

Study of Causally Ambiguous Duration Sorting (CADS)

Winthrop Williams



**SOCIETY
FOR
SCIENTIFIC
EXPLORATION**

1
00:00:08,790 --> 00:00:06,230

[Music]

2
00:00:12,709 --> 00:00:08,800
so let's talk about the hypothesis here

3
00:00:17,910 --> 00:00:14,230
what

4
00:00:19,670 --> 00:00:17,920
dr mosbridge found is that there's a

5
00:00:21,750 --> 00:00:19,680
correlation

6
00:00:23,109 --> 00:00:21,760
or at least there can be it's been found

7
00:00:25,029 --> 00:00:23,119
in some experiments there's a

8
00:00:29,189 --> 00:00:25,039
correlation between

9
00:00:30,950 --> 00:00:29,199
predecision and post-decision data

10
00:00:33,270 --> 00:00:30,960
in an experiment where there's a

11
00:00:35,670 --> 00:00:33,280
decision about how long that experiment

12
00:00:37,430 --> 00:00:35,680
will run so in other words the as you

13
00:00:39,190 --> 00:00:37,440

can see the little x's down here are

14

00:00:40,869 --> 00:00:39,200

data

15

00:00:42,229 --> 00:00:40,879

i can point with my mouse little x's

16

00:00:43,190 --> 00:00:42,239

down here data

17

00:00:45,430 --> 00:00:43,200

and

18

00:00:48,310 --> 00:00:45,440

each time the experiment runs a trial

19

00:00:49,510 --> 00:00:48,320

and it ran about uh 34 000 of these

20

00:00:50,630 --> 00:00:49,520

trials

21

00:00:52,869 --> 00:00:50,640

um

22

00:00:55,590 --> 00:00:52,879

each time it makes a decision where this

23

00:00:57,189 --> 00:00:55,600

vertical line is as to how long the

24

00:00:58,470 --> 00:00:57,199

remaining duration of the experiment

25

00:01:01,430 --> 00:00:58,480

will be

26
00:01:03,029 --> 00:01:01,440
and that remaining duration seems to

27
00:01:04,789 --> 00:01:03,039
affect somehow

28
00:01:07,109 --> 00:01:04,799
the data that

29
00:01:08,390 --> 00:01:07,119
either came before that decision

30
00:01:12,789 --> 00:01:08,400
or

31
00:01:16,630 --> 00:01:12,799
the decision with the data after that

32
00:01:21,590 --> 00:01:16,640
decision but still dependent on how long

33
00:01:25,749 --> 00:01:24,070
in order to make a comparison we have to

34
00:01:28,310 --> 00:01:25,759
have some data after the decision to

35
00:01:31,429 --> 00:01:28,320
compare to the data before the decision

36
00:01:32,469 --> 00:01:31,439
but the remaining duration after that

37
00:01:33,429 --> 00:01:32,479
matters

38
00:01:35,510 --> 00:01:33,439

for

39

00:01:37,109 --> 00:01:35,520

that correlation i'll get into that more

40

00:01:38,550 --> 00:01:37,119

detail and you'll see this slide again

41

00:01:42,069 --> 00:01:38,560

i'm going to bring it up two more times

42

00:01:44,149 --> 00:01:42,079

in this talk in different variations

43

00:01:46,469 --> 00:01:44,159

so let's talk about what julia

44

00:01:47,990 --> 00:01:46,479

mossbridge found

45

00:01:50,069 --> 00:01:48,000

and what her

46

00:01:52,469 --> 00:01:50,079

protocol was and

47

00:01:55,510 --> 00:01:52,479

what she means by what we mean by

48

00:01:56,469 --> 00:01:55,520

causally ambiguous duration sorting

49

00:01:58,950 --> 00:01:56,479

so

50

00:02:01,190 --> 00:01:58,960

um the experiments that she reported on

51
00:02:03,109 --> 00:02:01,200
in 2019 and 2021

52
00:02:05,910 --> 00:02:03,119
all involve these elements on the right

53
00:02:07,429 --> 00:02:05,920
and here's a plot from one of her talks

54
00:02:11,990 --> 00:02:07,439
so

55
00:02:13,830 --> 00:02:12,000
and a detector and photon counting and

56
00:02:16,070 --> 00:02:13,840
the light source and detector are both

57
00:02:19,110 --> 00:02:16,080
turned on and off

58
00:02:20,630 --> 00:02:19,120
as for each trial so when a trial begins

59
00:02:23,030 --> 00:02:20,640
the light source and detector are turned

60
00:02:25,190 --> 00:02:23,040
on and when that trial completes the

61
00:02:27,350 --> 00:02:25,200
light source and detector are turned off

62
00:02:28,949 --> 00:02:27,360
they stay off for three minutes and then

63
00:02:30,309 --> 00:02:28,959

they turn on again for the next trial

64

00:02:33,430 --> 00:02:30,319

which might have a different duration or

65

00:02:35,430 --> 00:02:33,440

the same duration as the previous trial

66

00:02:36,949 --> 00:02:35,440

and then the average photon counts as i

67

00:02:38,790 --> 00:02:36,959

mentioned

68

00:02:39,670 --> 00:02:38,800

show a dependence

69

00:02:41,270 --> 00:02:39,680

on

70

00:02:43,190 --> 00:02:41,280

the future

71

00:02:45,110 --> 00:02:43,200

random

72

00:02:47,350 --> 00:02:45,120

duration

73

00:02:49,670 --> 00:02:47,360

and the time scales involved are seconds

74

00:02:51,430 --> 00:02:49,680

to minutes

75

00:02:53,430 --> 00:02:51,440

and what you can see in this plot here

76

00:02:55,509 --> 00:02:53,440

the reason i'm showing this

77

00:02:58,229 --> 00:02:55,519

is that you can see very clearly here

78

00:03:01,350 --> 00:02:58,239

the yellow curve which is a

79

00:03:04,149 --> 00:03:01,360

average of long duration runs

80

00:03:05,670 --> 00:03:04,159

is distinctly different than the green

81

00:03:07,509 --> 00:03:05,680

blue and you can see a little purple

82

00:03:08,470 --> 00:03:07,519

curve here which are shorter duration

83

00:03:10,710 --> 00:03:08,480

runs

84

00:03:12,630 --> 00:03:10,720

and that difference between those longer

85

00:03:14,070 --> 00:03:12,640

and shorter duration runs

86

00:03:15,030 --> 00:03:14,080

doesn't just appear at the end of the

87

00:03:17,270 --> 00:03:15,040

run

88

00:03:22,149 --> 00:03:17,280

you see a difference in the earlier part

89

00:03:23,430 --> 00:03:22,159

of that of of those runs when averaged

90

00:03:24,420 --> 00:03:23,440

even though

91

00:03:26,149 --> 00:03:24,430

that

92

00:03:28,309 --> 00:03:26,159

[Music]

