Cam-CAN Newsletter 2015

CamCAN Cambridge Centre for Ageing and Neuroscience

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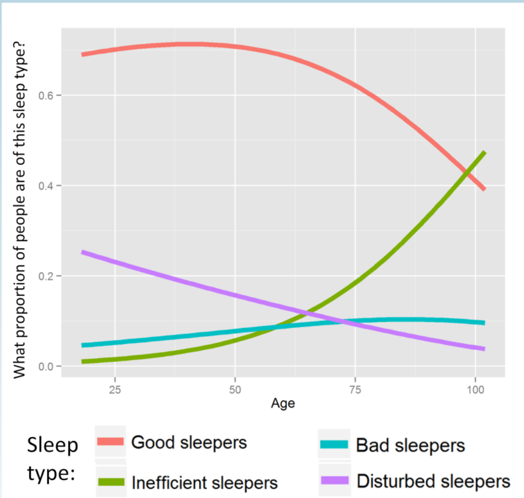
A good night's sleep

by Andrew Gadie, Meredith Shafto & Rogier Kievit

Sleep is a very important human behaviour, helping us to do everything from laying down memories to cleaning our brains of waste products. Disruptions to sleep are thought to be associated with various health problems. As part of the Cam-CAN project we are examining how sleeping patterns change across the lifespan, and what impact this might have on various health outcomes. To study this question, we asked over 2600 participants aged 18 to 102 to answer a series of questions about their typical sleep. For example, we wanted to find out whether people had trouble falling asleep, staying asleep, whether they needed sleep medication or whether they ever felt like their sleep quality affected their daily (awake) activities.

Using the responses to such questions we categorised people into four types of sleepers: “good”, “bad”, “inefficient” and “disturbed”. We then looked at how common each type was for people of different ages. Looking at the graph below, most people (70%) are “good sleepers”: They are generally happy with how well they sleep. Although many older people still belong to this group, this pattern becomes less common above age 75. A specific type of bad sleep, that we call “inefficient sleepers”, is much more more common in older adults (the green line): they report spending a long time in bed, but only being asleep part of the time. Younger people also suffer from poor sleep, but instead of being “inefficient sleepers”, they have a specific type of poor sleep that we call “disturbed sleepers” (purple line): these are people who take a long time to fall asleep, and generally report poor sleep quality. This type of sleep was especially common among 20 to 30 year olds, possibly reflecting new parents! Finally, a small group of people are “bad sleepers”: people who have trouble with all aspects of sleep, from falling asleep to staying asleep, and often find that their poor sleep affects their daily activities. About 4% of the population belongs to this sleep type, but it stays relatively stable across the lifespan.



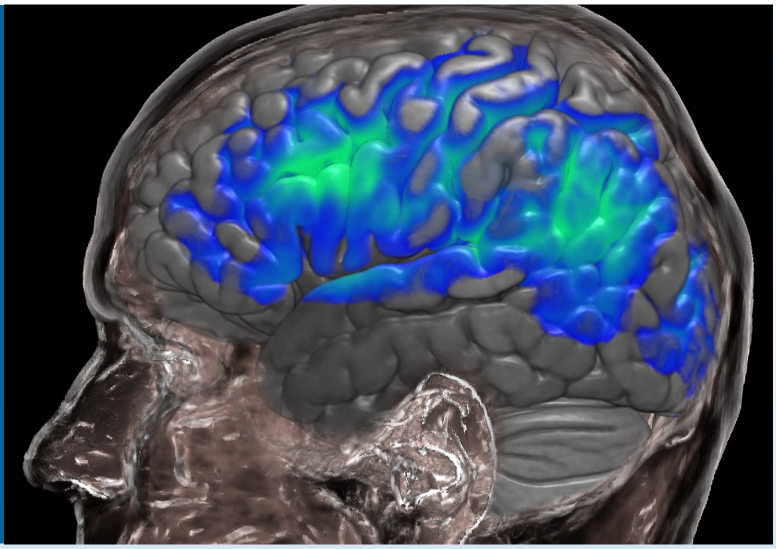
The next important question is whether poor sleep is related to poor health. We looked at four different domains of healthy ageing: brain health, physical health, cognitive health, and mental health. We found that poorer sleep was associated with poorer memory performance, but interestingly this effect was stronger in young people - this might suggest that older people’s memory capabilities are a bit more robust and able to cope with a poor night of sleep better than those of our younger volunteers! Interestingly we found no link between sleep quality and having a healthy brain, meaning that even people who slept poorly didn’t have noticeable damage to the connections between brain areas. We did find that people who slept poorly often reported poorer general health, and were more likely to have slightly higher bodyweight (BMI) and slightly elevated blood pressure. Finally, we found that people who slept poorly were much more likely to report symptoms of anxiety and depression. Perhaps this is unsurprising, as everyone will have experienced feeling sad or grumpy after sleeping poorly.

