This news article is about procrastination, so without further ado; let's take a look at it:

https://www.bbc.co.uk/news/health-45295392

I'll post the entire website here, as I'll be looking at a few areas in it, so once we can see the full page, we can start on each part.

26 August 2018 Share

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To procrastinate or not: the answer may be down to differences in how our brains are wired, a study suggests.

It identified two areas of the brain that determine whether we are more likely to get on with a task or continually put it off.

Researchers used a survey and scans of 264 people's brains to measure how proactive they were.

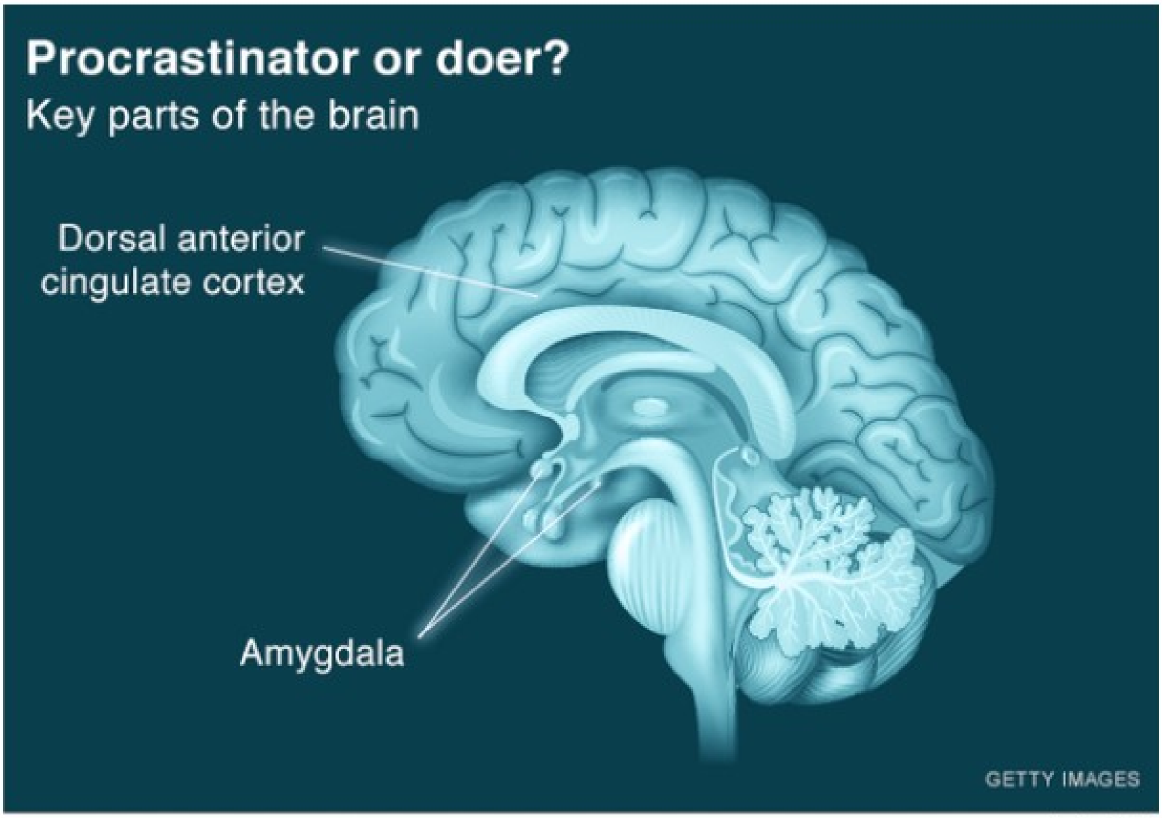
Experts say the study, in Psychological Science, underlines procrastination is more about managing emotions than time.

Big clue

It found that the amygdala - an almond-shaped structure in the temporal (side) lobe which processes our emotions and controls our motivation - was larger in procrastinators.

In these individuals, there were also poorer connections between the amygdala and a part of the brain called the dorsal anterior cingulate cortex (DACC).

The DACC uses information from the amygdala and decides what action the body will take. It helps keep the person on track by blocking out competing emotions and distractions.



Source: The Structural and Functional Signature of Action Control, Psychological Science BBC

"Individuals with a larger amygdala may be more anxious about the negative consequences of an action - they tend to hesitate and put off things," says Erhan Genç, one of the study authors, based at Ruhr University Bochum.

The researchers suggest that procrastinators are less able to filter out interfering emotions and distractions because the connections between the amygdala and the DACC in their brains are not as good as in proactive individuals.

Mindfulness control

Prof Tim Pychyl, from Carleton University, Ottawa, who has been **studying procrastination** for the past few decades, believes it is a problem with managing emotions rather than time.

