



1
00:00:07,909 --> 00:00:06,309
a number of studies always taking place

2
00:00:09,669 --> 00:00:07,919
onboard the international space station

3
00:00:11,509 --> 00:00:09,679
tracking astronaut health in a variety

4
00:00:13,110 --> 00:00:11,519
of ways whether it's different bodily

5
00:00:14,629 --> 00:00:13,120
systems or even how the astronauts are

6
00:00:17,029 --> 00:00:14,639
able to function while in that

7
00:00:19,029 --> 00:00:17,039
microgravity environment and we're lucky

8
00:00:20,550 --> 00:00:19,039
to be joined today uh by one of the

9
00:00:22,310 --> 00:00:20,560
principal investigators of a study

10
00:00:23,990 --> 00:00:22,320
that's actually that's taking a look

11
00:00:25,349 --> 00:00:24,000
kind of at a bit of the nuts and bolts

12
00:00:26,710 --> 00:00:25,359
of how the astronauts are able to

13
00:00:28,710 --> 00:00:26,720

function while they're in that

14

00:00:30,950 --> 00:00:28,720

microgravity for a long period of time

15

00:00:32,549 --> 00:00:30,960

and it's a study called cognition and

16

00:00:34,790 --> 00:00:32,559

i'm joined today by

17

00:00:36,470 --> 00:00:34,800

the principal investigator dr matthias

18

00:00:38,150 --> 00:00:36,480

basner from

19

00:00:40,389 --> 00:00:38,160

the university of pennsylvania school of

20

00:00:42,709 --> 00:00:40,399

medicine so first off dr basner thank

21

00:00:44,950 --> 00:00:42,719

you so much for joining me today and i'd

22

00:00:47,670 --> 00:00:44,960

like to jump right in so what exactly

23

00:00:50,069 --> 00:00:47,680

about the space environment could cause

24

00:00:52,950 --> 00:00:50,079

you know changes in the astronauts

25

00:00:54,630 --> 00:00:52,960

cognitive ability

26

00:00:57,590 --> 00:00:54,640

well good morning first of all and it's

27

00:00:59,750 --> 00:00:57,600

a pleasure to be on your program

28

00:01:02,150 --> 00:00:59,760

i mean first of all there is a

29

00:01:04,229 --> 00:01:02,160

of course psychological factors related

30

00:01:05,830 --> 00:01:04,239

to living in an isolated confined and

31

00:01:07,990 --> 00:01:05,840

extreme environment

32

00:01:10,070 --> 00:01:08,000

that could affect congress performance

33

00:01:11,990 --> 00:01:10,080

but there's also a lot of environmental

34

00:01:13,750 --> 00:01:12,000

stressors

35

00:01:16,630 --> 00:01:13,760

some of them unique to the space flight

36

00:01:18,870 --> 00:01:16,640

environment like microgravity or think

37

00:01:20,230 --> 00:01:18,880

of radiation during exploration type

38

00:01:21,510 --> 00:01:20,240

missions that can affect congress

39

00:01:23,830 --> 00:01:21,520

performance

40

00:01:24,950 --> 00:01:23,840

and another factor that we know of is

41

00:01:27,510 --> 00:01:24,960

like

42

00:01:30,310 --> 00:01:27,520

iss six-month iss missions are

43

00:01:32,310 --> 00:01:30,320

characterized by high workload periods

44

00:01:34,230 --> 00:01:32,320

and also chronic sleep restriction of

45

00:01:36,230 --> 00:01:34,240

course these factors may also affect

46

00:01:38,469 --> 00:01:36,240

cognitive performance

47

00:01:40,710 --> 00:01:38,479

okay so we know some of the

48

00:01:42,630 --> 00:01:40,720

you know external factors that can cause

49

00:01:44,630 --> 00:01:42,640

these what are some of the actual issues

50

00:01:45,830 --> 00:01:44,640

the cognitive issues that were that

51
00:01:47,670 --> 00:01:45,840
these could cause what are we what are

52
00:01:49,030 --> 00:01:47,680
we worried about

53
00:01:51,429 --> 00:01:49,040
well obviously you know cognitive

54
00:01:53,109 --> 00:01:51,439
performance has very many facets and all

55
00:01:55,670 --> 00:01:53,119
of them are important for mission

56
00:01:57,910 --> 00:01:55,680
success in one way or another

57
00:02:00,789 --> 00:01:57,920
