurring in

122
00:06:03,409 --> 00:06:00,780
brief bursts called chirps and those

123
00:06:06,230 --> 00:06:03,419
little chirps imagine that a nest and

124
00:06:07,940 --> 00:06:06,240
chirps but they called them chirps

125
00:06:12,800 --> 00:06:07,950
before they thought about nesting it

126
00:06:15,140 --> 00:06:12,810
just happened and now in the high

127
00:06:17,510 --> 00:06:15,150
functioning a DD you can see that we

128
00:06:20,000 --> 00:06:17,520
still have one two three four five six

129
00:06:22,570 --> 00:06:20,010
of them but boy are they weak and in low

130
00:06:25,219 --> 00:06:22,580
functioning a DD he's missing some nests

131
00:06:26,999 --> 00:06:25,229
there's some trooping not going on there

132
00:06:29,189 --> 00:06:27,009
so literally

133
00:06:33,869 --> 00:06:29,199
what we have here is conscious less

134
00:06:36,899 --> 00:06:33,879
conscious less conscious and literally

135
00:06:38,989 --> 00:06:36,909
on the biz index people that have a DD

136
00:06:44,309 --> 00:06:38,999
look like they're in stage one sleep

137
00:06:46,260 --> 00:06:44,319
there they're not fully conscious by the

138
00:06:51,269 --> 00:06:46,270

way a DD is very common to have sleep

139
00:06:53,670 --> 00:06:51,279
disturbances as well so the the actual

140
00:06:56,129 --> 00:06:53,680
original slide was looking only at the

141
00:06:57,719 --> 00:06:56,139
beta synchrony the beta synchrony takes

142
00:07:00,719 --> 00:06:57,729
about five hundred milliseconds although

143
00:07:03,329 --> 00:07:00,729
they called it here at 620 it actually

144
00:07:05,339 --> 00:07:03,339
occurs at about 500 and here in the high

145
00:07:07,409 --> 00:07:05,349
functioning a DD it's at 750

146
00:07:09,029 --> 00:07:07,419
milliseconds and here it just barely

147
00:07:11,719 --> 00:07:09,039
starts to happen at nine hundred

148
00:07:14,909 --> 00:07:11,729
milliseconds so the beta synchronization

149
00:07:16,379 --> 00:07:14,919
which is event related to the task it

150
00:07:21,719 --> 00:07:16,389
ends up being delayed further and

151
00:07:25,799 --> 00:07:21,729
further by being less conscious this is

152
00:07:29,579 --> 00:07:25,809
a by spectral index you can see on the

153
00:07:32,070 --> 00:07:29,589
upper right this is a Parkinson's

154
00:07:35,610 --> 00:07:32,080
patient when neural networks are bound

155
00:07:38,369 --> 00:07:35,620
and don't unlock gamma becomes

156
00:07:41,670 --> 00:07:38,379
persistent it doesn't occur in a dynamic

157
00:07:43,829 --> 00:07:41,680
chirp it's on so gamma is not

158
00:07:49,399 --> 00:07:43,839
necessarily a good thing it in fact

159
00:07:58,649 --> 00:07:49,409
occurs in pathology as well the off OOP

160
00:08:01,350 --> 00:07:58,659
let's go back if you go back here the

161
00:08:04,699 --> 00:08:01,360
non 45 degree angle line flares here

162
00:08:07,110 --> 00:08:04,709
this is a control a patient this is a

163
00:08:09,570 --> 00:08:07,120

Parkinson's patient with a bound neural

164
00:08:12,570 --> 00:08:09,580
network that's locked not just bound but

165
00:08:15,629 --> 00:08:12,580
locked and it loses the dynamic gammas

166
00:08:20,369 --> 00:08:15,639
on it just stays on that's pathological

167
00:08:23,399 --> 00:08:20,379
and as you can see if you gather not

168
00:08:26,579 --> 00:08:23,409
with respect to parkinsonism but all

169
00:08:29,009 --> 00:08:26,589
patients and you end up displaying all

170
00:08:31,709 --> 00:08:29,019
patients of all categories here the

171
00:08:33,899 --> 00:08:31,719
average of all patients you get off 45

172
00:08:35,600 --> 00:08:33,909
degree angle line flaring here the

173
00:08:40,409 --> 00:08:35,610
average of all controls you end up

174
00:08:44,100 --> 00:08:40,419
mimicking this display so when you have

175
00:08:46,019 --> 00:08:44,110
pathology it's extraordinarily common to

176
00:08:48,900 --> 00:08:46,029
end up seeing the lack of neural network

177
00:08:54,110 --> 00:08:48,910
dynamic shown as a by spectral index

178
00:08:57,300 --> 00:08:54,120
flare that's not appropriate so

179
00:09:02,100 --> 00:08:57,310
consciousness ends up being spawned by a

180
00:09:04,350 --> 00:09:02,110
cross spectral interaction between the

181
00:09:07,439 --> 00:09:04,360
slow cortical potentials or DC field

182
00:09:10,829 --> 00:09:07,449
potentials and neural network dynamics

183
00:09:15,110 --> 00:09:10,839
of gamma and when those two are related

184
00:09:19,680 --> 00:09:15,120
you're conscious the implication here

185
00:09:21,750 --> 00:09:19,690
for our next speaker is we actually did

186
00:09:24,840 --> 00:09:21,760
a recording on bill doing some healings

187
00:09:27,990 --> 00:09:24,850
and the implication for the model here

188
00:09:31,139 --> 00:09:28,000

is if you're looking for stuff that

189
00:09:34,560 --> 00:09:31,149
might be happening during these trance

190
00:09:37,980 --> 00:09:34,570
personal interactions look for cross

191
00:09:40,410 --> 00:09:37,990
spectral events that are associated with

192
00:09:43,470 --> 00:09:40,420
whatever these changes are that are

193
00:09:47,040 --> 00:09:43,480
happening during the healing and in fact

194
00:09:51,720 --> 00:09:47,050
using the by spectral approach we looked

195
00:09:53,790 --> 00:09:51,730
for harmonics suggesting that the neural

196
00:09:56,569 --> 00:09:53,800
networks were activated in a different