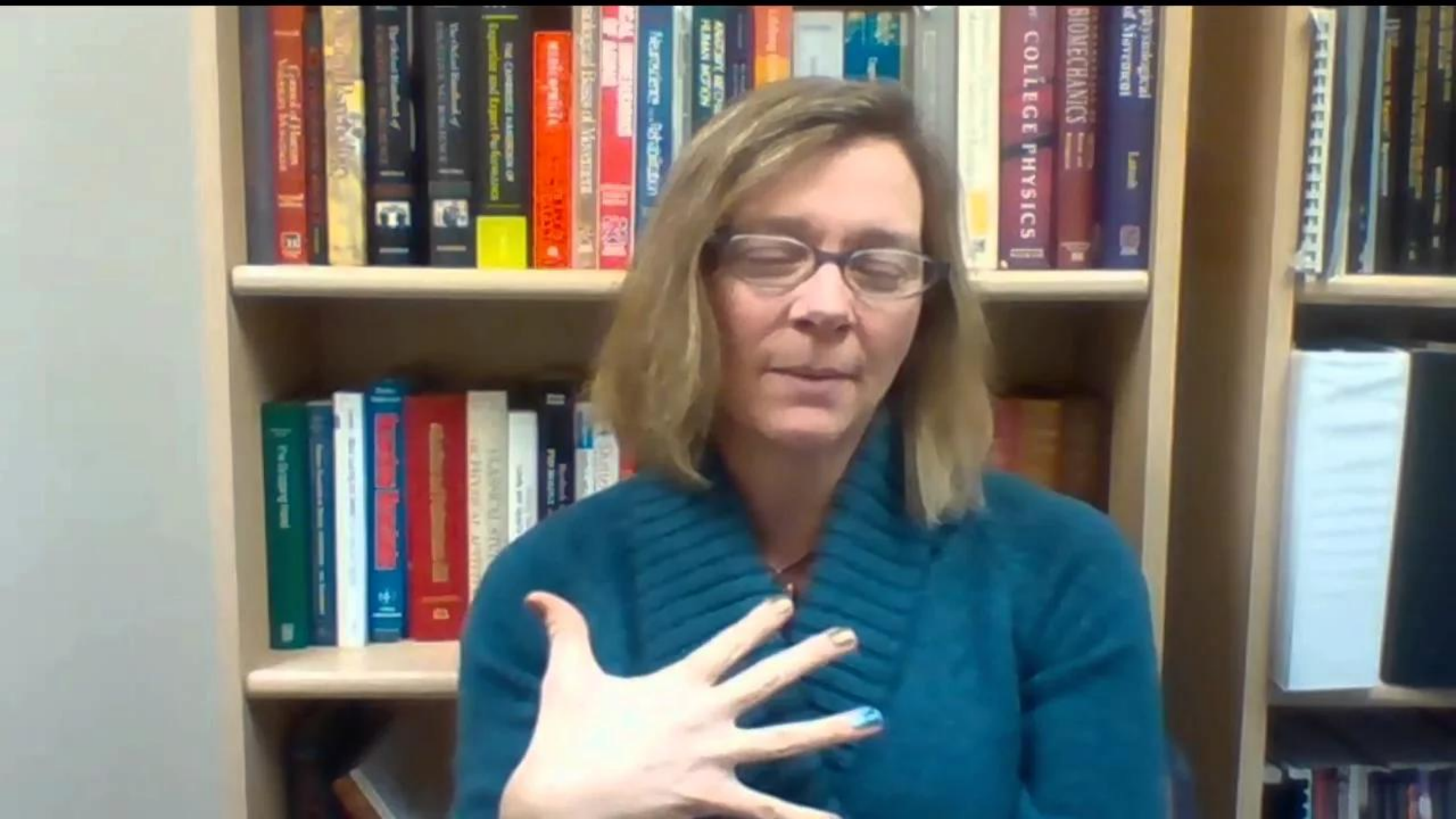
COLLEGE PHYSICS
BIOMECHANICS

1
00:00:08,470 --> 00:00:06,789
a major focus of science on the

2
00:00:10,310 --> 00:00:08,480
international space station is to learn

3
00:00:12,310 --> 00:00:10,320
about how extended exposure to the

4
00:00:14,789 --> 00:00:12,320
spaceflight environment impacts a human

5
00:00:15,790 --> 00:00:14,799
body from its bones and muscles to the

6
00:00:18,150 --> 00:00:15,800
eyes the

7
00:00:20,070 --> 00:00:18,160
cardiopulmonary system and the brain and

8
00:00:21,750 --> 00:00:20,080
nervous system

9
00:00:23,509 --> 00:00:21,760
one new experiment in that area is

10
00:00:25,990 --> 00:00:23,519
called space flight effects of

11
00:00:27,429 --> 00:00:26,000
neurocognitive performance or neural

12
00:00:29,349 --> 00:00:27,439
mapping for short and we're going to be

13
00:00:32,229 --> 00:00:29,359

talking next with principal investigator

14
00:00:34,069 --> 00:00:32,239
dr rachel seidler of the university of

15
00:00:35,350 --> 00:00:34,079
michigan she's joining us to tell us a

16
00:00:37,590 --> 00:00:35,360
little bit more about that research

17
00:00:39,590 --> 00:00:37,600
thanks so much for joining us rachel

18
00:00:41,670 --> 00:00:39,600
sure good morning brandi

19
00:00:43,430 --> 00:00:41,680
morning um well why don't we start with

20
00:00:44,950 --> 00:00:43,440
something simple and and maybe you can

21
00:00:47,670 --> 00:00:44,960
explain to us uh

22
00:00:50,470 --> 00:00:47,680
what uh or why we suspect long duration

23
00:00:52,630 --> 00:00:50,480
space flight causes changes to the brain

24
00:00:55,510 --> 00:00:52,640
sure right there are two lines of

25
00:00:58,069 --> 00:00:55,520
evidence that led us to develop this

26
00:01:00,470 --> 00:00:58,079
study one is that there have been

27
00:01:02,150 --> 00:01:00,480
numerous animal models flown in space

28
00:01:04,310 --> 00:01:02,160
that have shown changes to brain

29
00:01:06,390 --> 00:01:04,320
structure and function

30
00:01:09,270 --> 00:01:06,400
particularly in brain regions that are

31
00:01:11,190 --> 00:01:09,280
involved with sensory motor control

32
00:01:13,030 --> 00:01:11,200
and the other reason why we think there

33
00:01:14,710 --> 00:01:13,040
are likely changes in brain structure

34
00:01:17,510 --> 00:01:14,720
and function is that

35
00:01:19,749 --> 00:01:17,520
we know there are extensive changes in

36
00:01:22,789 --> 00:01:19,759
sensory motor behaviors particularly

37
00:01:23,590 --> 00:01:22,799
those that rely on the vestibular system

38
00:01:25,990 --> 00:01:23,600

and

39
00:01:27,830 --> 00:01:26,000
when we see dramatic changes like this

40