three examples are for example attention

58
00:02:03,990 --> 00:02:00,799
memory and reasoning that are very

59
00:02:06,950 --> 00:02:04,000
important what our test battery looks at

60
00:02:09,190 --> 00:02:06,960
also is spatial orientation

61
00:02:11,190 --> 00:02:09,200
risk decision making and emotional

62
00:02:13,750 --> 00:02:11,200
processing which we believe are really

63
00:02:16,390 --> 00:02:13,760

essential for mission success so one

64

00:02:18,070 --> 00:02:16,400

example is the emotional processing the

65

00:02:20,470 --> 00:02:18,080

so the question is if you're

66

00:02:22,229 --> 00:02:20,480

going to mars and flying back are you

67

00:02:24,550 --> 00:02:22,239

still able to read your fellow

68

00:02:26,949 --> 00:02:24,560

astronauts faces if somebody is angry

69

00:02:28,229 --> 00:02:26,959

are you still able to detect that and

70

00:02:29,270 --> 00:02:28,239

this is what we're looking at for

71

00:02:30,949 --> 00:02:29,280

example

72

00:02:33,190 --> 00:02:30,959

so a lot of the underlying things that

73

00:02:35,270 --> 00:02:33,200

can have a huge effect just on you know

74

00:02:37,910 --> 00:02:35,280

the day-to-day life of these astronauts

75

00:02:39,910 --> 00:02:37,920

on board you would mention fatigue and

76

00:02:41,589 --> 00:02:39,920

sleep have

77

00:02:43,190 --> 00:02:41,599

obviously i know when i don't get a good

78

00:02:44,790 --> 00:02:43,200

night's sleep that could that can ruin

79

00:02:46,470 --> 00:02:44,800

my whole day is that something you guys

80

00:02:47,430 --> 00:02:46,480

have kind of looked into how to better

81

00:02:49,350 --> 00:02:47,440

manage

82

00:02:51,509 --> 00:02:49,360

the sleep and fatigue factor of

83

00:02:53,830 --> 00:02:51,519

cognitive ability

84

00:02:55,750 --> 00:02:53,840

definitely yes and obviously fatigue

85

00:02:57,589 --> 00:02:55,760

resulting from sleep loss is only one

86

00:02:58,790 --> 00:02:57,599

factor that can affect cognitive

87

00:03:00,710 --> 00:02:58,800

performance

88

00:03:03,430 --> 00:03:00,720

nasa has actually put great effort in

89

00:03:05,350 --> 00:03:03,440

the past both in terms of basic research

90

00:03:07,350 --> 00:03:05,360

and in terms of applied research to

91

00:03:09,670 --> 00:03:07,360

mitigate the risk associated with

92

00:03:11,350 --> 00:03:09,680

chronic sleep loss i guess the best

93

00:03:13,830 --> 00:03:11,360

example is the lighting system the

94

00:03:15,750 --> 00:03:13,840

current fluorescent lighting system

95

00:03:18,070 --> 00:03:15,760

is in the process of being replaced with

96

00:03:20,390 --> 00:03:18,080

state-of-the-art led lighting where the

97

00:03:22,470 --> 00:03:20,400

intensity and spectral composition of

98

00:03:24,710 --> 00:03:22,480

the light can actually be varied

99

00:03:27,030 --> 00:03:24,720

systematically so for example in the

100

00:03:29,350 --> 00:03:27,040

morning you could expose the crew to

101
00:03:31,589 --> 00:03:29,360
alerting blue enriched light well in the

102
00:03:33,910 --> 00:03:31,599
evening you give them a

103
00:03:35,830 --> 00:03:33,920
red light which is promoting the

104
00:03:38,869 --> 00:03:35,840
secretion of melatonin which which helps

105
00:03:41,270 --> 00:03:38,879
them go to uh sleep more easily so these

106
00:03:43,110 --> 00:03:41,280
are just few examples

107
00:03:44,710 --> 00:03:43,120
pretty cool thing just you know playing

108
00:03:47,030 --> 00:03:44,720
with the lighting these men and women

109
00:03:49,430 --> 00:03:47,040
don't get you know normal sunrise sunset

110
00:03:51,270 --> 00:03:49,440
like we do so you don't know exactly

111
00:03:53,030 --> 00:03:51,280
how big of an effect that can have yeah

112
00:03:55,350 --> 00:03:53,040
they have it every 90 minutes pretty

113
