1
00:00:05,269 --> 00:00:03,169
attic Shiftwell this was a stable and

2
00:00:07,970 --> 00:00:05,279
flat as can be during the stick there

3
00:00:14,589 --> 00:00:07,980
there was no physiological evidence of

4
00:00:17,240 --> 00:00:14,599
him experiencing any pain whatsoever so

5
00:00:20,570 --> 00:00:17,250
what we've basically seen is that the

6
00:00:24,230 --> 00:00:20,580
eegees synchrony the turning on and off

7
00:00:28,400 --> 00:00:24,240
of these rhythms can be mediated by

8
00:00:31,009 --> 00:00:28,410
these DC field potentials but in a

9
00:00:33,560 --> 00:00:31,019
theoretical paper in by Weaver in

10
00:00:35,600 --> 00:00:33,570
nineteen ninety eight he suggested that

11
00:00:38,540 --> 00:00:35,610
we needed at least a hundred micro volt

12
00:00:41,020 --> 00:00:38,550
gradient where a millimeter away from it

13
00:00:46,569 --> 00:00:41,030

you'd have a hundred micro volts less

14
00:00:52,100 --> 00:00:46,579
voltage in the DC field potential and

15
00:00:55,130 --> 00:00:52,110
luckily we've known since 1875 that

16
00:00:57,650 --> 00:00:55,140
animals were capable of 150 to 200 micro

17
00:01:00,410 --> 00:00:57,660
volts per millimeter of field gradient

18
00:01:02,869 --> 00:01:00,420
so we do have enough juice to literally

19
00:01:05,719 --> 00:01:02,879
turn on and off synchrony or the

20
00:01:07,730 --> 00:01:05,729
rhythmic content of the brain and this

21
00:01:12,289 --> 00:01:07,740
can actually happen in the timescale of

22
00:01:14,929 --> 00:01:12,299
a millisecond you can initiate a rhythm

23
00:01:17,120 --> 00:01:14,939
you can create the onset of a rhythm

24
00:01:19,580 --> 00:01:17,130
within a millisecond or so using these

25
00:01:25,219 --> 00:01:19,590
DC field potentials and this is

26
00:01:28,640 --> 00:01:25,229
important the classical definition of

27
00:01:30,560 --> 00:01:28,650
binding that you're going to require a

28
00:01:32,210 --> 00:01:30,570
distant location to be bound with

29
00:01:35,210 --> 00:01:32,220
another location in order for things to

30
00:01:38,330 --> 00:01:35,220
work as an example if I move my hand I'm

31
00:01:40,850 --> 00:01:38,340
literally having a phase locking between

32
00:01:44,630 --> 00:01:40,860
my cerebellum the basal ganglia that

33
00:01:47,020 --> 00:01:44,640
modulate and smooth and help with

34
00:01:51,499 --> 00:01:47,030
movement the frontal lobe which

35
00:01:52,969 --> 00:01:51,509
initiates movement the motor strip this

36
00:01:57,560 --> 00:01:52,979
entire network has to have a

37
00:02:01,340 --> 00:01:57,570
phase-locked operation during the

38
00:02:03,319 --> 00:02:01,350

control of movement so the traditional

39
00:02:06,289 --> 00:02:03,329
view of this is that gamma is the

40
00:02:08,990 --> 00:02:06,299
binding rhythm but I'm here to here to

41
00:02:11,869 --> 00:02:09,000
tell you the heresy that gamma is far

42
00:02:13,790 --> 00:02:11,879
too slow to be the binding principle

43
00:02:16,150 --> 00:02:13,800
gamma emerges

44
00:02:19,340 --> 00:02:16,160
as a resonant property of bound networks

45
00:02:23,540 --> 00:02:19,350
it takes 45 milliseconds which is two

46
00:02:27,530 --> 00:02:23,550
wavelets worth of gamma for it to be

47
00:02:30,080 --> 00:02:27,540
seen in a neural network so it's a

48
00:02:32,450 --> 00:02:30,090
resonant property of having them bound

49
00:02:34,820 --> 00:02:32,460
but it's not the binding principle it's

50
00:02:36,440 --> 00:02:34,830
far too slow if you're going to bind a

51
00:02:39,260 --> 00:02:36,450
network for function you have to bind it

52
00:02:41,210 --> 00:02:39,270
now this millisecond not forty five

53
00:02:44,000 --> 00:02:41,220
milliseconds later after the fact so

54
00:02:45,740 --> 00:02:44,010