00:01:29,830 --> 00:01:27,840
on earth we know it's typically

41
00:01:32,870 --> 00:01:29,840
accompanied with some kind of

42
00:01:35,590 --> 00:01:32,880
neuroplastic changes in the brain

43
00:01:37,350 --> 00:01:35,600
so that's that's actual physical changes

44
00:01:38,870 --> 00:01:37,360
or just changes in the way the brain

45
00:01:41,830 --> 00:01:38,880
works

46
00:01:44,469 --> 00:01:41,840
both we'll be looking at both um with

47
00:01:47,109 --> 00:01:44,479
mri we can look at structural metrics of

48
00:01:49,590 --> 00:01:47,119
the brain so for example are there

49
00:01:52,230 --> 00:01:49,600
regional changes in gray matter volume

50
00:01:54,550 --> 00:01:52,240
which tends to reflect things like

51
00:01:56,149 --> 00:01:54,560
uh synaptic changes that are occurring

52
00:01:58,149 --> 00:01:56,159
with behavior

53
00:02:00,149 --> 00:01:58,159
uh we also will do something called

54
00:02:02,469 --> 00:02:00,159
diffusion-weighted imaging where we can

55
00:02:03,510 --> 00:02:02,479
look at large white matter tracks in the

56
00:02:05,030 --> 00:02:03,520
brain

57
00:02:07,350 --> 00:02:05,040
and then we will also do functional

58
00:02:09,430 --> 00:02:07,360
imaging so we can look at the various

59
00:02:11,510 --> 00:02:09,440
networks that the brain recruits to

60
00:02:13,110 --> 00:02:11,520
perform a given behavior

61
00:02:15,510 --> 00:02:13,120
and whether there's a change in the

62
00:02:17,110 --> 00:02:15,520
networks that are reliant on relied upon

63
00:02:19,670 --> 00:02:17,120

for various tasks

64
00:02:21,430 --> 00:02:19,680
from pre to post flight

65
00:02:23,750 --> 00:02:21,440
so i know a lot of uh

66
00:02:25,030 --> 00:02:23,760
there's a lot of pretty sophisticated

67
00:02:26,869 --> 00:02:25,040
equipment on board the space station but

68
00:02:29,750 --> 00:02:26,879
probably not everything you need to do

69
00:02:31,430 --> 00:02:29,760
all that what can they do in space

70
00:02:33,430 --> 00:02:31,440
right so we certainly we don't have an

71
00:02:36,309 --> 00:02:33,440
mri scanner on the space station at

72
00:02:39,110 --> 00:02:36,319
least not yet um so we're doing all of

73
00:02:41,670 --> 00:02:39,120
the brain scanning pre and post flight a

74
00:02:43,910 --> 00:02:41,680
couple of time points before people go

75
00:02:45,910 --> 00:02:43,920
up and then several time points when

76
00:02:48,710 --> 00:02:45,920
they get back so we can look at recovery

77
00:02:51,430 --> 00:02:48,720
of brain structure and function as well

78
00:02:54,070 --> 00:02:51,440
so what the crew are doing on station is

79
00:02:56,150 --> 00:02:54,080
a subset of our behavioral tests

80