93

00:03:29,430 --> 00:03:28,319

that decision hasn't really been

94

00:03:31,509 --> 00:03:29,440

implemented

95

00:03:33,430 --> 00:03:31,519

in any difference here and actually even

96

00:03:35,110 --> 00:03:33,440

before the decision is made here the red

97

00:03:37,110 --> 00:03:35,120

line is that decision about how long the

98

00:03:39,830 --> 00:03:37,120

duration will be even before that

99

00:03:42,789 --> 00:03:39,840

decision is made dr mossbridge found a

100

00:03:45,270 --> 00:03:42,799

difference between the longest duration

101

00:03:48,710 --> 00:03:45,280

trials and the shorter ones

102

00:03:52,710 --> 00:03:50,070

so

103

00:03:54,630 --> 00:03:52,720

the current experiment that i've run for

104

00:03:56,550 --> 00:03:54,640

it's actually just completed a two day

105

00:03:58,070 --> 00:03:56,560

two days ago it completed a year running

106

00:04:01,509 --> 00:03:58,080

but the data i'm reporting is just

107

00:04:03,830 --> 00:04:01,519

through february 21st

108

00:04:05,350 --> 00:04:03,840

there were key differences and upgrades

109

00:04:07,509 --> 00:04:05,360

in the hardware

110

00:04:09,670 --> 00:04:07,519

the photon detector

111

00:04:12,710 --> 00:04:09,680

instead of a photomultiplier tube

112

00:04:15,509 --> 00:04:12,720

is a single photon counting module in

113

00:04:17,509 --> 00:04:15,519

other words a reverse bias diode

114

00:04:18,870 --> 00:04:17,519

the pulse counting is done by a field

115

00:04:21,909 --> 00:04:18,880

programmable gate array which is

116

00:04:25,510 --> 00:04:21,919

independent of the computer

117

00:04:27,510 --> 00:04:25,520

there's random number generation um

118

00:04:29,270 --> 00:04:27,520

julia and i are quite excited about that

119

00:04:31,270 --> 00:04:29,280

is a big upgrade and i'll tell you more

120

00:04:32,150 --> 00:04:31,280

about that later

121

00:04:35,430 --> 00:04:32,160

um

122

00:04:36,310 --> 00:04:35,440

i used labview instead of matlab

123

00:04:40,390 --> 00:04:36,320

and

124

00:04:42,790 --> 00:04:40,400

independently written

125

00:04:45,670 --> 00:04:42,800

she had told me her protocol but

126

00:04:48,390 --> 00:04:45,680

i hadn't worked with any of her code

127

00:04:50,790 --> 00:04:48,400

and to ramp up and down the voltage for

128

00:04:53,430 --> 00:04:50,800

the inverse bias of that diode in the

129

00:04:54,150 --> 00:04:53,440

photodetector i used an rc circuit for

130

00:04:57,110 --> 00:04:54,160

that

131

00:05:00,550 --> 00:04:57,120

um there was an rc circuit already in

132

00:05:03,749 --> 00:05:00,560

the in the box that i had for operating

133

00:05:05,749 --> 00:05:03,759

that photodiode and what i did is jumper

134

00:05:07,110 --> 00:05:05,759

in some circuitry so the computer could

135

00:05:08,390 --> 00:05:07,120

turn it on and off instead of a manual

136

00:05:11,110 --> 00:05:08,400

switch

137

00:05:12,950 --> 00:05:11,120

and then um the operate the

138

00:05:15,029 --> 00:05:12,960

experiment was operated continuously 24

139

00:05:17,350 --> 00:05:15,039

7 for over six months

140

00:05:21,590 --> 00:05:17,360

whereas dr moss bridges experiments we

141

00:05:25,830 --> 00:05:23,110

okay so let's look at the optics as i

142

00:05:27,590 --> 00:05:25,840

mentioned we we're photon counting

143

00:05:29,270 --> 00:05:27,600

experiment our photons begin here from

144

00:05:31,749 --> 00:05:29,280

this light emitting diode

145

00:05:33,909 --> 00:05:31,759

this is turned on and off by the

146

00:05:36,230 --> 00:05:33,919

computer software in labview

147

00:05:38,790 --> 00:05:36,240

and then it hits a diffuser so that you

148

00:05:40,070 --> 00:05:38,800

get an even so like even if the led were

149

00:05:41,270 --> 00:05:40,080

to move a little bit it wouldn't affect

150

00:05:42,790 --> 00:05:41,280

the counting that much because it's

151
00:05:44,150 --> 00:05:42,800
being diffused here

152
00:05:45,510 --> 00:05:44,160
then it goes through some miscellaneous

153
00:05:46,950 --> 00:05:45,520
objects that just happen to be on the

154
00:05:49,510 --> 00:05:46,960
table and i didn't

155
00:05:50,950 --> 00:05:49,520
see need to remove them

156
00:05:52,790 --> 00:05:50,960
and then this is important it goes

157
00:05:54,390 --> 00:05:52,800
through this detuned bandpass filter

158
00:05:56,150 --> 00:05:54,400
what i mean by detuned is the bandpass

159
00:05:59,590 --> 00:05:56,160
filter is designed for infrared photons

160
00:06:01,510 --> 00:05:59,600
at 880 nanometers but this led is around

161
00:06:03,270 --> 00:06:01,520
650 so

162
00:06:05,110 --> 00:06:03,280
uh most of the light will be blocked by

163
00:06:07,270 --> 00:06:05,120

this that's important because it gets us

164

00:06:09,670 --> 00:06:07,280

down to a low counting rate

165

00:06:12,309 --> 00:06:09,680

and then the photons that are coupled

166

00:06:13,990 --> 00:06:12,319

into this fiber coupler go to the single

167

00:06:16,629 --> 00:06:14,000

photon county module that reverse bias

168

00:06:19,189 --> 00:06:16,639

diode that i mentioned previously

169

00:06:21,029 --> 00:06:19,199

so it's only about 3 000 counts per

170

00:06:22,469 --> 00:06:21,039

second we're getting here so that's a

171

00:06:25,029 --> 00:06:22,479

low enough rate that it seems

172

00:06:27,350 --> 00:06:25,039

appropriate for this kind of experiment

173

00:06:29,749 --> 00:06:27,360

okay so let's look at the overall

174

00:06:31,350 --> 00:06:29,759

experiment so this is the optics part

175

00:06:33,110 --> 00:06:31,360

and you see the optics part is shown

176

00:06:34,790 --> 00:06:33,120

here this red line

177

00:06:36,550 --> 00:06:34,800

that's representing the light coming

178

00:06:38,710 --> 00:06:36,560

from the light emitting diode to the

179

00:06:39,990 --> 00:06:38,720

single photon counting module here's the

180

00:06:41,029 --> 00:06:40,000

field programmable gate array i

181

00:06:43,510 --> 00:06:41,039

mentioned

182

00:06:45,909 --> 00:06:43,520

it is controlled by the computer but it

183

00:06:48,469 --> 00:06:45,919

counts autonomously and then feeds that

184

00:06:50,550 --> 00:06:48,479

data back to the computer

185

00:06:52,710 --> 00:06:50,560

the single photon county module is also

186

00:06:54,950 --> 00:06:52,720

powered it's powered by this power

187

00:06:57,430 --> 00:06:54,960

supply that i mentioned that has a

188

00:06:59,270 --> 00:06:57,440

resistor capacitor circuit that ramps

189

00:07:01,189 --> 00:06:59,280

the voltage up and down

190

00:07:02,950 --> 00:07:01,199

that's so that the

191

00:07:04,710 --> 00:07:02,960

the inverse

192

00:07:06,629 --> 00:07:04,720

bias diode is a little bit gentle just

193

00:07:08,230 --> 00:07:06,639

like a phototube so you need to ramp the

194

00:07:10,070 --> 00:07:08,240

voltage up and down

195

00:07:11,749 --> 00:07:10,080

and there's an optical isolator there

196

00:07:13,670 --> 00:07:11,759

that's just to avoid ground loops right

197

00:07:14,950 --> 00:07:13,680

because you have a connection here you

198

00:07:16,469 --> 00:07:14,960

have a connection

199

00:07:18,950 --> 00:07:16,479

here

200

00:07:20,390 --> 00:07:18,960

want to have a ground loop so i put an

201
00:07:22,150 --> 00:07:20,400
optical isolator there just to avoid

202
00:07:23,350 --> 00:07:22,160
that

203
00:07:25,430 --> 00:07:23,360
and then it's all controlled by this

204
00:07:28,070 --> 00:07:25,440
labview program it controls the led

205
00:07:31,350 --> 00:07:28,080
controls the counter and it controls the

206
00:07:33,589 --> 00:07:31,360
turning on and off of the detector now

207
00:07:34,469 --> 00:07:33,599
where do i get my random numbers

208
00:07:40,790 --> 00:07:34,479
to

209
00:07:43,029 --> 00:07:40,800
that comes from this whole system down

210
00:07:44,950 --> 00:07:43,039
here which is completely independent

211
00:07:46,390 --> 00:07:44,960
it's not a computer

212
00:07:48,469 --> 00:07:46,400
it is

213
00:07:49,589 --> 00:07:48,479

hardware implemented and

214

00:07:51,189 --> 00:07:49,599

this is the

215

00:07:52,710 --> 00:07:51,199

upgrade in the random number generator

216

00:07:54,230 --> 00:07:52,720

that i said that dr mossbridge and i are

217

00:07:55,029 --> 00:07:54,240

so excited about and i'll tell you about

218

00:07:57,029 --> 00:07:55,039

that

219

00:07:59,430 --> 00:07:57,039

next

220

00:08:00,950 --> 00:07:59,440

so um

221

00:08:03,110 --> 00:08:00,960

actually let me point out before i go to

222

00:08:05,270 --> 00:08:03,120

that next slide that there's

223

00:08:07,589 --> 00:08:05,280

a photo multiplier here

224

00:08:09,189 --> 00:08:07,599

this is independent of the photo