gamma emerges from bound networks but

55
00:02:48,830 --> 00:02:45,750
it's not the thing that binds them and

56
00:02:51,830 --> 00:02:48,840
it's easily understood why they've seen

57
00:02:53,690 --> 00:02:51,840
it as the binding rhythm because they've

58
00:02:56,810 --> 00:02:53,700
been looking with 40 a typically and

59
00:02:58,760 --> 00:02:56,820
Fourier smears the time domain and they

60
00:03:01,880 --> 00:02:58,770
don't see the the dynamics of the

61
00:03:03,590 --> 00:03:01,890
Fourier bursting and little chirps we'll

62
00:03:07,190 --> 00:03:03,600
see that in the displays I'm going to

63
00:03:10,100 --> 00:03:07,200

show you a little bit later this is an

64
00:03:12,290 --> 00:03:10,110
example of binding this is a each

65
00:03:15,650 --> 00:03:12,300
electrode in a high-density array has

66
00:03:17,750 --> 00:03:15,660
its own little spot up there and if

67
00:03:19,790 --> 00:03:17,760
you're perceiving something it takes you

68
00:03:23,720 --> 00:03:19,800
about 300 milliseconds to differentiate

69
00:03:27,199 --> 00:03:23,730
one stimulus from another and so let's

70
00:03:29,120 --> 00:03:27,209
say I threw out a double negative and

71
00:03:31,540 --> 00:03:29,130
your English teachers you know you've

72
00:03:34,130 --> 00:03:31,550
suddenly heard a semantic non sequitur

73
00:03:36,020 --> 00:03:34,140
there's a detector in your brain that

74
00:03:40,150 --> 00:03:36,030
will go off when you hear something

75
00:03:42,979 --> 00:03:40,160
that's not right and it's you know

76
00:03:45,290 --> 00:03:42,989
nicely that they refer to as a semantic

77
00:03:49,070 --> 00:03:45,300
non sequitur detector but let me tell

78
00:03:51,350 --> 00:03:49,080
you it's a BS detector yeah yeah when

79
00:03:53,000 --> 00:03:51,360
you hear something that's not right it

80
00:03:55,430 --> 00:03:53,010
takes you three hundred milliseconds to

81
00:03:58,250 --> 00:03:55,440
actually differentiate what you've heard

82
00:04:00,440 --> 00:03:58,260
from something else but at 400

83
00:04:03,440 --> 00:04:00,450
milliseconds your brain is going to have

84
00:04:05,840 --> 00:04:03,450
to identify whether it's BS or not just

85
00:04:08,490 --> 00:04:05,850
before you encode it into memory at 450

86
00:04:10,740 --> 00:04:08,500
milliseconds so

87
00:04:14,460 --> 00:04:10,750
the display that you see up front here

88
00:04:16,229 --> 00:04:14,470

is showing us that as as you approach

89
00:04:20,520 --> 00:04:16,239
this time period there are areas that

90
00:04:24,510 --> 00:04:20,530
are bound in and turned on to evaluate

91
00:04:27,420 --> 00:04:24,520
the the BS in the frontal lobe these are

92
00:04:29,790 --> 00:04:27,430
evaluative areas perceptual areas are

93
00:04:31,950 --> 00:04:29,800
now locked out if you're hearing BS you

94
00:04:33,420 --> 00:04:31,960
don't want to hear anymore BS so you're

95
00:04:36,470 --> 00:04:33,430
literally lock locking out your

96
00:04:39,270 --> 00:04:36,480
perceptual areas in locking in your

97
00:04:41,550 --> 00:04:39,280
evaluative frontal lobe areas and this

98
00:04:45,600 --> 00:04:41,560
happens on an instantaneous basis so

99
00:04:48,780 --> 00:04:45,610
binding is an important function it's

100
00:04:50,520 --> 00:04:48,790
how neural networks actually work and as

101
00:04:52,950 --> 00:04:50,530
a demonstration of it here you can see

102
00:04:57,030 --> 00:04:52,960
areas that are on an instantaneous basis

103
00:04:59,040 --> 00:04:57,040
when you hear something that is BS areas

104
00:05:00,990 --> 00:04:59,050
that evaluated are being turned on and

105
00:05:02,820 --> 00:05:01,000
locked in and areas that are going to

106
00:05:08,340 --> 00:05:02,830
continue to give you more BS are locked

107