Taken together, we find that sleep changes across the lifespan in many different ways, and that getting a good night’s sleep is, on average, associated with better health. Together our results give a fascinating insight into how sleep changes across the lifespan, and how this affects our health. Ultimately we hope to translate these findings into advice on how to best deal with our changing body clocks across the lifespan.

Supported by: BBSRC bioscience for the future | University of Cambridge | MRC Cognition and Brain Sciences Unit

Human brains age less than previously thought

by Kamen Tsvetanov



The colours indicate those areas of the brain that are rich in blood supply but are most affected by vascular changes with age. The cooler (greener) the colour, the greater the vascular effect observed in older adults.

Older brains may be more similar to younger brains than previously thought! Cam-CAN research has shown that changes in the ageing brain observed using functional magnetic resonance imaging (fMRI) – one of the standard ways of measuring brain activity – may actually be due to changes in our *vasculature* (blood vessels*)*, rather than changes in the activity of our *neurons* (nerve cells). Given the large number of fMRI studies used to assess the ageing brain, our findings challenge the current theories of ageing and have important consequences for how researchers use fMRI to understand how the brain changes with age.

When the brain is engaged in a task, neurons (the brain cells responsible for our cognition and function) become active. This leads to a regional increase in oxygen-rich blood flow in order to supply the extra energy the neurons need. Scientists use fMRI to observe these blood flow changes and have traditionally interpreted them as a measure of the neural activity in the brain. However, what is often neglected is that the blood supply is also affected by the health of each individual's vascular network. Without carefully correcting the data to take account for age differences that exist in the blood vessels in the brain, the fMRI signal can be mistakenly interpreted as wholly attributable to neuronal differences. This means that researchers may overestimate the changes in cognition and function they see in older people.

It is possible to measure the vascular signal during fMRI. For example, by manipulating the levels of oxygen in the blood by asking participants to hold their breath or breathe through a mask. However, such methods have not been widely used in studies of ageing, possibly because they are difficult to implement and not well tolerated. The unique combination of data collected in Cam-CAN has allowed us to look at this problem and develop a new way of correcting fMRI signals to account for individual vascular effects. We do this by using a measure called 'resting state', which is the fMRI data we collect when an individual is at rest in the scanner and not engaged in an activity that would generate a large neuronal response. The resting state should give us a baseline measure of the individual's vascular signal. By taking the fMRI signals we collect during a mental task and subtracting this baseline measure we can obtain a more accurate estimate of actual neuronal activity within the brain areas activated during the task.

To test this we used the Cam-CAN fMRI experiment that looked at our senses and movement. Using the conventional method, ignoring the differences in the baseline of vascular health, we found that older adults showed reduced fMRI signal in their sensory areas compared to younger adults doing the same task. However, after baseline correction, the results showed that it might actually be vascular health, not brain function, which accounts for most age-related differences in the fMRI signal. In other words, our results suggest that the age differences in brain activity may be overestimated in previous fMRI studies of ageing.

Why is this important? By publishing our findings we hope to increase awareness amongst the research community of the importance of the vascular signal in fMRI data. We encourage researchers to include resting state data in their experiments as a quick and easy measure that can be used to account for vascular changes. Our research has clearly shown that without correction for non-neural signals when looking at fMRI data, fMRI studies of the effects of age on cognition may misinterpret the effect of age as a neurocognitive, rather than a neurovascular, phenomena.