225

00:08:10,950 --> 00:08:09,199

detector here in the single photon

226
00:08:13,029 --> 00:08:10,960
counting module this is an independent

227
00:08:15,110 --> 00:08:13,039
photo multiplier attached to a big tank

228
00:08:16,790 --> 00:08:15,120
of simulator oil this thing is big it's

229
00:08:17,990 --> 00:08:16,800
it spans between two levels in the

230
00:08:19,589 --> 00:08:18,000
building

231
00:08:21,589 --> 00:08:19,599
and then it goes through some amplifiers

232
00:08:22,950 --> 00:08:21,599
and threshold discriminator and then it

233
00:08:24,550 --> 00:08:22,960
hooks up to a pseudo-random number

234
00:08:26,230 --> 00:08:24,560
generator but the numbers that are

235
00:08:27,909 --> 00:08:26,240
generated aren't just pseudorandom it

236
00:08:29,510 --> 00:08:27,919
actually incorporates

237
00:08:31,029 --> 00:08:29,520
the true randomness over here and i'll

238
00:08:33,909 --> 00:08:31,039

explain how that works as i go through

239

00:08:36,230 --> 00:08:33,919

the those next slides

240

00:08:38,070 --> 00:08:36,240

so this is the top end of a photo

241

00:08:39,110 --> 00:08:38,080

multiplier tube it's it's pretty big

242

00:08:42,149 --> 00:08:39,120

it's uh

243

00:08:44,230 --> 00:08:42,159

like kind of the size of a watermelon um

244

00:08:45,910 --> 00:08:44,240

and the photo multiplier tube is down

245

00:08:48,150 --> 00:08:45,920

below and then down below that is tank

246

00:08:50,470 --> 00:08:48,160

scintillator oil supported by these

247

00:08:52,230 --> 00:08:50,480

uh steel beams

248

00:08:53,350 --> 00:08:52,240

and it

249

00:08:54,630 --> 00:08:53,360

when

250

00:08:56,870 --> 00:08:54,640

stuff happens

251
00:08:58,389 --> 00:08:56,880
uh in the atmosphere or nearby you may

252
00:09:00,470 --> 00:08:58,399
get a particle that passes through that

253
00:09:01,829 --> 00:09:00,480
tank you get a flash of light that gives

254
00:09:03,670 --> 00:09:01,839
you a pulse out of the photomultiplier

255
00:09:06,630 --> 00:09:03,680
tube and because it's a pretty big tank

256
00:09:08,870 --> 00:09:06,640
we get about 40 hertz uh pulse rate out

257
00:09:11,030 --> 00:09:08,880
of this

258
00:09:13,590 --> 00:09:11,040
and this provides the true randomness

259
00:09:15,190 --> 00:09:13,600
for our random number generator

260
00:09:18,630 --> 00:09:15,200
then

261
00:09:20,870 --> 00:09:18,640
to get uniform likelihood in the numbers

262
00:09:24,310 --> 00:09:20,880
those true random pulses

263
00:09:25,430 --> 00:09:24,320

are used as the clock inputs on each of

264

00:09:33,350 --> 00:09:25,440

these

265

00:09:35,190 --> 00:09:33,360

bit shift registers

266

00:09:37,350 --> 00:09:35,200

and i can talk more about this when we

267

00:09:39,110 --> 00:09:37,360

get to q a but i enjoyed building this

268

00:09:40,389 --> 00:09:39,120

circuit and

269

00:09:43,030 --> 00:09:40,399

basically

270

00:09:45,350 --> 00:09:43,040

it the pseudorandom numbers are advanced

271

00:09:46,710 --> 00:09:45,360

to the next random number each times

272

00:09:49,269 --> 00:09:46,720

there's a detection in that tank

273

00:09:50,790 --> 00:09:49,279

assimilator oil so when there's a detect

274

00:09:52,550 --> 00:09:50,800

detection in the tank

275

00:09:54,070 --> 00:09:52,560

then you get an advancement to the next

276

00:09:56,389 --> 00:09:54,080

number and because those detections in

277

00:09:58,550 --> 00:09:56,399

the tank are happening at about 40 hertz

278

00:09:59,430 --> 00:09:58,560

about every two seconds you get a whole

279

00:10:03,670 --> 00:09:59,440

fresh

280

00:10:06,630 --> 00:10:03,680

uh 80 bits here in in these random bits

281

00:10:09,590 --> 00:10:08,470

and that's used

282

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

right here

283

00:10:14,710 --> 00:10:11,440

two bits of that information are

284

00:10:16,550 --> 00:10:14,720

collected by the labview system and like

285

00:10:18,790 --> 00:10:16,560

i said these are independent so the

286

00:10:21,590 --> 00:10:18,800

labview system doesn't know what's going

287

00:10:24,550 --> 00:10:21,600

on there's just two wires connected from

288

00:10:26,230 --> 00:10:24,560

that hardware circuit to inputs of the

289

00:10:27,430 --> 00:10:26,240

labview system

290

00:10:29,350 --> 00:10:27,440

and

291

00:10:32,389 --> 00:10:29,360

then they're just literally two jumper

292

00:10:34,310 --> 00:10:32,399

wires like that and the labview system

293

00:10:36,870 --> 00:10:34,320

simply says i want to read these two

294

00:10:38,230 --> 00:10:36,880

digital inputs boom and it gets a random

295

00:10:40,550 --> 00:10:38,240

pair of bits

296

00:10:42,870 --> 00:10:40,560

and uses that to determine what the

297

00:10:44,710 --> 00:10:42,880

duration of the trial will be let me go

298

00:10:46,870 --> 00:10:44,720

through the whole trial so

299

00:10:49,350 --> 00:10:46,880

each time a trial occurs

300

00:10:52,150 --> 00:10:49,360

the system let's say is off initially

301

00:10:53,990 --> 00:10:52,160

right when that trial begins

302

00:10:56,310 --> 00:10:54,000

there's a warm-up period

303

00:10:59,030 --> 00:10:56,320

after the photon counter and photon

304

00:11:01,110 --> 00:10:59,040

source the led are turned on

305

00:11:02,949 --> 00:11:01,120

that warm-up period lasts for six

306

00:11:04,790 --> 00:11:02,959

seconds in my experiment that's

307

00:11:06,310 --> 00:11:04,800

different than dr mossberg's experiment

308

00:11:07,670 --> 00:11:06,320

my system requires the six second

309

00:11:10,389 --> 00:11:07,680

warm-up

310

00:11:12,550 --> 00:11:10,399

and then there's three periods of

311

00:11:14,550 --> 00:11:12,560

counting of 11 seconds each for the

312

00:11:17,030 --> 00:11:14,560

photons so that's when you see on those

313

00:11:18,550 --> 00:11:17,040

plots those three dots at the beginning

314

00:11:21,350 --> 00:11:18,560

you'll see that again

315

00:11:23,350 --> 00:11:21,360

that's or the three x's that's um those

316

00:11:25,670 --> 00:11:23,360

three counts that occur in every trial

317

00:11:27,350 --> 00:11:25,680

regardless of the random number then

318

00:11:29,430 --> 00:11:27,360

depending on the random number that's

319

00:11:33,509 --> 00:11:29,440

chosen

320

00:11:37,110 --> 00:11:33,519

you either have 0 20 30 or 60 additional

321

00:11:39,910 --> 00:11:37,120

counts so those would be 20 30

322

00:11:41,910 --> 00:11:39,920

60 or 0 additional 11 second per period

323

00:11:43,110 --> 00:11:41,920

so this whole trial can go on for

324

00:11:45,829 --> 00:11:43,120

several minutes

325

00:11:48,389 --> 00:11:45,839

after which there's a three second off

326

00:11:50,629 --> 00:11:48,399

time where both the detector and the

327

00:11:52,389 --> 00:11:50,639

source are off before beginning again

328

00:11:54,949 --> 00:11:52,399

and that's a key feature of the

329

00:11:56,949 --> 00:11:54,959

experiment that dr mossbridge did and

330

00:11:59,030 --> 00:11:56,959

seems to be key to getting this to work

331

00:12:02,790 --> 00:11:59,040

and so i replicated that in this

332

00:12:05,990 --> 00:12:04,389

so let's look um

333

00:12:08,069 --> 00:12:06,000

this is the second time you've seen this

334

00:12:09,750 --> 00:12:08,079

before i started out this with my first

335

00:12:11,110 --> 00:12:09,760

slide

336

00:12:13,430 --> 00:12:11,120

but i'm pointing to different things

337

00:12:15,990 --> 00:12:13,440

here so i was just talking about how the

338

00:12:18,150 --> 00:12:16,000

random number chooses how long the trial

339

00:12:20,310 --> 00:12:18,160

will go on for and you can see here the

340

00:12:21,910 --> 00:12:20,320

random number shows that the trial would

341

00:12:23,670 --> 00:12:21,920

go on for zero additional counts and you

342

00:12:25,990 --> 00:12:23,680

see there's just those three right it

343

00:12:28,230 --> 00:12:26,000

just did the three initial counts

344

00:12:30,230 --> 00:12:28,240

um you'll see it says here times 10 to

345

00:12:32,150 --> 00:12:30,240

the fourth so this is about 30 000

346

00:12:34,150 --> 00:12:32,160

counts in each one of these

347

00:12:37,190 --> 00:12:34,160

bins right so there's three bins of

348

00:12:38,870 --> 00:12:37,200

counting before uh the random number and

349

00:12:40,310 --> 00:12:38,880

then at this point the random number

350

00:12:41,350 --> 00:12:40,320

said we're not going to go on so okay

351
00:12:43,190 --> 00:12:41,360
fine

352
00:12:45,430 --> 00:12:43,200
here the random number said we're going

353
00:12:47,269 --> 00:12:45,440
to count for 20 more times

354
00:12:49,430 --> 00:12:47,279
and here 30 more here's another 20.

