

IS THE UNIVERSE CONSCIOUS?



**MICHAEL
LEVIN**



**CHRIS
FIELDS**



**KARL
FRISTON**

1
00:00:04,150 --> 00:00:02,230
as always you can click on the timestamp

2
00:00:06,230 --> 00:00:04,160
in the description as well as here to

3
00:00:08,230 --> 00:00:06,240
skip this longish introduction the

4
00:00:10,310 --> 00:00:08,240
theories of everything channel is back

5
00:00:11,830 --> 00:00:10,320
with a new season starting with last

6
00:00:12,950 --> 00:00:11,840
week's ama which will be in the

7
00:00:14,470 --> 00:00:12,960
description

8
00:00:16,710 --> 00:00:14,480
from this point forward there will be

9
00:00:18,950 --> 00:00:16,720
new content approximately once a week

10
00:00:21,349 --> 00:00:18,960
sometimes even more frequently today's

11
00:00:23,429 --> 00:00:21,359
guests are carl fristen mike 11 and

12
00:00:25,670 --> 00:00:23,439
chris field the former two have been on

13
00:00:27,830 --> 00:00:25,680

this channel and mentioned several times

14

00:00:30,150 --> 00:00:27,840

prior whereas chris fields is making his

15

00:00:32,709 --> 00:00:30,160

debut chris fields is a researcher in

16

00:00:35,030 --> 00:00:32,719

topological quantum field theory as well

17

00:00:37,110 --> 00:00:35,040

as information theory and publishes work

18

00:00:39,190 --> 00:00:37,120

on what constitutes an observer carl

19

00:00:41,430 --> 00:00:39,200

fristin is a professor of neuroscience

20

00:00:43,030 --> 00:00:41,440

at the university college london and is

21

00:00:44,630 --> 00:00:43,040

the inventor of the free energy

22

00:00:46,790 --> 00:00:44,640

principle michael levin is the

23

00:00:49,029 --> 00:00:46,800

developmental and synthetic biologist at

24

00:00:51,189 --> 00:00:49,039

the tufts university the links to all

25

00:00:52,869 --> 00:00:51,199

their previous podcasts on the toad

26

00:00:54,790 --> 00:00:52,879

channel will be in the description my

27

00:00:56,150 --> 00:00:54,800

name is kurt jaymungal i'm a torontonian

28

00:00:58,709 --> 00:00:56,160

filmmaker with a background in

29

00:01:00,709 --> 00:00:58,719

mathematical physics dedicated to the

30

00:01:02,709 --> 00:01:00,719

explication quote unquote of the

31

00:01:05,030 --> 00:01:02,719

variegated terrain of theories of

32

00:01:06,950 --> 00:01:05,040

everything primarily from a theoretical

33

00:01:09,030 --> 00:01:06,960

physics perspective but as well as

34

00:01:10,950 --> 00:01:09,040

trying to understand what role does

35

00:01:13,270 --> 00:01:10,960

consciousness have as constitutive

36

00:01:15,749 --> 00:01:13,280

reality is it emergent is it fundamental

37

00:01:18,469 --> 00:01:15,759

now the goals of theo locutions is to

38

00:01:20,230 --> 00:01:18,479

interject seldomly if at all allowing

39

00:01:21,910 --> 00:01:20,240

each guest to give their perspectives on

40

00:01:23,990 --> 00:01:21,920

one another's thoughts essentially

41

00:01:25,670 --> 00:01:24,000

giving us the experience of a fly on the

42

00:01:27,429 --> 00:01:25,680

wall for the sorts of academic

43

00:01:29,990 --> 00:01:27,439

conversations that would ordinarily

44

00:01:32,310 --> 00:01:30,000

occur behind closed doors spurring

45

00:01:34,310 --> 00:01:32,320

research in real time one of the central

46

00:01:36,310 --> 00:01:34,320

issues of today's podcast is the concept

47

00:01:38,469 --> 00:01:36,320

of babbling which i haven't heard

48

00:01:40,390 --> 00:01:38,479

discussed virtually anywhere else

49

00:01:42,469 --> 00:01:40,400

outside of child development or language

50

00:01:44,630 --> 00:01:42,479

acquisition though it can be generalized

51
00:01:46,710 --> 00:01:44,640
metaphorically perhaps even literally to

52
00:01:48,950 --> 00:01:46,720
the vacuum fluctuations to interpret

53
00:01:50,630 --> 00:01:48,960
what vacuum fluctuations are doing as an

54
00:01:53,190 --> 00:01:50,640
indicator of the universe's

55
00:01:55,270 --> 00:01:53,200
proto-consciousness that is the universe

56
00:01:57,109 --> 00:01:55,280
babbling to understand itself but i

57
00:01:59,109 --> 00:01:57,119
won't spoil the surprise if you'd like

58
00:02:01,510 --> 00:01:59,119
to hear more podcasts like these then do

59
00:02:03,910 --> 00:02:01,520
consider going to patreon.com

60
00:02:06,389 --> 00:02:03,920
kurtjmungle as the patrons and the

61
00:02:08,469 --> 00:02:06,399
sponsors are the only reasons that i'm

62
00:02:10,389 --> 00:02:08,479
able to do this full time with regard to

63
00:02:12,229 --> 00:02:10,399

sponsors there's one for today's episode

64

00:02:13,830 --> 00:02:12,239

and that is brilliant during the winter

65

00:02:16,150 --> 00:02:13,840

break i decided to brush up on the

66

00:02:17,910 --> 00:02:16,160

fundamentals of information theory which

67

00:02:19,589 --> 00:02:17,920

is what constructor theory is heavily

68

00:02:21,430 --> 00:02:19,599

based in and i'd like to do an episode

69

00:02:23,110 --> 00:02:21,440

on that so i took brilliant's course on

70

00:02:25,350 --> 00:02:23,120

knowledge and uncertainty and random

71

00:02:27,510 --> 00:02:25,360

variables and after taking that course i

72

00:02:29,910 --> 00:02:27,520

could finally see why entropy is defined

73

00:02:32,470 --> 00:02:29,920

the way it is why the formula for it is

74

00:02:34,790 --> 00:02:32,480

extremely natural there are plenty of

75

00:02:36,309 --> 00:02:34,800

courses you can even learn group theory

76

00:02:38,390 --> 00:02:36,319

which is what's being referenced when

77

00:02:41,910 --> 00:02:38,400

you hear that the internal symmetries of

78

00:02:44,390 --> 00:02:41,920

the standard model is u_1 cross s_2 cross

79

00:02:47,110 --> 00:02:44,400

su 3 those are league groups visit

80

00:02:48,949 --> 00:02:47,120

brilliant.org toe to get 20 off the

81

00:02:51,830 --> 00:02:48,959

annual subscription i recommend that you

82

00:02:53,990 --> 00:02:51,840

don't stop before four lessons just keep

83

00:02:56,150 --> 00:02:54,000

pursuing until you've accomplished at

84

00:02:57,990 --> 00:02:56,160

least four and i think you'll be greatly

85

00:03:00,070 --> 00:02:58,000

surprised at the ease at which you can

86

00:03:02,229 --> 00:03:00,080

now comprehend subjects you previously

87

00:03:04,149 --> 00:03:02,239

had a difficult time grocking and now on

88

00:03:06,630 --> 00:03:04,159

to today's episode which is one that i'm

89

00:03:08,390 --> 00:03:06,640

extremely lucky to be able to present to

90

00:03:10,470 --> 00:03:08,400

you all you'll be able to see the mutual

91

00:03:12,710 --> 00:03:10,480

respect that the guests have for one

92

00:03:14,309 --> 00:03:12,720

another we start off actually by asking

93

00:03:16,149 --> 00:03:14,319

what is it that you respect about each

94

00:03:18,470 --> 00:03:16,159

other's work enjoy this theo locution

95

00:03:21,190 --> 00:03:18,480

between carl fristen michael levin and

96

00:03:22,149 --> 00:03:21,200

chris fields i've been extremely excited

97

00:03:24,070 --> 00:03:22,159

about this

98

00:03:26,630 --> 00:03:24,080

so professor what do you find unique

99

00:03:29,270 --> 00:03:26,640

about carl's and chris's work and what

100

00:03:31,270 --> 00:03:29,280

is it that you respect about them

101

00:03:33,030 --> 00:03:31,280

well what a great question i think all

102

00:03:35,750 --> 00:03:33,040

discussions should uh should should

103

00:03:37,430 --> 00:03:35,760

start with that question um uh there's a

104

00:03:39,270 --> 00:03:37,440

lot i mean i think i think uh the most

105

00:03:41,430 --> 00:03:39,280

basic thing i can say is this that i'm

106

00:03:44,149 --> 00:03:41,440

i'm often asked by by uh conference

107

00:03:45,509 --> 00:03:44,159

organizers and students as far as who

108

00:03:47,589 --> 00:03:45,519

who they should follow yeah who's whose

109

00:03:50,390 --> 00:03:47,599

work they should um keep track of and

110

00:03:52,149 --> 00:03:50,400

and so i keep lists and uh and and carl

111

00:03:53,910 --> 00:03:52,159

and chris are at the very top of two

112

00:03:56,309 --> 00:03:53,920

specific lists for me and i'm just

113

00:03:58,710 --> 00:03:56,319

always amazed about this is that the

114

00:04:01,270 --> 00:03:58,720

first the first is that um both of them

115

00:04:03,350 --> 00:04:01,280

are experts in at least three different

116

00:04:05,350 --> 00:04:03,360

fields but probably more so so so they

117

00:04:07,270 --> 00:04:05,360

have the ability to kind of merge really

118

00:04:08,390 --> 00:04:07,280

deep um understanding of different

119

00:04:10,309 --> 00:04:08,400

fields i mean there's many people that

120

00:04:12,309 --> 00:04:10,319

are experts in one thing

121

00:04:14,149 --> 00:04:12,319

but i'm just i'm just always incredibly

122

00:04:16,390 --> 00:04:14,159

impressed that's how they uh both of

123

00:04:18,310 --> 00:04:16,400

them can we weave together a really deep

124

00:04:20,870 --> 00:04:18,320

knowledge from from from diverse

125

00:04:22,710 --> 00:04:20,880

disciplines and and and that leads to

126

00:04:24,870 --> 00:04:22,720

the kind of the second thing that that

127

00:04:26,950 --> 00:04:24,880

i'm really inspired by which is just the

128

00:04:28,310 --> 00:04:26,960

kind of the sheer density of new ideas

129

00:04:30,310 --> 00:04:28,320

you know it's hard enough to push things

130

00:04:32,310 --> 00:04:30,320

in one just kind of one known direction

131

00:04:34,230 --> 00:04:32,320

and do science and so on but both both

132

00:04:36,629 --> 00:04:34,240

chris and carl's work um consistently

133

00:04:38,629 --> 00:04:36,639

make me think in new ways uh give me

134

00:04:41,350 --> 00:04:38,639

ideas i've never never thought of before

135

00:04:43,350 --> 00:04:41,360

it's just just just amazing so yeah so

136

00:04:44,870 --> 00:04:43,360

i'm super excited to be able to work

137

00:04:46,150 --> 00:04:44,880

with both of them and to have this

138

00:04:47,430 --> 00:04:46,160

discussion

139

00:04:50,469 --> 00:04:47,440

great

140

00:04:51,990 --> 00:04:50,479

chris same question but toward michael

141

00:04:55,030 --> 00:04:52,000

and carl

142

00:04:56,550 --> 00:04:55,040

uh well i can say that

143

00:04:58,390 --> 00:04:56,560

one thing i certainly

144

00:04:59,670 --> 00:04:58,400

admire

145

00:05:01,430 --> 00:04:59,680

is that

146

00:05:03,510 --> 00:05:01,440

uh

147

00:05:05,590 --> 00:05:03,520

michael and carl are both

148

00:05:08,070 --> 00:05:05,600

top-level biologists who are interested

149

00:05:14,070 --> 00:05:08,080

in theory

150

00:05:15,029 --> 00:05:14,080

and have a deep understanding

151
00:05:17,590 --> 00:05:15,039
of

152
00:05:18,390 --> 00:05:17,600
uh theory

153
00:05:19,590 --> 00:05:18,400
and

154
00:05:22,310 --> 00:05:19,600
uh

155
00:05:24,629 --> 00:05:22,320
something that i enormously admire

156
00:05:26,390 --> 00:05:24,639
is that both of them

157
00:05:29,430 --> 00:05:26,400
have that interest

158
00:05:31,510 --> 00:05:29,440
and yet are deeply engaged in practical

159
00:05:32,629 --> 00:05:31,520
applications

160
00:05:34,950 --> 00:05:32,639
uh

161
00:05:38,629 --> 00:05:34,960
carl and mental health and

162
00:05:41,029 --> 00:05:38,639
mike and regenerative biology

163
00:05:45,430 --> 00:05:41,039

and that's

164

00:05:49,270 --> 00:05:47,029

carl what is it that you find unique

165

00:05:51,029 --> 00:05:49,280

about michael's and chris's work and

166

00:05:53,749 --> 00:05:51,039

what do you particularly respect about

167

00:05:55,590 --> 00:05:53,759

them as people perhaps

168

00:05:57,749 --> 00:05:55,600

i deliberately haven't rehearsed an

169

00:05:58,629 --> 00:05:57,759

answer so what i say comes from the

170

00:05:59,510 --> 00:05:58,639

heart

171

00:06:04,150 --> 00:05:59,520

um

172

00:06:07,029 --> 00:06:04,160

i first met him vicariously through a

173

00:06:08,070 --> 00:06:07,039

friend giovanni pizzulo

174

00:06:09,670 --> 00:06:08,080

and

175

00:06:11,590 --> 00:06:09,680

didn't really know very much about his

176

00:06:14,070 --> 00:06:11,600

work until i visited his website and

177

00:06:16,550 --> 00:06:14,080

then i realized how influential and

178

00:06:19,270 --> 00:06:16,560

important he was and then i recognized

179

00:06:21,350 --> 00:06:19,280

all the little bulletins you get on

180

00:06:23,110 --> 00:06:21,360

social media and emails i started to

181

00:06:24,790 --> 00:06:23,120

recognize his name and realize that he

182

00:06:26,390 --> 00:06:24,800

was you know he was quite a mover and

183

00:06:28,150 --> 00:06:26,400

shaker out there

184

00:06:30,390 --> 00:06:28,160

what i like about both of them they both

185

00:06:34,230 --> 00:06:30,400

think really really fast and they both

186

00:06:37,270 --> 00:06:34,240

think out of the box um

187

00:06:39,189 --> 00:06:37,280

so i think what characterizes

188

00:06:42,150 --> 00:06:39,199

both of their thinking really is just to

189

00:06:44,230 --> 00:06:42,160

ask what is a thing in and of itself

190

00:06:46,790 --> 00:06:44,240

without making any prior assumptions and

191

00:06:48,870 --> 00:06:46,800

then putting it back together

192

00:06:52,309 --> 00:06:48,880

from basic principles and coming up with

193

00:06:55,189 --> 00:06:52,319

some sometimes counter-intuitive um

194

00:06:58,390 --> 00:06:55,199

conclusions and but for me

195

00:07:00,710 --> 00:06:58,400

almost uh universally exactly the same

196

00:07:02,230 --> 00:07:00,720

counter-intuitive conclusions i've come

197

00:07:03,909 --> 00:07:02,240

to after about 10 years of thinking

198

00:07:06,150 --> 00:07:03,919

about a particular problem but never

199

00:07:09,029 --> 00:07:06,160

dare tell anybody but they do they write

200

00:07:11,589 --> 00:07:09,039

it down very eloquently and

201

00:07:14,150 --> 00:07:11,599

they're very very productive

202

00:07:17,670 --> 00:07:14,160

chris i've known for less long and i've

203

00:07:20,469 --> 00:07:17,680

met him via mike um and

204

00:07:23,749 --> 00:07:20,479

in addition to that in the same way that

205

00:07:26,629 --> 00:07:23,759

many people i meet have physics envy and

206

00:07:29,270 --> 00:07:26,639

i've got quantum envy uh for about chris

207

00:07:31,589 --> 00:07:29,280

yeah he just seems to know so much

208

00:07:34,390 --> 00:07:31,599

and think about the world in a way which

209

00:07:37,589 --> 00:07:34,400

i don't have that sort of fluency in but

210

00:07:39,270 --> 00:07:37,599

it sounds really really useful and and

211

00:07:41,270 --> 00:07:39,280

quite correct so i'm hoping if i hang

212

00:07:42,230 --> 00:07:41,280

around long enough some of it will rub

213

00:07:43,670 --> 00:07:42,240

off on me

214

00:07:46,390 --> 00:07:43,680

should be able to use the words without

215

00:07:47,589 --> 00:07:46,400

sounding like an idiot

216

00:07:49,270 --> 00:07:47,599

what would be an example of this

217

00:07:50,950 --> 00:07:49,280

out-of-the-box thinking you mentioned

218

00:07:52,309 --> 00:07:50,960

thinking about what is a thing in and of

219

00:07:56,230 --> 00:07:52,319

itself

220

00:08:01,350 --> 00:07:59,110

there are numerous examples um the first

221

00:08:02,869 --> 00:08:01,360

thing that just came to mind was just

222

00:08:04,350 --> 00:08:02,879

putting together

223

00:08:06,790 --> 00:08:04,360

fundamental questions about

224

00:08:08,790 --> 00:08:06,800

self-organization if you were varela uh

225

00:08:11,110 --> 00:08:08,800

you know so autophagus self-assembly

226

00:08:13,029 --> 00:08:11,120

self-construction if you're a chemist it

227

00:08:14,710 --> 00:08:13,039

would be self-assembly if you're a

228

00:08:17,749 --> 00:08:14,720

theoretical biologist

229

00:08:21,189 --> 00:08:17,759

um you will be wondering about why on

230

00:08:22,950 --> 00:08:21,199

earth is it that um all multicellular

231

00:08:25,270 --> 00:08:22,960

organisms form

232

00:08:27,029 --> 00:08:25,280

because there's a deep paradox there yep

233

00:08:29,350 --> 00:08:27,039

if it is the case that i have to have a

234

00:08:31,749 --> 00:08:29,360

surface as a little organ

235

00:08:33,509 --> 00:08:31,759

then some of myself have cells have to

236

00:08:35,750 --> 00:08:33,519

stop replicating and yet that is in

237

00:08:37,670 --> 00:08:35,760

direct contradiction to the principles

238

00:08:40,070 --> 00:08:37,680

of natural selection i'm going to turn

239

00:08:42,389 --> 00:08:40,080

off my reproductive capacity my adaptive

240

00:08:44,949 --> 00:08:42,399

fitness so defined in a theoretical

241

00:08:46,949 --> 00:08:44,959

context so i just really sit down

242

00:08:49,430 --> 00:08:46,959

grasping the nettle i'm thinking about

243

00:08:52,150 --> 00:08:49,440

well these things exist

244

00:08:54,070 --> 00:08:52,160

what principles could possibly explain

245

00:08:56,070 --> 00:08:54,080

the paradoxes were looked at from sort

246

00:08:58,389 --> 00:08:56,080

of the unilateral the monothematic view

247

00:09:01,110 --> 00:08:58,399

of natural selection for example or the

248

00:09:03,990 --> 00:09:01,120

monothematic view of self-organization

249

00:09:06,630 --> 00:09:04,000

in physics so thinking out of the box

250

00:09:08,790 --> 00:09:06,640

literally in this instance um entails

251
00:09:11,030 --> 00:09:08,800
being able to take multiple perspectives

252
00:09:12,710 --> 00:09:11,040
on a particular problem and seeing the

253
00:09:14,790 --> 00:09:12,720
contradictions and seeing how they can

254
00:09:17,509 --> 00:09:14,800
be resolved now they'll be one of many

255
00:09:18,870 --> 00:09:17,519
examples uh look there was a paper like

256
00:09:20,310 --> 00:09:18,880
i'm afraid i can't remember the specific

257
00:09:23,110 --> 00:09:20,320
one perhaps mike and chris will be able

258
00:09:24,470 --> 00:09:23,120
to enlighten me but there was one

259
00:09:26,470 --> 00:09:24,480
paper

260
00:09:28,389 --> 00:09:26,480
written i i think about a year or two

261
00:09:31,350 --> 00:09:28,399
ago where they actually listed i think

262
00:09:34,630 --> 00:09:31,360
there were 15 basic conclusions about

263
00:09:38,150 --> 00:09:34,640

the the fundamentals and the and the

264

00:09:41,670 --> 00:09:38,160

the nature of self-organization and self

265

00:09:43,829 --> 00:09:41,680

as distinct from other uh in any system

266

00:09:46,070 --> 00:09:43,839

and you know this listing uh

267

00:09:49,750 --> 00:09:46,080

15 really interesting points and

268

00:09:51,509 --> 00:09:49,760

predictions all of which either um i'm

269

00:09:53,110 --> 00:09:51,519

sure will be formally demonstrably

270

00:09:54,870 --> 00:09:53,120

analytically um

271

00:09:57,990 --> 00:09:54,880

true uh or

272

00:10:01,110 --> 00:09:58,000

at least yield or be amenable to a

273

00:10:03,910 --> 00:10:01,120

mathematical analysis um or would be

274

00:10:06,310 --> 00:10:03,920

empirically verifiable um over the next

275

00:10:07,990 --> 00:10:06,320

few years

276

00:10:09,590 --> 00:10:08,000

what was that

277

00:10:11,430 --> 00:10:09,600

there was a paper in neuroscience of

278

00:10:12,389 --> 00:10:11,440

consciousness

279

00:10:14,069 --> 00:10:12,399

of

280

00:10:14,949 --> 00:10:14,079