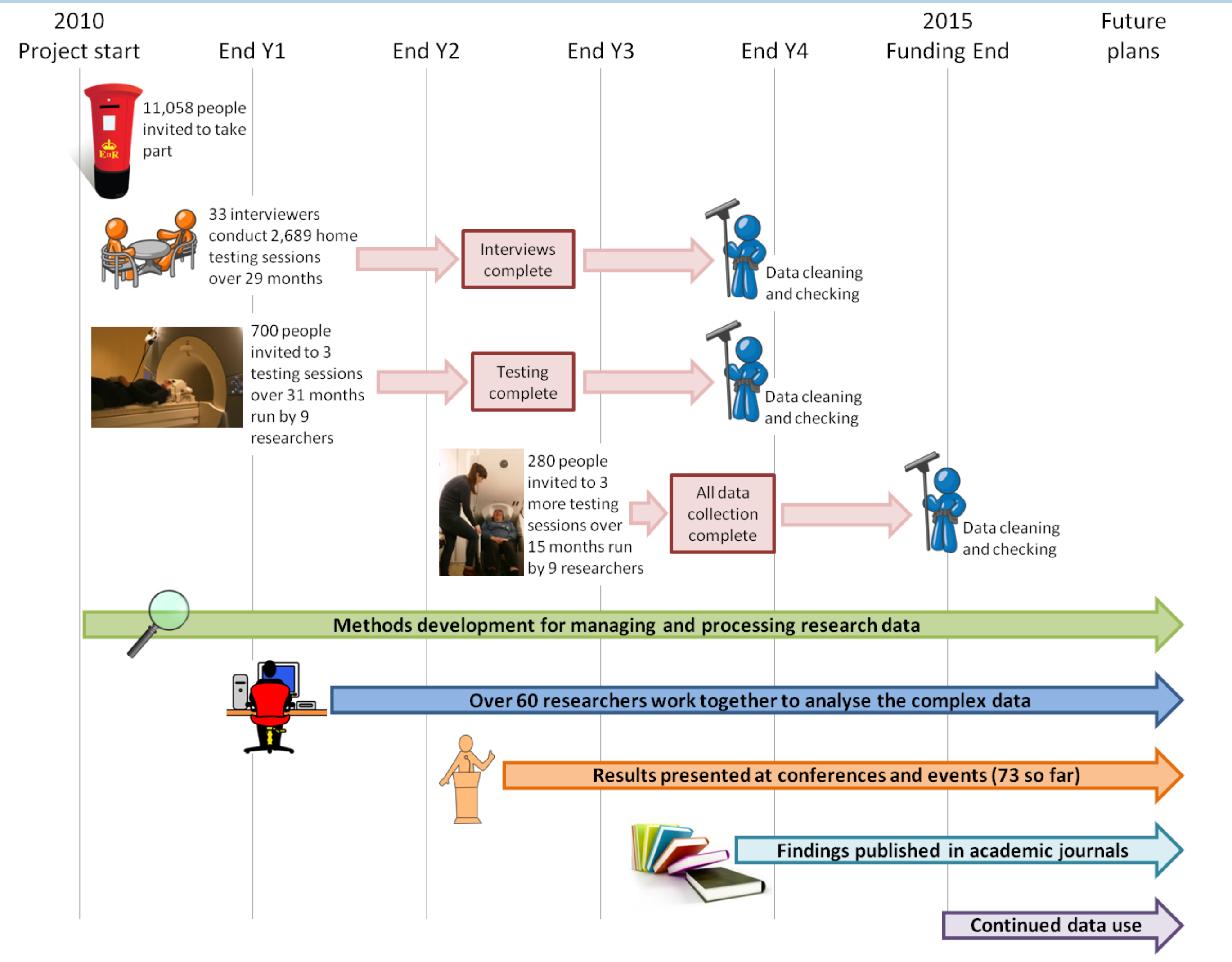
The lifecycle of a project

by Marie Dixon

Participants often ask us when the results of the project will be published. The huge amount of data we collected includes over 90 different tasks and data types. It is therefore too broad to lead to just one result published in a single paper. Instead, the data is being examined in many different combinations. It is the results of these individual targeted investigations which will be published to shed new light on questions of cognition and ageing.

So how long does it take to publish? The graphic below shows the stages that we've been through with the Cam-CAN project, starting with initial invitation letters being sent out in 2010 to the current in-depth analysis, interpretation and presentation of results. It was in mid-2013 that the first wave of data collection was completed and we could start looking for conclusive findings across the full age-range of participants. The data analysis requires tools and methods to be developed to process the data, and expertise and time to explore relationships and uncover relevant findings. It is only after extensive analysis and rigorous testing of our scientific ideas that we can confidently write up our results for presentation at academic conferences or submission to scientific journals. Our work is then reviewed by experts in the field to make sure it is of the highest academic standard before it can be accepted for publication. It can take many months or even years to reach this stage.