355
00:12:51,350 --> 00:12:49,440
here's another one where it just counted

356
00:12:53,030 --> 00:12:51,360
uh for three and then stopped and here's

357
00:12:55,990 --> 00:12:53,040
one where it went on for 60 additional

358
00:12:58,949 --> 00:12:56,710
so

359
00:13:01,110 --> 00:12:58,959
the trials have a minimum of a 3 and a

360
00:13:05,030 --> 00:13:01,120
maximum of 63

361
00:13:08,389 --> 00:13:07,430
so here's what the data looked like over

362
00:13:10,949 --> 00:13:08,399
the whole

363
00:13:14,470 --> 00:13:10,959

six month plus period of time

364

00:13:18,389 --> 00:13:14,480

we completed 34 454 trials

365

00:13:20,629 --> 00:13:18,399

for a total of 1 million 47 902 of those

366

00:13:21,590 --> 00:13:20,639

11 second measurements

367

00:13:24,310 --> 00:13:21,600

and

368

00:13:27,509 --> 00:13:24,320

so there's a dot on this plot for each

369

00:13:29,509 --> 00:13:27,519

one of those one million measurements

370

00:13:30,870 --> 00:13:29,519

you can see there's

371

00:13:32,230 --> 00:13:30,880

quite a

372

00:13:33,670 --> 00:13:32,240

a lot of interesting features in this

373

00:13:35,829 --> 00:13:33,680

data

374

00:13:38,069 --> 00:13:35,839

there's sort of a general downtrend

375

00:13:39,430 --> 00:13:38,079

there's a daily variation and actually

376

00:13:40,949 --> 00:13:39,440

if you look under that there's actually

377

00:13:43,189 --> 00:13:40,959

twice daily variation you can't really

378

00:13:44,550 --> 00:13:43,199

see here but these little bumps you're

379

00:13:47,110 --> 00:13:44,560

seeing you know

380

00:13:49,030 --> 00:13:47,120

one two three four five those little

381

00:13:53,350 --> 00:13:49,040

bumps are each one day

382

00:13:58,150 --> 00:13:55,910

there's also this sort of larger

383

00:14:00,870 --> 00:13:58,160

movement about every 25 days there's

384

00:14:02,389 --> 00:14:00,880

these kind of larger movements and dips

385

00:14:04,069 --> 00:14:02,399

and these are not particularly

386

00:14:05,829 --> 00:14:04,079

correlated with times that i went in the

387

00:14:06,870 --> 00:14:05,839

room to backup data or anything like

388

00:14:08,550 --> 00:14:06,880

that

389

00:14:09,750 --> 00:14:08,560

this is one continuous run of the

390

00:14:12,150 --> 00:14:09,760

experiment

391

00:14:13,910 --> 00:14:12,160

that's actually still run

392

00:14:15,269 --> 00:14:13,920

was still running until tuesday when i

393

00:14:17,269 --> 00:14:15,279

shut it down

394

00:14:19,590 --> 00:14:17,279

so

395

00:14:21,350 --> 00:14:19,600

the computer was not restart the

396

00:14:22,870 --> 00:14:21,360

software was running continuously all

397

00:14:24,790 --> 00:14:22,880

the hardware was running continuously

398

00:14:26,389 --> 00:14:24,800

there were no power outages

399

00:14:28,310 --> 00:14:26,399

during the whole time

400

00:14:30,389 --> 00:14:28,320

you can also see there's interesting

401
00:14:31,750 --> 00:14:30,399
things going up here and going down here

402
00:14:34,629 --> 00:14:31,760
which

403
00:14:35,990 --> 00:14:34,639
i'll talk about in a couple slides later

404
00:14:38,470 --> 00:14:36,000
i want to point out that there's a

405
00:14:39,670 --> 00:14:38,480
really big change in the data right here

406
00:14:41,110 --> 00:14:39,680
that

407
00:14:43,590 --> 00:14:41,120
up to here

408
00:14:45,350 --> 00:14:43,600
it's kind of sort of a similar pattern

409
00:14:48,310 --> 00:14:45,360
and then the pattern really changes i'll

410
00:14:49,910 --> 00:14:48,320
talk about that in the next slide

411
00:14:51,990 --> 00:14:49,920
so

412
00:14:53,030 --> 00:14:52,000
dr mosbridge noticed

413
00:14:54,710 --> 00:14:53,040

that

414

00:14:55,509 --> 00:14:54,720

you know just looking things up online

415

00:14:57,350 --> 00:14:55,519

like

416

00:14:58,790 --> 00:14:57,360

what happened on the 17th of january and

417

00:15:01,030 --> 00:14:58,800

she looked at some newspaper headlines

418

00:15:03,189 --> 00:15:01,040

and there was this headline about

419

00:15:04,629 --> 00:15:03,199

officials being pegged as uh you know

420

00:15:05,990 --> 00:15:04,639

for stuff

421

00:15:07,509 --> 00:15:06,000

um

422

00:15:08,710 --> 00:15:07,519

that was a major flashpoint that didn't

423

00:15:09,990 --> 00:15:08,720

turn out to be a big flashpoint but

424

00:15:11,430 --> 00:15:10,000

there was a lot of energy a lot of

425

00:15:13,269 --> 00:15:11,440

concern about it

426

00:15:14,629 --> 00:15:13,279

so maybe emotions affect these things

427

00:15:16,629 --> 00:15:14,639

like they affect the global

428

00:15:18,629 --> 00:15:16,639

consciousness project

429

00:15:20,310 --> 00:15:18,639

there's also striking situations where

430

00:15:23,430 --> 00:15:20,320

you don't see anything the here

431

00:15:25,030 --> 00:15:23,440

september 22nd is the

432

00:15:27,670 --> 00:15:25,040

fall equinox and here's the winter

433

00:15:30,949 --> 00:15:27,680

solstice on december 21st and there's no

434

00:15:34,790 --> 00:15:32,870

thing that seems to be happening there

435

00:15:37,509 --> 00:15:34,800

but there's other ones like election day

436

00:15:39,350 --> 00:15:37,519

uh november 3rd appears to be just right

437

00:15:41,430 --> 00:15:39,360

before there's this significant change

438

00:15:43,269 --> 00:15:41,440

in the data and these could just be

439

00:15:45,590 --> 00:15:43,279

coincidences maybe this is when the

440

00:15:47,110 --> 00:15:45,600

weather changed or something in berkeley

441

00:15:49,269 --> 00:15:47,120

so

442

00:15:50,629 --> 00:15:49,279

um this is interesting but it's not the

443

00:15:52,629 --> 00:15:50,639

main focus of this talk so i'm going to

444

00:15:54,470 --> 00:15:52,639

set this aside for now and get back to

445

00:15:56,470 --> 00:15:54,480

the main focus which is looking at the

446

00:16:00,230 --> 00:15:56,480

correlations within each run with it

447

00:16:04,870 --> 00:16:01,030

so

448

00:16:08,870 --> 00:16:07,030

things that are really outlined here

449

00:16:10,230 --> 00:16:08,880

above and below

450

00:16:42,790 --> 00:16:10,240

i

451
00:16:45,670 --> 00:16:42,800
be groups

452
00:16:47,430 --> 00:16:45,680
and so i used that in

453
00:16:49,030 --> 00:16:47,440
noticing what are the outliers and

454
00:16:50,710 --> 00:16:49,040
setting them aside

455
00:16:53,030 --> 00:16:50,720
you'll see later i do the analysis with

456
00:16:55,509 --> 00:16:53,040
and without the outliers and the results

457
00:16:57,509 --> 00:16:55,519
are actually fairly similar but this was

458
00:16:59,670 --> 00:16:57,519
one of the initial things i did was to

459
00:17:01,620 --> 00:16:59,680
identify outliers

460
00:17:03,030 --> 00:17:01,630
and so there's my outliers

461
00:17:04,230 --> 00:17:03,040
[Music]