00:03:57,270 --> 00:03:55,360

much uh dusk and dawn so yeah

114

00:03:59,910 --> 00:03:57,280

okay so what are some of the things your

115

00:04:01,509 --> 00:03:59,920

test your or how are you guys testing

116

00:04:03,350 --> 00:04:01,519

this what are some of the actual actions

117

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

you're doing to try and test this

118

00:04:07,350 --> 00:04:05,360

cognitive ability

119

00:04:10,550 --> 00:04:07,360

yeah so our software is installed on one

120

00:04:12,630 --> 00:04:10,560

of the hr fpcs in the columbus module

121

00:04:14,550 --> 00:04:12,640

cognition itself is a battery of 10

122

00:04:16,710 --> 00:04:14,560

cognitive tests specifically designed

123

00:04:17,749 --> 00:04:16,720

for the astronaut population because we

124

00:04:21,509 --> 00:04:17,759

know

125

00:04:23,830 --> 00:04:21,519

they're highly motivated so just taking

126

00:04:26,390 --> 00:04:23,840

a standard cognitive test may not work

127

00:04:28,070 --> 00:04:26,400

for this population it takes less than

128

00:04:29,830 --> 00:04:28,080

20 minutes to administer you know that

129

00:04:31,990 --> 00:04:29,840

time is gold on the space station it's

130

00:04:33,909 --> 00:04:32,000

very rare

131

00:04:35,749 --> 00:04:33,919

the battery covers a broad range of

132

00:04:37,590 --> 00:04:35,759

cognitive domains and we know which

133

00:04:39,749 --> 00:04:37,600

brain regions are recruited by each of

134

00:04:41,670 --> 00:04:39,759

the individual tests which is important

135

00:04:43,350 --> 00:04:41,680

so we can make indirect

136

00:04:45,909 --> 00:04:43,360

inferences

137

00:04:47,670 --> 00:04:45,919

if we see a decrement in one test we may

138

00:04:49,430 --> 00:04:47,680

know what brain region is affected which

139

00:04:51,430 --> 00:04:49,440

is important because we don't have

140

00:04:53,670 --> 00:04:51,440

neuroimaging capability on the station

141

00:04:55,670 --> 00:04:53,680

right now what the astronauts currently

142

00:04:58,390 --> 00:04:55,680

do they take the the full battery four

143

00:04:59,990 --> 00:04:58,400

times pre-flight eleven times in flight

144

00:05:01,510 --> 00:05:00,000

with two to three week intervals during

145

00:05:03,749 --> 00:05:01,520

six-month missions

146

00:05:05,430 --> 00:05:03,759

and uh three times post-flight and the

147

00:05:07,590 --> 00:05:05,440

data then compared within each

148

00:05:10,390 --> 00:05:07,600

individual astronaut but we also

149

00:05:12,469 --> 00:05:10,400

generated normative data on the ground

150

00:05:14,469 --> 00:05:12,479

an astronaut in an astronaut population

151
00:05:16,469 --> 00:05:14,479
that is not affected by any of the space

152
00:05:18,390 --> 00:05:16,479
space flight stressors

153
00:05:19,350 --> 00:05:18,400
cognition is also part of the 12-month

154
00:05:21,270 --> 00:05:19,360
mission

155
00:05:24,310 --> 00:05:21,280
and it's also part of the twin study

156
00:05:26,310 --> 00:05:24,320
that nasa is performing right now okay

157
00:05:27,909 --> 00:05:26,320
so after we've you know collected all

158
00:05:29,990 --> 00:05:27,919
the data and we're able to look at how

159
00:05:32,070 --> 00:05:30,000
is how is this going to be able to help

160
00:05:33,749 --> 00:05:32,080
you know what what will your test be

161
00:05:36,629 --> 00:05:33,759
able to do to you know

162
00:05:38,950 --> 00:05:36,639
help prove the cognitive improve on the

163
00:05:40,390 --> 00:05:38,960

the cognitive ability of astronauts only

164

00:05:41,749 --> 00:05:40,400

you know on space station missions but

165

00:05:43,270 --> 00:05:41,759

say astronauts like you had mentioned

166

00:05:45,990 --> 00:05:43,280

before on a trip to mars or something

167

00:05:48,469 --> 00:05:46,000