arguing for

281

00:10:48,790 --> 00:10:14,959

a

282

00:10:49,590 --> 00:10:48,800

world how did they see the world

283

00:10:51,990 --> 00:10:49,600

uh

284

00:10:54,389 --> 00:10:52,000

how does it how does e coli perceive the

285

00:10:55,269 --> 00:10:54,399

world for example

286

00:10:57,590 --> 00:10:55,279

and

287

00:11:00,949 --> 00:10:57,600

we suggested that

288

00:11:03,430 --> 00:11:00,959

the the answer is in in terms of of the

289

00:11:06,310 --> 00:11:03,440

sorts of things that we call taste and

290

00:11:10,870 --> 00:11:07,590

but that

291

00:11:13,590 --> 00:11:10,880

experiences of taste and viscosity are

292

00:11:16,230 --> 00:11:13,600

perfectly good kinds of experiences

293

00:11:17,110 --> 00:11:16,240

and that if we think about

294

00:11:19,990 --> 00:11:17,120

how

295

00:11:23,590 --> 00:11:20,000

these kinds of systems

296

00:11:30,550 --> 00:11:26,550

and solve problems within their worlds

297

00:11:34,550 --> 00:11:32,949

unified understanding of what it meant

298

00:11:37,030 --> 00:11:34,560

to be

299

00:11:38,790 --> 00:11:37,040

a system that was aware

300

00:11:40,870 --> 00:11:38,800

and so you're trying to

301
00:11:43,030 --> 00:11:40,880
use e coli as a

302
00:11:45,430 --> 00:11:43,040
means of understanding yourself or

303
00:11:47,110 --> 00:11:45,440
humans by the way is this a project do

304
00:11:48,710 --> 00:11:47,120
you feel like your undertaking is an

305
00:11:50,629 --> 00:11:48,720
attempt for you to understand yourself

306
00:11:52,389 --> 00:11:50,639
or you're trying to understand humans

307
00:11:54,230 --> 00:11:52,399
like i'm wondering is this more

308
00:11:57,430 --> 00:11:54,240
philanthropic or it's selfish and then

309
00:11:59,350 --> 00:11:57,440
it bleeds into the philanthropic

310
00:12:03,670 --> 00:11:59,360
well i i actually also want to

311
00:12:08,230 --> 00:12:05,670
and b we have

312
00:12:11,269 --> 00:12:08,240
we don't have a great understanding of

313
00:12:12,870 --> 00:12:11,279

of the lives of other organisms

314

00:12:15,350 --> 00:12:12,880

professor levin

315

00:12:17,990 --> 00:12:15,360

what puzzle do you find most important

316

00:12:20,150 --> 00:12:18,000

what do you think about on a semi daily

317

00:12:22,629 --> 00:12:20,160

basis or even perhaps multiple times a

318

00:12:25,030 --> 00:12:22,639

day and then we'll go around the table

319

00:12:27,430 --> 00:12:25,040

here with chris fields and carl fursten

320

00:12:28,949 --> 00:12:27,440

next and then it's essentially me taking

321

00:12:30,790 --> 00:12:28,959

a backseat and allowing you all to free

322

00:12:33,430 --> 00:12:30,800

flow just for the audience to know i

323

00:12:35,829 --> 00:12:33,440

know you all know this template already

324

00:12:38,470 --> 00:12:35,839

yeah um so so the thing i think about

325

00:12:40,470 --> 00:12:38,480

many times a day has to do with the

326

00:12:42,949 --> 00:12:40,480

scaling of cognition so i want to

327

00:12:46,310 --> 00:12:42,959

understand to two two major things one

328

00:12:48,550 --> 00:12:46,320

is how it is that uh some collection of

329

00:12:49,750 --> 00:12:48,560

competent uh parts comes together to

330

00:12:52,389 --> 00:12:49,760

form a

331

00:12:53,509 --> 00:12:52,399

an emergent self with preferences goals

332

00:12:55,509 --> 00:12:53,519

memories

333

00:12:57,269 --> 00:12:55,519

cognitive capacities that belong to it

334

00:12:58,710 --> 00:12:57,279

but not to the individual parts so i

335

00:13:00,870 --> 00:12:58,720

want to understand how that how that

336

00:13:03,190 --> 00:13:00,880

emerges how the goals of uh you know

337

00:13:04,949 --> 00:13:03,200

sort of humble um

338

00:13:07,350 --> 00:13:04,959

a simple uh simple kinds of systems

339

00:13:08,949 --> 00:13:07,360

scale up into much more grandiose goals

340

00:13:11,269 --> 00:13:08,959

that we see in during during development

341

00:13:13,990 --> 00:13:11,279

during behavior uh you know during uh

342

00:13:16,069 --> 00:13:14,000

culture and and so on and and i'm also

343

00:13:17,829 --> 00:13:16,079

very interested in uh the sort of the

344

00:13:19,670 --> 00:13:17,839

left side of that spectrum where does it

345

00:13:22,389 --> 00:13:19,680

begin you know is there really a zero on

346

00:13:23,670 --> 00:13:22,399

the spectrum i think that uh all of us

347

00:13:25,110 --> 00:13:23,680

we here would agree that there is a

348

00:13:27,350 --> 00:13:25,120

spectrum for these things it's not a set

349

00:13:28,790 --> 00:13:27,360

of binary categories but what happens at

350

00:13:30,150 --> 00:13:28,800

the very left side of the spectrum and

351
00:13:31,829 --> 00:13:30,160
so one of the first questions you know

352
00:13:33,910 --> 00:13:31,839
when we get to that that um that i'd

353
00:13:36,069 --> 00:13:33,920
written down to ask both chris and

354
00:13:38,069 --> 00:13:36,079
carlos to sort of comment on

355
00:13:40,069 --> 00:13:38,079
what does the what does the venn diagram

356
00:13:41,670 --> 00:13:40,079
look like of of the set of things that

357
00:13:43,829 --> 00:13:41,680
are alive versus the set of things that

358
00:13:45,750 --> 00:13:43,839
are cognitive yeah how do those two

359
00:13:47,269 --> 00:13:45,760
categories relate to each other until

360
00:13:49,030 --> 00:13:47,279
they overlap is one a subset of the

361
00:13:51,110 --> 00:13:49,040
other and what really happens at the

362
00:13:53,990 --> 00:13:51,120
very beginning you know like

363
00:13:55,750 --> 00:13:54,000

can we can we develop a kind of um

364

00:13:57,509 --> 00:13:55,760

which which i think i think both of them

365

00:13:59,509 --> 00:13:57,519

have been working on a kind of basically

366

00:14:03,189 --> 00:13:59,519

a kind of pan psychism that doesn't

367

00:14:04,949 --> 00:14:03,199

doesn't sort of paint on new cognitive

368

00:14:07,590 --> 00:14:04,959

mysteries on top of physics that works

369

00:14:09,990 --> 00:14:07,600

perfectly well but instead to try and to

370

00:14:12,230 --> 00:14:10,000

try to view physics from the bottom up

371

00:14:14,310 --> 00:14:12,240

as having already a useful cognitive

372

00:14:16,310 --> 00:14:14,320

lens on it and how does that help us to

373

00:14:19,509 --> 00:14:16,320

build up cognition so that's that's

374

00:14:22,790 --> 00:14:19,519

something that i think about every day

375

00:14:22,800 --> 00:14:25,269

um

376

00:14:29,430 --> 00:14:26,949

i i thought

377

00:14:30,710 --> 00:14:29,440

every day or almost every day for a long

378

00:14:31,829 --> 00:14:30,720

time

379

00:14:33,750 --> 00:14:31,839

about

380

00:14:34,710 --> 00:14:33,760

why

381

00:14:36,790 --> 00:14:34,720

we

382

00:14:40,150 --> 00:14:36,800

humans

383

00:14:44,470 --> 00:14:40,160

see objects embedded in space-time

384

00:14:46,790 --> 00:14:44,480

so why do we see things

385

00:14:47,990 --> 00:14:46,800

that we treat as independent of each

386

00:14:50,389 --> 00:14:48,000

other

387

00:14:52,790 --> 00:14:50,399

and why do we

388

00:14:54,230 --> 00:14:52,800

see them operate on them interact with

389

00:14:56,829 --> 00:14:54,240

them

390

00:14:59,829 --> 00:14:56,839

as

391

00:15:02,310 --> 00:14:59,839

embedded in this coordinate system that

392

00:15:03,189 --> 00:15:02,320

we call space

393

00:15:05,430 --> 00:15:03,199

and

394

00:15:08,150 --> 00:15:05,440

uh equally important

395

00:15:11,030 --> 00:15:08,160

why do we see them as maintaining

396

00:15:13,350 --> 00:15:11,040

their identities as things

397

00:15:19,030 --> 00:15:13,360

over this other coordinate that we call

398

00:15:22,550 --> 00:15:21,269

carl

399

00:15:25,430 --> 00:15:22,560

um

400

00:15:28,310 --> 00:15:25,440

i have to confess i spend recurrently

401
00:15:30,150 --> 00:15:28,320
most of my time thinking about me um but

402
00:15:31,350 --> 00:15:30,160
in an academic sense you know how do i

403
00:15:32,230 --> 00:15:31,360
work

404
00:15:34,550 --> 00:15:32,240
so

405
00:15:37,749 --> 00:15:34,560
it's a curious mixture of

406
00:15:40,710 --> 00:15:37,759
introspection and trying to understand

407
00:15:42,310 --> 00:15:40,720
why i can introspect uh in from the

408
00:15:45,590 --> 00:15:42,320
perspective or through the lens of a

409
00:15:48,470 --> 00:15:45,600
physicist so i i spend most of my time

410
00:15:51,990 --> 00:15:48,480
dissembling preconceptions the gifts

411
00:15:53,590 --> 00:15:52,000
that uh our sentience has given us um

412
00:15:56,069 --> 00:15:53,600
and try to

413
00:15:58,389 --> 00:15:56,079

reassemble them in relation to

414

00:16:01,030 --> 00:15:58,399

physics density dynamics uh you know

415

00:16:02,790 --> 00:16:01,040

that that has to be articulated in terms

416

00:16:05,030 --> 00:16:02,800

of the kind of maths that a physicist

417

00:16:07,350 --> 00:16:05,040

would use which would be effectively

418

00:16:08,870 --> 00:16:07,360

differential equations and the calculus

419

00:16:11,269 --> 00:16:08,880

of variations

420

00:16:12,069 --> 00:16:11,279

and having done that there are so many

421

00:16:16,150 --> 00:16:12,079

um

422

00:16:18,790 --> 00:16:16,160

parts but not that many uh but the

423

00:16:20,629 --> 00:16:18,800

combinatorics then lead you to the

424

00:16:23,189 --> 00:16:20,639

the kinds of questions that mike was was

425

00:16:26,069 --> 00:16:23,199

talking about so you know what different

426

00:16:27,910 --> 00:16:26,079

ways could this um

427

00:16:28,870 --> 00:16:27,920

physics of sentience

428

00:16:31,590 --> 00:16:28,880

um

429

00:16:33,430 --> 00:16:31,600

be manifest what possible ways could it

430

00:16:37,189 --> 00:16:33,440

be manifest and how does that address

431

00:16:40,949 --> 00:16:37,199

the distinction between um things

432

00:16:43,749 --> 00:16:40,959

particles creatures um that would show

433

00:16:45,670 --> 00:16:43,759

the kind of sense-making and to my mind

434

00:16:47,910 --> 00:16:45,680

an important aspect is planning that

435

00:16:50,470 --> 00:16:47,920

this would disambiguate them from other

436

00:16:52,389 --> 00:16:50,480

natural kinds or particular kinds that

437

00:16:54,629 --> 00:16:52,399

don't have that kind of facility and

438

00:16:56,310 --> 00:16:54,639

what underwrites that um

439

00:16:58,949 --> 00:16:56,320

so that's what i spend most of my time

440

00:16:59,749 --> 00:16:58,959

doing i have to say in conversation both

441

00:17:03,189 --> 00:16:59,759

with

442

00:17:06,150 --> 00:17:03,199

mike and chris and other people um

443

00:17:08,949 --> 00:17:06,160

there you can easily get distracted um

444

00:17:09,750 --> 00:17:08,959

in in a rightful way um

445

00:17:13,189 --> 00:17:09,760

by

446

00:17:14,710 --> 00:17:13,199

um thinking about that mechanics in uh

447

00:17:18,230 --> 00:17:14,720

exactly what chris was talking to which

448

00:17:20,870 --> 00:17:18,240

is a scale-free way but in my rhetoric

449

00:17:22,710 --> 00:17:20,880

that scale freeness speaks more to the

450

00:17:24,789 --> 00:17:22,720

coupling between different scales that

451

00:17:26,150 --> 00:17:24,799

mike was alluding to

452

00:17:28,789 --> 00:17:26,160

so how does

453

00:17:31,029 --> 00:17:28,799

this um mechanics this physics of

454

00:17:33,270 --> 00:17:31,039

sentience which which i understand

455

00:17:34,070 --> 00:17:33,280

largely in terms of probability theory

456

00:17:37,270 --> 00:17:34,080

and

457

00:17:38,710 --> 00:17:37,280

effectively bayesian um probability

458

00:17:40,950 --> 00:17:38,720

theory

459

00:17:43,510 --> 00:17:40,960

so what you have is a bayesian mechanics

460

00:17:46,230 --> 00:17:43,520

how does that basic mechanics apply at

461

00:17:47,830 --> 00:17:46,240

one scale and another scale and then of

462

00:17:50,310 --> 00:17:47,840

course the big questions is how did the

463

00:17:52,950 --> 00:17:50,320

two scales couple to each other so that

464

00:17:56,150 --> 00:17:52,960

that that for me is something that i i

465

00:17:57,510 --> 00:17:56,160

find myself increasingly pressed upon

466

00:18:00,390 --> 00:17:57,520

largely through conversations and

467

00:18:02,230 --> 00:18:00,400

collaborations um

468

00:18:03,909 --> 00:18:02,240

that does mean that i spend a lot of my

469

00:18:05,750 --> 00:18:03,919

time thinking about that and you're

470

00:18:08,230 --> 00:18:05,760

writing demos or mathematical equations

471

00:18:11,270 --> 00:18:08,240

trying to try to get to the um

472

00:18:13,270 --> 00:18:11,280

the uh the underpinnings of it

473

00:18:15,190 --> 00:18:13,280

mike i see you nodding so what is it

474

00:18:17,350 --> 00:18:15,200

about what carl said i'm sorry okay

475

00:18:18,230 --> 00:18:17,360

professor 11 i apologize and what is it

476

00:18:23,830 --> 00:18:18,240

that

477

00:18:25,750 --> 00:18:23,840

feeling like you agree with it

478

00:18:27,750 --> 00:18:25,760

well as as usual i mean he said it

479

00:18:29,510 --> 00:18:27,760

perfectly i couldn't i couldn't say it

480

00:18:32,150 --> 00:18:29,520

better myself i think that's uh that's

481

00:18:34,310 --> 00:18:32,160

that's exactly the kind of um

482

00:18:36,150 --> 00:18:34,320

uh research agenda that i'm interested

483

00:18:38,710 --> 00:18:36,160

in i mean that's that really is the kind

484

00:18:40,070 --> 00:18:38,720

of a very good um description of what i

485

00:18:41,510 --> 00:18:40,080

think we're all looking for in a certain

486

00:18:43,270 --> 00:18:41,520

sense

487

00:18:44,150 --> 00:18:43,280

is there a difference between cognition

488

00:18:45,270 --> 00:18:44,160

and

489

00:18:47,750 --> 00:18:45,280

consciousness

490

00:18:49,990 --> 00:18:47,760

is one distinct is there overlap

491

00:18:52,470 --> 00:18:50,000

is someone a subset

492

00:18:54,390 --> 00:18:52,480

i i actually can't conceive of

493

00:18:55,669 --> 00:18:54,400

cognition without

494

00:18:56,789 --> 00:18:55,679

consciousness

495

00:19:00,470 --> 00:18:56,799

which i

496

00:19:02,870 --> 00:19:00,480

i prefer to call awareness

497

00:19:05,270 --> 00:19:02,880

not just to be perverse but because in

498

00:19:07,750 --> 00:19:05,280

many cases

499

00:19:09,830 --> 00:19:07,760

consciousness is

500

00:19:12,630 --> 00:19:09,840

used in a way that implicitly means

501
00:19:16,310 --> 00:19:12,640
self-consciousness

502
00:19:21,350 --> 00:19:16,320
whereas awareness is often used in a way

503
00:19:24,789 --> 00:19:22,470
and

504
00:19:27,190 --> 00:19:24,799
it's i i find it difficult to conceive

505
00:19:29,110 --> 00:19:27,200
of cognition without any kind of

506
00:19:30,950 --> 00:19:29,120
awareness at all

507
00:19:32,549 --> 00:19:30,960
so so so could i just so i'll ask a

508
00:19:34,230 --> 00:19:32,559
question then based on what what chris

509
00:19:36,230 --> 00:19:34,240
just said and then what when you know

510
00:19:37,750 --> 00:19:36,240
and what carl has to say about it so so

511
00:19:39,669 --> 00:19:37,760
what do you think about the so-called

512
00:19:42,150 --> 00:19:39,679
hard problem is there in fact a hard

513
00:19:44,310 --> 00:19:42,160

problem at all

514

00:19:46,549 --> 00:19:44,320

i would um

515

00:19:47,669 --> 00:19:46,559

i would take andy clark's view on this

516

00:19:49,430 --> 00:19:47,679

uh

517

00:19:51,750 --> 00:19:49,440

who has worked closely with david

518

00:19:55,430 --> 00:19:51,760

chalmers

519

00:19:57,110 --> 00:19:55,440

i i i don't think so no i i i don't

520

00:19:58,789 --> 00:19:57,120

think that the hard problem in and of

521

00:20:00,470 --> 00:19:58,799

itself is um

522

00:20:03,909 --> 00:20:00,480

is the um

523

00:20:06,710 --> 00:20:03,919

interesting um focus of inquiry

524

00:20:09,270 --> 00:20:06,720

i think the um the move that i see in

525

00:20:11,830 --> 00:20:09,280

philosophy um has been to the meta

526
00:20:12,630 --> 00:20:11,840
problem or the meta hard problem which

527
00:20:14,549 --> 00:20:12,640
is

528
00:20:17,190 --> 00:20:14,559
um as andy clark puts it quite

529
00:20:20,390 --> 00:20:17,200
succinctly is why do we spend so much

530
00:20:21,669 --> 00:20:20,400
time puzzling about why we are aware

531
00:20:23,669 --> 00:20:21,679
so

532
00:20:24,549 --> 00:20:23,679
just asking that question

533
00:20:25,830 --> 00:20:24,559
um

534
00:20:27,510 --> 00:20:25,840
speaks to i think the nature of the

535
00:20:30,630 --> 00:20:27,520
heart problem which is a sort of very

536
00:20:32,789 --> 00:20:30,640
much a second order a meta um a metric

537
00:20:35,750 --> 00:20:32,799
capability that we can

538
00:20:39,750 --> 00:20:35,760

make sense of our own sense-making and

539

00:20:42,070 --> 00:20:39,760

we um associate that with selfhood so

540

00:20:43,510 --> 00:20:42,080

one has to ask the question what kinds

541

00:20:46,230 --> 00:20:43,520

of systems

542

00:20:48,710 --> 00:20:46,240

again i think particles or creatures

543

00:20:52,549 --> 00:20:48,720

would have the capacity

544

00:20:53,750 --> 00:20:52,559

to represent selfhood and furthermore

545

00:20:55,750 --> 00:20:53,760

represent

546

00:20:57,350 --> 00:20:55,760

the counterfactuals

547

00:20:59,750 --> 00:20:57,360

that would enable you to ask the

548

00:21:01,909 --> 00:20:59,760

question why am i conscious that

549

00:21:04,310 --> 00:21:01,919

immediately just logically presupposes

550

00:21:06,390 --> 00:21:04,320

that there is an alternative hypothesis

551
00:21:07,430 --> 00:21:06,400
some other counterfactual that i'm not

552
00:21:10,310 --> 00:21:07,440
conscious

553
00:21:12,950 --> 00:21:10,320
so imagine now you're talking to

554
00:21:15,070 --> 00:21:12,960
a creature you're talking to me that has

555
00:21:18,390 --> 00:21:15,080
this capacity to imagine

556
00:21:21,110 --> 00:21:18,400
counterfactuals that cannot exist

557
00:21:23,510 --> 00:21:21,120
so that's a remarkable capacity to have

558
00:21:25,430 --> 00:21:23,520
you know um from my point of view a sort

559
00:21:26,310 --> 00:21:25,440
of internal world moral regenerative

560
00:21:29,430 --> 00:21:26,320
model

561
00:21:31,909 --> 00:21:29,440
where counterfactuals can exist is quite

562
00:21:34,630 --> 00:21:31,919
remarkable i i don't imagine that a

563
00:21:36,070 --> 00:21:34,640

thermostat or a virus or

564

00:21:37,990 --> 00:21:36,080

an e coli

565

00:21:39,870 --> 00:21:38,000

will have a sufficiently sophisticated

566

00:21:43,430 --> 00:21:39,880

set of you know

567

00:21:45,029 --> 00:21:43,440

electrochemical uh dynamics or kinetics

568

00:21:46,230 --> 00:21:45,039

that would enable them to physically

569

00:21:48,630 --> 00:21:46,240

represent

570

00:21:50,149 --> 00:21:48,640

counterfactuals of this sort and i could

571

00:21:52,549 --> 00:21:50,159

go on um

572

00:21:54,230 --> 00:21:52,559

the the usual line of argument is why do

573

00:21:57,110 --> 00:21:54,240

we have models why do we have the

574

00:22:00,310 --> 00:21:57,120

capacity to represent counterfactuals um

575

00:22:01,430 --> 00:22:00,320

the you end up with saying yes you have

576
00:22:02,630 --> 00:22:01,440
to have them

577
00:22:05,350 --> 00:22:02,640
just if you

578
00:22:06,870 --> 00:22:05,360
[Music]