00:02:58,550 --> 00:02:56,160
and they're doing this at three time

81
00:03:01,270 --> 00:02:58,560
points throughout their mission so

82
00:03:03,589 --> 00:03:01,280
uh verts did his first neural mapping

83
00:03:06,550 --> 00:03:03,599
behavioral testing yesterday

84
00:03:09,270 --> 00:03:06,560
and the tests that he's doing include a

85
00:03:11,910 --> 00:03:09,280
mental rotation test so we show him

86
00:03:14,869 --> 00:03:11,920
different cube shapes on the screen

87
00:03:17,110 --> 00:03:14,879
he has to mentally rotate these shapes

88
00:03:21,270 --> 00:03:17,120

and indicate whether they match a target

89
00:03:23,430 --> 00:03:21,280
or not we also are asking him to do some

90
00:03:25,750 --> 00:03:23,440
dual tasking with cognitive and motor

91
00:03:28,070 --> 00:03:25,760
tasks so we have him do

92
00:03:29,589 --> 00:03:28,080
tasks one at a time and then he has to

93
00:03:31,190 --> 00:03:29,599
put them together and do them at the

94
00:03:33,509 --> 00:03:31,200
same time

95
00:03:36,309 --> 00:03:33,519
and then we also have a manual sensory

96
00:03:38,309 --> 00:03:36,319
motor adaptation task where he uses a

97
00:03:40,229 --> 00:03:38,319
small joystick to hit targets on a

98
00:03:43,270 --> 00:03:40,239
computer screen that's displayed in

99
00:03:47,670 --> 00:03:46,070
okay and i guess i know that uh barry

100
00:03:49,990 --> 00:03:47,680
wilmore was going to be taking some

101
00:03:51,750 --> 00:03:50,000
photos of verts as he was uh going

102
00:03:53,990 --> 00:03:51,760
through some of those tests this morning

103
00:03:55,830 --> 00:03:54,000
is that is that part of the actual test

104
00:03:57,670 --> 00:03:55,840
or is it just to verify that everything

105
00:03:59,670 --> 00:03:57,680
looks like it's supposed to

106
00:04:01,509 --> 00:03:59,680
yeah the photos are to help us document

107
00:04:03,750 --> 00:04:01,519
that everything's going fine we have a

108
00:04:06,949 --> 00:04:03,760
couple of different configurations that

109
00:04:09,990 --> 00:04:06,959
we ask the crew to perform these tests

110
00:04:12,710 --> 00:04:10,000
in so for one they have their feet

111
00:04:15,750 --> 00:04:12,720
in straps so their feet are pressed onto

112
00:04:18,310 --> 00:04:15,760
a surface and often times when the crew

113
00:04:21,590 --> 00:04:18,320

do this they actually have an illusion

114
00:04:23,430 --> 00:04:21,600
that up is up and and down is down and

115
00:04:26,070 --> 00:04:23,440
we're wondering how this

116
00:04:28,710 --> 00:04:26,080
orientation anchoring will affect their

117
00:04:30,629 --> 00:04:28,720
ability to perform our tasks so we also

118
00:04:33,749 --> 00:04:30,639