462
00:17:06,870 --> 00:17:04,240
there are approximately a thousand

463
00:17:09,029 --> 00:17:06,880

outliers in the whole million counts

464

00:17:10,630 --> 00:17:09,039

uh but they cluster in about 64 out of

465

00:17:12,949 --> 00:17:10,640

the 34 000 trials so they're pretty

466

00:17:15,350 --> 00:17:12,959

heavily clustered and so

467

00:17:17,029 --> 00:17:15,360

uh can be fairly um

468

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

you just remove those trials and it's

469

00:17:21,350 --> 00:17:18,640

pretty straightforward since we're doing

470

00:17:23,350 --> 00:17:21,360

a trial by trial

471

00:17:25,510 --> 00:17:23,360

approaching the analysis

472

00:17:27,829 --> 00:17:25,520

okay now this is the third time i'm

473

00:17:29,750 --> 00:17:27,839

showing you this slide

474

00:17:31,909 --> 00:17:29,760

i've changed things a little bit

475

00:17:34,150 --> 00:17:31,919

i'm calling attention to the trials that

476
00:17:36,630 --> 00:17:34,160
have data after the decision so remember

477
00:17:38,710 --> 00:17:36,640
there's a decision here by random number

478
00:17:41,350 --> 00:17:38,720
as to how long the trial will go on

479
00:17:44,310 --> 00:17:41,360
whether it's going to go on for 0 20 30

480
00:17:45,909 --> 00:17:44,320
or 60 counts however i'm

481
00:17:48,390 --> 00:17:45,919
paying special attention to the ones

482
00:17:49,430 --> 00:17:48,400
that have at least some counts after the

483
00:17:51,909 --> 00:17:49,440
decision

484
00:17:54,070 --> 00:17:51,919
because an analysis approach that dr

485
00:17:56,390 --> 00:17:54,080
mosbridge came up with utilizes a

486
00:17:59,830 --> 00:17:56,400
correlation between those before and

487
00:18:03,190 --> 00:18:00,789
okay

488
00:18:04,950 --> 00:18:03,200

so here's a schematic of that analysis

489

00:18:07,590 --> 00:18:04,960

that dr mossbridge came up with and that

490

00:18:09,110 --> 00:18:07,600

i implemented in matlab

491

00:18:09,990 --> 00:18:09,120

so

492

00:18:16,150 --> 00:18:10,000

the

493

00:18:17,830 --> 00:18:16,160

collected

494

00:18:20,070 --> 00:18:17,840

and so

495

00:18:22,230 --> 00:18:20,080

the

496

00:18:23,830 --> 00:18:22,240

for each day

497

00:18:25,590 --> 00:18:23,840

we look at the

498

00:18:27,110 --> 00:18:25,600

pre-decision data on the trials and we

499

00:18:28,390 --> 00:18:27,120

look at the post-decision data on the

500

00:18:29,270 --> 00:18:28,400

trials

501
00:18:31,830 --> 00:18:29,280
and

502
00:18:33,430 --> 00:18:31,840
we average over actually just two of the

503
00:18:36,230 --> 00:18:33,440
three pre-decision

504
00:18:38,870 --> 00:18:36,240
data counts and we average over all of

505
00:18:41,350 --> 00:18:38,880
the post-decision data accounts okay

506
00:18:45,430 --> 00:18:41,360
those averages form an x-y pair in some

507
00:18:46,630 --> 00:18:45,440
arbitrary space for each trial okay so

508
00:18:48,789 --> 00:18:46,640
now we do

509
00:18:51,590 --> 00:18:48,799
is

510
00:18:54,710 --> 00:18:51,600
depending on the duration of that trial

511
00:18:56,789 --> 00:18:54,720
we sort those x y values

512
00:18:59,430 --> 00:18:56,799
so that they contribute to either

513
00:19:02,150 --> 00:18:59,440

an average of the 20

514

00:19:04,549 --> 00:19:02,160

so so in other words all the x's

515

00:19:06,710 --> 00:19:04,559

for for the 20 duration trials get

516

00:19:08,870 --> 00:19:06,720

averaged and all the y's for the 20

517

00:19:12,390 --> 00:19:08,880

duration trials get averaged that forms

518

00:19:15,270 --> 00:19:12,400

this x20 y20 pair same way for the 30s

519

00:19:17,510 --> 00:19:15,280

same way for the 60s so we have three xy

520

00:19:19,909 --> 00:19:17,520

pairs and we do a correlation and we get

521

00:19:21,190 --> 00:19:19,919

the row value or we're just calling it r

522

00:19:22,230 --> 00:19:21,200

here

523

00:19:23,029 --> 00:19:22,240

and that

524

00:19:25,590 --> 00:19:23,039

uh

525

00:19:28,150 --> 00:19:25,600

that our value then gets averaged over

526
00:19:29,350 --> 00:19:28,160
all 210 days so we get one r value for

527
00:19:32,549 --> 00:19:29,360
each day

528
00:19:33,430 --> 00:19:32,559
and then we average those 210 r values

529
00:19:34,470 --> 00:19:33,440
and

530
00:19:36,630 --> 00:19:34,480
um

531
00:19:38,950 --> 00:19:36,640
what we find is a rather strong

532
00:19:40,710 --> 00:19:38,960
correlation the average correlation is

533
00:19:42,710 --> 00:19:40,720
quite strong and that's shown by this

534
00:19:45,270 --> 00:19:42,720
line here on the graph

535
00:19:46,390 --> 00:19:45,280
almost 0.75

536
00:19:47,590 --> 00:19:46,400
on the other hand

537
00:19:49,750 --> 00:19:47,600
if we

538
00:19:52,870 --> 00:19:49,760

take each x y pair and contribute it

539

00:19:53,669 --> 00:19:52,880

instead to a random

540

00:19:57,990 --> 00:19:53,679

x

541

00:20:00,150 --> 00:19:58,000

even though the actual duration might be

542

00:20:02,710 --> 00:20:00,160

20 it might be con

543

00:20:06,070 --> 00:20:02,720

that x y average might be contributed to

544

00:20:08,310 --> 00:20:06,080

the x 30 y 30 pair for example okay and

545

00:20:10,390 --> 00:20:08,320

we do the scramble in such a way that we

546

00:20:12,070 --> 00:20:10,400

preserve for each day

547

00:20:16,390 --> 00:20:12,080

the number of

548

00:20:17,990 --> 00:20:16,400

x and y that contribute to the x 20 y 20

549

00:20:19,669 --> 00:20:18,000

and the number that contribute to the x

550

00:20:23,190 --> 00:20:19,679

30 y 30 and the number that contribute

551
00:20:25,590 --> 00:20:23,200
to the x 60 y60 so we preserve how many

552
00:20:28,950 --> 00:20:25,600
trials contribute to each if we do that

553
00:20:30,310 --> 00:20:28,960
correlation we get again 210 r values

554
00:20:33,350 --> 00:20:30,320
one for each day

555
00:20:35,350 --> 00:20:33,360
and then averaging those 210 values we

556
00:20:37,590 --> 00:20:35,360
get a much weaker correlation

557
00:20:40,390 --> 00:20:37,600
and that's demonstrated by doing this

558
00:20:43,110 --> 00:20:40,400
scramble 40 000 times you know 40 000

559
00:20:44,310 --> 00:20:43,120
different random numbers

560
00:20:46,710 --> 00:20:44,320
and then

561
00:20:49,430 --> 00:20:46,720
um that forms this

562
00:20:50,789 --> 00:20:49,440
histogram here shown

563
00:20:53,270 --> 00:20:50,799

which performs

564

00:20:55,830 --> 00:20:53,280

quite a rather nice bell curve

565

00:21:00,470 --> 00:20:58,710

let me move to the next slide

566

00:21:02,149 --> 00:21:00,480

so here

567

00:21:03,590 --> 00:21:02,159

this is that same plot i just showed you

568

00:21:05,990 --> 00:21:03,600

but just bigger

569

00:21:07,270 --> 00:21:06,000

and here i'm calculating

570

00:21:09,190 --> 00:21:07,280

a sigma

571