Although the current phase of the project comes to an end later this year, our network of Cam-CAN approved researchers will continue to study the data and publish findings for many years to come. We also hope to secure new funding for further research so you may well hear from us again in the future.



Details of all our presentations and publications can be found on our website at:
www.cam-can.com/publications

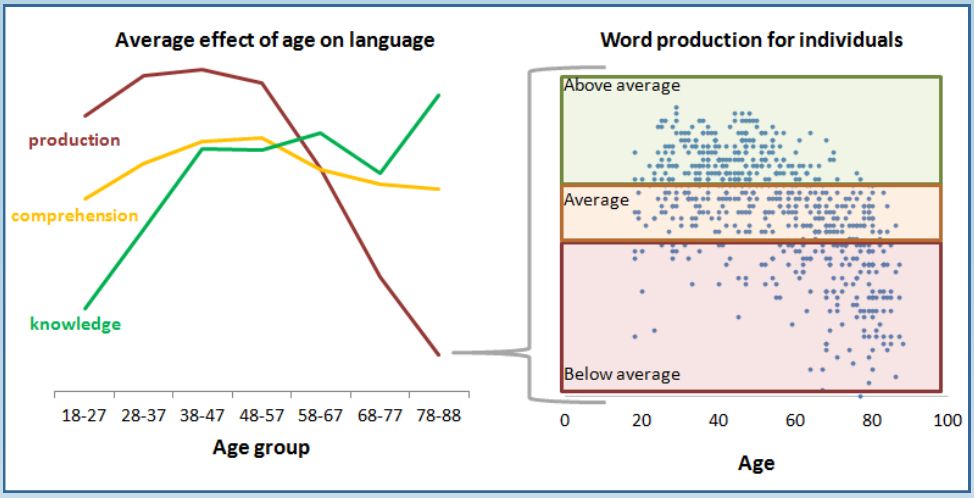
Seeing the complex side of cognitive ageing: Decline, preservation and improvement

by Meredith Shafto

Studies of cognitive ageing focus on identifying abilities that decline with age, and aim to help people reverse or avoid these declines. This focus can lead to a view of ageing as a disease that we catch at pensionable age, to be cured or vaccinated against. The Cam-CAN project joins a growing number of researchers in taking a view of cognitive ageing as a process of lifelong development, with some losses, but also some gains. One of the key aims of Cam-CAN is to examine why the effect of age varies for different cognitive abilities and for different people.

As an example, consider three measures related to language that we gathered from our Cam-CAN participants: (1) word production, measured by having participants name pictures of everyday objects as quickly as possible; (2) sentence comprehension, measured by having participants make judgments about whether sentences are acceptable or unacceptable; and (3) word knowledge, measured by having participants select which of two words in a pair is real versus made up. The figure below shows the different relationships between these measures and age. In the graph on the left, the red line shows word production, which tends to decline with age, leading to the frustrating experience of forgetting words and names. However, the yellow line shows sentence comprehension, which remains stable across the lifespan. Finally, the green line shows word knowledge, which increases across the lifespan as we continue to gain new vocabulary into old age.

A second source of variation is clear from the graph on the right. This shows word production performance for each participant across the Cam-CAN age range (18 and older), with each blue dot representing one person's score. You can see that more of the younger participants perform above average, and more of the older participants perform below average, but there is a great deal of *individual* variability, with some older adults performing very well and some younger adults performing very poorly.



In Cam-CAN, we want to understand both of these types of variability: why the *average* effect of age is different for different cognitive abilities, and why some *individuals* continue to perform well in old age, while others do not. Understanding the reasons for this variability is important for finding ways to avoid or reverse the negative effects of ageing. Moreover, appreciating the complexity of cognitive ageing reminds us that not everything goes downhill with age, and giving equal weight to preserved or improved abilities can help change our expectations about ageing.

A huge 'thank you' from the Cam-CAN team

It feels like a long time since we launched Cam-CAN and I gave you our first project update back in 2011. You have been part of an enormous project that has been an impressive undertaking both logistically and scientifically. We really can't thank you enough for giving up your time to be part of this research. You have helped us create an absolute gem of a dataset that will be used for years to come to advance our understanding of healthy ageing.

I really hope you've enjoyed reading about some of the projects our research team have been working on. Although this is our last project newsletter for the time being we will still provide updates of the important science coming out of the Cam-CAN data via our website. Once again, thank you so much for being part of this amazing project.

Professor Lorraine K Tyler
Principal Investigator

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