579
00:22:09,909 --> 00:22:06,880
contemplate

580
00:22:11,590 --> 00:22:09,919
things at plan so things plan

581
00:22:14,710 --> 00:22:11,600
they have to have

582
00:22:17,029 --> 00:22:14,720
um an ability to simulate the future

583
00:22:19,909 --> 00:22:17,039
that because they have to simulate or

584
00:22:22,070 --> 00:22:19,919
represent at some elemental level the

585
00:22:23,270 --> 00:22:22,080
consequences of their action upon the

586
00:22:25,590 --> 00:22:23,280
world

587
00:22:26,630 --> 00:22:25,600
and if they have now the capacity to

588
00:22:28,310 --> 00:22:26,640

represent

589

00:22:30,789 --> 00:22:28,320

something that has not yet happened

590

00:22:32,390 --> 00:22:30,799

namely in the future then they now have

591

00:22:34,950 --> 00:22:32,400

the capacity to represent counter

592

00:22:36,710 --> 00:22:34,960

factual outcomes so i think

593

00:22:38,549 --> 00:22:36,720

the meta hard problem

594

00:22:40,070 --> 00:22:38,559

inherits simply because we have a

595

00:22:41,510 --> 00:22:40,080

sufficiently

596

00:22:43,029 --> 00:22:41,520

temporally deep

597

00:22:45,909 --> 00:22:43,039

generative model

598

00:22:47,669 --> 00:22:45,919

that can represent the consequences of

599

00:22:48,549 --> 00:22:47,679

our actions and of course using the word

600

00:22:49,830 --> 00:22:48,559

our

601
00:22:52,630 --> 00:22:49,840
implies

602
00:22:54,149 --> 00:22:52,640
some kind of elemental agency and some

603
00:22:55,669 --> 00:22:54,159
kind of self-worth because it's only me

604
00:22:57,350 --> 00:22:55,679
that's doing the acting and the

605
00:22:59,909 --> 00:22:57,360
consequences of my action not your

606
00:23:02,390 --> 00:22:59,919
action uh so so

607
00:23:04,070 --> 00:23:02,400
in in that sense i think that the hard

608
00:23:06,950 --> 00:23:04,080
problem um

609
00:23:09,190 --> 00:23:06,960
sort of pales into into insignificance

610
00:23:13,830 --> 00:23:09,200
in relation to the the meta problem of

611
00:23:18,630 --> 00:23:16,310
can i pursue that just a little bit

612
00:23:21,990 --> 00:23:18,640
i think you raise an extraordinarily

613
00:23:22,950 --> 00:23:22,000

interesting point here carl

614

00:23:25,909 --> 00:23:22,960

and so

615

00:23:31,990 --> 00:23:25,919

i want to ask you

616

00:23:32,000 --> 00:23:35,270

do you think that

617

00:23:40,230 --> 00:23:37,029

organisms

618

00:23:42,149 --> 00:23:40,240

that can plan

619

00:23:44,549 --> 00:23:42,159

necessarily

620

00:23:46,950 --> 00:23:44,559

are able to represent multiple

621

00:23:49,110 --> 00:23:46,960

counterfactuals

622

00:23:51,990 --> 00:23:49,120

so let's give an example

623

00:23:56,230 --> 00:23:52,000

of suppose you're a cheetah chasing a

624

00:24:02,870 --> 00:23:58,549

you're planning your moves

625

00:24:06,470 --> 00:24:02,880

while looking at the gazelle's moves

626

00:24:08,230 --> 00:24:06,480

and your objective is success

627

00:24:11,110 --> 00:24:08,240

do you think that the cheetah worries

628

00:24:13,430 --> 00:24:11,120

about the other counterfactual condition

629

00:24:15,590 --> 00:24:13,440

where the gazelle isn't caught

630

00:24:17,990 --> 00:24:15,600

or does it just represent this one

631

00:24:21,190 --> 00:24:18,000

counterfactual condition that is in a

632

00:24:26,549 --> 00:24:23,510

i think that's an excellent question i

633

00:24:30,630 --> 00:24:28,149

and when i answer these questions i

634

00:24:32,870 --> 00:24:30,640

think how would i simulate this how

635

00:24:33,750 --> 00:24:32,880

would i put a cheater in silico

636

00:24:35,029 --> 00:24:33,760

and

637

00:24:36,870 --> 00:24:35,039

integrate

638

00:24:38,630 --> 00:24:36,880

according to the differential equations

639

00:24:42,230 --> 00:24:38,640

that must be present under certain

640

00:24:45,029 --> 00:24:42,240

assumptions um and my guess is that the

641

00:24:47,269 --> 00:24:45,039

cheetah chasing the gazelle would as you

642

00:24:49,669 --> 00:24:47,279

say just be pursuing a path of least

643

00:24:52,630 --> 00:24:49,679

action and it would not have an explicit

644

00:24:54,470 --> 00:24:52,640

representation of alternative paths so

645

00:24:57,029 --> 00:24:54,480

it would be responding in the moment in

646

00:24:59,190 --> 00:24:57,039

a reflexive habitual way so that's a

647

00:25:02,390 --> 00:24:59,200

really important question because if we

648

00:25:04,710 --> 00:25:02,400

don't have or all of our behavior

649

00:25:06,710 --> 00:25:04,720

is just a manifestation of pursuing

650

00:25:08,870 --> 00:25:06,720

those paths of least resistance or

651
00:25:10,470 --> 00:25:08,880
mathematically those you know paths of

652
00:25:12,950 --> 00:25:10,480
space reaction

653
00:25:15,430 --> 00:25:12,960
um then there is no counterfactual to

654
00:25:17,510 --> 00:25:15,440
select from and there is no notion of

655
00:25:19,990 --> 00:25:17,520
planning in the sense of i am going to

656
00:25:23,029 --> 00:25:20,000
do this as opposed to that but that

657
00:25:26,470 --> 00:25:23,039
doesn't mean to say biological organisms

658
00:25:28,230 --> 00:25:26,480
um don't have the capacity to

659
00:25:31,830 --> 00:25:28,240
plan multiple futures and i'll just give

660
00:25:33,750 --> 00:25:31,840
you one real simple example of um

661
00:25:35,350 --> 00:25:33,760
your our brains and i would imagine even

662
00:25:37,430 --> 00:25:35,360
the brains of reptiles to a certain

663
00:25:40,789 --> 00:25:37,440

extent um

664

00:25:43,269 --> 00:25:40,799

being able to plan multiple um

665

00:25:44,310 --> 00:25:43,279

actions in the future and that's in eye

666

00:25:46,630 --> 00:25:44,320

movements

667

00:25:49,350 --> 00:25:46,640

so if i just take one of the simplest

668

00:25:52,310 --> 00:25:49,360

problems in terms of planning or perhaps

669

00:25:54,710 --> 00:25:52,320

not the simplest but one of the um

670

00:25:57,669 --> 00:25:54,720

the the the problems of planning that

671

00:25:59,110 --> 00:25:57,679

have to be resolved within um

672

00:26:00,870 --> 00:25:59,120

you know several hundred milliseconds

673

00:26:03,590 --> 00:26:00,880

given that we have to choose where to

674

00:26:05,590 --> 00:26:03,600

look every 250 milliseconds in order to

675

00:26:07,590 --> 00:26:05,600

gather the right kind of information to

676
00:26:09,590 --> 00:26:07,600
make you know to construct the scene in

677
00:26:11,909 --> 00:26:09,600
which we are situated and coming back to

678
00:26:14,549 --> 00:26:11,919
your preoccupation chris your you know

679
00:26:15,909 --> 00:26:14,559
how on earth do we then explain these

680
00:26:16,870 --> 00:26:15,919
sparse

681
00:26:19,510 --> 00:26:16,880
um

682
00:26:21,590 --> 00:26:19,520
uh psychotic samples

683
00:26:23,750 --> 00:26:21,600
within some frame of reference and

684
00:26:24,390 --> 00:26:23,760
space-time sort of phrase how do we you

685
00:26:26,549 --> 00:26:24,400
know

686
00:26:29,190 --> 00:26:26,559
sense make with reference to some

687
00:26:30,789 --> 00:26:29,200
constructs such as space and time but

688
00:26:33,909 --> 00:26:30,799

the point i'm making here

689

00:26:35,590 --> 00:26:33,919

is the anatomy of um

690

00:26:38,870 --> 00:26:35,600

many uh

691

00:26:41,269 --> 00:26:38,880

brains many phenotypes does have the

692

00:26:43,430 --> 00:26:41,279

capacity to represent the consequences

693

00:26:45,750 --> 00:26:43,440

of looking everywhere at the same time

694

00:26:46,789 --> 00:26:45,760

at once before they have looked so these

695

00:26:48,630 --> 00:26:46,799

are sort of

696

00:26:50,230 --> 00:26:48,640

sometimes referred to as salience maps

697

00:26:51,590 --> 00:26:50,240

and we know that

698

00:26:53,190 --> 00:26:51,600

there are good candidates for these

699

00:26:54,950 --> 00:26:53,200

salience maps for example the deep

700

00:26:57,269 --> 00:26:54,960

layers of the superior colliculus and

701
00:27:00,710 --> 00:26:57,279
what could have argue um possibly some

702
00:27:03,510 --> 00:27:00,720
anatomy of the pulvina so if you look at

703
00:27:07,350 --> 00:27:03,520
the um if you like the neuronal encoding

704
00:27:09,909 --> 00:27:07,360
of the salience of where the salience of

705
00:27:13,430 --> 00:27:09,919
the next place to look

706
00:27:15,830 --> 00:27:13,440
what's going to grab my attention

707
00:27:18,630 --> 00:27:15,840
and make that be manifest overtly with

708
00:27:21,350 --> 00:27:18,640
an eye movement to go look over there

709
00:27:23,430 --> 00:27:21,360
then there you can interpret i think the

710
00:27:25,750 --> 00:27:23,440
anatomy the oculomotor system and

711
00:27:28,149 --> 00:27:25,760
especially the um

712
00:27:30,070 --> 00:27:28,159
that which underlies uh circadian

713
00:27:31,269 --> 00:27:30,080

control synthetic eye movements as

714

00:27:33,909 --> 00:27:31,279

entertaining

715

00:27:37,350 --> 00:27:33,919

a whole range possibly millions of

716

00:27:42,470 --> 00:27:39,909

plans of action and the consequences

717

00:27:44,310 --> 00:27:42,480

and then the brain literally selects the

718

00:27:46,470 --> 00:27:44,320

one that's most likely

719

00:27:48,230 --> 00:27:46,480

which you can simulate by doing bump

720

00:27:50,549 --> 00:27:48,240

attractors on these sort of salience

721

00:27:53,029 --> 00:27:50,559

maps or representations of the the

722

00:27:54,389 --> 00:27:53,039

salience of the epistemic affordance or

723

00:27:56,230 --> 00:27:54,399

the expected information again if i

724

00:27:58,149 --> 00:27:56,240

looked over here and over here and over

725

00:28:00,470 --> 00:27:58,159

here looked over here you select that

726

00:28:02,310 --> 00:28:00,480

your eyes jump over there and off you go

727

00:28:04,230 --> 00:28:02,320

again so i think it's a great question

728

00:28:05,510 --> 00:28:04,240

and in a sense speaks i think to a

729

00:28:07,750 --> 00:28:05,520

certain extent to what mike was alluding

730

00:28:09,590 --> 00:28:07,760

to before that there are certain

731

00:28:11,830 --> 00:28:09,600

setups or a certain sort of neuronal

732

00:28:13,430 --> 00:28:11,840

electrochemical um

733

00:28:15,110 --> 00:28:13,440

infrastructures

734

00:28:17,830 --> 00:28:15,120

out there

735

00:28:21,350 --> 00:28:17,840

that can be read as just pursuing

736

00:28:24,230 --> 00:28:21,360

passively such action in a reflexive way

737

00:28:26,149 --> 00:28:24,240

and there are others that may have this

738

00:28:29,750 --> 00:28:26,159

um richer structure this deeper

739

00:28:32,630 --> 00:28:29,760

structure that could be uh support the

740

00:28:34,870 --> 00:28:32,640

you know the the the active sentence and

741

00:28:37,990 --> 00:28:34,880

the sort of what i i'm reading now is

742

00:28:39,430 --> 00:28:38,000

cognition if cognition entails planning

743

00:28:42,149 --> 00:28:39,440

uh then i certainly think there has to

744

00:28:44,149 --> 00:28:42,159

be an act of selection in play here um

745

00:28:46,310 --> 00:28:44,159

selection what does that mean from

746

00:28:47,830 --> 00:28:46,320

something from what well multiple

747

00:28:49,750 --> 00:28:47,840

alternatives and then we come back to

748

00:28:51,750 --> 00:28:49,760

the central notion of this this counter

749

00:28:53,190 --> 00:28:51,760

factual

750

00:28:55,669 --> 00:28:53,200

mike is that what you had in mind in

751

00:28:58,310 --> 00:28:55,679

terms of breaking this sort of uh pan

752

00:29:00,310 --> 00:28:58,320

psychism uh sort of trap you know the

753

00:29:02,310 --> 00:29:00,320

different kinds of

754

00:29:03,750 --> 00:29:02,320

self-organization

755

00:29:05,990 --> 00:29:03,760

yeah i mean that's certainly certainly

756

00:29:08,070 --> 00:29:06,000

related you know uh the thing the the

757

00:29:09,110 --> 00:29:08,080

thing that i and and so i agree with

758

00:29:10,870 --> 00:29:09,120

chris's

759

00:29:12,789 --> 00:29:10,880

kind of gut feeling on this i find it

760

00:29:14,950 --> 00:29:12,799

very difficult to imagine cognition

761

00:29:17,029 --> 00:29:14,960

without some sort of awareness or or

762

00:29:18,630 --> 00:29:17,039

simple consciousness however what what

763

00:29:20,149 --> 00:29:18,640

strikes me as

764

00:29:22,389 --> 00:29:20,159

different than real about the hard

765

00:29:24,630 --> 00:29:22,399

problem is that unlike all the quote

766

00:29:26,549 --> 00:29:24,640

unquote easy problems and maybe unlike

767

00:29:29,029 --> 00:29:26,559

the meta hard problem

768

00:29:30,710 --> 00:29:29,039

we kind of know the format or the shape

769

00:29:32,149 --> 00:29:30,720

of answers to those questions right

770

00:29:34,389 --> 00:29:32,159

they're either they're numbers or their

771

00:29:36,310 --> 00:29:34,399

equations or their lists of capacities

772

00:29:39,269 --> 00:29:36,320

you know we we know what what a proper

773

00:29:40,789 --> 00:29:39,279

answer would look like and yet i find it

774

00:29:42,070 --> 00:29:40,799

very hard to imagine if we if somebody

775

00:29:43,909 --> 00:29:42,080

claimed to have a

776

00:29:45,669 --> 00:29:43,919

a good theory of consciousness and i

777

00:29:47,190 --> 00:29:45,679

were to ask them okay well what is the

778

00:29:49,029 --> 00:29:47,200

prediction of your theory in this

779

00:29:51,190 --> 00:29:49,039

particular case i don't know what the

780

00:29:52,870 --> 00:29:51,200

format of the answer looks like because

781

00:29:54,789 --> 00:29:52,880

numbers and the typical things we get

782

00:29:56,710 --> 00:29:54,799

don't do the trick they you know they're

783

00:29:58,870 --> 00:29:56,720

sort of third person descriptions and so

784

00:30:01,029 --> 00:29:58,880

so is the answer does the answer come in

785

00:30:02,470 --> 00:30:01,039

the form of a poem is it art is it you

786

00:30:04,310 --> 00:30:02,480

know something you have to literally

787

00:30:06,470 --> 00:30:04,320

plug yourself into to then have that

788

00:30:08,870 --> 00:30:06,480

experience like what's the i i find it

789

00:30:10,870 --> 00:30:08,880

different because i don't know what if

790

00:30:12,549 --> 00:30:10,880

we had a true a correct theory i don't

791

00:30:13,830 --> 00:30:12,559

know what that theory would output you

792

00:30:15,269 --> 00:30:13,840

know unlike for all these other theories

793

00:30:18,389 --> 00:30:15,279

where at least we have some idea of what

794

00:30:22,950 --> 00:30:20,310

well that's a better answer to the hard

795

00:30:25,269 --> 00:30:22,960

problem then that's very good

796

00:30:27,269 --> 00:30:25,279

before

797

00:30:28,630 --> 00:30:27,279

i'm sure the answer is quantum physics

798

00:30:30,950 --> 00:30:28,640

and that's that's what it's going to

799

00:30:32,950 --> 00:30:30,960

look like if we could if we could

800

00:30:35,990 --> 00:30:32,960

understand it the answer would be in

801
00:30:39,269 --> 00:30:36,000
quantum physics

802
00:30:42,630 --> 00:30:41,750
well i i'd like to to back up a little

803
00:30:43,909 --> 00:30:42,640
bit

804
00:30:45,350 --> 00:30:43,919
uh

805
00:30:47,510 --> 00:30:45,360
and in a sense

806
00:30:48,950 --> 00:30:47,520
play off what carl was just saying about

807
00:30:52,549 --> 00:30:48,960
alternatives and the role of

808
00:30:57,990 --> 00:30:55,750
i mean chalmers drives his arguments

809
00:31:01,909 --> 00:30:58,000
about the hard problem with

810
00:31:03,669 --> 00:31:01,919
the alternative of unconsciousness

811
00:31:05,750 --> 00:31:03,679
and

812
00:31:07,110 --> 00:31:05,760
this alternative

813
00:31:09,669 --> 00:31:07,120

makes

814

00:31:14,389 --> 00:31:09,679

great sense

815

00:31:16,389 --> 00:31:14,399

against the background of a particular

816

00:31:18,710 --> 00:31:16,399

set of assumptions about

817

00:31:19,990 --> 00:31:18,720

physics

818

00:31:22,549 --> 00:31:20,000

uh

819

00:31:25,750 --> 00:31:22,559

which is

820

00:31:28,630 --> 00:31:25,760

the assumption that

821

00:31:30,950 --> 00:31:28,640

nothing is going on cognitively in the

822

00:31:33,269 --> 00:31:30,960

physical world that there's that there's

823

00:31:34,950 --> 00:31:33,279

no reason to

824

00:31:38,630 --> 00:31:34,960

talk about

825

00:31:40,549 --> 00:31:38,640

uh experience or awareness or anything

826
00:31:44,389 --> 00:31:40,559
like that

827
00:31:49,590 --> 00:31:48,070
rocks or billiard balls or planets or

828
00:31:51,509 --> 00:31:49,600
electrons or

829
00:31:52,950 --> 00:31:51,519
anything else

830
00:31:54,310 --> 00:31:52,960
and

831
00:31:57,909 --> 00:31:54,320
in that case

832
00:32:00,950 --> 00:31:57,919
there is this

833
00:32:06,149 --> 00:32:02,310
that is

834
00:32:06,950 --> 00:32:06,159
not really a cut in scale

835
00:32:09,430 --> 00:32:06,960
of

836
00:32:13,190 --> 00:32:09,440
spatial scale or temporal scale

837
00:32:16,470 --> 00:32:13,200
but is in a sense a cut in some measure

838
00:32:20,870 --> 00:32:19,269

that suggests that

839

00:32:23,350 --> 00:32:20,880

below some

840

00:32:26,470 --> 00:32:23,360

cut point which may be a bright line and

841

00:32:29,029 --> 00:32:26,480

maybe a fuzzy area who knows

842

00:32:31,190 --> 00:32:29,039

there's the possibility

843

00:32:33,669 --> 00:32:31,200

or below some cut point there's there's

844

00:32:35,430 --> 00:32:33,679

no awareness at all none

845

00:32:37,350 --> 00:32:35,440

zero

846

00:32:39,590 --> 00:32:37,360

and above that cut point there's some

847

00:32:44,389 --> 00:32:39,600

possibility of awareness

848

00:32:47,430 --> 00:32:44,399

and in that case one's forced to say how

849

00:32:51,590 --> 00:32:47,440

what what could be added

850

00:32:54,549 --> 00:32:51,600

by complexity other than complexity

851
00:32:56,870 --> 00:32:54,559
to produce awareness

852
00:32:58,789 --> 00:32:56,880
and it's that intuition i believe that

853
00:33:00,310 --> 00:32:58,799
drives the hard problem

854
00:33:02,549 --> 00:33:00,320
do you mind explaining that a bit more

855
00:33:06,630 --> 00:33:02,559
what can be added by complexity that's

856
00:33:10,870 --> 00:33:08,830
well

857
00:33:12,470 --> 00:33:10,880
um yeah

858
00:33:13,750 --> 00:33:12,480
and one way to put it is

859
00:33:17,750 --> 00:33:13,760
complexity

860
00:33:19,909 --> 00:33:17,760
to happen

861
00:33:27,830 --> 00:33:19,919
and

862
00:33:29,350 --> 00:33:27,840
it's not clear quite how much complexity

863
00:33:31,750 --> 00:33:29,360

one has to add

864

00:33:33,509 --> 00:33:31,760

but as soon as one reaches the the right

865

00:33:34,630 --> 00:33:33,519

amount then

866

00:33:37,350 --> 00:33:34,640

uh

867

00:33:40,149 --> 00:33:37,360

out of the blue you've got awareness

868

00:33:42,950 --> 00:33:40,159

whereas without crossing that threshold

869

00:33:45,590 --> 00:33:42,960

you you had no awareness whatsoever

870

00:33:47,269 --> 00:33:45,600

so there's a zero point and the zero

871

00:33:48,549 --> 00:33:47,279

points somewhere on the scale of

872

00:33:53,350 --> 00:33:48,559

complexity

873

00:33:58,549 --> 00:33:55,750

so i think one can i can i think one can

874

00:34:00,230 --> 00:33:58,559

view a lot of research on

875

00:34:02,310 --> 00:34:00,240

consciousness

876

00:34:04,230 --> 00:34:02,320

as a way to escape that

877

00:34:05,350 --> 00:34:04,240

argument

878

00:34:06,470 --> 00:34:05,360

so

879

00:34:10,389 --> 00:34:06,480

i'll

880

00:34:12,389 --> 00:34:10,399

consider integrated information theory

881

00:34:14,869 --> 00:34:12,399

oh

882

00:34:16,869 --> 00:34:14,879

in integrated information theory the

883

00:34:19,030 --> 00:34:16,879

criterion for

884

00:34:22,389 --> 00:34:19,040

consciousness or awareness

885

00:34:25,430 --> 00:34:22,399

is actually very simple you you need to

886

00:34:27,909 --> 00:34:25,440

have an internal feedback loop

887

00:34:29,909 --> 00:34:27,919

and if you've got an internal feedback

888

00:34:31,750 --> 00:34:29,919

loop you're at least a candidate for

889

00:34:33,190 --> 00:34:31,760

being aware

890

00:34:35,030 --> 00:34:33,200

as long as you're not embedded in

891

00:34:39,510 --> 00:34:35,040

something bigger that has bigger

892

00:34:39,520 --> 00:34:42,629

and

893

00:34:47,190 --> 00:34:43,750

if one

894

00:34:53,990 --> 00:34:50,310

the work of peter strawson for example

895

00:34:56,230 --> 00:34:54,000

from a philosophical perspective

896

00:34:58,230 --> 00:34:56,240

his arguments toward

897

00:35:01,190 --> 00:34:58,240

pansysm

898

00:35:03,910 --> 00:35:01,200

are all arguments of the form

899

00:35:05,030 --> 00:35:03,920

there's no way to draw the lie

900

00:35:07,829 --> 00:35:05,040

in the

901
00:35:11,430 --> 00:35:07,839
scale of complexity

902
00:35:16,630 --> 00:35:11,440
and get a place where

903
00:35:18,069 --> 00:35:16,640
magic basically plausibly happens

904
00:35:19,910 --> 00:35:18,079
so

905
00:35:21,510 --> 00:35:19,920
i think i think chalmers did a real

906
00:35:23,190 --> 00:35:21,520
service in in

907
00:35:27,510 --> 00:35:23,200
posing the problem in that way because

908
00:35:29,990 --> 00:35:27,520
it forced us to think about this idea of

909
00:35:31,829 --> 00:35:30,000
magic or you could call it emergence if

910
00:35:34,550 --> 00:35:31,839
you wanted to

911
00:35:39,270 --> 00:35:34,560
of something completely new that was

912
00:35:45,430 --> 00:35:43,030
now i i do agree with carl that

913
00:35:49,349 --> 00:35:45,440

quantum theory can help us

914

00:35:55,750 --> 00:35:52,710

uh by being in effect a theory that's

915

00:35:59,670 --> 00:35:58,230

but we can we can get to that farther

916

00:36:00,870 --> 00:35:59,680

down the road

917

00:36:02,630 --> 00:36:00,880

do you have any reason to believe that

918

00:36:03,589 --> 00:36:02,640

we're embedded in something larger you

919

00:36:06,230 --> 00:36:03,599

mentioned in

920

00:36:09,030 --> 00:36:06,240

it there's the feedback loop that is

921

00:36:10,470 --> 00:36:09,040

necessary for consciousness and you said

922

00:36:12,150 --> 00:36:10,480

that

923

00:36:14,470 --> 00:36:12,160

one is conscious as long as one is not

924

00:36:16,230 --> 00:36:14,480

embedded in something else that's

925

00:36:17,990 --> 00:36:16,240

of which that is conscious like there's

926
00:36:19,349 --> 00:36:18,000
a larger feedback loop there

927
00:36:21,030 --> 00:36:19,359
do you see there being some larger

928
00:36:23,349 --> 00:36:21,040
feedback loop some people say the

929
00:36:25,670 --> 00:36:23,359
universe itself is conscious or that

930
00:36:27,349 --> 00:36:25,680
societies can act as some larger level

931
00:36:29,030 --> 00:36:27,359
consciousness

932
00:36:31,270 --> 00:36:29,040
like with each of us acting as neurons

933
00:36:33,270 --> 00:36:31,280
in some sense

934
00:36:36,470 --> 00:36:33,280
well i would certainly wouldn't want to

935
00:36:37,910 --> 00:36:36,480
rule that view out a priori

936
00:36:41,829 --> 00:36:37,920
i mean it's it's obvious that we're

937
00:36:42,790 --> 00:36:41,839
embedded in much bigger systems

938
00:36:46,950 --> 00:36:42,800

and

939

00:36:49,430 --> 00:36:46,960

essentially nothing about the cognitive

940

00:36:51,190 --> 00:36:49,440

capacities of those systems

941

00:36:53,190 --> 00:36:51,200

yeah

942

00:36:54,790 --> 00:36:53,200

michael

943

00:36:56,550 --> 00:36:54,800

yeah yeah i think i think that's a

944

00:36:59,190 --> 00:36:56,560

really important question and i i think

945

00:37:00,550 --> 00:36:59,200

a lot about the perspective of let's say

946

00:37:02,150 --> 00:37:00,560

you know if you were a neural network or

947

00:37:04,870 --> 00:37:02,160

something like this being trained and so

948

00:37:06,870 --> 00:37:04,880

on what would the perspective of a sub

949

00:37:08,870 --> 00:37:06,880

component of that be what you know let's

950

00:37:11,349 --> 00:37:08,880

say if you had the capacity as a neuron

951
00:37:12,950 --> 00:37:11,359
to sort of look around and ask yourself

952
00:37:14,390 --> 00:37:12,960
you know do i do i live in a cold

953
00:37:17,510 --> 00:37:14,400
mechanical universe that doesn't care

954
00:37:19,750 --> 00:37:17,520
what happens or uh is there some some

955
00:37:21,829 --> 00:37:19,760
sort of uh agency in my environment that

956
00:37:24,150 --> 00:37:21,839
you know am i when i'm as a piece of

957
00:37:26,069 --> 00:37:24,160
that network am i am i learning from my

958
00:37:27,270 --> 00:37:26,079
environment or am i being trained right

959
00:37:28,790 --> 00:37:27,280
because when you're being trained right

960
00:37:30,550 --> 00:37:28,800
the real question is like how many how

961
00:37:32,470 --> 00:37:30,560
many um agents are there in that

962
00:37:34,150 --> 00:37:32,480
interaction is it just you learning as

963
00:37:35,349 --> 00:37:34,160

you will you're the boss and you're sort

964

00:37:36,950 --> 00:37:35,359
of learning whatever from your

965

00:37:38,310 --> 00:37:36,960
environment or are you actually being

966

00:37:40,150 --> 00:37:38,320
trained because the environment is an

967

00:37:41,990 --> 00:37:40,160
agent with an agenda that is training

968

00:37:44,069 --> 00:37:42,000
you for some particular purpose right

969

00:37:45,910 --> 00:37:44,079
and so so this question of uh how would

970

00:37:47,589 --> 00:37:45,920
you know so so you look around and you

971

00:37:48,870 --> 00:37:47,599
see you say to yourself well

972

00:37:50,470 --> 00:37:48,880
if you're a piece of this of this

973

00:37:52,390 --> 00:37:50,480
network and it's being trained for some

974

00:37:54,470 --> 00:37:52,400
image image recognition task you know

975

00:37:55,990 --> 00:37:54,480
you you would be i think wrong to come

976

00:37:57,510 --> 00:37:56,000

to the conclusion that you live in a in

977

00:37:59,190 --> 00:37:57,520

a mechanical universe you would you

978

00:38:01,270 --> 00:37:59,200

should come to the conclusion that it's

979

00:38:03,430 --> 00:38:01,280

actually it's clearly rewarding you and

980

00:38:05,349 --> 00:38:03,440

punishing you for for specific things

981

00:38:07,030 --> 00:38:05,359

it's not neutral with respect to what

982

00:38:08,950 --> 00:38:07,040

you do and for some reason it really

983

00:38:10,950 --> 00:38:08,960

likes it when you find you know you find

984

00:38:12,470 --> 00:38:10,960

um pictures of dog eyes or something

985

00:38:14,230 --> 00:38:12,480

like this and you have no idea that what

986