00:21:10,549 --> 00:21:09,200

for the

572

00:21:11,669 --> 00:21:10,559

original assignment the correct

573

00:21:13,270 --> 00:21:11,679

assignment

574

00:21:14,390 --> 00:21:13,280

of the data

575

00:21:16,310 --> 00:21:14,400

in

576
00:21:17,669 --> 00:21:16,320
by duration versus the scrambled

577
00:21:18,950 --> 00:21:17,679
assignments

578
00:21:21,350 --> 00:21:18,960
and so

579
00:21:23,190 --> 00:21:21,360
uh the way i've done that is to take the

580
00:21:27,190 --> 00:21:23,200
original r value the correct assignment

581
00:21:29,750 --> 00:21:27,200
r value subtract the r value for the

582
00:21:31,990 --> 00:21:29,760
average of the scrambles and then divide

583
00:21:34,950 --> 00:21:32,000
by the standard deviation for those

584
00:21:39,190 --> 00:21:34,960
scrambles and that produces a

585
00:21:44,710 --> 00:21:41,990
i mentioned earlier that this is

586
00:21:46,549 --> 00:21:44,720
pretty robust to outlier removal so if i

587
00:21:48,310 --> 00:21:46,559
put those outliers back in like just

588
00:21:50,710 --> 00:21:48,320

ignore that part of the presentation

589

00:21:53,350 --> 00:21:50,720

where i talked about outliers

590

00:21:57,350 --> 00:21:53,360

then we get a sigma of 5.27 it's not

591

00:21:59,830 --> 00:21:58,470

um

592

00:22:02,710 --> 00:21:59,840

this is

593

00:22:04,149 --> 00:22:02,720

so far the major result that we've come

594

00:22:06,390 --> 00:22:04,159

up with

595

00:22:09,190 --> 00:22:06,400

it's the um

596

00:22:10,230 --> 00:22:09,200

it's the strongest result so far and

597

00:22:13,990 --> 00:22:10,240

we're still

598

00:22:18,230 --> 00:22:14,000

doing a lot of analysis to figure out if

599

00:22:19,990 --> 00:22:18,240

we can come up with um something better

600

00:22:21,750 --> 00:22:20,000

in addition to this

601
00:22:24,310 --> 00:22:21,760
but in the meantime

602
00:22:26,789 --> 00:22:24,320
dr mossbridge has also looked at

603
00:22:27,590 --> 00:22:26,799
some day night variation because

604
00:22:29,750 --> 00:22:27,600
uh

605
00:22:30,870 --> 00:22:29,760
remember the experiment she did she only

606
00:22:32,789 --> 00:22:30,880
measured during the day and i'm

607
00:22:34,310 --> 00:22:32,799
measuring day and night so that gives an

608
00:22:36,149 --> 00:22:34,320
opportunity to compare those so i'll

609
00:22:37,350 --> 00:22:36,159
show that in the next line one of the

610
00:22:38,149 --> 00:22:37,360
things that

611
00:22:40,230 --> 00:22:38,159
um

612
00:22:41,669 --> 00:22:40,240
these are slides generated by dr

613
00:22:42,789 --> 00:22:41,679

mossbridge that i've put into this

614

00:22:43,750 --> 00:22:42,799

presentation

615

00:22:46,070 --> 00:22:43,760

um

616

00:22:48,470 --> 00:22:46,080

one of the things that she noticed is

617

00:22:50,549 --> 00:22:48,480

that there's a significant difference

618

00:22:52,789 --> 00:22:50,559

between day and night data so looking

619

00:22:55,110 --> 00:22:52,799

over the whole

620

00:22:57,590 --> 00:22:55,120

six plus months of data

621

00:22:59,590 --> 00:22:57,600

um and this is sort of

622

00:23:01,510 --> 00:22:59,600

you know it's it's sort of sort of

623

00:23:03,669 --> 00:23:01,520

significant sort of in the noise we're

624

00:23:05,750 --> 00:23:03,679

not claiming the significance of this

625

00:23:06,950 --> 00:23:05,760

uh at this point but you see that

626

00:23:08,789 --> 00:23:06,960

there's this kind of interesting

627

00:23:10,470 --> 00:23:08,799

reversal

628

00:23:12,070 --> 00:23:10,480

that nighttime data has kind of an

629

00:23:13,270 --> 00:23:12,080

opposite character to date time data in

630

00:23:16,310 --> 00:23:13,280

a certain way

631

00:23:18,470 --> 00:23:16,320

in in how the how the data separates by

632

00:23:20,230 --> 00:23:18,480

trial duration

633

00:23:21,110 --> 00:23:20,240

we see that again here

634

00:23:22,470 --> 00:23:21,120

so

635

00:23:24,310 --> 00:23:22,480

horizontally are three different

636

00:23:25,590 --> 00:23:24,320

comparisons here this is

637

00:23:27,669 --> 00:23:25,600

the um

638

00:23:30,470 --> 00:23:27,679

what i call the 20s where there's

639

00:23:31,909 --> 00:23:30,480

20 counts after the decision and this is

640

00:23:33,510 --> 00:23:31,919

the zeros where there's zero counts

641

00:23:35,510 --> 00:23:33,520

after the decision you see the

642

00:23:37,510 --> 00:23:35,520

comparison there and then at night time

643

00:23:39,110 --> 00:23:37,520

you get the reverse of that

644

00:23:41,190 --> 00:23:39,120

well i should say this is

645

00:23:43,750 --> 00:23:41,200

data before the winter solstice so i'm

646

00:23:45,669 --> 00:23:43,760

going to show you two plots two charts

647

00:23:47,190 --> 00:23:45,679

of six plots each before the winter

648

00:23:49,510 --> 00:23:47,200

solstice and after the winter solstice

649

00:23:52,149 --> 00:23:49,520

okay so this is the first of two

650

00:23:53,350 --> 00:23:52,159

slides before the winter solstice

651
00:23:54,149 --> 00:23:53,360
um

652
00:23:56,149 --> 00:23:54,159
and

653
00:23:59,990 --> 00:23:56,159
you can see that there's

654
00:24:02,310 --> 00:24:00,000
this reversal right like and and here

655
00:24:05,029 --> 00:24:02,320
again more showing the reversal

656
00:24:07,029 --> 00:24:05,039
okay now after the winter solstice look

657
00:24:08,630 --> 00:24:07,039
at this

658
00:24:10,310 --> 00:24:08,640
this is in the same direction instead of

659
00:24:12,470 --> 00:24:10,320
reversed

660
00:24:13,909 --> 00:24:12,480
so this is just really a curious thing

661
00:24:16,390 --> 00:24:13,919
like we don't know why what this is

662
00:24:18,390 --> 00:24:16,400
about but it seems like something to

663
00:24:19,830 --> 00:24:18,400

investigate further and here's the other

664

00:24:22,070 --> 00:24:19,840

plot

665

00:24:25,110 --> 00:24:22,080

showing that as well

666

00:24:27,029 --> 00:24:25,120

you can see here maybe there's some

667

00:24:30,630 --> 00:24:27,039

uh it's not quite reversed maybe there's

668

00:24:34,549 --> 00:24:32,310

fluctuation in how these things relate

669

00:24:36,630 --> 00:24:34,559

to each other for some curves relating

670

00:24:38,230 --> 00:24:36,640

than others

671

00:24:39,510 --> 00:24:38,240

so to sum up

672

00:24:41,269 --> 00:24:39,520

um

673

00:24:43,029 --> 00:24:41,279

this has been a replication and

674

00:24:43,909 --> 00:24:43,039

extension

675

00:24:46,630 --> 00:24:43,919

um

676
00:24:47,909 --> 00:24:46,640
the up the apparatus has been upgraded

677
00:24:49,830 --> 00:24:47,919
um

678
00:24:51,350 --> 00:24:49,840
i've run day night collection instead of

679
00:24:52,149 --> 00:24:51,360
just during the days

680
00:24:53,990 --> 00:24:52,159
um

681
00:24:56,310 --> 00:24:54,000
it's possible that there's sensitivity