how is this how is this going to help

168

00:05:50,710 --> 00:05:48,479

yeah so right now a cognition is really

169

00:05:53,029 --> 00:05:50,720

a research tool and what we want to do

170

00:05:55,670 --> 00:05:53,039

we want to find out how individual

171

00:05:57,990 --> 00:05:55,680

spaceflight stressors affect cognitive

172

00:06:00,629 --> 00:05:58,000

performance with the goal to mitigate

173

00:06:02,390 --> 00:06:00,639

these risks so it's you know what are

174

00:06:03,990 --> 00:06:02,400

the individual stressors how do they

175

00:06:06,390 --> 00:06:04,000

affect performance is there something we

176

00:06:08,550 --> 00:06:06,400

can do about it obviously in the long

177

00:06:10,309 --> 00:06:08,560

run what we would like to see is to

178

00:06:13,270 --> 00:06:10,319

really transition

179

00:06:15,270 --> 00:06:13,280

cognition into operations so that we can

180

00:06:17,990 --> 00:06:15,280

use this tool to monitor astronaut

181

00:06:20,550 --> 00:06:18,000

cognitive performance very much like

182

00:06:21,510 --> 00:06:20,560

nasa is doing with winscad right now

183

00:06:25,990 --> 00:06:21,520

what the

184

00:06:29,350 --> 00:06:26,000

astronaut

185

00:06:31,350 --> 00:06:29,360

gets immediate feedback so the software

186

00:06:33,590 --> 00:06:31,360

will provide a standardized score after

187

00:06:36,150 --> 00:06:33,600

each test and with all it will also show

188

00:06:38,309 --> 00:06:36,160

historic data so the astronaut can see

189

00:06:40,309 --> 00:06:38,319

how he or she has performed on the test

190

00:06:43,909 --> 00:06:40,319

in the past and how the current test

191

00:06:45,510 --> 00:06:43,919

about uh compares to that data

192

00:06:47,749 --> 00:06:45,520

very cool and one thing we're always

193

00:06:49,189 --> 00:06:47,759

interested in finding out you know so

194

00:06:51,189 --> 00:06:49,199

much what we do on board the station

195

00:06:53,189 --> 00:06:51,199

having some direct benefits to you know

196

00:06:55,270 --> 00:06:53,199

those of us back down here on earth how

197

00:06:57,029 --> 00:06:55,280

could this cognition study potentially

198

00:06:59,189 --> 00:06:57,039

help you know just regular people back

199

00:07:01,029 --> 00:06:59,199

down here on the surface

200

00:07:03,270 --> 00:07:01,039

well as i mentioned earlier now this is

201
00:07:04,950 --> 00:07:03,280
we specifically designed designed this

202
00:07:06,629 --> 00:07:04,960
for astronauts and

203
00:07:07,909 --> 00:07:06,639
astronauts are high performing

204
00:07:09,510 --> 00:07:07,919
populations but there are other

205
00:07:11,670 --> 00:07:09,520
high-performing populations on the

206
00:07:14,230 --> 00:07:11,680
ground think for example of medical

207
00:07:16,550 --> 00:07:14,240
doctors where we could apply this this

208
00:07:18,469 --> 00:07:16,560
test battery in these populations

209
00:07:21,029 --> 00:07:18,479
cognition is already embedded in four

210
00:07:23,110 --> 00:07:21,039
antarctic stations uh which nasa

211
00:07:24,870 --> 00:07:23,120
actually uses as a space space analog

212
00:07:27,350 --> 00:07:24,880
environments and obviously you know

213
00:07:29,029 --> 00:07:27,360

these environments are also harsh

214

00:07:31,189 --> 00:07:29,039

with threat to life conditions with

215

00:07:32,950 --> 00:07:31,199

confinement isolation

216

00:07:34,469 --> 00:07:32,960

and also with the strange lighting

217

00:07:36,950 --> 00:07:34,479

conditions that we have on the space

218

00:07:38,309 --> 00:07:36,960

station on a trip to mars so you know in

219

00:07:41,589 --> 00:07:38,319

the end we can also help these

220

00:07:43,670 --> 00:07:41,599

populations to uh to to monitor them and

221

00:07:45,830 --> 00:07:43,680

to to find out which factors are