00:38:15,750 --> 00:38:14,240

what it does is recognize dog faces out

987

00:38:16,870 --> 00:38:15,760

of you know all the other all the other

988

00:38:18,790 --> 00:38:16,880

inputs so

989

00:38:20,950 --> 00:38:18,800

no doubt there's some kind of gerdelian

990

00:38:22,630 --> 00:38:20,960

limit to to be able to actually

991

00:38:25,510 --> 00:38:22,640

understand what the larger system is

992

00:38:27,750 --> 00:38:25,520

doing but i wonder if we can even have

993

00:38:29,750 --> 00:38:27,760

some evidence that uh just just for the

994

00:38:32,230 --> 00:38:29,760

fact that yes there is a greater you

995

00:38:33,510 --> 00:38:32,240

know sort of a agential dynamic going on

996

00:38:35,349 --> 00:38:33,520

in which i'm caught up even if you're

997

00:38:36,870 --> 00:38:35,359

not able to you know sort of comprehend

998

00:38:38,630 --> 00:38:36,880

what that's going to what that's going

999

00:38:39,670 --> 00:38:38,640

to be i i don't know i don't know what

1000

00:38:41,030 --> 00:38:39,680

that's going to look like but i think

1001

00:38:44,230 --> 00:38:41,040

it's pretty important and i think as

1002

00:38:46,550 --> 00:38:44,240

chris said we really don't have a very

1003

00:38:49,829 --> 00:38:46,560

good science at all of

1004

00:38:52,069 --> 00:38:49,839

trying to predict or control

1005

00:38:54,390 --> 00:38:52,079

the cognitive capacities of systems made

1006

00:38:56,470 --> 00:38:54,400

up of parts so so we can know many

1007

00:38:59,030 --> 00:38:56,480

things about parts cells robotics or

1008

00:39:00,950 --> 00:38:59,040

whatever and we routinely make these

1009

00:39:02,710 --> 00:39:00,960

larger systems have then and then get

1010

00:39:04,550 --> 00:39:02,720

surprised about what it does or doesn't

1011

00:39:05,910 --> 00:39:04,560

do or what what what the goals are going

1012

00:39:08,390 --> 00:39:05,920

to be what goals is it capable of

1013

00:39:11,829 --> 00:39:08,400

pursuing what preferences does it have

1014

00:39:14,550 --> 00:39:11,839

this is probably an existential level um

1015

00:39:18,390 --> 00:39:14,560

job for for society is to get a good

1016

00:39:18,400 --> 00:39:22,390

you have done that there haven't you

1017

00:39:22,400 --> 00:39:25,990

well we've started anyway

1018

00:39:28,950 --> 00:39:28,230

i mean you couldn't i i would go film

1019

00:39:30,550 --> 00:39:28,960

that

1020

00:39:31,750 --> 00:39:30,560

i think i think your work would

1021

00:39:34,550 --> 00:39:31,760

represent

1022

00:39:36,870 --> 00:39:34,560

a substantive and established um

1023

00:39:38,790 --> 00:39:36,880

formal framework to address exactly

1024

00:39:41,430 --> 00:39:38,800

those issues um

1025

00:39:44,310 --> 00:39:41,440

and you can see your embryonic versions

1026

00:39:47,190 --> 00:39:44,320

arising in many different fields i just

1027

00:39:49,670 --> 00:39:47,200

came back from a meeting

1028

00:39:51,270 --> 00:39:49,680

of economists and financiers and they

1029

00:39:53,990 --> 00:39:51,280

are trying to make the move from

1030

00:39:56,310 --> 00:39:54,000

behavioral economics to cognitive

1031

00:39:58,150 --> 00:39:56,320

economics and they were exactly

1032

00:39:59,430 --> 00:39:58,160

addressing these kinds of issues you're

1033

00:40:00,230 --> 00:39:59,440

understanding

1034

00:40:01,109 --> 00:40:00,240

the

1035

00:40:03,510 --> 00:40:01,119

um

1036

00:40:07,030 --> 00:40:03,520

the notion of distributed cognition in a

1037

00:40:08,630 --> 00:40:07,040

market um so you know and ultimately

1038

00:40:10,950 --> 00:40:08,640

that they cannot they'll come knocking

1039

00:40:12,230 --> 00:40:10,960

at your door i can see that i can see

1040

00:40:14,630 --> 00:40:12,240

exactly the

1041

00:40:16,710 --> 00:40:14,640

sequence of people um you know searching

1042

00:40:18,150 --> 00:40:16,720

around for people to talk about um

1043

00:40:20,790 --> 00:40:18,160

illuminating

1044

00:40:22,150 --> 00:40:20,800

that realization that the i mean it

1045

00:40:23,750 --> 00:40:22,160

comes back to what we were talking about

1046

00:40:25,829 --> 00:40:23,760

before where you've started and you know

1047

00:40:28,230 --> 00:40:25,839

i was picking up on the um

1048

00:40:30,230 --> 00:40:28,240

on the the link between different scales

1049

00:40:32,309 --> 00:40:30,240

of self-organization where every scale

1050

00:40:33,510 --> 00:40:32,319

has you know complies with the same

1051

00:40:34,950 --> 00:40:33,520

principles but how does that

1052

00:40:36,150 --> 00:40:34,960

contextualize and i think one really

1053

00:40:38,470 --> 00:40:36,160

interesting

1054

00:40:41,190 --> 00:40:38,480

example of that um

1055

00:40:43,990 --> 00:40:41,200

is to think about an individual in an

1056

00:40:45,990 --> 00:40:44,000

ensemble or a society and just to

1057

00:40:47,270 --> 00:40:46,000

wrestle the argument back to pick up on

1058

00:40:48,069 --> 00:40:47,280

something that chris was saying about

1059

00:40:51,750 --> 00:40:48,079

you know

1060

00:40:54,230 --> 00:40:51,760

between

1061

00:40:57,349 --> 00:40:54,240

the kind of

1062

00:40:59,109 --> 00:40:57,359

mechanics that would qualify

1063

00:41:02,150 --> 00:40:59,119

as

1064

00:41:04,470 --> 00:41:02,160

conscious in the sense of being

1065

00:41:06,790 --> 00:41:04,480

self-aware and i'm distinguishing that

1066

00:41:09,270 --> 00:41:06,800

from the kind of consciousness that

1067

00:41:11,030 --> 00:41:09,280

would just entail qualitative experience

1068

00:41:13,510 --> 00:41:11,040

you know a loss of phenomenal uh

1069

00:41:16,309 --> 00:41:13,520

transparency so i'm talking about now

1070

00:41:19,030 --> 00:41:16,319

self-awareness is you know one of one of

1071

00:41:21,589 --> 00:41:19,040

the bright lines that may be very blurry

1072

00:41:25,109 --> 00:41:21,599

blurry and vague but certainly one which

1073

00:41:27,430 --> 00:41:25,119

is induced by uh the hard problem

1074

00:41:30,550 --> 00:41:27,440

you know just asking a simple question

1075

00:41:33,589 --> 00:41:30,560

your what kind of explanation for my

1076
00:41:35,030 --> 00:41:33,599
world whether i'm a single neuron or a

1077
00:41:36,550 --> 00:41:35,040
single person

1078
00:41:39,430 --> 00:41:36,560
and would

1079
00:41:43,030 --> 00:41:39,440
enable me or justify

1080
00:41:45,670 --> 00:41:43,040
the notion that i am myself

1081
00:41:47,670 --> 00:41:45,680
and the obvious answer is

1082
00:41:49,349 --> 00:41:47,680
when i have to disambiguate between the

1083
00:41:51,910 --> 00:41:49,359
consequences of my action and your

1084
00:41:53,190 --> 00:41:51,920
action if you are very similar to me

1085
00:41:55,270 --> 00:41:53,200
so if i

1086
00:41:56,630 --> 00:41:55,280
you know managed to survive in on an

1087
00:41:58,870 --> 00:41:56,640
alien planet

1088
00:42:01,030 --> 00:41:58,880

where there are no structures like like

1089

00:42:02,950 --> 00:42:01,040

me that could cause the same sense to

1090

00:42:05,510 --> 00:42:02,960

consequences

1091

00:42:07,670 --> 00:42:05,520

then there would be no problem inferring

1092

00:42:11,109 --> 00:42:07,680

did i cause that or did you cause that

1093

00:42:14,390 --> 00:42:11,119

so just having um the existence of a

1094

00:42:16,710 --> 00:42:14,400

population of con specifics in some sort

1095

00:42:19,030 --> 00:42:16,720

of formal structural sense

1096

00:42:21,030 --> 00:42:19,040

suddenly induces the inference problem

1097

00:42:22,790 --> 00:42:21,040

did you cause that do i cause that and

1098

00:42:25,349 --> 00:42:22,800

of course that naturally calls for

1099

00:42:27,430 --> 00:42:25,359

generative models or internal dynamics

1100

00:42:28,230 --> 00:42:27,440

representations on the inside

1101

00:42:30,550 --> 00:42:28,240

um

1102

00:42:33,030 --> 00:42:30,560

that entertain the hypothesis on the

1103

00:42:36,069 --> 00:42:33,040

notion that that's me

1104

00:42:38,230 --> 00:42:36,079

as opposed to not me so you get for free

1105

00:42:40,710 --> 00:42:38,240

in and only in this context where you've

1106

00:42:42,390 --> 00:42:40,720

put lots of these particles together

1107

00:42:43,670 --> 00:42:42,400

like you know the

1108

00:42:47,510 --> 00:42:43,680

if you like the license or the

1109

00:42:51,030 --> 00:42:47,520

motivation to have a hypothesis um you

1110

00:42:53,030 --> 00:42:51,040

know a representation of selfhood um

1111

00:42:54,470 --> 00:42:53,040

that you know from the statisticians

1112

00:42:55,910 --> 00:42:54,480

point of view

1113

00:42:57,829 --> 00:42:55,920

is exactly

1114

00:42:59,910 --> 00:42:57,839

the justification for the increased

1115

00:43:01,430 --> 00:42:59,920

complexity that chris was talking about

1116

00:43:05,270 --> 00:43:01,440

so i was listening to that really

1117

00:43:07,670 --> 00:43:05,280

interesting sort of uh um sort of

1118

00:43:09,990 --> 00:43:07,680

nod to iit and all it brings to the

1119

00:43:13,430 --> 00:43:10,000

table in terms of this sort of you know

1120

00:43:15,510 --> 00:43:13,440

commitment to some threshold crossing or

1121

00:43:18,069 --> 00:43:15,520

trans traversing a cut

1122

00:43:21,190 --> 00:43:18,079

with increasing complexity but why i

1123

00:43:23,109 --> 00:43:21,200

mean one simple answer is that um

1124

00:43:25,670 --> 00:43:23,119

you know if you ask a statistician what

1125

00:43:28,069 --> 00:43:25,680

is complexity and they'll tell you well

1126

00:43:31,109 --> 00:43:28,079

um it's basically the degrees of freedom

1127

00:43:32,309 --> 00:43:31,119

you're using up to explain some sensory

1128

00:43:34,870 --> 00:43:32,319

data

1129

00:43:36,790 --> 00:43:34,880

um you could articulate it as a kl or

1130

00:43:38,710 --> 00:43:36,800

relative entry between a posterior prior

1131

00:43:40,470 --> 00:43:38,720

if you're a bayesian but in essence it's

1132

00:43:44,069 --> 00:43:40,480

just the degrees of freedom

1133

00:43:45,990 --> 00:43:44,079

you're um using in order to accurately

1134

00:43:48,550 --> 00:43:46,000

explain these data

1135

00:43:51,190 --> 00:43:48,560

so mathematically the evidence is equal

1136

00:43:53,430 --> 00:43:51,200

to the accuracy minus the complexity so

1137

00:43:56,150 --> 00:43:53,440

why would you need what why why is that

1138

00:43:57,109 --> 00:43:56,160

useful well an increase in complexity

1139

00:44:02,309 --> 00:43:57,119

license

1140

00:44:04,150 --> 00:44:02,319

accuracy so the simple argument would go

1141

00:44:07,670 --> 00:44:04,160

and if i am

1142

00:44:08,950 --> 00:44:07,680

obliged to model and predict and explain

1143

00:44:11,190 --> 00:44:08,960

a world

1144

00:44:12,790 --> 00:44:11,200

and that is constituted by other things

1145

00:44:14,790 --> 00:44:12,800

like me

1146

00:44:17,349 --> 00:44:14,800

then the accuracy of my predictions will

1147

00:44:19,589 --> 00:44:17,359

be greatly enhanced if i have a

1148

00:44:20,470 --> 00:44:19,599

representation of me as distinct from

1149

00:44:23,430 --> 00:44:20,480

you

1150

00:44:26,069 --> 00:44:23,440

and if that entails an increase in the

1151
00:44:27,670 --> 00:44:26,079
degrees of freedom namely adding in this

1152
00:44:29,349 --> 00:44:27,680
extra kind of a hypothesis and

1153
00:44:30,150 --> 00:44:29,359
everything that it entails

1154
00:44:32,950 --> 00:44:30,160
then

1155
00:44:34,870 --> 00:44:32,960
i'm going to have a greater complexity

1156
00:44:37,910 --> 00:44:34,880
but it's a complexity that is more than

1157
00:44:40,069 --> 00:44:37,920
paid for by the uh by the increase

1158
00:44:41,510 --> 00:44:40,079
increase in the accuracy

1159
00:44:43,750 --> 00:44:41,520
and i you know

1160
00:44:45,109 --> 00:44:43,760
just coming back to you know my original

1161
00:44:47,430 --> 00:44:45,119
point um

1162
00:44:50,710 --> 00:44:47,440
yeah i think a lot of the work um that

1163
00:44:51,510 --> 00:44:50,720

you've done at the cellular level

1164

00:44:53,750 --> 00:44:51,520

um

1165

00:44:55,589 --> 00:44:53,760

would be very gracefully translated to

1166

00:44:57,270 --> 00:44:55,599

the societal level and to things like

1167

00:45:01,109 --> 00:44:57,280

economics and to

1168

00:45:03,670 --> 00:45:01,119

echo niche construction and in ethology

1169

00:45:04,950 --> 00:45:03,680

and i know chris is probably wanting to

1170

00:45:07,589 --> 00:45:04,960

say this

1171

00:45:09,990 --> 00:45:07,599

but language has one way of facilitating

1172

00:45:12,550 --> 00:45:10,000

that notion that ability to

1173

00:45:15,109 --> 00:45:12,560

um to efficiently with minimum

1174

00:45:17,190 --> 00:45:15,119

complexity in this instance um

1175

00:45:19,270 --> 00:45:17,200

do this distributed cognition so i'm

1176
00:45:20,790 --> 00:45:19,280
both trained being trained and learning

1177
00:45:22,470 --> 00:45:20,800
at the same time and we're doing it

1178
00:45:25,030 --> 00:45:22,480
together to invent some kind of

1179
00:45:28,790 --> 00:45:25,040
generalized synchrony

1180
00:45:30,470 --> 00:45:28,800
so i mentioned language for chris there

1181
00:45:32,950 --> 00:45:30,480
the font hope he wants to pick that one

1182
00:45:33,750 --> 00:45:32,960
up

1183
00:45:35,750 --> 00:45:33,760
oh

1184
00:45:38,150 --> 00:45:35,760
well well again what i'd actually like

1185
00:45:41,190 --> 00:45:38,160
to do is back up a little bit

1186
00:45:42,550 --> 00:45:41,200
and uh put some of what you just said

1187
00:45:46,870 --> 00:45:42,560
into

1188
00:45:49,430 --> 00:45:46,880

very simple active inference language

1189

00:45:52,550 --> 00:45:49,440

if i see something happening

1190

00:45:55,030 --> 00:45:52,560

on my markov blanket on my interface

1191

00:45:59,109 --> 00:45:55,040

with the world

1192

00:46:02,630 --> 00:45:59,119

then i always have the question

1193

00:46:04,710 --> 00:46:02,640

did i do that or did the world do that

1194

00:46:07,349 --> 00:46:04,720

where the world means everything outside

1195

00:46:11,030 --> 00:46:09,270

and

1196

00:46:14,309 --> 00:46:11,040

in a sense

1197

00:46:16,790 --> 00:46:14,319

the answer is always the world did it so

1198

00:46:19,270 --> 00:46:16,800

the question becomes

1199

00:46:21,750 --> 00:46:19,280

did the world do that in response to

1200

00:46:24,390 --> 00:46:21,760

something i did to it

1201

00:46:27,190 --> 00:46:24,400

or did it just do it

1202

00:46:29,589 --> 00:46:27,200

not not in consequence of any of my

1203

00:46:31,589 --> 00:46:29,599

actions

1204

00:46:34,390 --> 00:46:31,599

and so one gets immediately to this kind

1205

00:46:36,950 --> 00:46:34,400

of babbling scenario that we've talked

1206

00:46:38,150 --> 00:46:36,960

about many times

1207

00:46:41,589 --> 00:46:38,160

in which

1208

00:46:44,790 --> 00:46:41,599

an infant or a robot or some system

1209

00:46:45,990 --> 00:46:44,800

is trying to figure out

1210

00:46:48,710 --> 00:46:46,000

by

1211

00:46:50,150 --> 00:46:48,720

measuring correlations

1212

00:46:53,349 --> 00:46:50,160

whether

1213

00:46:57,750 --> 00:46:53,359

the world's inputs to it have anything

1214

00:46:58,630 --> 00:46:57,760

to do with its inputs to the world

1215

00:46:59,510 --> 00:46:58,640

and

1216

00:47:01,430 --> 00:46:59,520

just

1217

00:47:03,510 --> 00:47:01,440

asking that question

1218

00:47:07,510 --> 00:47:03,520

requires enormous

1219

00:47:12,550 --> 00:47:10,630

because one has to represent one's

1220

00:47:16,150 --> 00:47:12,560

actions

1221

00:47:19,349 --> 00:47:16,160

and represent them pretty well in time

1222

00:47:21,829 --> 00:47:19,359

and one has to

1223

00:47:24,230 --> 00:47:21,839

have a good memory

1224

00:47:26,230 --> 00:47:24,240

to represent enough actions to get any

1225

00:47:29,349 --> 00:47:26,240

kind of statistical support for drawing

1226

00:47:31,589 --> 00:47:29,359

an inference about correlation

1227

00:47:33,910 --> 00:47:31,599

and

1228

00:47:38,710 --> 00:47:33,920

that memory has to

1229

00:47:41,670 --> 00:47:38,720

be represented as a memory

1230

00:47:44,069 --> 00:47:41,680

uh not just part of one's own current

1231

00:47:45,589 --> 00:47:44,079

input

1232

00:47:47,829 --> 00:47:45,599

so i think this

1233

00:47:49,270 --> 00:47:47,839

question that you

1234

00:47:53,349 --> 00:47:49,280

posed

1235

00:47:54,870 --> 00:47:53,359

is really the key question faced by any

1236

00:47:57,109 --> 00:47:54,880

agent at all

1237

00:47:58,710 --> 00:47:57,119

that's trying to get a model off the

1238

00:47:59,589 --> 00:47:58,720

ground

1239

00:48:03,349 --> 00:47:59,599

which

1240

00:48:06,790 --> 00:48:03,359

question that mike asked early early on

1241

00:48:07,910 --> 00:48:06,800

about how does this all start

1242

00:48:11,430 --> 00:48:07,920

uh

1243

00:48:14,230 --> 00:48:11,440

maybe it starts with babbling

1244

00:48:16,790 --> 00:48:14,240

in very simple systems

1245

00:48:18,630 --> 00:48:16,800

you know i i was thinking recently uh

1246

00:48:20,549 --> 00:48:18,640

this this this whole issue of how many

1247

00:48:21,910 --> 00:48:20,559

agents are there and where is the border

1248

00:48:24,150 --> 00:48:21,920

between the agent and the world and how

1249

00:48:25,589 --> 00:48:24,160

do you self-model that border is is a

1250

00:48:27,190 --> 00:48:25,599

fascinating topic and there's a there's

1251

00:48:29,430 --> 00:48:27,200

an amazing um

1252

00:48:30,950 --> 00:48:29,440

developmental model for this which is

1253

00:48:32,790 --> 00:48:30,960

which is that you know we often talk

1254

00:48:33,990 --> 00:48:32,800

about one embryo and the embryo does

1255

00:48:35,990 --> 00:48:34,000

this in the embryo does that but

1256

00:48:37,990 --> 00:48:36,000

actually what happens at the beginning

1257

00:48:40,150 --> 00:48:38,000

let's say for example an amniote embryos

1258

00:48:42,230 --> 00:48:40,160

is that there's a there's a flat blasted

1259

00:48:43,430 --> 00:48:42,240

disc which has just a few cell layers

1260

00:48:44,790 --> 00:48:43,440

thick so it's kind of think of it like a

1261

00:48:45,910 --> 00:48:44,800

like a frisbee and it just has a few

1262

00:48:48,069 --> 00:48:45,920

cell layers

1263

00:48:51,030 --> 00:48:48,079

and normally what has to happen is that

1264

00:48:53,430 --> 00:48:51,040

one point in this in this disc breaks

1265

00:48:55,109 --> 00:48:53,440

symmetry and then organizes the primary

1266

00:48:56,790 --> 00:48:55,119

axis of the first embryo and basically

1267

00:48:58,470 --> 00:48:56,800

tells all the other cells

1268

00:48:59,510 --> 00:48:58,480

don't do it because because i'm doing it

1269

00:49:02,630 --> 00:48:59,520

and that's how you end up with one

1270

00:49:04,470 --> 00:49:02,640

embryo now that process is very easily

1271

00:49:05,829 --> 00:49:04,480

perturbed and and i many people have

1272

00:49:07,510 --> 00:49:05,839

done it i used to do it in my in my

1273

00:49:09,750 --> 00:49:07,520

graduate work and what you can do is if

1274

00:49:11,910 --> 00:49:09,760

you perturb that process that initial

1275

00:49:14,309 --> 00:49:11,920

blasto disc that undifferentiated sort

1276

00:49:15,510 --> 00:49:14,319

of pool of of cells which are these sort

1277

00:49:18,549 --> 00:49:15,520

of proto

1278

00:49:20,630 --> 00:49:18,559

uh low-level proto-proto-agents that

1279

00:49:22,309 --> 00:49:20,640

pool can break up into not one embryo

1280

00:49:24,069 --> 00:49:22,319

but actually multiple and so you can

1281

00:49:25,670 --> 00:49:24,079

have so i did this in in bird embryos

1282

00:49:27,109 --> 00:49:25,680

and you could have twins and chicken and

1283

00:49:28,870 --> 00:49:27,119

duck and things like this you can have

1284

00:49:29,990 --> 00:49:28,880

in humans humans have exactly the same

1285

00:49:31,349 --> 00:49:30,000

structure

1286

00:49:32,790 --> 00:49:31,359

you can get them head to head you can

1287

00:49:34,630 --> 00:49:32,800

have to get them side by side you can

1288

00:49:36,069 --> 00:49:34,640

get all sorts of geometries you can get

1289

00:49:38,870 --> 00:49:36,079

triplets you can get multiple

1290

00:49:41,190 --> 00:49:38,880

individuals awry emerging by different

1291

00:49:42,470 --> 00:49:41,200

partitions of this of this

1292

00:49:44,390 --> 00:49:42,480

really kind of

1293

00:49:46,150 --> 00:49:44,400

medium this particular medium where

1294

00:49:47,750 --> 00:49:46,160

where you have a bunch of cells and you

1295

00:49:49,589 --> 00:49:47,760

don't know ahead of time how many

1296

00:49:51,750 --> 00:49:49,599

individuals at the level of how many

1297

00:49:54,309 --> 00:49:51,760

larger individuals so embryos are going

1298

00:49:55,910 --> 00:49:54,319

to arise from this medium because the

1299

00:49:57,190 --> 00:49:55,920

the dynamics by which in that's you know

1300

00:49:59,190 --> 00:49:57,200

local activation and long-range

1301
00:50:01,190 --> 00:49:59,200
inhibition and things like that the the

1302
00:50:03,510 --> 00:50:01,200
dynamics that break up that that

1303
00:50:06,069 --> 00:50:03,520
undifferentiated ocean of of potential

1304
00:50:08,549 --> 00:50:06,079
selves into one two or three or more

1305
00:50:10,790 --> 00:50:08,559
selves is actually um it's very dynamic

1306
00:50:12,470 --> 00:50:10,800
it can it can go different ways

1307
00:50:14,150 --> 00:50:12,480
and then you get interesting interesting

1308
00:50:16,390 --> 00:50:14,160
things like this so for example you

1309
00:50:17,910 --> 00:50:16,400
might know that human conjoined twins

1310
00:50:20,230 --> 00:50:17,920
that are you know sort of stuck together

1311
00:50:22,390 --> 00:50:20,240
side to side one of the twins often has

1312
00:50:24,150 --> 00:50:22,400
left right asymmetry defects and it's

1313
00:50:26,710 --> 00:50:24,160

because when you have two twins side by

1314

00:50:28,390 --> 00:50:26,720

side the cells in the middle both twins

1315

00:50:29,990 --> 00:50:28,400

can't quite agree on who they belong to

1316

00:50:31,670 --> 00:50:30,000

are they the right side of this twin or

1317

00:50:33,430 --> 00:50:31,680

are they the left side of that twin and

1318

00:50:34,630 --> 00:50:33,440

both twins think they belong to them but

1319

00:50:36,549 --> 00:50:34,640

in fact they're overlapping they're the

1320

00:50:37,990 --> 00:50:36,559

same cells and so one side will have

1321

00:50:39,510 --> 00:50:38,000

correct left and right the other guy the

1322

00:50:41,270 --> 00:50:39,520

other side will have like two rights for

1323

00:50:43,510 --> 00:50:41,280

example right and this ends up this ends

1324

00:50:44,950 --> 00:50:43,520

up giving one of the twins laterality

1325

00:50:47,510 --> 00:50:44,960

defects with respect to heart and gut

1326
00:50:49,829 --> 00:50:47,520
patterning and so so their models each

1327
00:50:52,549 --> 00:50:49,839
twins as as the collective of cells

1328
00:50:53,510 --> 00:50:52,559
tries to compute uh things like which

1329
00:50:54,870 --> 00:50:53,520
which

1330
00:50:57,109 --> 00:50:54,880
where things are and what's left and

1331
00:50:59,190 --> 00:50:57,119
what's right and so on their models can

1332
00:51:00,710 --> 00:50:59,200
disagree with each other they can they

1333
00:51:02,470 --> 00:51:00,720
can draw the boundary between self and

1334
00:51:04,230 --> 00:51:02,480
world in different ways and you can have

1335
00:51:05,910 --> 00:51:04,240
these sort of disputes over certain

1336
00:51:07,030 --> 00:51:05,920
areas as to where who they actually

1337
00:51:08,950 --> 00:51:07,040
belong to

1338
00:51:10,470 --> 00:51:08,960

and and so so i'm just i'm just

1339

00:51:12,630 --> 00:51:10,480

incredibly interested in this in this

1340

00:51:14,390 --> 00:51:12,640

process of of emerging of

1341

00:51:16,950 --> 00:51:14,400

individualization so to speak out of

1342

00:51:19,430 --> 00:51:16,960

this like ocean of of potentiality these

1343

00:51:22,069 --> 00:51:19,440

cells you know 50 000 cells and some

1344

00:51:24,069 --> 00:51:22,079

number of individuals at the um at the

1345

00:51:25,510 --> 00:51:24,079

embryo level will be formed and each of

1346

00:51:26,950 --> 00:51:25,520

them will have specific goals in

1347

00:51:29,829 --> 00:51:26,960

morphospace each of them will try to

1348

00:51:31,430 --> 00:51:29,839

achieve very specific morphologies uh

1349

00:51:33,030 --> 00:51:31,440

and uh and they've and then you don't

1350

00:51:35,589 --> 00:51:33,040

know ahead of time how many there were

1351
00:51:37,190 --> 00:51:35,599
going to be you know

1352
00:51:38,309 --> 00:51:37,200
carl what occurs to you when you hear

1353
00:51:39,190 --> 00:51:38,319
that

1354
00:51:44,950 --> 00:51:39,200
um

1355
00:51:51,190 --> 00:51:47,030
just thinking about the imperatives for

1356
00:51:54,790 --> 00:51:52,470
so

1357
00:51:56,630 --> 00:51:54,800
when i hear that was a fascinating story

1358
00:51:58,309 --> 00:51:56,640
um and don't let me forget we ought to

1359
00:51:59,829 --> 00:51:58,319
explain to the viewers what babbling

1360
00:52:01,589 --> 00:51:59,839
means just in this context as well

1361
00:52:03,270 --> 00:52:01,599
because that's quite illuminating

1362
00:52:06,470 --> 00:52:03,280
perhaps we can i'm not sure that the

1363
00:52:08,630 --> 00:52:06,480

cells do do motor babbling um but they

1364

00:52:11,190 --> 00:52:08,640

certainly resolve um the same kind of

1365

00:52:13,750 --> 00:52:11,200

problem um so my um chris correct me if

1366

00:52:15,030 --> 00:52:13,760

i'm wrong but by babbling all we mean is

1367

00:52:18,790 --> 00:52:15,040

that when you're

1368

00:52:19,510 --> 00:52:18,800

first born into any universe you've got

1369

00:52:20,390 --> 00:52:19,520

to

1370

00:52:21,589 --> 00:52:20,400

um

1371

00:52:24,069 --> 00:52:21,599

work out

1372

00:52:26,390 --> 00:52:24,079

or test the hypothesis that i cause that

1373

00:52:28,069 --> 00:52:26,400

or the world caused that and so you

1374

00:52:29,349 --> 00:52:28,079

don't know you don't have a self model

1375

00:52:31,589 --> 00:52:29,359

you don't you know

1376

00:52:33,910 --> 00:52:31,599

whether this is sort of

1377

00:52:35,510 --> 00:52:33,920

a declarative model completely so

1378

00:52:38,549 --> 00:52:35,520

personal just

1379

00:52:40,950 --> 00:52:38,559

hardwired into the um the synaptic

1380