682
00:24:58,310 --> 00:24:56,320
to astronomical or emotional events that

683
00:25:00,310 --> 00:24:58,320
bears further investigation

684
00:25:03,190 --> 00:25:00,320
um and there's a lot of work to do in

685
00:25:04,789 --> 00:25:03,200
understanding these causally ambiguous

686
00:25:05,909 --> 00:25:04,799
duration sorting and why that's

687
00:25:06,950 --> 00:25:05,919
happening

688
00:25:09,350 --> 00:25:06,960

um

689

00:25:12,870 --> 00:25:09,360

so i'll close there and ask questions

690

00:25:16,549 --> 00:25:14,470

thank you so much for that really

691

00:25:18,950 --> 00:25:16,559

interesting presentation

692

00:25:21,110 --> 00:25:18,960

and we've got quite a lot of buzz in the

693

00:25:22,710 --> 00:25:21,120

chat so i'm going to go through some of

694

00:25:23,909 --> 00:25:22,720

those questions and

695

00:25:25,029 --> 00:25:23,919

um

696

00:25:28,149 --> 00:25:25,039

hopefully we can get through some of

697

00:25:31,350 --> 00:25:28,159

them in this time um let's see so the

698

00:25:34,710 --> 00:25:31,360

first question is about

699

00:25:36,950 --> 00:25:34,720

whether any of the variations in counts

700

00:25:38,870 --> 00:25:36,960

could be correlated with sun activity

701
00:25:40,390 --> 00:25:38,880
like sun spots or flares

702
00:25:42,710 --> 00:25:40,400
um

703
00:25:44,390 --> 00:25:42,720
yeah there's a slide here

704
00:25:47,830 --> 00:25:44,400
about um

705
00:25:48,870 --> 00:25:47,840
geomagnetic uh fluctuations right here

706
00:25:53,029 --> 00:25:48,880
um

707
00:25:54,470 --> 00:25:53,039
there's

708
00:25:57,110 --> 00:25:54,480
that would be a good thing to look at

709
00:25:59,590 --> 00:25:57,120
yes

710
00:26:02,310 --> 00:25:59,600
could i add to that just briefly

711
00:26:04,549 --> 00:26:02,320
yes please um so the donald are there

712
00:26:06,470 --> 00:26:04,559
geometric magnetic or these are yeah

713
00:26:08,390 --> 00:26:06,480

these are geomagnetic field fluctuations

714

00:26:10,710 --> 00:26:08,400

with the seasons you know the earth is

715

00:26:13,269 --> 00:26:10,720

in this little spot in the middle

716

00:26:14,789 --> 00:26:13,279

and so clearly even within each season

717

00:26:17,190 --> 00:26:14,799

well not clearly because you can't see

718

00:26:19,350 --> 00:26:17,200

but the sun is over here

719

00:26:21,350 --> 00:26:19,360

i don't know if you can see my mouse um

720

00:26:23,990 --> 00:26:21,360

no can't see your mouse yeah the sun

721

00:26:26,710 --> 00:26:24,000

would be over here right exactly and so

722

00:26:28,870 --> 00:26:26,720

at night time that's flipped

723

00:26:30,630 --> 00:26:28,880

so this shows the seasonal

724

00:26:32,230 --> 00:26:30,640

and by inference

725

00:26:34,549 --> 00:26:32,240

the day night difference so there could

726
00:26:37,190 --> 00:26:34,559
be a whole geomagnetic effect that could

727
00:26:38,789 --> 00:26:37,200
happen on the electrons in the detector

728
00:26:42,470 --> 00:26:38,799
as potentially as well as the medium

729
00:26:49,190 --> 00:26:43,590
thank you

730
00:26:51,830 --> 00:26:49,200
next question are you planning on

731
00:26:53,909 --> 00:26:51,840
exploring any pre-registered event

732
00:26:55,909 --> 00:26:53,919
correlations with these data patterns as

733
00:26:59,110 --> 00:26:55,919
with the gcp

734
00:27:01,029 --> 00:26:59,120
data that we know more about

735
00:27:02,630 --> 00:27:01,039
um i don't have

736
00:27:03,909 --> 00:27:02,640
i don't know what my plans are with this

737
00:27:07,590 --> 00:27:03,919
next exactly

738
00:27:09,110 --> 00:27:07,600

but that could be a good idea yeah yeah

739

00:27:10,870 --> 00:27:09,120

i would like to say like

740

00:27:12,789 --> 00:27:10,880

this we just discovered those very

741

00:27:15,430 --> 00:27:12,799

recently and that wasn't the main point

742

00:27:17,510 --> 00:27:15,440

but there's a lot of work to do

743

00:27:18,310 --> 00:27:17,520

yeah it's very interesting

744

00:27:19,110 --> 00:27:18,320

um

745

00:27:22,389 --> 00:27:19,120

see

746

00:27:25,269 --> 00:27:22,399

um do you have any information on what

747

00:27:26,230 --> 00:27:25,279

causes the diurnal variation what about

748

00:27:27,990 --> 00:27:26,240

the

749

00:27:29,830 --> 00:27:28,000

steep dips that seem to come more or

750

00:27:33,029 --> 00:27:29,840

less regularly especially in the first

751

00:27:35,110 --> 00:27:33,039

part of the data many days apart

752

00:27:37,750 --> 00:27:35,120

i don't know what the steep tips are

753

00:27:39,510 --> 00:27:37,760

um i i kept track of when i would go in

754

00:27:41,590 --> 00:27:39,520

the room to upload data and stuff like

755

00:27:43,190 --> 00:27:41,600

that or when i had the lights on there

756

00:27:45,269 --> 00:27:43,200

was one time where the lights got

757

00:27:46,950 --> 00:27:45,279

changed and so people other people were

758

00:27:49,669 --> 00:27:46,960

in the room for a little while changing

759

00:27:51,909 --> 00:27:49,679

the lights um and

760

00:27:54,230 --> 00:27:51,919

that's not strong that you know maybe

761

00:27:56,389 --> 00:27:54,240

one of the things is due to that but

762

00:27:58,549 --> 00:27:56,399

that doesn't seem to be a major cause

763

00:28:00,230 --> 00:27:58,559

as far as the diurnal variations could

764

00:28:01,990 --> 00:28:00,240

easily be temperature

765

00:28:03,430 --> 00:28:02,000

you know almost any instrumentation will

766

00:28:04,470 --> 00:28:03,440

vary with temperature

767

00:28:07,190 --> 00:28:04,480

um

768

00:28:08,630 --> 00:28:07,200

for the latter half of the the year

769

00:28:11,510 --> 00:28:08,640

uh i've now been running with a

770

00:28:14,070 --> 00:28:11,520

thermometer in the room uh logging so

771

00:28:17,110 --> 00:28:14,080

we'll see if that is correlated

772

00:28:19,510 --> 00:28:17,120

so watch this space yeah

773

00:28:21,110 --> 00:28:19,520

yeah this is very interesting it's very

774

00:28:21,990 --> 00:28:21,120

hot off the press as well

775

00:28:24,310 --> 00:28:22,000

um

776

00:28:27,029 --> 00:28:24,320

there was a major increase in sunspots

777

00:28:29,029 --> 00:28:27,039

and solar flux in november to december

778

00:28:30,789 --> 00:28:29,039

um in this person says it might be

779

00:28:33,190 --> 00:28:30,799

interesting to look at solar weather

780

00:28:34,950 --> 00:28:33,200

correlations as you go forward

781

00:28:35,990 --> 00:28:34,960

yes i think that's a good thing to look

782

00:28:39,110 --> 00:28:36,000

at

783

00:28:40,549 --> 00:28:39,120

actually because um

784

00:28:43,590 --> 00:28:40,559

who was the one who asked that question

785

00:28:45,110 --> 00:28:43,600

doug that was doug richards yeah doug

786

00:28:47,350 --> 00:28:45,120