00:05:10,680 --> 00:05:08,350
out traditionally again gamma is the

108
00:05:12,480 --> 00:05:10,690
binding rhythm that's the the gospel

109
00:05:13,740 --> 00:05:12,490
according to neurology at this point

110
00:05:16,770 --> 00:05:13,750
it's being taught in most of the

111
00:05:19,530 --> 00:05:16,780
universities but it's BS when I hear it

112
00:05:22,409 --> 00:05:19,540
my somatic non sequitur detector goes

113
00:05:27,840 --> 00:05:22,419

off before they probably start talking

114
00:05:30,860 --> 00:05:27,850
so but it's not the binding rhythm it's

115
00:05:35,310 --> 00:05:30,870
it's a property of being bound

116
00:05:37,680 --> 00:05:35,320
event-related potentials some of you may

117
00:05:40,770 --> 00:05:37,690
not be into EEG and ERPs and all of

118
00:05:42,450 --> 00:05:40,780
these so let's suggest what an ERP

119
00:05:45,570 --> 00:05:42,460
actually is before we talk about them a

120
00:05:49,860 --> 00:05:45,580
little bit you're going to receive this

121
00:05:52,890 --> 00:05:49,870
a sensory input as that reaches the

122
00:05:54,930 --> 00:05:52,900
cortex that's in a vote response that's

123
00:05:57,420 --> 00:05:54,940
like the knee-jerk you know boom that's

124
00:06:00,210 --> 00:05:57,430
a reflex it's just passing the signal up

125
00:06:02,450 --> 00:06:00,220
to the brain but from that point on the

126
00:06:07,100 --> 00:06:02,460
event-related potential is the brains

127
00:06:09,510 --> 00:06:07,110
oscillatory response to that input and

128
00:06:11,190 --> 00:06:09,520
essentially what happens is that at

129
00:06:11,750 --> 00:06:11,200
about a hundred milliseconds you get the

130
00:06:16,340 --> 00:06:11,760
court

131
00:06:18,140 --> 00:06:16,350
arrival of the signal and this is

132
00:06:19,970 --> 00:06:18,150
essentially very very similar to

133
00:06:22,400 --> 00:06:19,980
something called the perceptual frame if

134
00:06:25,670 --> 00:06:22,410
you perceive to stimuli and they're

135
00:06:27,950 --> 00:06:25,680
within about 75 to approximately 100

136
00:06:30,320 --> 00:06:27,960
milliseconds of each other you time lock

137
00:06:33,200 --> 00:06:30,330
them subjectively in your own mind as

138
00:06:35,540 --> 00:06:33,210

having happened at the same moment now

139
00:06:37,340 --> 00:06:35,550
you can perceive a 100 millisecond

140
00:06:40,100 --> 00:06:37,350
difference in time I mean that's not

141
00:06:42,020 --> 00:06:40,110
it's a tenth of a second you can you can

142
00:06:44,240 --> 00:06:42,030
tell something happened in a tenth of a

143
00:06:45,770 --> 00:06:44,250
second but if they happen within a tenth

144
00:06:47,840 --> 00:06:45,780
of a second literally they're bound

145
00:06:51,530 --> 00:06:47,850
together into the same perceptual packet

146
00:06:54,560 --> 00:06:51,540
and the brain processes these packets as

147
00:06:57,590 --> 00:06:54,570
a as a discrete chunk that's being

148
00:07:00,940 --> 00:06:57,600
processed you knit them back together

149
00:07:03,590 --> 00:07:00,950
into a stream that appears to be

150
00:07:07,990 --> 00:07:03,600
continuous but literally you're taking

151
00:07:10,670 --> 00:07:08,000
snapshots of the background of your life

152
00:07:15,020 --> 00:07:10,680
about ten times a second assuming your

153
00:07:17,090 --> 00:07:15,030
alpha frequency is Jen hurts people had

154
00:07:19,130 --> 00:07:17,100
have a faster alpha frequency have a

155
00:07:21,350 --> 00:07:19,140
faster snapshot they have an over

156
00:07:23,750 --> 00:07:21,360
sampling rate that's a little bit better

157
00:07:25,370 --> 00:07:23,760
and in fact they have a better semantic

158
00:07:28,550 --> 00:07:25,380
memory performance and typically a

159
00:07:30,920 --> 00:07:28,560
higher intelligence this work is out of