00:52:42,950 --> 00:52:40,960

efficacy and connectivity of your brain

1381

00:52:45,349 --> 00:52:42,960

so the first thing you have to do is

1382

00:52:47,349 --> 00:52:45,359

just to work out what you can control

1383

00:52:50,390 --> 00:52:47,359

and what you can't control

1384

00:52:52,309 --> 00:52:50,400

and the idea is that you you

1385

00:52:54,950 --> 00:52:52,319

engage in

1386

00:52:57,270 --> 00:52:54,960

what i would call epistemic or respond

1387

00:52:59,990 --> 00:52:57,280

to epistemic affordances or epistemic

1388

00:53:02,230 --> 00:53:00,000

plans that reveal knowledge they resolve

1389

00:53:05,910 --> 00:53:02,240

uncertainty and in this instance it's

1390

00:53:09,349 --> 00:53:05,920

the uncertainty about whether

1391

00:53:13,030 --> 00:53:09,359

i was the cause of this rattle rattling

1392

00:53:17,430 --> 00:53:13,040

so if you imagine um motor babbling

1393

00:53:19,109 --> 00:53:17,440

as manifest in a little baby

1394

00:53:22,470 --> 00:53:19,119

rattling its rattle

1395

00:53:25,829 --> 00:53:22,480

generating both the sensations

1396

00:53:27,109 --> 00:53:25,839

from the muscles and the skin but also

1397

00:53:30,309 --> 00:53:27,119

the visual

1398

00:53:32,390 --> 00:53:30,319

and the auditory sensations all co-occur

1399

00:53:34,870 --> 00:53:32,400

providing definitive evidence that

1400

00:53:37,510 --> 00:53:34,880

there's something special about

1401

00:53:39,190 --> 00:53:37,520

this process and this event

1402

00:53:41,510 --> 00:53:39,200

that um

1403

00:53:44,390 --> 00:53:41,520

that provides the basis for the

1404

00:53:45,910 --> 00:53:44,400

hypothesis there's a unitary cause

1405

00:53:48,549 --> 00:53:45,920

there's a unitary cause which is me

1406

00:53:50,950 --> 00:53:48,559

shaking the rattle but of course it may

1407

00:53:53,349 --> 00:53:50,960

take several months if not years to

1408

00:53:55,750 --> 00:53:53,359

actually get there to actually realize

1409

00:53:58,549 --> 00:53:55,760

that causes me so what can you imagine

1410

00:54:00,950 --> 00:53:58,559

sort of you know robots learning about

1411

00:54:03,109 --> 00:54:00,960

the uh the manipulator that they can

1412

00:54:06,630 --> 00:54:03,119

articulate all the the way in which they

1413

00:54:10,309 --> 00:54:06,640

can move around and you know um

1414

00:54:11,910 --> 00:54:10,319

for ambulate um but i think the idea

1415

00:54:14,870 --> 00:54:11,920

bring it back to sort of where the self

1416

00:54:16,230 --> 00:54:14,880

had come from um

1417

00:54:17,910 --> 00:54:16,240

it would um

1418

00:54:20,230 --> 00:54:17,920

rest upon

1419

00:54:21,829 --> 00:54:20,240

the testing the hypothesis which has to

1420

00:54:24,150 --> 00:54:21,839

be physically represented with a deep

1421

00:54:25,349 --> 00:54:24,160

more complex genetic model and sense

1422

00:54:28,150 --> 00:54:25,359

making

1423

00:54:30,230 --> 00:54:28,160

that in fact it's me that's actually

1424

00:54:31,990 --> 00:54:30,240

caused this single cause of all these

1425

00:54:34,950 --> 00:54:32,000

proprioceptive

1426

00:54:37,829 --> 00:54:34,960

motor sensations visual sensations

1427

00:54:39,270 --> 00:54:37,839

auditory sensations um and that would be

1428

00:54:41,990 --> 00:54:39,280

especially prescient when you're

1429

00:54:44,710 --> 00:54:42,000

starting to realize that some of these

1430

00:54:47,030 --> 00:54:44,720

causes which you thought were you

1431

00:54:50,230 --> 00:54:47,040

of the sort associated with nurturing

1432

00:54:52,390 --> 00:54:50,240

and suckling um were actually due to mum

1433

00:54:54,390 --> 00:54:52,400

and we come back to this argument to to

1434

00:54:57,510 --> 00:54:54,400

actually have a good hypothesis which

1435

00:55:00,069 --> 00:54:57,520

explains why i am not in charge of mum

1436

00:55:01,589 --> 00:55:00,079

because she is now not always responding

1437

00:55:03,829 --> 00:55:01,599

to me when i cry

1438

00:55:05,829 --> 00:55:03,839

yeah to have to explain that i have to

1439

00:55:07,270 --> 00:55:05,839

now develop a hypothesis yes it was me

1440

00:55:09,829 --> 00:55:07,280

causing all of this

1441

00:55:12,309 --> 00:55:09,839

um but sometimes there's something else

1442

00:55:14,390 --> 00:55:12,319

else out there that's not me but very

1443

00:55:17,030 --> 00:55:14,400

much like me and that's mum and then you

1444

00:55:18,950 --> 00:55:17,040

can see how there would be a pressure

1445

00:55:21,270 --> 00:55:18,960

in terms of you know finding the best

1446

00:55:23,349 --> 00:55:21,280

explanations for your sensations to to

1447

00:55:25,270 --> 00:55:23,359

have that so if you take that notion now

1448

00:55:26,789 --> 00:55:25,280

think of the same problem uh from the

1449

00:55:29,750 --> 00:55:26,799

point of view of a cell

1450

00:55:31,510 --> 00:55:29,760

um you know what are the impaired or a

1451

00:55:35,990 --> 00:55:31,520

bunch of cells that have to work

1452

00:55:37,190 --> 00:55:36,000

together or will ultimately form a uh an

1453

00:55:38,870 --> 00:55:37,200

embryo

1454

00:55:40,549 --> 00:55:38,880

via this process of symmetry breaking

1455

00:55:42,309 --> 00:55:40,559

you you know you have to ask what are

1456

00:55:45,270 --> 00:55:42,319

the underlying imperatives how how could

1457

00:55:46,950 --> 00:55:45,280

it be any other way um and of course it

1458

00:55:48,789 --> 00:55:46,960

could be more like i said it could be

1459

00:55:51,670 --> 00:55:48,799

lots of ways but

1460

00:55:53,990 --> 00:55:51,680

the ways the ways in which it goes wrong

1461

00:55:57,349 --> 00:55:54,000

um which would be another way of saying

1462

00:56:00,150 --> 00:55:57,359

um those rare occasions or the the ways

1463

00:56:03,510 --> 00:56:00,160

that it doesn't happen in

1464

00:56:06,150 --> 00:56:03,520

consequence of their rarity um involve

1465

00:56:08,069 --> 00:56:06,160

this ambiguity again

1466

00:56:09,990 --> 00:56:08,079

literally in this in the context of some

1467

00:56:12,150 --> 00:56:10,000

cells not knowing whether they're

1468

00:56:14,549 --> 00:56:12,160

belonging to one twin or or another twin

1469

00:56:15,349 --> 00:56:14,559

from the from the cell's perspective

1470

00:56:19,190 --> 00:56:15,359

um

1471

00:56:21,510 --> 00:56:19,200

nature of ambiguity and of course you

1472

00:56:22,630 --> 00:56:21,520

know it is exactly the same

1473

00:56:24,630 --> 00:56:22,640

um

1474

00:56:25,750 --> 00:56:24,640

one can account

1475

00:56:26,710 --> 00:56:25,760

for

1476

00:56:28,829 --> 00:56:26,720

the

1477

00:56:30,549 --> 00:56:28,839

simple observation that

1478

00:56:33,109 --> 00:56:30,559

self-organization

1479

00:56:37,190 --> 00:56:33,119

does not tolerate ambiguity does not

1480

00:56:39,990 --> 00:56:37,200

tolerate uncertainty it's only um

1481

00:56:41,990 --> 00:56:40,000

manifest in the context of

1482

00:56:45,270 --> 00:56:42,000

accurate and

1483

00:56:47,670 --> 00:56:45,280

well-evidenced definitive uh exchanges

1484

00:56:49,109 --> 00:56:47,680

so come back to chris's notion of your

1485

00:56:51,589 --> 00:56:49,119

sense making

1486

00:56:53,109 --> 00:56:51,599

projecting onto my markov blanket or my

1487

00:56:55,430 --> 00:56:53,119

holographic screen from the point of

1488

00:56:57,190 --> 00:56:55,440

view of the quantum formulation

1489

00:56:59,030 --> 00:56:57,200

that i need to resolve all the

1490

00:57:00,950 --> 00:56:59,040

uncertainty uh

1491

00:57:02,230 --> 00:57:00,960

as much uncertainty as i can but put

1492

00:57:03,829 --> 00:57:02,240

that another way

1493

00:57:05,190 --> 00:57:03,839

um as in a more slightly more

1494

00:57:07,510 --> 00:57:05,200

deflationary way

1495

00:57:09,109 --> 00:57:07,520

stuff which we see the way the universe

1496

00:57:10,630 --> 00:57:09,119

seems to work

1497

00:57:12,789 --> 00:57:10,640

is um

1498

00:57:16,470 --> 00:57:12,799

can be described as

1499

00:57:18,309 --> 00:57:16,480

um realizing processes that minimize

1500

00:57:21,750 --> 00:57:18,319

this this kind of uncertainty and

1501
00:57:24,390 --> 00:57:21,760
ambiguity and simply maximize the mutual

1502
00:57:27,030 --> 00:57:24,400
predictability of what's being projected

1503
00:57:29,510 --> 00:57:27,040
or impressed upon my surface on my

1504
00:57:32,309 --> 00:57:29,520
holographic screen or my markov blanket

1505
00:57:33,750 --> 00:57:32,319
uh so i you know that's what i was that

1506
00:57:36,950 --> 00:57:33,760
was going through my mind i thought it

1507
00:57:40,630 --> 00:57:36,960
was a beautiful example of of you know

1508
00:57:41,829 --> 00:57:40,640
when it goes wrong the the the the the

1509
00:57:46,950 --> 00:57:41,839
the

1510
00:57:48,630 --> 00:57:46,960
game and uh and that tells you something

1511
00:57:50,470 --> 00:57:48,640
quite fundamental about when it goes

1512
00:57:53,270 --> 00:57:50,480
right and when it goes right it's just

1513
00:57:56,390 --> 00:57:53,280

basically um a statement of what exists

1514

00:57:58,230 --> 00:57:56,400

and what you know what what perseveres

1515

00:57:59,670 --> 00:57:58,240

over time chris did you have anything to

1516

00:58:02,309 --> 00:57:59,680

say to add to that

1517

00:58:04,150 --> 00:58:02,319

well i would be interested to uh

1518

00:58:06,230 --> 00:58:04,160

to see how actually

1519

00:58:08,870 --> 00:58:06,240

how

1520

00:58:09,750 --> 00:58:08,880

mike responds to

1521

00:58:10,950 --> 00:58:09,760

that

1522

00:58:13,109 --> 00:58:10,960

uh

1523

00:58:16,390 --> 00:58:13,119

discourse with respect to the example of

1524

00:58:19,750 --> 00:58:16,400

this embryonic sheet where

1525

00:58:23,670 --> 00:58:19,760

the cells are each trying to figure out

1526

00:58:24,630 --> 00:58:23,680

what they're supposed to do

1527

00:58:27,270 --> 00:58:24,640

uh

1528

00:58:30,549 --> 00:58:29,270

there's they're still

1529

00:58:32,470 --> 00:58:30,559

uh

1530

00:58:34,390 --> 00:58:32,480

they still certainly believe that they

1531

00:58:36,470 --> 00:58:34,400

should be reproducing so they they

1532

00:58:37,670 --> 00:58:36,480

definitely do that and they signal to

1533

00:58:39,430 --> 00:58:37,680

each other

1534

00:58:41,109 --> 00:58:39,440

but somehow their

1535

00:58:43,510 --> 00:58:41,119

the collective effect of all of that

1536

00:58:46,309 --> 00:58:43,520

signaling to each other

1537

00:58:49,430 --> 00:58:46,319

is to organize different roles for them

1538

00:58:52,390 --> 00:58:49,440

for each for themselves

1539

00:58:53,750 --> 00:58:52,400

so how does the symmetry breaking occur

1540

00:58:55,670 --> 00:58:53,760

yeah so so that's that's really

1541

00:58:57,190 --> 00:58:55,680

interesting so as i was hearing um carl

1542

00:58:59,990 --> 00:58:57,200

talk about this i realized a couple of

1543

00:59:02,309 --> 00:59:00,000

things that um first of all uh as we

1544

00:59:03,990 --> 00:59:02,319

were saying before feedback loops are

1545

00:59:06,309 --> 00:59:04,000

absolutely central to this process

1546

00:59:07,910 --> 00:59:06,319

because the easiest way to prevent any

1547

00:59:11,030 --> 00:59:07,920

of this from happening and to end up

1548

00:59:13,270 --> 00:59:11,040

with a uh uh um kind of a mono um you

1549

00:59:14,789 --> 00:59:13,280

know sort of uh i you know a very a

1550

00:59:17,030 --> 00:59:14,799

featureless sheet where there are no

1551
00:59:19,109 --> 00:59:17,040
embryos is to block that is to block the

1552
00:59:20,549 --> 00:59:19,119
positive feedback loop that yeah so so

1553
00:59:22,549 --> 00:59:20,559
that long that that short range

1554
00:59:24,549 --> 00:59:22,559
inhibition long range activation that

1555
00:59:26,309 --> 00:59:24,559
says to one cell i'm going to now be the

1556
00:59:28,549 --> 00:59:26,319
organizer i'm going to make this axis

1557
00:59:30,150 --> 00:59:28,559
everybody else don't do it you those are

1558
00:59:31,510 --> 00:59:30,160
both feedback loops and so if you break

1559
00:59:33,190 --> 00:59:31,520
those feedback loops you get nothing so

1560
00:59:35,349 --> 00:59:33,200
so the feedback loops are right at the

1561
00:59:36,470 --> 00:59:35,359
beginning of this process and and the

1562
00:59:37,750 --> 00:59:36,480
other thing that that i thought was

1563
00:59:40,950 --> 00:59:37,760

really interesting that carl just said

1564

00:59:41,829 --> 00:59:40,960

is about the cells babbling so what i

1565

00:59:43,910 --> 00:59:41,839

think

1566

00:59:45,349 --> 00:59:43,920

it's a really good name for what we see

1567

00:59:46,549 --> 00:59:45,359

when you take a cell and you put it out

1568

00:59:48,390 --> 00:59:46,559

into a dish

1569

00:59:50,150 --> 00:59:48,400

what you'll see you'll and in fact in

1570

00:59:51,829 --> 00:59:50,160

any in any new environment you will see

1571

00:59:53,910 --> 00:59:51,839

two things that i think are probably

1572

00:59:55,589 --> 00:59:53,920

babbling in different spaces one is that

1573

00:59:57,510 --> 00:59:55,599

in physical space you will see that it's

1574

00:59:59,430 --> 00:59:57,520

incredibly active it's constantly

1575

01:00:00,390 --> 00:59:59,440

putting out and pulling back these these

1576

01:00:02,630 --> 01:00:00,400

um

1577

01:00:03,750 --> 01:00:02,640

kind of extensions so these cytoplasmic

1578

01:00:05,190 --> 01:00:03,760

extensions that have all kinds of

1579

01:00:06,390 --> 01:00:05,200

sensors on them they're not just sitting

1580

01:00:07,670 --> 01:00:06,400

the cell is never just sitting there

1581

01:00:09,430 --> 01:00:07,680

waiting for something to happen it's

1582

01:00:10,950 --> 01:00:09,440

constantly probing its environment it's

1583

01:00:13,910 --> 01:00:10,960

incredibly active i'm sure it's taking

1584

01:00:15,430 --> 01:00:13,920

all kinds of energy costs to do all this

1585

01:00:17,430 --> 01:00:15,440

um there are videos of it that are just

1586

01:00:18,870 --> 01:00:17,440

remarkable on online and you know we see

1587

01:00:20,390 --> 01:00:18,880

them every day the other the other

1588

01:00:23,270 --> 01:00:20,400

babbling takes place in transcriptional

1589

01:00:25,349 --> 01:00:23,280

space so gene expression is also never

1590

01:00:26,390 --> 01:00:25,359

just sort of still and this is you know

1591

01:00:28,069 --> 01:00:26,400

these are the genes that are expressed

1592

01:00:29,750 --> 01:00:28,079

and i'm just gonna sit here and do that

1593

01:00:31,670 --> 01:00:29,760

all the genes are constantly going up

1594

01:00:33,510 --> 01:00:31,680

and down within specific ranges as it

1595

01:00:35,829 --> 01:00:33,520

sort of wiggles in this transcriptional

1596

01:00:38,069 --> 01:00:35,839

space and i think both and probably

1597

01:00:39,910 --> 01:00:38,079

physiologically metabolically i bet this

1598

01:00:42,950 --> 01:00:39,920

is going on in all these other spaces

1599

01:00:44,549 --> 01:00:42,960

and i think babbling is an excellent uh

1600

01:00:46,150 --> 01:00:44,559

framework for for understanding what

1601
01:00:48,069 --> 01:00:46,160
it's actually doing it's actually taking

1602
01:00:50,150 --> 01:00:48,079
these little actions looking for

1603
01:00:52,069 --> 01:00:50,160
evidence of specific things that it can

1604
01:00:54,470 --> 01:00:52,079
then make use of to start to draw you

1605
01:00:56,150 --> 01:00:54,480
know to draw boundaries and and as chris

1606
01:00:57,270 --> 01:00:56,160
as chris was saying i think what happens

1607
01:01:00,470 --> 01:00:57,280
is that

1608
01:01:02,549 --> 01:01:00,480
in this blastoderm you get uh

1609
01:01:04,710 --> 01:01:02,559
what what what will happen is that once

1610
01:01:06,549 --> 01:01:04,720
once that that individuation starts

1611
01:01:09,829 --> 01:01:06,559
where there's a specific cell that

1612
01:01:12,309 --> 01:01:09,839
starts to go down this road of uh being

1613
01:01:14,710 --> 01:01:12,319

the organizer of this new

1614

01:01:16,710 --> 01:01:14,720

larger collective it immediately begins

1615

01:01:18,470 --> 01:01:16,720

to distort the action space for all the

1616

01:01:20,789 --> 01:01:18,480

nearby cells it starts putting out all

1617

01:01:22,950 --> 01:01:20,799

kinds of signals you know reward signals

1618

01:01:25,030 --> 01:01:22,960

and and physical forces and all these

1619

01:01:27,829 --> 01:01:25,040

other things that now

1620

01:01:29,430 --> 01:01:27,839

are going to bend the uh the option for

1621

01:01:32,230 --> 01:01:29,440

all the other cells and the best example

1622

01:01:34,069 --> 01:01:32,240

of that we have are these xenobots where

1623

01:01:35,910 --> 01:01:34,079

these things are just made of embryonic

1624

01:01:37,510 --> 01:01:35,920

skin cells and if you look at a standard

1625

01:01:39,109 --> 01:01:37,520

old embryo you get this idea that well

1626
01:01:41,270 --> 01:01:39,119
what do skin cells want to do they want

1627
01:01:42,390 --> 01:01:41,280
to be a passive two-dimensional layer on

1628
01:01:43,750 --> 01:01:42,400
the outside of the animal they do

1629
01:01:45,829 --> 01:01:43,760
nothing except sit there keep out the

1630
01:01:47,510 --> 01:01:45,839
bacteria you know nice and a boring

1631
01:01:49,109 --> 01:01:47,520
two-dimensional life but what you find

1632
01:01:50,710 --> 01:01:49,119
out is that that's only true because the

1633
01:01:52,789 --> 01:01:50,720
other cells are basically bullying them

1634
01:01:54,630 --> 01:01:52,799
into it left to their own devices with

1635
01:01:56,309 --> 01:01:54,640
the in the absence of these instructive

1636
01:01:57,750 --> 01:01:56,319
interactions with the rest of the embryo

1637
01:01:59,029 --> 01:01:57,760
what they what the skin cells actually

1638
01:02:01,670 --> 01:01:59,039

want to do is get together into a

1639

01:02:03,990 --> 01:02:01,680

three-dimensional uh kind of ball like

1640

01:02:05,349 --> 01:02:04,000

architecture they are self-motile that

1641

01:02:07,190 --> 01:02:05,359

you know they'll run around and move and

1642

01:02:08,870 --> 01:02:07,200

do very have various behaviors including

1643

01:02:11,750 --> 01:02:08,880

make copies of themselves if provided

1644

01:02:12,710 --> 01:02:11,760

with materials and so that is completely

1645

01:02:14,549 --> 01:02:12,720

um

1646

01:02:16,549 --> 01:02:14,559

kind of obscured by standard development

1647

01:02:18,150 --> 01:02:16,559

where what you're seeing actually is is

1648

01:02:20,470 --> 01:02:18,160

cells in a space that was really

1649

01:02:22,069 --> 01:02:20,480

deformed by by all their neighbors right

1650

01:02:23,990 --> 01:02:22,079

and that's you know that kind of process

1651

01:02:25,589 --> 01:02:24,000

that that that starts to devel you know

1652

01:02:26,870 --> 01:02:25,599

make them make those distinctions where

1653

01:02:30,470 --> 01:02:26,880

the embryo

1654

01:02:32,710 --> 01:02:30,480

parts are inside and what parts are

1655

01:02:34,470 --> 01:02:32,720

supposedly outside of itself and that

1656

01:02:37,589 --> 01:02:34,480

that gets reinforced by all these early

1657

01:02:41,510 --> 01:02:39,430

carl or chris do you want to jump in on

1658

01:02:44,230 --> 01:02:41,520

that i think i think we've been

1659

01:02:48,230 --> 01:02:44,240

describing cyclists that says basically

1660

01:02:50,630 --> 01:02:48,240

that it's curiosity all the way down

1661

01:02:52,789 --> 01:02:50,640

every system is trying to figure out

1662

01:02:54,630 --> 01:02:52,799

what's going on i was struck with that

1663

01:02:56,549 --> 01:02:54,640

with this image of the little cells

1664

01:02:58,630 --> 01:02:56,559

putting out fingers you know this is

1665

01:03:00,870 --> 01:02:58,640

expiration your sort of true blue

1666

01:03:03,829 --> 01:03:00,880

exploration and mathematically it's

1667

01:03:05,510 --> 01:03:03,839

simply as it says it's um

1668

01:03:09,589 --> 01:03:05,520

what

1669

01:03:12,069 --> 01:03:09,599

artificial intelligence um research

1670

01:03:13,270 --> 01:03:12,079

aspires to which is artificial curiosity

1671

01:03:14,950 --> 01:03:13,280

you know

1672

01:03:16,390 --> 01:03:14,960

going out there getting the right kind

1673

01:03:18,069 --> 01:03:16,400

of data

1674

01:03:20,069 --> 01:03:18,079

that's going to maximally resolve your

1675

01:03:22,470 --> 01:03:20,079

uncertainty and paint the way the way

1676
01:03:25,589 --> 01:03:22,480
forward and of course it's

1677
01:03:28,470 --> 01:03:25,599
intimately related to planning

1678
01:03:31,510 --> 01:03:28,480
in the sense you have to um

1679
01:03:33,510 --> 01:03:31,520
realize that palpation you know whether

1680
01:03:36,309 --> 01:03:33,520
it's a little cell palpating whether

1681
01:03:39,109 --> 01:03:36,319
it's failure or podia or um whether it's

1682
01:03:41,349 --> 01:03:39,119
me palpating my visual world i move my

1683
01:03:43,270 --> 01:03:41,359
eyes around or whether it's the

1684
01:03:46,870 --> 01:03:43,280
little baby babbling and palpating it's

1685
01:03:49,109 --> 01:03:46,880
cot this this this this palpation

1686
01:03:50,789 --> 01:03:49,119
has to be planned

1687
01:03:52,549 --> 01:03:50,799
it could be planned in the sense of the

1688
01:03:55,270 --> 01:03:52,559

gazelle sorry because it's not the

1689

01:03:56,150 --> 01:03:55,280

gazelle the cheetah chasing the gazelle

1690

01:03:58,309 --> 01:03:56,160

so it doesn't have to be very

1691

01:04:00,150 --> 01:03:58,319

sophisticated cognitive conscious

1692

01:04:02,069 --> 01:04:00,160

planning but certainly has to has to be

1693

01:04:05,190 --> 01:04:02,079

planned it has to have this sort of

1694

01:04:07,270 --> 01:04:05,200

curious behavior um i mean it you know

1695

01:04:10,630 --> 01:04:07,280

it strikes me that that is such a

1696

01:04:14,230 --> 01:04:10,640

fundamental um aspect

1697

01:04:15,510 --> 01:04:14,240

that i think would qualify

1698

01:04:17,910 --> 01:04:15,520

behaviors

1699

01:04:20,069 --> 01:04:17,920

that have that aspect as cognitive in

1700

01:04:21,829 --> 01:04:20,079

some sense and it's so fundamental

1701

01:04:23,029 --> 01:04:21,839

because of course it's it's just an

1702

01:04:24,309 --> 01:04:23,039

expression

1703

01:04:26,710 --> 01:04:24,319

of

1704

01:04:27,430 --> 01:04:26,720

dynamics that apply

1705

01:04:29,990 --> 01:04:27,440

to

1706

01:04:30,870 --> 01:04:30,000

um action upon the world

1707

01:04:31,829 --> 01:04:30,880

um

1708

01:04:33,510 --> 01:04:31,839

that

1709

01:04:34,870 --> 01:04:33,520

underwrite

1710

01:04:36,950 --> 01:04:34,880

everything that we do as certainly as

1711

01:04:38,870 --> 01:04:36,960

scientists and one could imagine as as

1712

01:04:42,549 --> 01:04:38,880

human beings but certainly as scientists

1713

01:04:45,109 --> 01:04:42,559

you know that the maths of curiosity was

1714

01:04:47,270 --> 01:04:45,119

was actually worked out um by dennis

1715

01:04:50,150 --> 01:04:47,280

lindley in the 1950s

1716

01:04:51,670 --> 01:04:50,160

um in terms of expected information gain

1717

01:04:53,349 --> 01:04:51,680

and then reintroduced by people like

1718

01:04:55,990 --> 01:04:53,359

david mckay in the context of active

1719

01:04:58,630 --> 01:04:56,000

learning so bringing this active notion

1720

01:05:01,510 --> 01:04:58,640

that you can learn by actively acquiring

1721

01:05:03,109 --> 01:05:01,520

the right kind of data that optimizes

1722

01:05:06,870 --> 01:05:03,119

that kind of learning

1723

01:05:11,510 --> 01:05:09,750

the principles of optimum bayesian

1724

01:05:13,190 --> 01:05:11,520

experimental design

1725

01:05:15,510 --> 01:05:13,200

so it's exactly the same kind of

1726

01:05:17,109 --> 01:05:15,520

curiosity that we as scientists use all

1727

01:05:18,230 --> 01:05:17,119

the time whenever we design an

1728

01:05:20,829 --> 01:05:18,240

experiment

1729

01:05:23,829 --> 01:05:20,839

it's basically configuring actively

1730

01:05:26,710 --> 01:05:23,839

configuring some process to generate

1731

01:05:27,510 --> 01:05:26,720

something that can be sensed or measured

1732

01:05:31,349 --> 01:05:27,520

that

1733

01:05:33,109 --> 01:05:31,359

or affords the greatest amount of

1734

01:05:34,069 --> 01:05:33,119

information so

1735

01:05:36,309 --> 01:05:34,079

you know

1736

01:05:37,349 --> 01:05:36,319

the three of us as scientists uh have

1737

01:05:38,230 --> 01:05:37,359

become

1738

01:05:41,430 --> 01:05:38,240

um

1739

01:05:42,950 --> 01:05:41,440

experts at this kind of formal curiosity

1740

01:05:45,589 --> 01:05:42,960

simply you know

1741

01:05:47,589 --> 01:05:45,599

just by acquiring uh knowledge about

1742

01:05:49,430 --> 01:05:47,599

in the in the particular paradigms or

1743

01:05:51,029 --> 01:05:49,440

setups and the fields that we find

1744

01:05:53,029 --> 01:05:51,039

ourselves in the right way to do

1745

01:05:54,309 --> 01:05:53,039

experiments but you could argue that

1746

01:05:56,309 --> 01:05:54,319

that's life

1747

01:05:58,309 --> 01:05:56,319

you know in a sense that is the the

1748

01:05:59,990 --> 01:05:58,319

infant bubbling uh

1749

01:06:02,069 --> 01:06:00,000

it is you know

1750

01:06:04,470 --> 01:06:02,079

that kind of sense making getting

1751

01:06:06,870 --> 01:06:04,480

actively getting the right kind of data

1752

01:06:09,589 --> 01:06:06,880

to work out your place in the world

1753

01:06:11,430 --> 01:06:09,599

uh to work out what you know what you

1754

01:06:13,670 --> 01:06:11,440

should do next

1755

01:06:17,109 --> 01:06:13,680

is one of the most existentially

1756

01:06:19,109 --> 01:06:17,119

important imperatives um and you know i

1757

01:06:21,029 --> 01:06:19,119

was struck out you know but the

1758

01:06:23,349 --> 01:06:21,039

mechanics that mike was talking about in

1759

01:06:25,190 --> 01:06:23,359

terms of the you know

1760

01:06:26,870 --> 01:06:25,200

the little skin cells left their own

1761

01:06:29,029 --> 01:06:26,880

devices have it having a party and

1762

01:06:31,270 --> 01:06:29,039

forming balls and wandering around i

1763

01:06:32,549 --> 01:06:31,280

mean you know one could apply that kind

1764

01:06:34,710 --> 01:06:32,559

of mechanics

1765

01:06:36,950 --> 01:06:34,720

to people couldn't you or even even

1766

01:06:38,950 --> 01:06:36,960

cultures and countries we're all trying

1767