talk to us maybe i mean we need someone

787

00:28:48,950 --> 00:28:47,360

who knows what they're doing there

788

00:28:50,389 --> 00:28:48,960

that'd be great

789

00:28:51,909 --> 00:28:50,399

this is the purpose of this conference

790

00:28:53,669 --> 00:28:51,919

to make connections

791

00:28:55,830 --> 00:28:53,679

insight so that's great

792

00:28:57,669 --> 00:28:55,840

um another question from york can you

793

00:28:59,750 --> 00:28:57,679

use the correlation measurement between

794

00:29:02,630 --> 00:28:59,760

the pre-decision measurement and the

795

00:29:04,630 --> 00:29:02,640

first 20 post decision values to predict

796

00:29:07,110 --> 00:29:04,640

whether the remaining duration after 20

797

00:29:09,110 --> 00:29:07,120

trials is an additional 0 10 or 40

798

00:29:12,630 --> 00:29:09,120

trials and with what statistical

799

00:29:14,630 --> 00:29:12,640

confidence can you make this prediction

800

00:29:17,029 --> 00:29:14,640

uh i haven't come up with a way to do

801
00:29:18,789 --> 00:29:17,039
that uh i don't know if dr mossbridge

802
00:29:20,950 --> 00:29:18,799
has

803
00:29:22,789 --> 00:29:20,960
um yeah i'm working on that that's not

804
00:29:25,350 --> 00:29:22,799
in this paper but that's a that's

805
00:29:27,590 --> 00:29:25,360
obviously an interesting topic

806
00:29:29,830 --> 00:29:27,600
yeah lots of lots of fascinating

807
00:29:33,110 --> 00:29:29,840
possibilities here um

808
00:29:34,870 --> 00:29:33,120
can you both say anything about um what

809
00:29:36,549 --> 00:29:34,880
the next steps are then with this

810
00:29:38,830 --> 00:29:36,559
research agenda what what are you

811
00:29:41,269 --> 00:29:38,840
planning

812
00:29:43,750 --> 00:29:41,279
next well

813
00:29:45,350 --> 00:29:43,760

like i said we've got uh more

814

00:29:46,630 --> 00:29:45,360

additional data logging running since

815

00:29:49,350 --> 00:29:46,640

february

816

00:29:50,950 --> 00:29:49,360

we'll see if that tells us anything

817

00:29:52,630 --> 00:29:50,960

um

818

00:29:53,990 --> 00:29:52,640

we've got that whole set of data that i

819

00:29:57,029 --> 00:29:54,000

haven't looked at yet i've just been

820

00:29:58,389 --> 00:29:57,039

uploading it and backing it up

821

00:29:59,510 --> 00:29:58,399

um

822

00:30:01,190 --> 00:29:59,520

there's

823

00:30:03,350 --> 00:30:01,200

uh

824

00:30:06,149 --> 00:30:03,360

lots of different ways we could

825

00:30:07,990 --> 00:30:06,159

set up a photon counting

826

00:30:09,669 --> 00:30:08,000

and it may also be interesting to look

827

00:30:11,830 --> 00:30:09,679

at

828

00:30:14,389 --> 00:30:11,840

fermions instead of bosons

829

00:30:19,029 --> 00:30:14,399

so if we were to count electrons

830

00:30:22,789 --> 00:30:21,350

julia

831

00:30:24,070 --> 00:30:22,799

um i think those are interesting

832

00:30:25,590 --> 00:30:24,080

questions i think there are also

833

00:30:26,870 --> 00:30:25,600

interesting questions about when the

834

00:30:31,110 --> 00:30:26,880

knowledge

835

00:30:32,630 --> 00:30:31,120

the duration occurs um sort of an

836

00:30:34,630 --> 00:30:32,640

ontological

837

00:30:37,029 --> 00:30:34,640

versus epistemological sort of

838

00:30:39,830 --> 00:30:37,039

interpretation of quantum mechanics type

839

00:30:41,190 --> 00:30:39,840

of differentiation um

840

00:30:43,110 --> 00:30:41,200

i think

841

00:30:44,549 --> 00:30:43,120

basically publishing what we have so the

842

00:30:46,389 --> 00:30:44,559

first paper

843

00:30:48,830 --> 00:30:46,399

that i have out there and the conference

844

00:30:50,389 --> 00:30:48,840

proceedings are on like crappy equipment

845

00:30:56,389 --> 00:30:50,399

and

846

00:30:57,669 --> 00:30:56,399

i'm just grateful that i was actually

847

00:30:59,669 --> 00:30:57,679

looking something real and not an

848

00:31:01,750 --> 00:30:59,679

artifact and um

849

00:31:04,230 --> 00:31:01,760

so that's exciting and and sort of

850

00:31:06,549 --> 00:31:04,240

uncovering it more under i i think these

851
00:31:09,350 --> 00:31:06,559
these these seasonal

852
00:31:11,990 --> 00:31:09,360
day night variations are profound

853
00:31:13,430 --> 00:31:12,000
and especially not just the overall

854
00:31:15,110 --> 00:31:13,440
in the overall data but in the actual

855
00:31:16,070 --> 00:31:15,120
relationship between the durations i

856
00:31:16,870 --> 00:31:16,080
think that

857
00:31:20,710 --> 00:31:16,880
the

858
00:31:23,269 --> 00:31:20,720
imagine kind of like different weighted

859
00:31:24,870 --> 00:31:23,279
ropes and oscillating at different

860
00:31:26,950 --> 00:31:24,880
frequencies based on the weight and the

861
00:31:29,269 --> 00:31:26,960
weight is set by the duration sort of

862
00:31:32,149 --> 00:31:29,279
and so i think that that's how i

863
00:31:34,070 --> 00:31:32,159

envision it with no actual

864

00:31:37,110 --> 00:31:34,080

data but just sort of living with this

865

00:31:38,789 --> 00:31:37,120

experiment for a couple of years

866

00:31:41,029 --> 00:31:38,799

that's a good answer

867

00:31:43,909 --> 00:31:41,039

yeah i'll add that

868

00:31:47,190 --> 00:31:43,919

the random numbers in this experiment

869

00:31:48,710 --> 00:31:47,200

are selected once for the the

870

00:31:50,630 --> 00:31:48,720

choice of the four durations it would be

871

00:31:52,149 --> 00:31:50,640

interesting to try

872

00:31:54,789 --> 00:31:52,159

having the first random number just

873

00:31:57,190 --> 00:31:54,799

select whether the experiment concludes

874

00:31:59,669 --> 00:31:57,200

at that moment or not and then draw

875

00:32:01,590 --> 00:31:59,679

another random number to determine

876

00:32:03,830 --> 00:32:01,600

what happens next and whether the

877

00:32:05,990 --> 00:32:03,840

duration goes on longer and then between

878

00:32:08,389 --> 00:32:06,000

the 30 and 60 choice draw another random

879

00:32:10,389 --> 00:32:08,399

number yeah

880

00:32:12,230 --> 00:32:10,399

and there's some indications that if you

881

00:32:14,149 --> 00:32:12,240

don't choose a random duration in other

882

00:32:15,430 --> 00:32:14,159

words at least this is different we

883

00:32:17,430 --> 00:32:15,440

didn't show you this data but i'm just

884

00:32:20,149 --> 00:32:17,440

telling you based on my own observations

885

00:32:22,470 --> 00:32:20,159

um if you don't choose a random duration

886

00:32:24,470 --> 00:32:22,480

you actually might not get this duration

887

00:32:25,909 --> 00:32:24,480

sorting effect at all

888

00:32:27,570 --> 00:32:25,919

so it might be that there has to be a

889

00:32:29,590 --> 00:32:27,580

choice

890

00:32:31,830 --> 00:32:29,600

[Music]

891

00:32:33,590 --> 00:32:31,840

fascinating stuff thank you once again