have another configuration where they do

119
00:04:35,830 --> 00:04:33,759
the tasks and they're just floating uh

120
00:04:38,550 --> 00:04:35,840
in space and they're anchored to the

121
00:04:41,110 --> 00:04:38,560
equipment with a tether so the photo is

122
00:04:43,350 --> 00:04:41,120
to document that everything's

123
00:04:46,150 --> 00:04:43,360
set up appropriately in terms of these

124
00:04:48,230 --> 00:04:46,160
two configurations and i haven't had a

125
00:04:50,629 --> 00:04:48,240
chance to download the figure yet i hurt

126
00:04:52,550 --> 00:04:50,639
the photo i've heard they were taken

127
00:04:54,469 --> 00:04:52,560
um but we haven't had a chance to look

128
00:04:55,510 --> 00:04:54,479
yet we're very excited to see how it

129
00:04:56,870 --> 00:04:55,520
went

130
00:04:59,030 --> 00:04:56,880
well it sounds like really interesting

131
00:05:00,629 --> 00:04:59,040
research um is it something that you

132
00:05:02,150 --> 00:05:00,639
think you will help you develop counter

133
00:05:04,070 --> 00:05:02,160
measures or is it just good knowledge to

134
00:05:05,670 --> 00:05:04,080
have as you're planning for what types

135
00:05:07,189 --> 00:05:05,680
of activities crew members do or that

136
00:05:09,430 --> 00:05:07,199
sort of thing

137
00:05:12,230 --> 00:05:09,440
yes so to start with brandy this is

138
00:05:14,310 --> 00:05:12,240

really a risk assessment study no one

139
00:05:16,390 --> 00:05:14,320
has yet looked at how space flight

140
00:05:17,830 --> 00:05:16,400
affects the brain

141
00:05:20,070 --> 00:05:17,840
you know whether there's actually

142
00:05:23,270 --> 00:05:20,080
atrophy that occurs or if it all seems

143
00:05:25,909 --> 00:05:23,280
to be compensatory plasticity or perhaps

144
00:05:28,710 --> 00:05:25,919
a combination of the two so we don't

145
00:05:31,029 --> 00:05:28,720
really know what the risk level is

146
00:05:33,189 --> 00:05:31,039
so really this study is tracking what

147
00:05:35,350 --> 00:05:33,199
changes take place in the brain

148
00:05:37,749 --> 00:05:35,360
and then we will also document the time

149
00:05:40,230 --> 00:05:37,759
course of recovery and then this will

150
00:05:42,469 --> 00:05:40,240
help us to understand how significant of

151
00:05:44,310 --> 00:05:42,479
a risk is this

152
00:05:46,070 --> 00:05:44,320
what kind of counter measures do we need

153
00:05:47,430 --> 00:05:46,080
to think about evaluating and

154
00:05:49,430 --> 00:05:47,440
implementing

155
00:05:51,830 --> 00:05:49,440
we do have a parallel study that we're

156
00:05:55,189 --> 00:05:51,840
connect conducting here on earth in one

157
00:05:57,029 --> 00:05:55,199