01:06:41,190 --> 01:06:38,960

to find our place and we're all trying

1768

01:06:42,470 --> 01:06:41,200

to work out how to respond to those

1769

01:06:43,990 --> 01:06:42,480

constraints

1770

01:06:47,670 --> 01:06:44,000

people around us at many different

1771

01:06:51,829 --> 01:06:50,230

put on our behavior and try and infer

1772

01:06:52,950 --> 01:06:51,839

well how am i meant to behave in this

1773

01:06:54,549 --> 01:06:52,960

situation

1774

01:06:57,029 --> 01:06:54,559

so even if we all start off with the

1775

01:06:59,190 --> 01:06:57,039

same genetic code and the same sort of

1776

01:07:01,430 --> 01:06:59,200

model of you know

1777

01:07:03,589 --> 01:07:01,440

how people behave

1778

01:07:05,990 --> 01:07:03,599

the context in which we find ourselves

1779

01:07:07,910 --> 01:07:06,000

now needs to be inferred in order to

1780

01:07:09,750 --> 01:07:07,920

have to know how to behave in this

1781

01:07:11,829 --> 01:07:09,760

context either with a child or as a

1782

01:07:13,990 --> 01:07:11,839

mother as a politician or as an aid

1783

01:07:15,990 --> 01:07:14,000

worker or a first responder whatever you

1784

01:07:18,150 --> 01:07:16,000

want you have to make that inference and

1785

01:07:21,270 --> 01:07:18,160

of course that inference

1786

01:07:23,670 --> 01:07:21,280

inferring that context requires

1787

01:07:24,710 --> 01:07:23,680

the curious behavior that

1788

01:07:26,470 --> 01:07:24,720

that

1789

01:07:29,109 --> 01:07:26,480

chris had picked up on

1790

01:07:31,029 --> 01:07:29,119

in mike's example

1791

01:07:33,750 --> 01:07:31,039

wow could could you know what i'd love

1792

01:07:34,950 --> 01:07:33,760

to hear is each of you talk about um

1793

01:07:38,710 --> 01:07:34,960

what is the

1794

01:07:40,549 --> 01:07:38,720

simplest most basic uh

1795

01:07:41,430 --> 01:07:40,559

thing so you know hopefully going down

1796

01:07:43,430 --> 01:07:41,440

to like

1797

01:07:44,789 --> 01:07:43,440

physics prior to life but but whatever

1798

01:07:46,309 --> 01:07:44,799

you like what is the most basic thing

1799

01:07:48,069 --> 01:07:46,319

that is able to do that because that's

1800

01:07:49,750 --> 01:07:48,079

what i find in in talking about this

1801

01:07:51,990 --> 01:07:49,760

stuff to other communities the thing

1802

01:07:53,990 --> 01:07:52,000

that people are the most resistant to is

1803

01:07:55,829 --> 01:07:54,000

this idea that these kind of dynamics

1804

01:07:57,750 --> 01:07:55,839

this this kind of uh exploration

1805

01:07:59,670 --> 01:07:57,760

curiosity prediction all of these things

1806

01:08:01,190 --> 01:07:59,680

that we're talking about that you know

1807

01:08:03,349 --> 01:08:01,200

people people think it's it's brains

1808

01:08:05,270 --> 01:08:03,359

first and then you can do all these

1809

01:08:07,349 --> 01:08:05,280

these these great things i i would love

1810

01:08:09,349 --> 01:08:07,359

to hear um you know what you think is

1811

01:08:10,789 --> 01:08:09,359

the simplest physical system that can do

1812

01:08:16,470 --> 01:08:10,799

that kind of thing so that we can talk

1813

01:08:22,630 --> 01:08:18,550

while chris is thinking about that with

1814

01:08:27,910 --> 01:08:25,110

not a trivial answer but a formal um

1815

01:08:31,590 --> 01:08:27,920

answer uh i i think it's

1816

01:08:33,669 --> 01:08:31,600

um you'd have to identify the um the

1817

01:08:36,309 --> 01:08:33,679

depth of planning

1818

01:08:38,070 --> 01:08:36,319

um that underwrote the

1819

01:08:39,669 --> 01:08:38,080

the dynamics of the behavior of the

1820

01:08:42,390 --> 01:08:39,679

system um

1821

01:08:43,669 --> 01:08:42,400

in question um and that would be

1822

01:08:45,189 --> 01:08:43,679

basically

1823

01:08:47,110 --> 01:08:45,199

if you were putting this in a sort of

1824

01:08:50,149 --> 01:08:47,120

path integral formulation it would be

1825

01:08:52,630 --> 01:08:50,159

the sort of the the amount of time over

1826
01:08:55,189 --> 01:08:52,640
which you are integrating your paths and

1827
01:08:56,470 --> 01:08:55,199
you're evaluating the best way forward

1828
01:08:57,990 --> 01:08:56,480
um

1829
01:09:02,630 --> 01:08:58,000
once you move

1830
01:09:03,590 --> 01:09:02,640
scales

1831
01:09:06,390 --> 01:09:03,600
um

1832
01:09:09,669 --> 01:09:06,400
then the depth of that planning i think

1833
01:09:12,990 --> 01:09:09,679
eludes um physical realizations that

1834
01:09:15,669 --> 01:09:13,000
could be written down in terms of um

1835
01:09:18,829 --> 01:09:15,679
representations in terms of

1836
01:09:23,189 --> 01:09:18,839
concentrations and

1837
01:09:25,669 --> 01:09:23,199
um depolarizations and the like um and

1838
01:09:28,709 --> 01:09:25,679

one has to move to a quantum discrete

1839

01:09:30,550 --> 01:09:28,719

time representation so you know

1840

01:09:33,110 --> 01:09:30,560

i guess i'm basically making the

1841

01:09:36,390 --> 01:09:33,120

difference between the sort of um

1842

01:09:41,349 --> 01:09:36,400

the the the kind of dynamics you'd find

1843

01:09:42,470 --> 01:09:41,359

in a uh in chemotaxis or a thermostat um

1844

01:09:45,349 --> 01:09:42,480

that could be written down as

1845

01:09:46,870 --> 01:09:45,359

differential equations in fact

1846

01:09:48,950 --> 01:09:46,880

the kind of differential equations we

1847

01:09:50,550 --> 01:09:48,960

used in one of those early

1848

01:09:53,829 --> 01:09:50,560

pattern formation papers and knowing

1849

01:09:55,510 --> 01:09:53,839

your place uh approaches um where

1850

01:09:57,750 --> 01:09:55,520

everything could be articulated in terms

1851
01:10:00,310 --> 01:09:57,760
of differential equations so that there

1852
01:10:02,149 --> 01:10:00,320
is a kind of planning but it's not of

1853
01:10:04,470 --> 01:10:02,159
the curious kind that we talked about

1854
01:10:07,189 --> 01:10:04,480
it's just following the most likely

1855
01:10:08,950 --> 01:10:07,199
paths of at least action so i would say

1856
01:10:10,950 --> 01:10:08,960
that they're not cognitive in the sense

1857
01:10:13,750 --> 01:10:10,960
that they have planning

1858
01:10:16,390 --> 01:10:13,760
um so i put chemotaxis and thermostats

1859
01:10:18,229 --> 01:10:16,400
and possibly most viruses probably at a

1860
01:10:21,030 --> 01:10:18,239
precognitive

1861
01:10:22,310 --> 01:10:21,040
or proto-cognitive level but as soon as

1862
01:10:24,229 --> 01:10:22,320
you get to

1863
01:10:27,110 --> 01:10:24,239

um

1864

01:10:29,669 --> 01:10:27,120

generator models that can roll out deep

1865

01:10:32,149 --> 01:10:29,679

into the future and i i repeat just when

1866

01:10:34,149 --> 01:10:32,159

you try to implement this in silico

1867

01:10:35,750 --> 01:10:34,159

you know using computer simulations you

1868

01:10:38,070 --> 01:10:35,760

really have to move to a discrete time

1869

01:10:40,070 --> 01:10:38,080

representation um which i think is a

1870

01:10:42,070 --> 01:10:40,080

non-trivial thing i mean just for

1871

01:10:45,110 --> 01:10:42,080

example remember the sort of the eye

1872

01:10:47,189 --> 01:10:45,120

movement example yeah we sense make

1873

01:10:49,430 --> 01:10:47,199

by getting little snapshots of the world

1874

01:10:51,990 --> 01:10:49,440

every 250 milliseconds

1875

01:10:53,669 --> 01:10:52,000

uh it's not like i've got i am a

1876
01:10:55,510 --> 01:10:53,679
thermostat and i'm taking a continuous

1877
01:10:57,750 --> 01:10:55,520
record of the temperature that is a

1878
01:11:01,669 --> 01:10:57,760
continuous i'm actually getting

1879
01:11:04,070 --> 01:11:01,679
quantal observations um and i think once

1880
01:11:07,990 --> 01:11:04,080
you move to that kind of generative

1881
01:11:11,510 --> 01:11:08,000
model or biophysics that entails um the

1882
01:11:13,270 --> 01:11:11,520
gradient flows under that genitive model

1883
01:11:15,030 --> 01:11:13,280
then i think you're in a position to

1884
01:11:16,870 --> 01:11:15,040
talk about sort of planning and

1885
01:11:19,669 --> 01:11:16,880
cognition and curiosity of the kind that

1886
01:11:21,430 --> 01:11:19,679
would we're talking about uh so i you

1887
01:11:23,270 --> 01:11:21,440
know i'd literally put time constants on

1888
01:11:24,709 --> 01:11:23,280

this i'd say about you know 300

1889

01:11:26,709 --> 01:11:24,719
milliseconds if you've got the ability

1890

01:11:28,390 --> 01:11:26,719
to represent the future

1891

01:11:29,430 --> 01:11:28,400
300 milliseconds

1892

01:11:31,189 --> 01:11:29,440
you know

1893

01:11:33,350 --> 01:11:31,199
sorry represent the consequences of your

1894

01:11:35,669 --> 01:11:33,360
actions more than 300 milliseconds in

1895

01:11:39,350 --> 01:11:35,679
the future then i put you in

1896

01:11:41,030 --> 01:11:39,360
having crossed that one of those cuts

1897

01:11:44,070 --> 01:11:41,040
um and

1898

01:11:46,950 --> 01:11:44,080
moved from from being a sort of um yeah

1899

01:11:49,189 --> 01:11:46,960
a virus to you know to to i don't know

1900

01:11:51,430 --> 01:11:49,199
perhaps an insect i'm not sure

1901

01:11:53,590 --> 01:11:51,440

perhaps you had to go

1902

01:11:54,950 --> 01:11:53,600

are you seriously putting the 300 ml

1903

01:11:57,110 --> 01:11:54,960

seconds forward or like or is that

1904

01:11:57,990 --> 01:11:57,120

facetious

1905

01:12:00,550 --> 01:11:58,000

um

1906

01:12:02,630 --> 01:12:00,560

it's it's facetious but

1907

01:12:03,990 --> 01:12:02,640

but not as facetious as it might as you

1908

01:12:05,750 --> 01:12:04,000

might think

1909

01:12:07,270 --> 01:12:05,760

i do think that they're

1910

01:12:12,390 --> 01:12:07,280

yeah i think there's a

1911

01:12:15,030 --> 01:12:12,400

there's one way of celebrating the um

1912

01:12:16,709 --> 01:12:15,040

the escapes from pan psychism that we

1913

01:12:18,390 --> 01:12:16,719

started off with when you know when mike

1914

01:12:20,630 --> 01:12:18,400

was saying what he spends his time

1915

01:12:22,630 --> 01:12:20,640

talking about one of the ways is to

1916

01:12:24,149 --> 01:12:22,640

commit to vagueness and you know how

1917

01:12:25,910 --> 01:12:24,159

many um

1918

01:12:29,110 --> 01:12:25,920

how many grains of sand do i need before

1919

01:12:31,430 --> 01:12:29,120

this is all becomes a pile um and try

1920

01:12:34,149 --> 01:12:31,440

and work out what the uh what the

1921

01:12:35,430 --> 01:12:34,159

quantity is uh that defines that

1922

01:12:37,590 --> 01:12:35,440

spectrum that we were talking about

1923

01:12:39,750 --> 01:12:37,600

before uh along the switch there is

1924

01:12:41,910 --> 01:12:39,760

vagueness at some point consciousness of

1925

01:12:44,870 --> 01:12:41,920

a certain kind um

1926

01:12:47,270 --> 01:12:44,880

arises um but i also think there are

1927

01:12:49,189 --> 01:12:47,280

natural kinds that actually have bright

1928

01:12:50,470 --> 01:12:49,199

lines between them

1929

01:12:52,709 --> 01:12:50,480

and you know

1930

01:12:54,229 --> 01:12:52,719

what i'm saying here and i i don't think

1931

01:12:56,149 --> 01:12:54,239

i said it before and i probably wouldn't

1932

01:12:57,270 --> 01:12:56,159

say it again um

1933

01:13:01,830 --> 01:12:57,280

but

1934

01:13:03,830 --> 01:13:01,840

in my experience

1935

01:13:05,990 --> 01:13:03,840

qualitatively different kinds of

1936

01:13:08,229 --> 01:13:06,000

generative models that represent time in

1937

01:13:09,669 --> 01:13:08,239

very very different ways you can get so

1938

01:13:12,310 --> 01:13:09,679

mathematically things like kalman

1939

01:13:15,110 --> 01:13:12,320

filters that can be cast or linear

1940

01:13:17,750 --> 01:13:15,120

quadratic control robotics

1941

01:13:20,390 --> 01:13:17,760

and the like that can be cast purely in

1942

01:13:22,149 --> 01:13:20,400

terms of futures that are represented in

1943

01:13:24,070 --> 01:13:22,159

terms of velocities and accelerations

1944

01:13:25,510 --> 01:13:24,080

and higher order motions that are just

1945

01:13:26,630 --> 01:13:25,520

in the dynamics and the equations of

1946

01:13:28,390 --> 01:13:26,640

motion

1947

01:13:30,149 --> 01:13:28,400

uh and you can realize and build these

1948

01:13:31,270 --> 01:13:30,159

things you can simulate them and they

1949

01:13:33,030 --> 01:13:31,280

behave

1950

01:13:35,430 --> 01:13:33,040

in a very plausible way you can get them

1951

01:13:37,030 --> 01:13:35,440

to do handwriting you can get them to

1952

01:13:38,390 --> 01:13:37,040

self-organize and do all sorts of

1953

01:13:40,470 --> 01:13:38,400

interesting things

1954

01:13:42,790 --> 01:13:40,480

our thermostat

1955

01:13:44,390 --> 01:13:42,800

but that's um

1956

01:13:45,990 --> 01:13:44,400

that's as far as it goes these things

1957

01:13:47,270 --> 01:13:46,000

don't show curious behavior to do

1958

01:13:50,310 --> 01:13:47,280

curious behavior you're really gonna

1959

01:13:51,750 --> 01:13:50,320

roll out much further into the future

1960

01:13:54,070 --> 01:13:51,760

and in running out further into the

1961

01:13:55,910 --> 01:13:54,080

future it's very difficult to represent

1962

01:13:57,590 --> 01:13:55,920

the future just using differential

1963

01:13:59,189 --> 01:13:57,600

equations unless you move to very very

1964

01:14:00,950 --> 01:13:59,199

high orders of motion

1965

01:14:03,189 --> 01:14:00,960

and at which point you start to sort of

1966

01:14:05,030 --> 01:14:03,199

you know to minimize that complexity

1967

01:14:08,149 --> 01:14:05,040

start to articulate things in discrete

1968

01:14:09,669 --> 01:14:08,159

time and then the maths and so the mass

1969

01:14:12,709 --> 01:14:09,679

the new

1970

01:14:14,149 --> 01:14:12,719

the um numerics become much simpler and

1971

01:14:15,590 --> 01:14:14,159

doable

1972

01:14:16,950 --> 01:14:15,600

and

1973

01:14:18,470 --> 01:14:16,960

then you've got a qualitatively

1974

01:14:20,149 --> 01:14:18,480

different kind of genitive model you

1975

01:14:22,550 --> 01:14:20,159

move from a continuous to a discrete

1976

01:14:26,630 --> 01:14:22,560

time a quant a quantized generative

1977

01:14:28,790 --> 01:14:26,640

model um so that for me is not does not

1978

01:14:30,950 --> 01:14:28,800

allow a vagueness you know there is

1979

01:14:33,270 --> 01:14:30,960

actually a natural kind that will

1980

01:14:36,070 --> 01:14:33,280

represent things in the moment in terms

1981

01:14:38,310 --> 01:14:36,080

of flows and dynamics and other natural

1982

01:14:40,709 --> 01:14:38,320

kinds that will represent things um in

1983

01:14:44,310 --> 01:14:40,719

terms of discrete not universal clock

1984

01:14:46,070 --> 01:14:44,320

time but discrete iterations um and i'm

1985

01:14:47,910 --> 01:14:46,080

saying that the you know for for

1986

01:14:50,070 --> 01:14:47,920

certainly our scale of interactions and

1987

01:14:52,070 --> 01:14:50,080

the way that we sense make i would have

1988

01:14:54,390 --> 01:14:52,080

thought 300 milliseconds was not a

1989

01:14:57,189 --> 01:14:54,400

controversial um i say that because

1990

01:14:58,950 --> 01:14:57,199

that's the cognitive moment it's also

1991

01:15:00,870 --> 01:14:58,960

the time interval between the way that

1992

01:15:02,709 --> 01:15:00,880

we sample the world not just with our

1993

01:15:03,910 --> 01:15:02,719

eyes but when we sniff

1994

01:15:06,310 --> 01:15:03,920

we sniff

1995

01:15:08,070 --> 01:15:06,320

at a frequency which means that each new

1996

01:15:10,070 --> 01:15:08,080

sampling of that well that palpation

1997

01:15:13,350 --> 01:15:10,080

with our chemo acceptors and olfactory

1998

01:15:15,430 --> 01:15:13,360

receptors is again every couple you know

1999

01:15:17,430 --> 01:15:15,440

every 200 milliseconds so suggest to me

2000

01:15:20,149 --> 01:15:17,440

there's a sort of discrete

2001

01:15:22,470 --> 01:15:20,159

belief updating um and it is a discrete

2002

01:15:24,870 --> 01:15:22,480

belief updating that is underwritten by

2003

01:15:27,270 --> 01:15:24,880

the way we act the plans have to be in

2004

01:15:29,030 --> 01:15:27,280

these discrete chunks of time so that's

2005

01:15:30,790 --> 01:15:29,040

where the 300 second milliseconds come

2006

01:15:33,270 --> 01:15:30,800

from you see it everywhere

2007

01:15:35,750 --> 01:15:33,280

mice whisking they whisk at that

2008

01:15:37,510 --> 01:15:35,760

frequency so they touch the palpate

2009

01:15:40,229 --> 01:15:37,520

every 300 milliseconds the way i'm

2010

01:15:42,470 --> 01:15:40,239

speaking now every phoneme is reaching

2011

01:15:44,149 --> 01:15:42,480

your ears every 300 milliseconds or so

2012

01:15:49,350 --> 01:15:44,159

or

2013

01:15:51,270 --> 01:15:49,360

our biological scale

2014

01:15:53,189 --> 01:15:51,280

that's they does seem to be this

2015

01:15:56,149 --> 01:15:53,199

uncharacteristic uh

2016

01:16:00,390 --> 01:15:56,159

timestamp that's purely empirical so you

2017

01:16:05,430 --> 01:16:02,950

the facetious aspect inherits from the

2018

01:16:07,189 --> 01:16:05,440

fact that that's that's very egocentric

2019

01:16:09,030 --> 01:16:07,199

it's just for things like me i don't

2020

01:16:11,189 --> 01:16:09,040

know if it's the things like cells or

2021

01:16:13,590 --> 01:16:11,199

quantum physics well it's interesting

2022

01:16:15,590 --> 01:16:13,600

because in physics the number three has

2023

01:16:16,790 --> 01:16:15,600

an interesting role in fundamental

2024

01:16:18,229 --> 01:16:16,800

physics because there's three

2025

01:16:20,630 --> 01:16:18,239

generations of

2026

01:16:22,470 --> 01:16:20,640

of matter and there's that number three

2027

01:16:24,390 --> 01:16:22,480

crops up and it's a mystery as to why so

2028

01:16:26,229 --> 01:16:24,400

it sounds like the number 300 or 300

2029

01:16:29,350 --> 01:16:26,239

milliseconds a unit attached to it or

2030

01:16:31,350 --> 01:16:29,360

neuroscience maybe a a fundamental

2031

01:16:32,550 --> 01:16:31,360

constant so chris

2032

01:16:34,870 --> 01:16:32,560

what are some of the deep thoughts that

2033

01:16:36,790 --> 01:16:34,880

you were having

2034

01:16:38,709 --> 01:16:36,800

well i i was just having a visual

2035

01:16:39,910 --> 01:16:38,719

impression actually when mike was

2036

01:16:42,709 --> 01:16:39,920

talking

2037

01:16:44,790 --> 01:16:42,719

and um

2038

01:16:46,070 --> 01:16:44,800

of babbling

2039

01:16:48,070 --> 01:16:46,080

and

2040

01:16:51,990 --> 01:16:48,080

the visual impression was of our our

2041

01:16:52,000 --> 01:16:54,630

and

2042

01:16:57,750 --> 01:16:56,229

when we think of when we think of the

2043

01:17:00,709 --> 01:16:57,760

vacuum

2044

01:17:02,870 --> 01:17:00,719

or at least i think of it

2045

01:17:05,590 --> 01:17:02,880

visually as little things popping in and

2046

01:17:06,870 --> 01:17:05,600

out of existence all the time

2047

01:17:09,669 --> 01:17:06,880

and

2048

01:17:14,229 --> 01:17:11,590

one can think of that as a as a kind of

2049

01:17:16,390 --> 01:17:14,239

babbling right the the field itself is

2050

01:17:18,630 --> 01:17:16,400

exploring what's going on outside of

2051

01:17:20,550 --> 01:17:18,640

itself

2052

01:17:21,350 --> 01:17:20,560

that's extremely interesting

2053

01:17:24,070 --> 01:17:21,360

by

2054

01:17:29,110 --> 01:17:26,310

forming a little entity to go off and

2055

01:17:30,950 --> 01:17:29,120

explore and then report back

2056

01:17:33,510 --> 01:17:30,960

so this is a this is a very different

2057

01:17:35,189 --> 01:17:33,520

picture from the one that that

2058

01:17:36,630 --> 01:17:35,199

carl gave

2059

01:17:37,590 --> 01:17:36,640

in that

2060

01:17:39,750 --> 01:17:37,600

um

2061

01:17:41,430 --> 01:17:39,760

but i suppose it also has a similarity

2062

01:17:42,630 --> 01:17:41,440

or two

2063

01:17:44,709 --> 01:17:42,640

that

2064

01:17:47,750 --> 01:17:44,719

when we write down

2065

01:17:49,350 --> 01:17:47,760

uh a model of that activity it is

2066

01:17:57,510 --> 01:17:49,360

discrete

2067

01:18:00,550 --> 01:17:57,520

even though it's it's modeled in a

2068

01:18:02,950 --> 01:18:00,560

continuous space time which

2069

01:18:06,950 --> 01:18:04,950

once when digs a little bit deeply the

2070

01:18:09,030 --> 01:18:06,960

continuous space time itself becomes

2071

01:18:11,270 --> 01:18:09,040

discrete

2072

01:18:13,910 --> 01:18:11,280

but

2073

01:18:17,030 --> 01:18:13,920

this raises a question for me

2074

01:18:19,189 --> 01:18:17,040

which is another of the things that i

2075

01:18:21,189 --> 01:18:19,199

think about a lot

2076

01:18:24,550 --> 01:18:21,199

um

2077

01:18:28,149 --> 01:18:24,560

which is the question of

2078

01:18:31,990 --> 01:18:28,159

what we mean by randomness

2079

01:18:35,430 --> 01:18:33,750

certainly to take a bayesian point of

2080

01:18:36,630 --> 01:18:35,440

view where probabilities are all

2081

01:18:37,990 --> 01:18:36,640

subjective

2082

01:18:41,110 --> 01:18:38,000

uh

2083

01:18:44,149 --> 01:18:41,120

it becomes very difficult to say what

2084

01:18:46,310 --> 01:18:44,159

randomness might mean if if used in a

2085

01:18:49,030 --> 01:18:46,320

way that's meant to be objective or to

2086

01:18:51,830 --> 01:18:49,040

refer to something objective

2087

01:18:54,630 --> 01:18:51,840

and we model things like

2088

01:18:58,149 --> 01:18:54,640

fluctuations in the vacuum as

2089

01:19:02,790 --> 01:19:00,709

which from a bayesian point of view just

2090

01:19:05,270 --> 01:19:02,800

means

2091

01:19:07,110 --> 01:19:05,280

it's uncertain to us it represents

2092

01:19:09,430 --> 01:19:07,120

information that we

2093

01:19:13,910 --> 01:19:09,440

don't have and quite possibly can't get

2094

01:19:20,709 --> 01:19:17,750

but if we think of that system

2095

01:19:22,390 --> 01:19:20,719

as an agent

2096

01:19:24,630 --> 01:19:22,400

then of course you're expected to be

2097

01:19:25,830 --> 01:19:24,640

exploring its world whatever it is

2098

01:19:27,350 --> 01:19:25,840

whatever

2099

01:19:30,950 --> 01:19:27,360

uh

2100

01:19:34,310 --> 01:19:33,030

and

2101
01:19:35,830 --> 01:19:34,320
maybe

2102
01:19:38,310 --> 01:19:35,840
we can really think of babbling all the

2103
01:19:39,990 --> 01:19:38,320
way down as a model of of what's

2104
01:19:42,630 --> 01:19:40,000
happening in

2105
01:19:46,870 --> 01:19:42,640
these phenomena that we

2106
01:19:50,070 --> 01:19:48,390
but we also

2107
01:19:52,470 --> 01:19:50,080
don't typically think of these sorts of

2108
01:19:53,990 --> 01:19:52,480
systems as agents

2109
01:19:55,750 --> 01:19:54,000
this is this is this is incredibly

2110
01:19:57,669 --> 01:19:55,760
interesting um

2111
01:20:00,390 --> 01:19:57,679
what i heard what i heard carl

2112
01:20:03,110 --> 01:20:00,400
saying among other things is that there

2113
01:20:05,510 --> 01:20:03,120

is a there is a qualitative transition

2114

01:20:07,590 --> 01:20:05,520

when things go from analog to digital in

2115

01:20:10,550 --> 01:20:07,600

a certain sense right from from from

2116

01:20:12,870 --> 01:20:10,560

continuous to to phase and based on what

2117

01:20:14,229 --> 01:20:12,880

chris just said it would just remind us

2118

01:20:15,669 --> 01:20:14,239

to to think about the kind of the

2119

01:20:17,350 --> 01:20:15,679

quantum world where

2120

01:20:19,510 --> 01:20:17,360

at least to my understanding a lot of

2121

01:20:23,110 --> 01:20:19,520

things are in fact uh you know sort of

2122

01:20:25,189 --> 01:20:23,120

discrete does that mean that really

2123

01:20:27,910 --> 01:20:25,199

could it be that that that is the sort

2124

01:20:30,550 --> 01:20:27,920

of base state as chris just outlined

2125

01:20:32,790 --> 01:20:30,560

with with with that kind of uh

2126
01:20:35,189 --> 01:20:32,800
proto-cognitive exploration all the way

2127
01:20:37,750 --> 01:20:35,199
down and that these continuous models

2128
01:20:40,310 --> 01:20:37,760
that we put on top of it by by by course

2129
01:20:41,990 --> 01:20:40,320
graining um you know tiny events into

2130
01:20:44,149 --> 01:20:42,000
the kind of macroscopic things that we

2131
01:20:47,590 --> 01:20:44,159
see here that's that's an abstraction

2132
01:20:48,950 --> 01:20:47,600
that sort of loses the essential uh

2133
01:20:50,470 --> 01:20:48,960
mindfulness of it and then we have to

2134
01:20:52,070 --> 01:20:50,480
try to rebuild it again by the time we

2135
01:20:54,709 --> 01:20:52,080
get to brains but actually all we've

2136
01:20:55,910 --> 01:20:54,719
done is obscure the the fact that all

2137
01:20:57,669 --> 01:20:55,920
the way from the beginning it was

2138
01:20:59,669 --> 01:20:57,679

already digital to start with and we

2139

01:21:01,430 --> 01:20:59,679

just sort of put some put some vaseline

2140

01:21:02,870 --> 01:21:01,440

on our lens here you know to make

2141

01:21:04,870 --> 01:21:02,880

everything look um you know sort of

2142

01:21:06,390 --> 01:21:04,880

continuous which then which then made it

2143

01:21:08,310 --> 01:21:06,400

look like there was nothing going on at

2144

01:21:09,750 --> 01:21:08,320

the lower levels and then somehow we're

2145

01:21:11,750 --> 01:21:09,760

we're shocked that we have to recover it

2146

01:21:13,030 --> 01:21:11,760

from from somewhere later on

2147

01:21:14,870 --> 01:21:13,040

that that's that's what i just heard

2148

01:21:16,550 --> 01:21:14,880

from the combination of those two

2149

01:21:18,310 --> 01:21:16,560

explanations

2150

01:21:19,830 --> 01:21:18,320

it's a very interesting idea and it

2151

01:21:21,830 --> 01:21:19,840

connects nicely to the history of

2152

01:21:27,270 --> 01:21:21,840

mathematics

2153

01:21:28,790 --> 01:21:27,280

post descartes and leibniz

2154

01:21:31,270 --> 01:21:28,800

which was

2155

01:21:34,470 --> 01:21:31,280

all built around the idea of continuous

2156

01:21:36,229 --> 01:21:34,480

functions and analysis and calculus and

2157

01:21:38,550 --> 01:21:36,239

so on

2158

01:21:40,830 --> 01:21:38,560

very very nice convenient mathematics to

2159

01:21:44,070 --> 01:21:40,840

use

2160

01:21:49,189 --> 01:21:44,080

but uh

2161

01:21:52,470 --> 01:21:50,950

carl did you have any thoughts to add to

2162

01:21:52,860 --> 01:21:52,480

that

2163

01:21:54,149 --> 01:21:52,870

um

2164

01:21:56,629 --> 01:21:54,159

[Music]