160
00:07:36,680 --> 00:07:30,930
salzburg austria a wolfgang klemish as

161
00:07:40,330 --> 00:07:36,690
lab in salzburg the this 100 millisecond

162
00:07:43,700 --> 00:07:40,340
time frame also has the initial

163
00:07:46,010 --> 00:07:43,710

processing of sensory inputs the

164
00:07:49,580 --> 00:07:46,020
Association cortex immediately adjacent

165
00:07:52,550 --> 00:07:49,590
to the primary sensory area receives the

166
00:07:55,760 --> 00:07:52,560
relay and the immediate surround in

167
00:07:58,160 --> 00:07:55,770
about that same time frame and the

168
00:08:00,290 --> 00:07:58,170
stimulus azhar projected up from the

169
00:08:02,450 --> 00:08:00,300
sensory areas in the back of the head up

170
00:08:04,610 --> 00:08:02,460
to the prefrontal and sensory

171
00:08:06,560 --> 00:08:04,620
integration areas the frontal areas are

172
00:08:09,200 --> 00:08:06,570
a valued of the parietal areas are

173
00:08:11,750 --> 00:08:09,210
sensory integration shortly thereafter

174
00:08:15,590 --> 00:08:11,760
so the brain is starting to actually

175
00:08:17,150 --> 00:08:15,600
process these pieces of information but

176
00:08:19,470 --> 00:08:17,160
the event-related potential has a

177
00:08:21,030 --> 00:08:19,480
specific morphology

178
00:08:23,820 --> 00:08:21,040
I'd like to mention it right now

179
00:08:25,890 --> 00:08:23,830
essentially if you phase reset or press

180
00:08:28,470 --> 00:08:25,900
the reset button and start alpha

181
00:08:30,930 --> 00:08:28,480
frequencies and theta frequencies at the

182
00:08:33,240 --> 00:08:30,940
same time add the two waveforms together

183
00:08:36,510 --> 00:08:33,250
and let them free run you get the wave

184
00:08:39,680 --> 00:08:36,520
shape of the event-related potential the

185
00:08:42,900 --> 00:08:39,690
DC field potentials can phase reset or

186
00:08:45,300 --> 00:08:42,910
initiate oscillatory activity within a

187
00:08:47,700 --> 00:08:45,310
millisecond so that the DC field

188
00:08:49,530 --> 00:08:47,710

potentials are literally hitting a reset

189
00:08:53,790 --> 00:08:49,540
button so that your brain can then

190
00:08:57,720 --> 00:08:53,800
process this activity the importance of

191
00:09:00,570 --> 00:08:57,730
this is that you have two basic systems

192
00:09:04,850 --> 00:09:00,580
within your brain that function for

193
00:09:08,970 --> 00:09:04,860
memory memory requires the frontal lobe

194
00:09:11,940 --> 00:09:08,980
and limbic systems theta frequencies

195
00:09:14,070 --> 00:09:11,950
which are slower as well as the more

196
00:09:16,050 --> 00:09:14,080
posterior alpha frequencies and they

197
00:09:18,900 --> 00:09:16,060
have to interact the frontal lobe is

198
00:09:21,540 --> 00:09:18,910
your working memory theta is associated

199
00:09:23,070 --> 00:09:21,550
with working memory and retrieval the

200
00:09:24,930 --> 00:09:23,080
Alpha frequencies on the back of the

201
00:09:27,390 --> 00:09:24,940
head are associated with semantic memory

202
00:09:30,870 --> 00:09:27,400
but for memory to work you have to take

203
00:09:32,930 --> 00:09:30,880
stuff from short-term hold the working

204
00:09:36,330 --> 00:09:32,940
memory and put it into long-term memory

205
00:09:39,210 --> 00:09:36,340
so if those two systems didn't have a

206
00:09:41,490 --> 00:09:39,220
method of interaction there'd be no data

207
00:09:45,090 --> 00:09:41,500
transfer between your working memory and

208
00:09:48,090 --> 00:09:45,100
your long-term memory and as Capri Bream

209
00:09:53,670 --> 00:09:48,100
has identified the memory storage itself

210
00:09:55,920 --> 00:09:53,680
is hollow holonomic holographic is what

211
00:09:58,800 --> 00:09:55,930
you put on a plate that holonomic is is