of nasa's bedrest analog environments

158
00:05:59,430 --> 00:05:57,039
and we're seeing a lot of changes there

159
00:06:01,189 --> 00:05:59,440
and brain structure and function so we

160
00:06:03,270 --> 00:06:01,199
really think we'll see some parallel

161
00:06:05,029 --> 00:06:03,280
effects with space flight

162
00:06:06,710 --> 00:06:05,039
well it sounds fascinating are there

163
00:06:08,309 --> 00:06:06,720

benefits to those of us here on earth as

164
00:06:10,790 --> 00:06:08,319
well

165
00:06:12,469 --> 00:06:10,800
yes um you know certainly you can think

166
00:06:14,309 --> 00:06:12,479
about um

167
00:06:16,070 --> 00:06:14,319
a lot of the changes that we see in

168
00:06:19,110 --> 00:06:16,080
behavior with flight come from

169
00:06:21,590 --> 00:06:19,120
alterations in vestibular processing so

170
00:06:23,110 --> 00:06:21,600
the vestibular system is the small organ

171
00:06:26,070 --> 00:06:23,120
in the inner ear that helps you to

172
00:06:29,029 --> 00:06:26,080
maintain your balance and orientation

173
00:06:31,830 --> 00:06:29,039
and this is a system that shows declines

174
00:06:33,430 --> 00:06:31,840
with age and contributes to falling

175
00:06:35,430 --> 00:06:33,440
there are also patients that have

176
00:06:38,230 --> 00:06:35,440
different lesions to the vestibular

177
00:06:39,830 --> 00:06:38,240
system so better understanding of how we

178
00:06:41,670 --> 00:06:39,840
adapt to

179
00:06:43,909 --> 00:06:41,680
conditions in which the vestibular

180
00:06:46,070 --> 00:06:43,919
system is functioning differently as

181
00:06:49,270 --> 00:06:46,080
well as just unloading of the body and

182
00:06:51,670 --> 00:06:49,280
reduce somatosensory inputs i think will

183
00:06:53,990 --> 00:06:51,680
be really important for understanding

184
00:06:55,189 --> 00:06:54,000
not only healthy aging but also some of

185
00:06:57,589 --> 00:06:55,199
these

186
00:06:58,870 --> 00:06:57,599
vestibular conditions and as well for

187
00:07:01,110 --> 00:06:58,880
people that are

188
00:07:03,749 --> 00:07:01,120

on long duration bed rest or for some

189
00:07:07,430 --> 00:07:03,759
reason having a substantial drop in

190
00:07:08,629 --> 00:07:07,440
their activity and sensory inputs

191
00:07:10,070 --> 00:07:08,639
okay well we will look forward to

192
00:07:11,830 --> 00:07:10,080
hearing more about that as you continue

193
00:07:13,430 --> 00:07:11,840
on continue on with the research thank

194
00:07:15,830 --> 00:07:13,440
you so much for joining us again that

195
00:07:17,270 --> 00:07:15,840
was dr rachel seidler who is the

196
00:07:19,350 --> 00:07:17,280
principal investigator for the neuro