2165

01:21:58,709 --> 01:21:56,639

yeah i i'd probably um

2166

01:22:00,310 --> 01:21:58,719

this is why i wanted to hang out with

2167

01:22:01,430 --> 01:22:00,320

with mike and chris to learn about

2168

01:22:02,950 --> 01:22:01,440

quantum theory because i do think

2169

01:22:04,149 --> 01:22:02,960

there's something fundamental about this

2170

01:22:05,910 --> 01:22:04,159

sort of

2171

01:22:07,910 --> 01:22:05,920

the way that we carve up the world or

2172

01:22:10,709 --> 01:22:07,920

the world the way the world can only be

2173

01:22:11,750 --> 01:22:10,719

defined in a carved way into tiles or

2174

01:22:13,110 --> 01:22:11,760

quantum

2175

01:22:13,910 --> 01:22:13,120

discrete things

2176

01:22:20,470 --> 01:22:13,920

um

2177

01:22:22,950 --> 01:22:20,480

observations that we just heard i think

2178

01:22:24,390 --> 01:22:22,960

are quite fundamental um and it would be

2179

01:22:25,189 --> 01:22:24,400

great to understand

2180

01:22:26,950 --> 01:22:25,199

um

2181

01:22:28,870 --> 01:22:26,960

everything from the sort of cultural

2182

01:22:31,189 --> 01:22:28,880

perspective a discretized perspective

2183

01:22:35,030 --> 01:22:31,199

and how continuous constructs rights you

2184

01:22:37,430 --> 01:22:35,040

know space and time emerge from that um

2185

01:22:40,950 --> 01:22:37,440

you know if necessary um

2186

01:22:44,149 --> 01:22:40,960

having said that um i have to say that

2187

01:22:46,229 --> 01:22:44,159

um as a physicist i would bring

2188

01:22:47,510 --> 01:22:46,239

something else to the table so i'm quite

2189

01:22:49,830 --> 01:22:47,520

comfortable dealing with random

2190

01:22:52,229 --> 01:22:49,840

fluctuations so for me random

2191

01:22:53,990 --> 01:22:52,239

fluctuations are just variables that

2192

01:22:55,830 --> 01:22:54,000

change very very quickly

2193

01:22:58,709 --> 01:22:55,840

so if i want to write down

2194

01:23:00,070 --> 01:22:58,719

um as a physicist so now i don't talk

2195

01:23:02,550 --> 01:23:00,080

about a physicist that doesn't know

2196

01:23:04,149 --> 01:23:02,560

anything about quantum mechanics um so i

2197

01:23:06,950 --> 01:23:04,159

just want to write down a launchvan

2198

01:23:09,350 --> 01:23:06,960

equation to describe my universe um i

2199

01:23:10,950 --> 01:23:09,360

write it as a mixture of states and

2200

01:23:12,709 --> 01:23:10,960

random fluctuations and somebody asked

2201

01:23:14,470 --> 01:23:12,719

me what licenses i just saw the

2202

01:23:17,510 --> 01:23:14,480

manufacturations are very very quick and

2203

01:23:19,430 --> 01:23:17,520

the uh the states are very very slow um

2204

01:23:20,629 --> 01:23:19,440

and this is just a natural consequence

2205

01:23:25,030 --> 01:23:20,639

of

2206

01:23:26,470 --> 01:23:25,040

know i i could

2207

01:23:28,790 --> 01:23:26,480

make them even slower by going to the

2208

01:23:31,189 --> 01:23:28,800

next stage scale and throw each and even

2209

01:23:33,030 --> 01:23:31,199

more fast stuff so there's nothing

2210

01:23:35,110 --> 01:23:33,040

really if you like

2211

01:23:36,629 --> 01:23:35,120

problematic uh from the point of view of

2212

01:23:40,390 --> 01:23:36,639

that kind of physicist

2213

01:23:42,870 --> 01:23:40,400

um in in the random fluctuations um

2214

01:23:45,030 --> 01:23:42,880

uh it just means that all the

2215

01:23:47,189 --> 01:23:45,040

stuff that determines flows and dynamics

2216

01:23:50,310 --> 01:23:47,199

of the kind that we can

2217

01:23:52,229 --> 01:23:50,320

that we engage with and we can plan um

2218

01:23:54,870 --> 01:23:52,239

has a particular form

2219

01:23:56,310 --> 01:23:54,880

that particular form um

2220

01:24:00,470 --> 01:23:56,320

does actually

2221

01:24:03,110 --> 01:24:00,480

bring a quantal aspect um to the table

2222

01:24:05,669 --> 01:24:03,120

or a discretization aspect of the table

2223

01:24:07,430 --> 01:24:05,679

that may or may not be if you like

2224

01:24:08,790 --> 01:24:07,440

explained away or absorbed into a

2225

01:24:10,390 --> 01:24:08,800

quantum information theoretical

2226

01:24:11,990 --> 01:24:10,400

treatment but what i'm talking about

2227

01:24:14,950 --> 01:24:12,000

here

2228

01:24:16,709 --> 01:24:14,960

are the mathematical image of light

2229

01:24:17,990 --> 01:24:16,719

life cycles and biorhythms and

2230

01:24:20,229 --> 01:24:18,000

oscillations

2231

01:24:22,310 --> 01:24:20,239

and i mean that right from the other the

2232

01:24:25,189 --> 01:24:22,320

perspective of a dendrite in my

2233

01:24:27,750 --> 01:24:25,199

hippocampus oscillating away at a fast

2234

01:24:30,470 --> 01:24:27,760

gamma frequency you know sort of

2235

01:24:32,390 --> 01:24:30,480

say 80 hertz through to the

2236

01:24:35,030 --> 01:24:32,400

the motion of the heavenly bodies

2237

01:24:37,270 --> 01:24:35,040

wherever you look you get the this

2238

01:24:38,070 --> 01:24:37,280

solenoidal flow

2239

01:24:40,070 --> 01:24:38,080

um

2240

01:24:42,310 --> 01:24:40,080

that is characteristic of things that

2241

01:24:45,189 --> 01:24:42,320

hang around and don't dissipate almost

2242

01:24:46,790 --> 01:24:45,199

immediately um and these are not part of

2243

01:24:48,550 --> 01:24:46,800

the random flute version but they become

2244

01:24:51,669 --> 01:24:48,560

more evident as you go away from the

2245

01:24:55,910 --> 01:24:51,679

fast random stuff into the slow um the

2246

01:24:59,350 --> 01:24:55,920

slow uh dynamics um in the sense that

2247

01:25:01,030 --> 01:24:59,360

you know clearly uh the orbit of the

2248

01:25:02,470 --> 01:25:01,040

moon around

2249

01:25:04,709 --> 01:25:02,480

well the orbit of the earth around the

2250

01:25:06,790 --> 01:25:04,719

sun for example this deals with very

2251
01:25:08,229 --> 01:25:06,800
very massive large things where all the

2252
01:25:10,790 --> 01:25:08,239
random fluctuations are effectively

2253
01:25:12,629 --> 01:25:10,800
averaged to zero um whereas if you go

2254
01:25:15,030 --> 01:25:12,639
down to the quantum scale

2255
01:25:17,990 --> 01:25:15,040
um then you know you're not licensed to

2256
01:25:20,550 --> 01:25:18,000
do that and these solenoidal flows um

2257
01:25:22,390 --> 01:25:20,560
become much less um much less apparent

2258
01:25:25,669 --> 01:25:22,400
but our scale

2259
01:25:29,189 --> 01:25:25,679
if we uh if life is um

2260
01:25:33,350 --> 01:25:29,199
on this reading of physics um

2261
01:25:35,510 --> 01:25:33,360
sufficiently classical to have um

2262
01:25:37,590 --> 01:25:35,520
oscillations biorhythms

2263
01:25:39,830 --> 01:25:37,600

um things that would you need for

2264

01:25:42,149 --> 01:25:39,840

feedback that didn't go off to plus or

2265

01:25:44,470 --> 01:25:42,159

minus infinity for example just saying

2266

01:25:46,790 --> 01:25:44,480

that you're keeping you're circulating

2267

01:25:49,030 --> 01:25:46,800

in some states or phase space

2268

01:25:51,110 --> 01:25:49,040

in a way that you keep yourself to some

2269

01:25:52,870 --> 01:25:51,120

attracting set and as you move through

2270

01:25:54,470 --> 01:25:52,880

this you are naturally going to be

2271

01:25:56,149 --> 01:25:54,480

oscillating

2272

01:26:00,149 --> 01:25:56,159

in a highly non-linear possibly chaotic

2273

01:26:02,390 --> 01:26:00,159

way but still the essence is life cycles

2274

01:26:05,350 --> 01:26:02,400

if that's the case then the poncharis

2275

01:26:07,189 --> 01:26:05,360

section does indeed permit a description

2276

01:26:08,709 --> 01:26:07,199

that is necessarily discretized in the

2277

01:26:10,950 --> 01:26:08,719

sense you're going to pass through the

2278

01:26:14,790 --> 01:26:10,960

neighborhood of various states and

2279

01:26:17,030 --> 01:26:16,229

recurrently

2280

01:26:18,229 --> 01:26:17,040

so

2281

01:26:20,229 --> 01:26:18,239

that's what i was thinking from the

2282

01:26:21,590 --> 01:26:20,239

point of view of a physicist who does

2283

01:26:24,070 --> 01:26:21,600

not have the fluency of quantum

2284

01:26:26,629 --> 01:26:24,080

mechanics to get back to a discrete

2285

01:26:29,030 --> 01:26:26,639

thing but it also i think um

2286

01:26:32,149 --> 01:26:29,040

highlights the um

2287

01:26:35,750 --> 01:26:32,159

the deep connection between

2288

01:26:40,070 --> 01:26:35,760

things recurring discretely or occurring

2289

01:26:44,390 --> 01:26:42,470

being one way of defining another

2290

01:26:46,950 --> 01:26:44,400

characteristic of

2291

01:26:50,310 --> 01:26:46,960

biological self-organization which is

2292

01:26:51,510 --> 01:26:50,320

basically the repeat biorhythms and life

2293

01:26:53,830 --> 01:26:51,520

cycles

2294

01:26:55,430 --> 01:26:53,840

that have this sort of self-contained

2295

01:26:57,270 --> 01:26:55,440

itinerancy because in that

2296

01:27:00,709 --> 01:26:57,280

self-containment you've got this natural

2297

01:27:02,470 --> 01:27:00,719

resolution of ambiguity and uncertainty

2298

01:27:04,950 --> 01:27:02,480

because you always know you're you're on

2299

01:27:06,709 --> 01:27:04,960

the same arterial path repeatedly

2300

01:27:08,790 --> 01:27:06,719

visiting the states that you once

2301

01:27:10,310 --> 01:27:08,800

occupied so that that's what i would say

2302

01:27:12,070 --> 01:27:10,320

from the point of view of physicist i

2303

01:27:13,430 --> 01:27:12,080

may say something very different in a

2304

01:27:16,070 --> 01:27:13,440

few years time when i've learned more

2305

01:27:18,790 --> 01:27:16,080

about quantum theory so let me ask chris

2306

01:27:21,110 --> 01:27:18,800

could you ever describe that kind of

2307

01:27:23,590 --> 01:27:21,120

mathematic physicist's treatment of

2308

01:27:29,350 --> 01:27:23,600

dynamics in pure quantum information

2309

01:27:33,350 --> 01:27:31,590

well i i think if we if we try to think

2310

01:27:34,870 --> 01:27:33,360

of scaling up from

2311

01:27:37,030 --> 01:27:34,880

from

2312

01:27:42,870 --> 01:27:37,040

um

2313

01:27:45,030 --> 01:27:42,880

fields then this looks impossible

2314

01:27:47,590 --> 01:27:45,040

but

2315

01:27:50,070 --> 01:27:47,600

if we think of it

2316

01:27:51,430 --> 01:27:50,080

informationally maybe it doesn't look

2317

01:27:52,950 --> 01:27:51,440

impossible

2318

01:27:55,669 --> 01:27:52,960

now

2319

01:27:58,310 --> 01:27:55,679

i'll go back to john wheeler's

2320

01:28:01,590 --> 01:27:58,320

notion that a bit is fundamentally the

2321

01:28:02,830 --> 01:28:01,600

answer to a yes or no question

2322

01:28:05,270 --> 01:28:02,840

and

2323

01:28:07,350 --> 01:28:05,280

information the information theory is

2324

01:28:09,830 --> 01:28:07,360

about bits and systems that exchange

2325

01:28:09,840 --> 01:28:14,870

but

2326

01:28:18,390 --> 01:28:16,550

question

2327

01:28:19,750 --> 01:28:18,400

do you mind repeating that last part but

2328

01:28:24,950 --> 01:28:19,760

what

2329

01:28:25,910 --> 01:28:24,960

doesn't specify is the complexity of the

2330

01:28:29,110 --> 01:28:25,920

question

2331

01:28:31,990 --> 01:28:29,120

that has a yes or no answer

2332

01:28:34,550 --> 01:28:32,000

so in in your case carl you have an

2333

01:28:36,870 --> 01:28:34,560

oscillatory system that

2334

01:28:39,830 --> 01:28:36,880

passes after a discrete time a

2335

01:28:40,629 --> 01:28:39,840

particular boundary

2336

01:28:43,189 --> 01:28:40,639

so

2337

01:28:47,189 --> 01:28:43,199

the the system may well be asking the

2338

01:28:49,910 --> 01:28:47,199

question have i passed this boundary

2339

01:28:52,950 --> 01:28:49,920

and the answer is yes or no

2340

01:28:55,430 --> 01:28:52,960

or am i passing the boundary right now

2341

01:28:57,270 --> 01:28:55,440

well that's one bit

2342

01:29:01,189 --> 01:28:57,280

uh that's a yes or no question but it's

2343

01:29:05,669 --> 01:29:02,310

so

2344

01:29:08,149 --> 01:29:05,679

it may be that we can

2345

01:29:10,629 --> 01:29:08,159

develop

2346

01:29:14,229 --> 01:29:10,639

a theory that leaves the complexity of

2347

01:29:16,629 --> 01:29:14,239

the generative model unspecified

2348

01:29:19,510 --> 01:29:16,639

and concentrates

2349

01:29:22,229 --> 01:29:19,520

just on the bit flow

2350

01:29:25,990 --> 01:29:22,239

across the boundary

2351
01:29:28,229 --> 01:29:26,000
that counts as evidence in one direction

2352
01:29:30,870 --> 01:29:28,239
and perturbative action in the other

2353
01:29:35,669 --> 01:29:33,030
and and then i think the two pictures

2354
01:29:37,669 --> 01:29:35,679
fit together rather nicely

2355
01:29:40,310 --> 01:29:37,679
because one can imagine that

2356
01:29:41,830 --> 01:29:40,320
generative model operating it that the

2357
01:29:45,750 --> 01:29:41,840
general model being the model that

2358
01:29:45,760 --> 01:29:50,709
operating in many different scales

2359
01:29:57,990 --> 01:29:52,550
where one could think of the scales as

2360
01:30:02,229 --> 01:29:59,510
and this gets back in a sense to your

2361
01:30:03,750 --> 01:30:02,239
question about language

2362
01:30:06,470 --> 01:30:03,760
how

2363
01:30:09,350 --> 01:30:06,480

language is a way of posing questions

2364

01:30:10,470 --> 01:30:09,360

it's a way of babbling in the world

2365

01:30:13,350 --> 01:30:10,480

now this

2366

01:30:14,709 --> 01:30:13,360

process of babbling it seems to me as

2367

01:30:16,470 --> 01:30:14,719

far as i understand it's like poking and

2368

01:30:18,070 --> 01:30:16,480

prodding to test your own self model to

2369

01:30:20,550 --> 01:30:18,080

see what's the difference between me and

2370

01:30:22,629 --> 01:30:20,560

the world it sounds like that

2371

01:30:24,790 --> 01:30:22,639

never stops even though we

2372

01:30:27,110 --> 01:30:24,800

call it babbling as if infants do it

2373

01:30:28,709 --> 01:30:27,120

does it ever stop are we not engaging in

2374

01:30:30,229 --> 01:30:28,719

this right now

2375

01:30:31,350 --> 01:30:30,239

and i like this phrase babbling all the

2376

01:30:33,110 --> 01:30:31,360

way down

2377

01:30:34,870 --> 01:30:33,120

i'm gonna put that on a t-shirt by the

2378

01:30:36,550 --> 01:30:34,880

way chris or and it also by the way

2379

01:30:38,310 --> 01:30:36,560

seems like babbling all the way up too

2380

01:30:41,350 --> 01:30:38,320

because we're constantly engaging in

2381

01:30:43,430 --> 01:30:41,360

this so firstly is that true

2382

01:30:44,149 --> 01:30:43,440

does babbling have an end

2383

01:30:47,590 --> 01:30:44,159

and

2384

01:30:49,510 --> 01:30:47,600

presume a self

2385

01:30:51,669 --> 01:30:49,520

in order to test the self

2386

01:30:53,030 --> 01:30:51,679

what i mean is carl when you were

2387

01:30:56,229 --> 01:30:53,040

speaking about

2388

01:30:58,229 --> 01:30:56,239

the process of babbling it's the infant

2389

01:30:59,590 --> 01:30:58,239

doing something on the world in order to

2390

01:31:02,229 --> 01:30:59,600

make a model

2391

01:31:03,750 --> 01:31:02,239

but that first part was it's it is doing

2392

01:31:05,990 --> 01:31:03,760

something to the world to me already

2393

01:31:07,270 --> 01:31:06,000

presumes the external world whereas the

2394

01:31:09,830 --> 01:31:07,280

way that i'm understanding it is that

2395

01:31:12,149 --> 01:31:09,840

the self is a model but it's also

2396

01:31:14,629 --> 01:31:12,159

in your point of view it's something

2397

01:31:17,110 --> 01:31:14,639

objective and i believe from my readings

2398

01:31:20,870 --> 01:31:17,120

of chris i don't i believe chris is more

2399

01:31:22,390 --> 01:31:20,880

on the non-dual end where it's it's it's

2400

01:31:25,510 --> 01:31:22,400

that's less the case so i'm unsure

2401

01:31:27,189 --> 01:31:25,520

anyway i just said a slew so please

2402

01:31:28,470 --> 01:31:27,199

respond to it as you

2403

01:31:30,870 --> 01:31:28,480

as you wish

2404

01:31:33,750 --> 01:31:30,880

right well i mean just to um

2405

01:31:36,149 --> 01:31:33,760

dispel the notion that the self is um

2406

01:31:38,550 --> 01:31:36,159

objective no i i didn't mean that i i

2407

01:31:39,990 --> 01:31:38,560

meant it in exactly the same way that um

2408

01:31:42,470 --> 01:31:40,000

i think both chris and mike have been

2409

01:31:44,950 --> 01:31:42,480

intimating that you know from the inside

2410

01:31:46,629 --> 01:31:44,960

of a cell or a person or the baby's

2411

01:31:48,149 --> 01:31:46,639

skull um

2412

01:31:51,350 --> 01:31:48,159

your

2413

01:31:55,510 --> 01:31:51,360

self um is

2414

01:31:57,590 --> 01:31:55,520

quite a a sophisticated um construct

2415

01:31:59,350 --> 01:31:57,600

fantasy hypothesis

2416

01:32:01,590 --> 01:31:59,360

that is physically realized possibly

2417

01:32:03,510 --> 01:32:01,600

neuronally in some lucky creatures and

2418

01:32:06,229 --> 01:32:03,520

some lucky children uh you may actually

2419

01:32:07,350 --> 01:32:06,239

find some children never get that far

2420

01:32:09,189 --> 01:32:07,360

you know i'm thinking here of people

2421

01:32:11,430 --> 01:32:09,199

with severe autism for example who don't

2422

01:32:15,510 --> 01:32:11,440

have a theory of mind simply because

2423

01:32:19,990 --> 01:32:15,520

they never developed the notion that um

2424

01:32:21,669 --> 01:32:20,000

i am a person um and you know what comes

2425

01:32:23,590 --> 01:32:21,679

along with that is that

2426
01:32:25,590 --> 01:32:23,600
you know if you've got very very severe

2427
01:32:28,550 --> 01:32:25,600
autism or you know if he likes other

2428
01:32:30,870 --> 01:32:28,560
theoretically idealized autism and that

2429
01:32:33,510 --> 01:32:30,880
means that personhood doesn't exist so

2430
01:32:36,310 --> 01:32:33,520
you would be i would regard you as an

2431
01:32:38,149 --> 01:32:36,320
animate french or you know

2432
01:32:39,669 --> 01:32:38,159
some um

2433
01:32:41,590 --> 01:32:39,679
interesting autonomous vehicle but you

2434
01:32:43,430 --> 01:32:41,600
would never be a person because i don't

2435
01:32:45,590 --> 01:32:43,440
i don't have the hypothesis that you

2436
01:32:47,590 --> 01:32:45,600
know there are people out there and that

2437
01:32:50,310 --> 01:32:47,600
people share certain sort of phenotypic

2438
01:32:52,310 --> 01:32:50,320

characteristics and um have intentions

2439

01:32:54,149 --> 01:32:52,320

in the same sense that i have intentions

2440

01:32:56,470 --> 01:32:54,159

so i just i'm not aware of that because

2441

01:32:58,629 --> 01:32:56,480

i just don't don't have that hypothesis

2442

01:33:00,390 --> 01:32:58,639

so it's a long-winded way of saying that

2443

01:33:03,189 --> 01:33:00,400

i didn't mean to imply

2444

01:33:04,390 --> 01:33:03,199

any objectivity here i was more going

2445

01:33:05,110 --> 01:33:04,400

the other way really i'm just saying

2446

01:33:07,189 --> 01:33:05,120

that

2447

01:33:10,149 --> 01:33:07,199

selfhood um

2448

01:33:11,669 --> 01:33:10,159

that would be one part of consciousness

2449

01:33:13,830 --> 01:33:11,679

and if you

2450

01:33:16,950 --> 01:33:13,840

want to associate cognition and

2451

01:33:19,030 --> 01:33:16,960

consciousness then perhaps possibly um

2452

01:33:22,229 --> 01:33:19,040

that kind of minimal selfhood would you

2453

01:33:23,430 --> 01:33:22,239

know would be necessarily part of of

2454

01:33:26,629 --> 01:33:23,440

cognition

2455

01:33:29,590 --> 01:33:26,639

this is a gift that you have to get by

2456

01:33:31,750 --> 01:33:29,600

crossing one of those bright lines

2457

01:33:35,030 --> 01:33:31,760

and it's just a fantasy that you bring

2458

01:33:37,270 --> 01:33:35,040

to the table to make sense of

2459

01:33:39,430 --> 01:33:37,280

all the impressions on your sort of

2460

01:33:41,590 --> 01:33:39,440

sensory surface or your holographic

2461

01:33:44,149 --> 01:33:41,600

screen or your or your cell surface or

2462

01:33:46,709 --> 01:33:44,159

also the receptors you are equipped with

2463

01:33:49,110 --> 01:33:46,719

um to sense what's going on out there

2464

01:33:50,709 --> 01:33:49,120

does that make sense yeah i know that

2465

01:33:51,750 --> 01:33:50,719

mike and and chris you may have a

2466

01:33:54,870 --> 01:33:51,760

response to that but i just want to

2467

01:33:56,950 --> 01:33:54,880

quickly respond to what professor first

2468

01:33:59,030 --> 01:33:56,960

was saying is so

2469

01:34:01,350 --> 01:33:59,040

and this is to both of you how do you

2470

01:34:03,830 --> 01:34:01,360

then prevent an existential crisis as

2471

01:34:05,910 --> 01:34:03,840

you start to study this so for example

2472

01:34:07,750 --> 01:34:05,920

carl before you and i were speaking and

2473

01:34:10,070 --> 01:34:07,760

i told you about some experiences i had

2474

01:34:11,910 --> 01:34:10,080

where i've deeply felt what you're

2475

01:34:14,870 --> 01:34:11,920

saying as being true that the self is a

2476

01:34:16,550 --> 01:34:14,880

fantasy and this oneness with all this

2477

01:34:18,550 --> 01:34:16,560

world being generated in one's mind and

2478

01:34:20,390 --> 01:34:18,560

i felt like that was akin to a psychotic

2479

01:34:22,470 --> 01:34:20,400

episode and it was extremely

2480

01:34:24,790 --> 01:34:22,480

destabilizing and to be quite frank i'm

2481

01:34:27,189 --> 01:34:24,800

still recovering from that and so i'm

2482

01:34:31,350 --> 01:34:27,199

unsure how any of you all

2483

01:34:34,229 --> 01:34:31,360

do this work without constantly

2484

01:34:36,390 --> 01:34:34,239

being in a debilitating state of of

2485

01:34:38,310 --> 01:34:36,400

existence well existence is the question

2486

01:34:40,390 --> 01:34:38,320

here that it's an existential crisis

2487

01:34:43,109 --> 01:34:40,400

which i'm inquiring about so how is it

2488

01:34:44,950 --> 01:34:43,119

that you prevent yourself from getting

2489

01:34:47,270 --> 01:34:44,960

into that how could you say these words

2490

01:34:49,750 --> 01:34:47,280

of well the self is is not objective the

2491

01:34:52,229 --> 01:34:49,760

self may be a a fantasy quote unquote

2492

01:34:54,790 --> 01:34:52,239

but not then be able to to not speak and

2493

01:34:56,149 --> 01:34:54,800

look around you in awe and and horror at

2494

01:34:57,990 --> 01:34:56,159

the same time

2495

01:34:59,830 --> 01:34:58,000

okay so that's a psychological uh

2496

01:35:01,430 --> 01:34:59,840

philosophical question anyone who wants

2497

01:35:03,590 --> 01:35:01,440

to take that up

2498

01:35:06,310 --> 01:35:03,600

i think i think there is a good deal of

2499

01:35:07,189 --> 01:35:06,320

existential um

2500

01:35:11,109 --> 01:35:07,199

what

2501

01:35:13,590 --> 01:35:11,990

uh

2502

01:35:15,750 --> 01:35:13,600

in doing what we're doing so it's just

2503

01:35:17,750 --> 01:35:15,760

par for the course

2504

01:35:22,229 --> 01:35:17,760

right

2505

01:35:22,239 --> 01:35:25,910

i'm not sure when gets over it

2506

01:35:29,270 --> 01:35:27,109

i i

2507

01:35:29,830 --> 01:35:29,280

think it's more

2508

01:35:33,430 --> 01:35:29,840

um

2509

01:35:33,440 --> 01:35:38,790

being comfortable with it

2510

01:35:43,750 --> 01:35:41,270

you know i i i think you raise a really

2511

01:35:46,390 --> 01:35:43,760

a really important point and it's i

2512

01:35:47,270 --> 01:35:46,400

think this is in a class of

2513

01:35:50,470 --> 01:35:47,280

uh

2514

01:35:53,510 --> 01:35:50,480

a number of really destabilizing um

2515

01:35:55,109 --> 01:35:53,520

uh ideas that one picks up as one gets

2516

01:35:57,109 --> 01:35:55,119

older and studies things and there are

2517

01:35:59,109 --> 01:35:57,119

many of these i remember as a child

2518

01:36:01,109 --> 01:35:59,119

being completely freaked out by the fact

2519

01:36:02,950 --> 01:36:01,119

that i realized that you know we grow up

2520

01:36:04,310 --> 01:36:02,960

and we become these adults and these

2521

01:36:06,070 --> 01:36:04,320

adults bear

2522

01:36:07,750 --> 01:36:06,080

some resemblance to the children but

2523

01:36:09,270 --> 01:36:07,760

they're definitely not the same thing

2524

01:36:11,030 --> 01:36:09,280

and so in some sense you could sort of

2525

01:36:12,629 --> 01:36:11,040

see it coming it's almost even even

2526
01:36:13,910 --> 01:36:12,639
before you realize that you're gonna you

2527
01:36:16,229 --> 01:36:13,920
know you're gonna you're gonna die

2528
01:36:17,430 --> 01:36:16,239
biologically someday before long before

2529
01:36:19,910 --> 01:36:17,440
that you realize that you're going to

2530
01:36:21,510 --> 01:36:19,920
undergo some transition that's going to

2531
01:36:24,310 --> 01:36:21,520
you know turn you into a completely

2532
01:36:26,629 --> 01:36:24,320
different sort of creature which really

2533
01:36:28,709 --> 01:36:26,639
you know has some continuity but maybe

2534
01:36:30,390 --> 01:36:28,719
not you know it's certainly not you

2535
01:36:32,390 --> 01:36:30,400
persisting in the same way as you are

2536
01:36:33,910 --> 01:36:32,400
now right so some kind of weird butter

2537
01:36:34,870 --> 01:36:33,920
you know caterpillar butterfly effect

2538
01:36:36,310 --> 01:36:34,880

where

2539

01:36:38,390 --> 01:36:36,320

you're just not going to be around in

2540

01:36:40,310 --> 01:36:38,400

that same way as as you are now right so

2541

01:36:42,070 --> 01:36:40,320

that's kind of the first thing you you

2542

01:36:43,510 --> 01:36:42,080

realize as a child and then there's many

2543

01:36:45,030 --> 01:36:43,520

others that sort of you know you learn

2544

01:36:46,709 --> 01:36:45,040

about boltzmann brains and all the

2545

01:36:48,229 --> 01:36:46,719

different you know human arguments so

2546

01:36:50,310 --> 01:36:48,239

but you know all the stuff that you know

2547

01:36:52,390 --> 01:36:50,320

i had to i i did um

2548

01:36:54,629 --> 01:36:52,400

i did a philosophy class with my son

2549

01:36:56,310 --> 01:36:54,639

when he was little uh uh we were doing

2550

01:36:58,070 --> 01:36:56,320

um homeschooling and so i kind of did

2551

01:36:59,910 --> 01:36:58,080

this and i realized very quickly that i

2552

01:37:01,590 --> 01:36:59,920

have to be very careful with this stuff

2553

01:37:03,830 --> 01:37:01,600

because if right somebody who has the

2554

01:37:06,790 --> 01:37:03,840

capacity to understand it it's extremely

2555

01:37:09,109 --> 01:37:06,800

destabilizing and i think that uh for at

2556

01:37:11,270 --> 01:37:09,119

this point for myself uh what you know i

2557

01:37:13,030 --> 01:37:11,280

sort of go with with descartes a little

2558

01:37:15,910 --> 01:37:13,040

bit in the following sense

2559

01:37:19,510 --> 01:37:15,920

i i i'm not depressed by it in the sense

2560

01:37:21,910 --> 01:37:19,520

that whatever we discover is is a truer

2561

01:37:23,590 --> 01:37:21,920

model of the self than we may have had

2562

01:37:25,510 --> 01:37:23,600

it doesn't it i don't i don't think

2563

01:37:28,550 --> 01:37:25,520

there's any way in which it makes it

2564

01:37:31,910 --> 01:37:28,560

less um it makes us less less less

2565

01:37:34,310 --> 01:37:31,920

valuable less interesting less engaging

2566

01:37:36,390 --> 01:37:34,320

all of that is still true it's just that

2567

01:37:38,070 --> 01:37:36,400

now we've realized that a different set

2568

01:37:39,830 --> 01:37:38,080

of mechanisms can now

2569

01:37:41,270 --> 01:37:39,840

implement that magic than we thought

2570

01:37:43,910 --> 01:37:41,280

right so you may have had so you know

2571

01:37:45,590 --> 01:37:43,920

some sort of um idea that well there has

2572

01:37:46,950 --> 01:37:45,600

to be some sort of um

2573

01:37:48,470 --> 01:37:46,960

different kind of unique process that

2574

01:37:51,030 --> 01:37:48,480

makes this permanent self and therefore

2575

01:37:53,270 --> 01:37:51,040

i'm this individual and i have i have uh

2576

01:37:55,750 --> 01:37:53,280

you know i have true true beliefs and

2577

01:37:57,030 --> 01:37:55,760

preferences and i exist in some way i i

2578

01:37:58,790 --> 01:37:57,040

don't think you can ever convince

2579

01:38:00,229 --> 01:37:58,800

yourself that you that that that isn't

2580

01:38:02,870 --> 01:38:00,239

true and that you don't exist it's just

2581

01:38:04,870 --> 01:38:02,880

that now you find out that actually

2582

01:38:06,470 --> 01:38:04,880

the way you get to be that is by these

2583

01:38:07,510 --> 01:38:06,480

sets of mechanisms and they're very

2584

01:38:09,430 --> 01:38:07,520

interesting it's the sort of thing that

2585

01:38:11,590 --> 01:38:09,440

carl and chris have been talking about

2586

01:38:13,350 --> 01:38:11,600

so that's what gets you to be this

2587

01:38:15,189 --> 01:38:13,360

individual this kind of individual and

2588

01:38:17,270 --> 01:38:15,199

it's kind of amazing that that works but

2589

01:38:18,790 --> 01:38:17,280

that doesn't to me that doesn't um

2590

01:38:20,070 --> 01:38:18,800

diminish all of the things all of the

2591

01:38:22,310 --> 01:38:20,080

things that i thought were true about

2592

01:38:24,229 --> 01:38:22,320

what the individual actually is right

2593

01:38:26,229 --> 01:38:24,239

your reality the reality of it the

2594

01:38:27,590 --> 01:38:26,239

impermanent impermanence is there but we

2595

01:38:28,629 --> 01:38:27,600

knew that from the time you were a kid

2596

01:38:30,550 --> 01:38:28,639

you knew that it wasn't going to be

2597

01:38:32,149 --> 01:38:30,560

permanent so that that part you know you

2598

01:38:33,910 --> 01:38:32,159

sort of have to deal with from the start

2599

01:38:35,430 --> 01:38:33,920

after that it's all you're learning

2600

01:38:37,189 --> 01:38:35,440

after that is just that you were really

2601

01:38:39,109 --> 01:38:37,199

mistaken about what it takes to be that

2602

01:38:41,030 --> 01:38:39,119

sort of creature you thought maybe it

2603

01:38:42,629 --> 01:38:41,040

had to be some magical whatever now you

2604

01:38:43,990 --> 01:38:42,639

think that wow it's a set of you know

2605

01:38:45,350 --> 01:38:44,000

feedback loops and whatever else so

2606

01:38:46,950 --> 01:38:45,360

that's surprising but

2607

01:38:48,229 --> 01:38:46,960

that's okay we we learn about you know

2608

01:38:49,830 --> 01:38:48,239

we learn about uh different

2609

01:38:51,430 --> 01:38:49,840

underpinnings to things all the time so

2610

01:38:53,750 --> 01:38:51,440

that's okay but i don't i don't think

2611

01:38:56,229 --> 01:38:53,760

any of it diminishes the the the sort of

2612

01:38:58,550 --> 01:38:56,239

um uh just the incredible awe of of

2613

01:39:00,070 --> 01:38:58,560

being a sentient being i can think about

2614

01:39:00,950 --> 01:39:00,080

these things

2615

01:39:03,510 --> 01:39:00,960

yeah

2616

01:39:07,350 --> 01:39:03,520

just to reiterate that sorry i didn't in

2617

01:39:10,390 --> 01:39:07,360

any way mean to demean um our selfhood

2618

01:39:13,189 --> 01:39:10,400

or yourself in particular um by calling

2619

01:39:16,070 --> 01:39:13,199

it a fantasy i actually meant it

2620

01:39:18,310 --> 01:39:16,080

and indeed have written about it um in

2621

01:39:19,590 --> 01:39:18,320

terms of something quite fantastic

2622

01:39:21,669 --> 01:39:19,600

so we've written papers called the

2623

01:39:25,109 --> 01:39:21,679

fantastic organ the brain is a fantastic

2624

01:39:27,510 --> 01:39:25,119

organ just because it can produce these

2625

01:39:28,790 --> 01:39:27,520

fantasies it's absolutely fantastic

2626

01:39:30,950 --> 01:39:28,800

and of course they

2627

01:39:33,830 --> 01:39:30,960

you know in relation to our early

2628

01:39:35,590 --> 01:39:33,840

conversation the capacity to have these

2629

01:39:37,430 --> 01:39:35,600

fantasies which have incredible

2630

01:39:38,950 --> 01:39:37,440

explanatory power

2631

01:39:42,790 --> 01:39:38,960

if you can attain them and you can

2632

01:39:44,870 --> 01:39:42,800

maintain them um is the part of the

2633

01:39:47,350 --> 01:39:44,880

complexity which allows us to cross

2634

01:39:51,270 --> 01:39:47,360

these bright lines or these gaps uh and

2635

01:39:53,430 --> 01:39:51,280

become our cuts and become um closer to

2636

01:39:55,830 --> 01:39:53,440

you know to the kind of creatures that

2637

01:39:57,109 --> 01:39:55,840

can can even entertain the notion of the

2638

01:39:58,790 --> 01:39:57,119

heart problem

2639

01:40:00,629 --> 01:39:58,800

just to so

2640

01:40:01,669 --> 01:40:00,639

mike i just love that better answer we

2641

01:40:02,629 --> 01:40:01,679

don't know what the answer will look

2642

01:40:04,310 --> 01:40:02,639

like

2643

01:40:06,470 --> 01:40:04,320

i'm going to tell andy clark about that

2644

01:40:08,070 --> 01:40:06,480

he'll tell david chalmers

2645

01:40:10,550 --> 01:40:08,080

but to come back to the point so i

2646

01:40:11,270 --> 01:40:10,560

didn't mean to demean that um

2647

01:40:12,310 --> 01:40:11,280

and

2648

01:40:14,390 --> 01:40:12,320

you know

2649

01:40:15,030 --> 01:40:14,400

phrases that i remember coming across

2650

01:40:17,510 --> 01:40:15,040

and

2651
01:40:19,510 --> 01:40:17,520
having to learn uh when i was a student

2652
01:40:22,629 --> 01:40:19,520
of things like existential angst and

2653
01:40:25,189 --> 01:40:22,639
ontological security all of these things

2654
01:40:27,189 --> 01:40:25,199
um you know rear their

2655
01:40:29,430 --> 01:40:27,199
face if you are worried about these

2656
01:40:31,669 --> 01:40:29,440
things but the very fact that you are

2657
01:40:34,870 --> 01:40:31,679
able to entertain the notion that you

2658
01:40:37,750 --> 01:40:34,880
are not real is quite remarkable um and

2659
01:40:39,990 --> 01:40:37,760
i repeat is it is a gift of a fantastic

2660
01:40:43,109 --> 01:40:40,000
sort it is a kind of fantasy that very

2661
01:40:45,430 --> 01:40:43,119
few um creatures haven't and sometimes

2662
01:40:47,990 --> 01:40:45,440
even few people have so there are people

2663
01:40:48,830 --> 01:40:48,000

who actually will go out there to try

2664

01:40:54,709 --> 01:40:48,840

and

2665

01:40:57,590 --> 01:40:54,719

treasure the uh the gift of being able

2666

01:41:00,070 --> 01:40:57,600

to make sense of the world as me and by

2667

01:41:01,189 --> 01:41:00,080

taking drugs or doing mindfulness

2668

01:41:03,350 --> 01:41:01,199

therapy

2669

01:41:04,870 --> 01:41:03,360

in order to actually get to a state

2670

01:41:07,189 --> 01:41:04,880

where um

2671

01:41:08,790 --> 01:41:07,199

so almost a freudian oceanic state where

2672

01:41:10,950 --> 01:41:08,800

selfhood is dissolved so they can

2673

01:41:13,750 --> 01:41:10,960

experience it and certainly if you've

2674

01:41:16,470 --> 01:41:13,760

taken um sort of psychedelic drugs in

2675

01:41:17,990 --> 01:41:16,480

sufficient quantity um you may have that

2676

01:41:20,790 --> 01:41:18,000

kind of experience that's a

2677

01:41:23,270 --> 01:41:20,800

derealization or dissociative experience

2678

01:41:26,070 --> 01:41:23,280

which is the realization that

2679

01:41:29,030 --> 01:41:26,080

your your construct your fantasy of

2680

01:41:31,590 --> 01:41:29,040

selfhood that is engaged and

2681

01:41:32,390 --> 01:41:31,600

engaging continuously and for as long as

2682

01:41:33,189 --> 01:41:32,400

you live

2683

01:41:36,790 --> 01:41:33,199

um

2684

01:41:38,870 --> 01:41:36,800

if you want to appreciate that then you

2685

01:41:41,750 --> 01:41:38,880

have to experience the you know

2686

01:41:43,109 --> 01:41:41,760

the alternative hypothesis uh so you

2687

01:41:45,750 --> 01:41:43,119

know

2688

01:41:48,310 --> 01:41:45,760

experiencing derealization or this is

2689

01:41:50,950 --> 01:41:48,320

depersonalization

2690

01:41:52,870 --> 01:41:50,960

is actually i think

2691

01:41:55,109 --> 01:41:52,880

one really important step to

2692

01:41:57,750 --> 01:41:55,119

self-understanding so i don't see it as

2693

01:41:58,790 --> 01:41:57,760

at all threatening nor diminishing it's

2694

01:42:00,709 --> 01:41:58,800

it's just

2695

01:42:02,149 --> 01:42:00,719

part of self-understanding which not

2696

01:42:03,830 --> 01:42:02,159

everybody gets

2697

01:42:06,189 --> 01:42:03,840

the opportunity to indulge i mean i mean

2698

01:42:08,790 --> 01:42:06,199

in some you know in some sense the most

2699

01:42:10,550 --> 01:42:08,800

destabilizing thing of all ought to be

2700

01:42:12,870 --> 01:42:10,560

just the bare facts of developmental

2701
01:42:16,229 --> 01:42:12,880
biology when you learn that you are in

2702
01:42:17,990 --> 01:42:16,239
fact not some sort of uh un indivisible

2703
01:42:19,590 --> 01:42:18,000
monadic whatever which i don't even i'm

2704
01:42:20,950 --> 01:42:19,600
not even sure what that would entail if

2705
01:42:22,390 --> 01:42:20,960
you were but but the fact that we are

2706
01:42:23,990 --> 01:42:22,400
all like all intelligence is our

2707
01:42:26,390 --> 01:42:24,000
collective intelligences we are all made

2708
01:42:28,629 --> 01:42:26,400
of parts and the idea that you used to

2709
01:42:31,590 --> 01:42:28,639
be this quiescent oocyte this little bag

2710
01:42:34,149 --> 01:42:31,600
of chemical reactions that did very

2711
01:42:36,229 --> 01:42:34,159
little and then very slowly sort of step

2712
01:42:38,470 --> 01:42:36,239
by step you turned into whatever you are

2713
01:42:40,310 --> 01:42:38,480

now if that's not destabilizing i don't

2714

01:42:42,149 --> 01:42:40,320

know what is because just knowing

2715

01:42:44,229 --> 01:42:42,159

nothing knowing nothing else about

2716

01:42:45,990 --> 01:42:44,239

evolution or i mean to me developmental

2717

01:42:47,910 --> 01:42:46,000

biology is sort of like the the you know

2718

01:42:49,910 --> 01:42:47,920

the queen of of all the sciences because

2719

01:42:52,070 --> 01:42:49,920

just that fact that you go from from

2720

01:42:53,910 --> 01:42:52,080

from chemistry and physics to mind in in

2721

01:42:56,229 --> 01:42:53,920

nine months plus to however many years

2722

01:42:57,830 --> 01:42:56,239

it takes uh and that and that you are

2723

01:43:00,229 --> 01:42:57,840

literally a collection of cells that you

2724

01:43:02,149 --> 01:43:00,239

could see in pond water more or less is

2725

01:43:03,350 --> 01:43:02,159

just if you know you're you're a bunch

2726

01:43:04,870 --> 01:43:03,360

of cells in the trench coat you know

2727

01:43:06,310 --> 01:43:04,880

like the in the cartoons like if if

2728

01:43:08,950 --> 01:43:06,320

that's not destabilizing i don't know

2729

01:43:10,870 --> 01:43:08,960

what i don't know what else is

2730

01:43:13,270 --> 01:43:10,880

so quickly just i know we have to get

2731

01:43:15,189 --> 01:43:13,280

going and i'd like to wrap

2732

01:43:16,550 --> 01:43:15,199

with a set of

2733

01:43:19,270 --> 01:43:16,560

brief questions

2734

01:43:21,030 --> 01:43:19,280

but quickly carl and perhaps well anyone

2735

01:43:23,350 --> 01:43:21,040

who would like to answer what is it that

2736

01:43:26,070 --> 01:43:23,360

separates those who are depersonalized

2737

01:43:27,430 --> 01:43:26,080

or go through certain psychotic episodes

2738

01:43:29,590 --> 01:43:27,440

from

2739

01:43:31,430 --> 01:43:29,600

what is it that separates those who are

2740

01:43:33,830 --> 01:43:31,440

fortunately like myself where it's

2741

01:43:35,430 --> 01:43:33,840

abating and i'm able to function and i'm

2742

01:43:37,510 --> 01:43:35,440

able to have friends and so on versus

2743

01:43:38,870 --> 01:43:37,520

those who go into

2744

01:43:40,870 --> 01:43:38,880

a ward

2745

01:43:43,109 --> 01:43:40,880

because obviously those issues can like

2746

01:43:44,950 --> 01:43:43,119

you mentioned it's a gift

2747

01:43:46,870 --> 01:43:44,960

for some it's not a gift i felt like for

2748

01:43:48,950 --> 01:43:46,880

myself would i don't want that gift to

2749

01:43:51,189 --> 01:43:48,960

go i'll return that gift i wish there

2750

01:43:52,709 --> 01:43:51,199

was a receipt with it but and i still

2751

01:43:54,870 --> 01:43:52,719

actually feel like that but for some

2752

01:43:56,950 --> 01:43:54,880

obviously it's it's it's a horrible and

2753

01:44:00,390 --> 01:43:56,960

persistent feeling so what is it that

2754

01:44:04,229 --> 01:44:02,229

well i'll answer from the point of view

2755

01:44:06,390 --> 01:44:04,239

of a

2756

01:44:08,470 --> 01:44:06,400

psychiatrist with a with with a

2757

01:44:11,109 --> 01:44:08,480

commitment to sort of a mechanistic or

2758

01:44:14,870 --> 01:44:11,119

theoretical uh understanding i i think

2759

01:44:16,950 --> 01:44:14,880

it's um the inability to resolve the um

2760

01:44:18,310 --> 01:44:16,960

the uncertainty that is

2761

01:44:20,470 --> 01:44:18,320

attends

2762

01:44:23,350 --> 01:44:20,480

entertaining the dual hypothesis that i

2763

01:44:24,629 --> 01:44:23,360

may exist or i may not exist as me

2764

01:44:26,470 --> 01:44:24,639

but as soon as you increase your

2765

01:44:27,830 --> 01:44:26,480

hypothesis space you naturally induced

2766

01:44:29,510 --> 01:44:27,840

uncertainty

2767

01:44:31,750 --> 01:44:29,520

an ambivalence and

2768

01:44:37,270 --> 01:44:31,760

a kind of ambiguity

2769

01:44:40,629 --> 01:44:38,950

we're talking about the same imperatives

2770

01:44:42,870 --> 01:44:40,639

that we've been talking about all along

2771

01:44:44,709 --> 01:44:42,880

which is to resolve uncertainty resolve

2772

01:44:46,870 --> 01:44:44,719

ambiguity to make the most sense of

2773

01:44:49,030 --> 01:44:46,880

things so if you've entertained this

2774

01:44:50,870 --> 01:44:49,040

hypothesis that you know you are not you

2775

01:44:52,709 --> 01:44:50,880

and you are you and you can't fully

2776

01:44:54,310 --> 01:44:52,719

resolve that then you will

2777

01:44:57,030 --> 01:44:54,320

find yourself in a state of chronic

2778

01:45:00,070 --> 01:44:57,040

uncertainty that unfortunately does have

2779

01:45:01,669 --> 01:45:00,080

pathological consequences um i'm not

2780

01:45:03,430 --> 01:45:01,679

sure that being in a psych ward is

2781

01:45:04,709 --> 01:45:03,440

necessarily too pathological i mean you

2782

01:45:06,629 --> 01:45:04,719

know

2783

01:45:08,550 --> 01:45:06,639

there are ways to live very nicely and

2784

01:45:09,990 --> 01:45:08,560

constructively and fantastically in

2785

01:45:12,390 --> 01:45:10,000

psych wars and i've done i spent two

2786

01:45:15,910 --> 01:45:12,400

years in the therapeutic community um

2787

01:45:18,870 --> 01:45:15,920

but there will be other sequelae of

2788

01:45:20,390 --> 01:45:18,880

an inability to resolve uncertainty

2789

01:45:22,229 --> 01:45:20,400

they're expressed clinically and

2790

01:45:24,550 --> 01:45:22,239

physiologically in terms of anaesthetic

2791

01:45:26,950 --> 01:45:24,560

load and the like and chronic stress and

2792

01:45:28,470 --> 01:45:26,960

the like which can be very unpleasant uh

2793

01:45:30,470 --> 01:45:28,480

and ultimately can have physical

2794

01:45:32,709 --> 01:45:30,480

consequences from the point of view you

2795

01:45:34,229 --> 01:45:32,719

know the effects on your body so the

2796

01:45:36,390 --> 01:45:34,239

question now is why can't some people

2797

01:45:38,390 --> 01:45:36,400

resolve that uncertainty i think it's

2798

01:45:39,189 --> 01:45:38,400

then a question of the

2799

01:45:41,830 --> 01:45:39,199

the

2800

01:45:45,590 --> 01:45:41,840

biophysical

2801
01:45:49,590 --> 01:45:45,600
processes that enable you to update your

2802
01:45:51,830 --> 01:45:49,600
beliefs and build good models of of your

2803
01:45:53,430 --> 01:45:51,840
world and that

2804
01:45:56,310 --> 01:45:53,440
again this is a very pragmatic answer

2805
01:45:57,590 --> 01:45:56,320
from the point of view of you know of of

2806
01:46:00,149 --> 01:45:57,600
clinical

2807
01:46:02,629 --> 01:46:00,159
of a clinician um

2808
01:46:05,109 --> 01:46:02,639
probably the answers lie in the way that

2809
01:46:05,910 --> 01:46:05,119
your brain has assembled itself

2810
01:46:10,950 --> 01:46:05,920
to

2811
01:46:12,790 --> 01:46:10,960
of evidence um and the it looks at the

2812
01:46:14,629 --> 01:46:12,800
mechanisms that underwrite that ability

2813
01:46:17,109 --> 01:46:14,639

to deploy attention

2814

01:46:18,629 --> 01:46:17,119

rest very much upon neuromodulating

2815

01:46:19,590 --> 01:46:18,639

neurotransmitters and the kind you you

2816

01:46:21,270 --> 01:46:19,600

know you'll have heard about in the

2817

01:46:24,830 --> 01:46:21,280

popular media and will have read about

2818

01:46:26,550 --> 01:46:24,840

things like dopamine serotonin um and

2819

01:46:28,870 --> 01:46:26,560

indeed um

2820

01:46:32,189 --> 01:46:28,880

oxytocin uh all the drugs that are

2821

01:46:34,629 --> 01:46:32,199

either used or the targets of um

2822

01:46:37,830 --> 01:46:34,639

psycholytics or psychedelics or

2823

01:46:39,910 --> 01:46:37,840

psychometrics or drugs that are used to

2824

01:46:44,310 --> 01:46:39,920

try and control some of these feelings

2825

01:46:48,470 --> 01:46:46,870

specifically that attend um anxiety

2826

01:46:49,669 --> 01:46:48,480

disorders and

2827

01:46:52,870 --> 01:46:49,679

depression

2828

01:46:55,030 --> 01:46:52,880

so you know understanding the and this

2829

01:46:57,590 --> 01:46:55,040

is the not the feedback loops that do

2830

01:46:58,629 --> 01:46:57,600

self-organization in a developing embryo

2831

01:47:00,709 --> 01:46:58,639

but

2832

01:47:02,950 --> 01:47:00,719

the same kinds of mechanisms that do the

2833

01:47:06,310 --> 01:47:02,960

feedback loops and self-organization of

2834

01:47:08,310 --> 01:47:06,320

different um structures within the brain

2835

01:47:09,910 --> 01:47:08,320

um that can be construed as blankets

2836

01:47:11,750 --> 01:47:09,920

within blankets or holographic screens

2837

01:47:15,669 --> 01:47:11,760

within holographic screens or cells

2838

01:47:17,510 --> 01:47:15,679

within cells um or um complying the same

2839

01:47:19,510 --> 01:47:17,520

principles but in the particular

2840

01:47:21,990 --> 01:47:19,520

instance of the brain doing this and

2841

01:47:25,270 --> 01:47:22,000

understanding the neurochemistry and the

2842

01:47:27,830 --> 01:47:25,280

biophysics of this fundamental

2843

01:47:30,950 --> 01:47:27,840

sense-making self-organization

2844

01:47:34,310 --> 01:47:30,960

um it turns out that these are certain

2845

01:47:35,109 --> 01:47:34,320

these neurochemical messages um

2846

01:47:37,270 --> 01:47:35,119

are

2847

01:47:39,430 --> 01:47:37,280

particularly important in resolving that

2848

01:47:41,910 --> 01:47:39,440

kind of uncertainty and it may be that

2849

01:47:43,910 --> 01:47:41,920

you are have either taken drugs or you

2850

01:47:46,229 --> 01:47:43,920

have just grown up to not be able to

2851
01:47:49,270 --> 01:47:46,239
deploy these neurotransmitters possibly

2852
01:47:51,109 --> 01:47:49,280
properly um again leading us to well how

2853
01:47:52,870 --> 01:47:51,119
would you gain control of it

2854
01:47:54,629 --> 01:47:52,880
well you might want to do mindfulness

2855
01:47:56,629 --> 01:47:54,639
training meditation and the like that

2856
01:47:58,950 --> 01:47:56,639
just internal attention state training

2857
01:48:03,109 --> 01:47:58,960
basically to mentalize

2858
01:48:06,790 --> 01:48:04,390
mike i know that you had a set of

2859
01:48:08,709 --> 01:48:06,800
questions that you're eager to ask

2860
01:48:10,149 --> 01:48:08,719
both carl and chris did you already get

2861
01:48:12,070 --> 01:48:10,159
to all of them

2862
01:48:14,390 --> 01:48:12,080
uh well that would be impossible but i

2863
01:48:16,229 --> 01:48:14,400

got to uh i get to men i get too many of

2864

01:48:17,750 --> 01:48:16,239

them most of the important ones i

2865

01:48:20,070 --> 01:48:17,760

learned i learned a massive amount today

2866

01:48:22,149 --> 01:48:20,080

this has been just amazing um but i will

2867

01:48:24,149 --> 01:48:22,159

be um pestering both of them with

2868

01:48:26,149 --> 01:48:24,159

additional questions in uh you know

2869

01:48:26,950 --> 01:48:26,159

years to come

2870

01:48:28,310 --> 01:48:26,960

great

2871

01:48:29,830 --> 01:48:28,320

to end i actually i have a question that

2872

01:48:31,750 --> 01:48:29,840

i didn't email you that just occurred to

2873

01:48:33,350 --> 01:48:31,760

me as you all were speaking it's

2874

01:48:35,990 --> 01:48:33,360

something that professor levin that you

2875

01:48:38,470 --> 01:48:36,000

said what are some aspects of your field

2876

01:48:41,270 --> 01:48:38,480

maybe their theories or concepts that

2877

01:48:43,669 --> 01:48:41,280

your peers are extremely resistant to

2878

01:48:45,669 --> 01:48:43,679

but you are not

2879

01:48:47,189 --> 01:48:45,679

wow um

2880

01:48:49,350 --> 01:48:47,199

i don't know if we got uh time for all

2881

01:48:51,910 --> 01:48:49,360

that but that's a lot that's a that's a

2882

01:48:53,750 --> 01:48:51,920

lot of stuff um i mean the most basic

2883

01:48:56,390 --> 01:48:53,760

there are many i mean the most basic

2884

01:48:58,709 --> 01:48:56,400

thing is this notion of uh profound

2885

01:49:00,950 --> 01:48:58,719

symmetries between these fields uh you

2886

01:49:05,030 --> 01:49:00,960

know this idea that you can um that you

2887

01:49:07,030 --> 01:49:05,040

can you can basically import uh

2888

01:49:09,270 --> 01:49:07,040

concepts and strategies from cognitive

2889

01:49:10,550 --> 01:49:09,280

neuroscience or behavioral science and

2890

01:49:13,030 --> 01:49:10,560

deploy them in other spaces

2891

01:49:14,709 --> 01:49:13,040

developmental biology and metabolism

2892

01:49:17,589 --> 01:49:14,719

that you can that it even makes sense to

2893

01:49:19,750 --> 01:49:17,599

talk about um you know goals memories uh

2894

01:49:21,350 --> 01:49:19,760

planning navigation uh all of these

2895

01:49:23,030 --> 01:49:21,360

kinds of things outside of what we're

2896

01:49:24,870 --> 01:49:23,040

used to which is some you know rat in

2897

01:49:26,950 --> 01:49:24,880

the maze or something like this so so

2898

01:49:28,950 --> 01:49:26,960

that continuum this idea that it goes

2899

01:49:31,030 --> 01:49:28,960

that that something important goes all

2900

01:49:33,030 --> 01:49:31,040

the way down or maybe a long way down

2901
01:49:35,990 --> 01:49:33,040
even if not all the way down that that

2902
01:49:38,149 --> 01:49:36,000
that is uh in in in a few circles that's

2903
01:49:39,669 --> 01:49:38,159
okay in most circles that that i would

2904
01:49:42,229 --> 01:49:39,679
deal with that's just that's just

2905
01:49:43,830 --> 01:49:42,239
complete you know complete heresy um

2906
01:49:47,430 --> 01:49:43,840
yeah there are many others but that's uh

2907
01:49:52,629 --> 01:49:49,750
chris

2908
01:49:55,030 --> 01:49:52,639
well i i think that mike really nailed

2909
01:50:00,470 --> 01:49:55,040
it with that answer

2910
01:50:04,870 --> 01:50:01,990
i would say

2911
01:50:07,510 --> 01:50:04,880
yes it's it's not

2912
01:50:10,149 --> 01:50:07,520
a popular idea that

2913
01:50:11,750 --> 01:50:10,159

physics and biology and psychology are

2914

01:50:13,589 --> 01:50:11,760

actually all more or less the same

2915

01:50:14,550 --> 01:50:13,599

science

2916

01:50:18,830 --> 01:50:14,560

but

2917

01:50:22,470 --> 01:50:20,149

[Music]

2918

01:50:24,070 --> 01:50:22,480

professor fristen

2919

01:50:25,990 --> 01:50:24,080

yeah well that would be my favorite

2920

01:50:28,550 --> 01:50:26,000

heresy i'm just going to agree with with

2921

01:50:30,950 --> 01:50:28,560

mike and chris you know the physics

2922

01:50:34,229 --> 01:50:30,960

biology psychology they're all the same

2923

01:50:37,030 --> 01:50:34,239

thing and i just wanted to end by saying

2924

01:50:38,390 --> 01:50:37,040

uh you know heresy i'm not so sure

2925

01:50:40,229 --> 01:50:38,400

anymore i i

2926

01:50:42,390 --> 01:50:40,239

you know the number of times for example

2927

01:50:44,950 --> 01:50:42,400

i see mike levin cited

2928

01:50:46,070 --> 01:50:44,960

in high-end philosophy journals and

2929

01:50:48,390 --> 01:50:46,080

treatments

2930

01:50:51,109 --> 01:50:48,400

um suggests to me that in fact it's

2931

01:50:53,750 --> 01:50:51,119

going to be the minority um in at least

2932

01:50:58,629 --> 01:50:53,760

in a few years time that that don't

2933

01:51:02,149 --> 01:50:58,639

subscribe to this more holistic um um

2934

01:51:04,709 --> 01:51:02,159

encompassing um and i think um correct

2935

01:51:06,390 --> 01:51:04,719

way of viewing um you know cellular life

2936

01:51:09,830 --> 01:51:06,400

sciences but you're more generally sort

2937

01:51:13,510 --> 01:51:11,750

so

2938

01:51:16,149 --> 01:51:13,520

you know who is going to be the heretic

2939

01:51:19,189 --> 01:51:16,159

in a few years time i i suspect it won't

2940

01:51:24,470 --> 01:51:21,510

and i'll end with one that i see

2941

01:51:25,669 --> 01:51:24,480

from particularly chris and michael is

2942

01:51:28,629 --> 01:51:25,679

it sounds like

2943

01:51:31,030 --> 01:51:28,639

what you all are doing or trying to

2944

01:51:32,550 --> 01:51:31,040

understand god or trying to come up with

2945

01:51:35,350 --> 01:51:32,560

the model of god and the reason why i

2946

01:51:37,030 --> 01:51:35,360

say that is because with looking at a

2947

01:51:39,189 --> 01:51:37,040

neuron and saying okay how can a neuron

2948

01:51:41,109 --> 01:51:39,199

look around and have some model and know

2949

01:51:42,629 --> 01:51:41,119

that it's embedded in something higher

2950

01:51:44,709 --> 01:51:42,639

that sounds to me like well if we apply

2951
01:51:46,950 --> 01:51:44,719
that to ourselves and continually do so

2952
01:51:49,750 --> 01:51:46,960
we would reach something akin to god and

2953
01:51:51,510 --> 01:51:49,760
then chris with the quantum babbling if

2954
01:51:53,030 --> 01:51:51,520
one can think of it like that well what

2955
01:51:54,550 --> 01:51:53,040
is babbling

2956
01:51:56,950 --> 01:51:54,560
i know that maybe you all don't want to

2957
01:51:58,149 --> 01:51:56,960
use the word god but for me

2958
01:52:00,390 --> 01:51:58,159
what i

2959
01:52:02,470 --> 01:52:00,400
i have that many of my peers are

2960
01:52:04,470 --> 01:52:02,480
extremely against would be to

2961
01:52:06,870 --> 01:52:04,480
philosophize about god or to explicate

2962
01:52:08,950 --> 01:52:06,880
god or to take god seriously as not an

2963
01:52:11,510 --> 01:52:08,960

old man in the sky with a beard

2964

01:52:13,750 --> 01:52:11,520

and so i i see you all as doing

2965

01:52:16,070 --> 01:52:13,760

something similar in him

2966

01:52:17,830 --> 01:52:16,080

i'm happy to be in your company i'm

2967

01:52:20,149 --> 01:52:17,840

extremely lucky

2968

01:52:21,750 --> 01:52:20,159

all science um

2969

01:52:23,669 --> 01:52:21,760

starts with an act of faith with a very

2970

01:52:25,669 --> 01:52:23,679

important act of faith which is that the

2971

01:52:28,310 --> 01:52:25,679

world is in some way understandable that

2972

01:52:30,149 --> 01:52:28,320

we are not just a bubble in this um you

2973

01:52:31,589 --> 01:52:30,159

know random universe that just happens

2974

01:52:33,830 --> 01:52:31,599

to you know as

2975

01:52:35,830 --> 01:52:33,840

a as a total random string of of of

2976

01:52:37,990 --> 01:52:35,840

coincidence looks like it's got laws and

2977

01:52:39,189 --> 01:52:38,000

then in a tomorrow somewhere you know

2978

01:52:40,950 --> 01:52:39,199

while you sleep the whole thing falls

2979

01:52:42,390 --> 01:52:40,960

apart and we go back to a random you

2980

01:52:45,669 --> 01:52:42,400

know sort of random distribution of

2981

01:52:47,430 --> 01:52:45,679

events so we all there's no proof of any

2982

01:52:49,589 --> 01:52:47,440

of it of any of that right we take we

2983

01:52:51,189 --> 01:52:49,599

have to take that on faith and that may

2984

01:52:52,790 --> 01:52:51,199

be for a scientist that may be the most

2985

01:52:54,629 --> 01:52:52,800

destabilizing thing if you can't get

2986

01:52:56,629 --> 01:52:54,639

yourself to believe that that that the

2987

01:52:58,470 --> 01:52:56,639

world isn't for some weird reason

2988

01:53:00,709 --> 01:52:58,480

understandable and amenable at least to

2989

01:53:02,470 --> 01:53:00,719

some extent to our logic and probing

2990

01:53:04,629 --> 01:53:02,480

then then you can't do science you can't

2991

01:53:07,350 --> 01:53:04,639

do any of the things that that we do so

2992

01:53:09,510 --> 01:53:07,360

so being uh useful and and hopefully

2993

01:53:11,270 --> 01:53:09,520

productive in in what we do

2994

01:53:12,870 --> 01:53:11,280

starts with that act of faith that is

2995

01:53:14,790 --> 01:53:12,880

just completely to my knowledge it's

2996

01:53:16,229 --> 01:53:14,800

it's it's it's it's an axiom it's not

2997

01:53:18,709 --> 01:53:16,239

based on any evidence that you could

2998

01:53:20,310 --> 01:53:18,719

possibly have so so i do think that sort

2999

01:53:22,470 --> 01:53:20,320

of underlies everything that we do just

3000

01:53:24,070 --> 01:53:22,480

this idea that we can in fact squeeze

3001
01:53:26,149 --> 01:53:24,080
some understanding out of what's going

3002
01:53:27,830 --> 01:53:26,159
on around us

3003
01:53:29,589 --> 01:53:27,840
i'd also think you'd be surprised i know

3004
01:53:31,270 --> 01:53:29,599
that you said that it doesn't comport

3005
01:53:33,189 --> 01:53:31,280
with the traditional definition of god

3006
01:53:34,550 --> 01:53:33,199
but it depends on what tradition and how

3007
01:53:36,629 --> 01:53:34,560
far back one goes because there are

3008
01:53:37,430 --> 01:53:36,639
mystics of let's say christian mystics

3009
01:53:39,270 --> 01:53:37,440
and his

3010
01:53:41,189 --> 01:53:39,280
muslim mystics or islamic mystics and so

3011
01:53:42,550 --> 01:53:41,199
on yeah and obviously then the eastern

3012
01:53:44,390 --> 01:53:42,560
end is much more

3013
01:53:47,350 --> 01:53:44,400

mystical

3014

01:53:48,870 --> 01:53:47,360

so okay well thank you all so much for

3015

01:53:51,830 --> 01:53:48,880

for

3016

01:53:53,910 --> 01:53:51,840

and thank you i've learned a

3017

01:53:57,030 --> 01:53:53,920

tremendous amount and i hope you all

3018

01:53:59,030 --> 01:53:57,040

have too i i'm blessed and thank you

3019

01:54:00,870 --> 01:53:59,040

so much

3020

01:54:03,589 --> 01:54:00,880

well thank you very much this was this

3021

01:54:04,950 --> 01:54:03,599

was a very interesting conversation and

3022

01:54:07,030 --> 01:54:04,960

thank you very much for putting it

3023

01:54:08,550 --> 01:54:07,040

together yeah absolutely this is this is

3024

01:54:09,510 --> 01:54:08,560

great great great idea thanks for having

3025

01:54:11,270 --> 01:54:09,520

us on

3026

01:54:13,270 --> 01:54:11,280

yeah i'm just super pleased super

3027

01:54:14,709 --> 01:54:13,280

pleased to have been part of it yeah it

3028

01:54:15,990 --> 01:54:14,719

went in directions that i didn't expect

3029

01:54:18,390 --> 01:54:16,000

i didn't i don't even think i looked at

3030

01:54:19,669 --> 01:54:18,400

my notes my my notepad here and i wrote

3031

01:54:22,070 --> 01:54:19,679

some notes but they occurred to me in

3032

01:54:24,470 --> 01:54:22,080

the moment okay thank you all mike i

3033

01:54:26,790 --> 01:54:24,480

know you got to get going and and

3034

01:54:29,669 --> 01:54:26,800

so well thank you all all right thank

3035

01:54:34,229 --> 01:54:29,679

you cheers cheers thanks so much bye

3036

01:54:37,910 --> 01:54:36,229

the podcast is now finished if you'd

3037

01:54:41,109 --> 01:54:37,920

like to support conversations like this

3038

01:54:45,189 --> 01:54:41,119

then do consider going to patreon.com

3039

01:54:47,830 --> 01:54:45,199

c-u-r-t j-a-i-m-u-n-g-a-l

3040

01:54:49,589 --> 01:54:47,840

that is kurt jaimungle it's support from

3041

01:54:51,430 --> 01:54:49,599

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