"This study provides physiological evidence of the problem procrastinators have with emotional control," he says.

"It shows how the emotional centres of the brain can overwhelm a person's ability for self-regulation."

Dr Pychyl is optimistic about the potential for change. He said: "**Research** has already shown that mindfulness meditation is related to amygdala shrinkage, expansion of the pre-frontal cortex and a weakening of the connection between these two areas".

He said this showed that changing the brain was possible.

Dr Caroline Schluter, the lead author of the study, said: "The brain is very responsive and can change throughout the lifespan."

Tips for procrastinators

Productivity expert Moyra Scott thinks we need to take personality into account when motivating ourselves.

"We need to recognise when we are procrastinating and have 'tricks' we can employ to get us doing something," she said.

Her top tips are:

- If you don't have an external deadline, use a timer to focus for set periods - for example, 25 minutes at a time with 5 minute breaks and a longer break every 90 minutes.
- Write a list of tasks but break it down into smaller, more specific ones. This makes them easier to action and complete.
- Try to minimise interruptions like email notifications. Putting your phone on airplane mode or going somewhere to work where you won't be disturbed will also help.
- Being "busy" is easier than doing the thing we are avoiding. Instead of doing the task at hand, we do other stuff instead and kid ourselves that we don't have the time. You do have the time. You just need to make it.

So, I have a few things that I want to look at. Firstly, the survey said that 264 brain scans were performed. Is that value correct?

Well, and this is the misleading thing with this article, they link to one piece of research:

"Dr Pychyl is optimistic about the potential for change. He said: "Research has already shown that mindfulness meditation is related to amygdala shrinkage, expansion of the pre-frontal cortex and a weakening of the connection between these two areas"."

This is this paper:

http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0064574

Now, although that is a full research paper, it was published in 2013. Plus, it says that they only looked at 155 adults:

Mindfulness, a psychological process reflecting attention and awareness to what is happening in the present moment, has been associated with increased well-being and decreased depression and anxiety in both healthy and patient populations. However, little research has explored underlying neural pathways. Recent work suggests that mindfulness (and mindfulness training interventions) may foster neuroplastic changes in cortico-limbic circuits responsible for stress and emotion regulation. Building on this work, we hypothesized that higher levels of dispositional mindfulness would be associated with decreased grey matter volume in the amgydala. In the present study, a self-report measure of dispositional mindfulness and structural MRI images were obtained from 155 healthy community adults. Volumetric analyses showed that higher dispositional mindfulness is associated with decreased grey matter volume in the right amygdala, and exploratory analyses revealed that higher dispositional mindfulness is also associated with decreased grey matter volume in the left caudate. Moreover, secondary analyses indicate that these amygdala and caudate volume associations persist after controlling for relevant demographic and individual difference factors (i.e., age, total grey matter volume, neuroticism, depression). Such volumetric differences may help explain why mindful individuals have reduced stress reactivity, and suggest new candidate structural neurobiological pathways linking mindfulness with mental and physical health outcomes.

I have also quoted it as well:

“Building on this work, we hypothesized that higher levels of dispositional mindfulness would be associated with decreased grey matter volume in the amgydala. In the present study, a self-report measure of dispositional mindfulness and structural MRI images were obtained from 155 healthy community adults”

So, this clearly isn’t the study the article is talking about, but I will come back to this paper later.

Now, the paper that it is based on was written by the lead author, Dr Caroline Schluter, and here it is:

http://journals.sagepub.com/doi/10.1177/0956797618779380

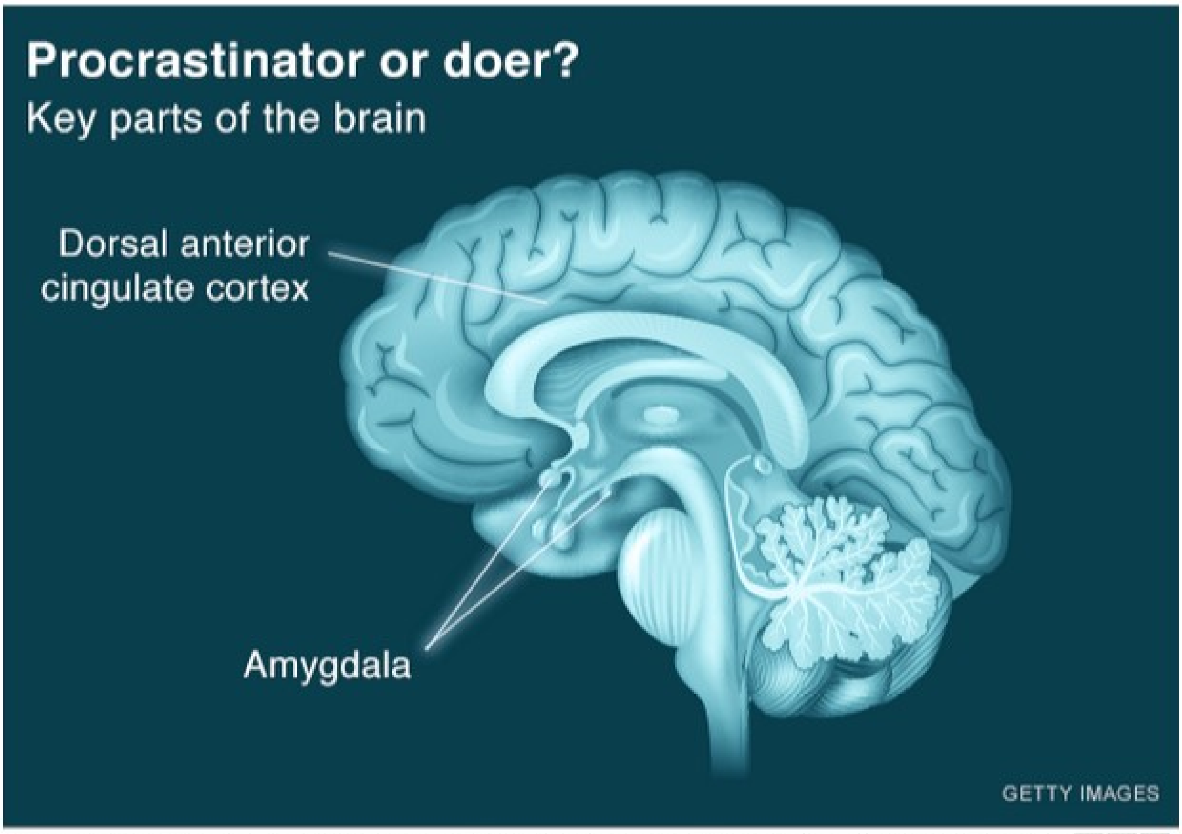
And it states:

“Here, we measured action control in a sample of 264 healthy adults and related interindividual differences in action control to variations in brain structure and resting-state connectivity.”

So, yes, the article is correct, it was 264 brain scans. Now, onto the next question.

In these individuals, there were also poorer connections between the amygdala and a part of the brain called the dorsal anterior cingulate cortex (DACC).

The DACC uses information from the amygdala and decides what action the body will take. It helps keep the person on track by blocking out competing emotions and distractions.



Source: The Structural and Functional Signature of Action Control, Psychological Science BBC

So, in the above, I'm looking at a few things. Firstly, does the dorsal anterior cingulate cortex (DACC) use information from the amygdala and decides what action the body will take. And does it help keep the person on track by blocking out competing emotions and distractions.

Also, in the picture, are those the exact location as shown?

Well, according to research papers, and even Wikipedia (which I use as you know, as a broad reference), states that it's actually the dACC. It's a little d, as the ACC is the main part, and the d just stands for a part of it, the dorsal. So, it's partially correct, with the meaning, just not with the abbreviation. But that's pretty tiny thing to be at fault with, so it's more or less correct.

Now, does it use information from the amygdala as stated?

Naturally, for this I need to have a look at some research papers, to see if it does or not.

But first, Wikipedia, as I found it stated this:

https://en.wikipedia.org/wiki/Anterior_cingulate_cortex

“The dorsal part of the ACC is connected with the prefrontal cortex and parietal cortex, as well as the motor system and the frontal eye fields,[8] making it a central station for processing top-down and bottom-up stimuli and assigning appropriate control to other areas in the brain. By contrast, the ventral part of the ACC is connected with the amygdala, nucleus accumbens, hypothalamus, hippocampus, and anterior insula, and is involved in assessing the salience of emotion and motivational information.”

The main parts of that quote are that the dorsal (dACC) is connected to the cortex, motor system and frontal eye lids. But the ventral (assuming vACC) is connected to the amygdala, nucleus accumbens, hypothalamus, hippocampus, and anterior insula.

So, that states that it’s not the dACC but the vACC (I’m calling it vACC as its still part of the main ACC). I found this in one science website and I’ve bolded the main parts

https://www.sciencedirect.com/topics/neuroscience/anterior-cingulate-cortex

“The ventral anterior cingulate is part of the brain “default mode network” whereas the dorsal anterior cingulate is a component of the frontoparietal attention networks. The **ventral anterior cingulate cortex** includes subcallosal and precallosal portions that have extensive connections with the insula, prefrontal cortex, **amygdala**, hypothalamus, and brain stem.”

So, again it looks like it’s not the dACC as the article suggests. So that part is incorrect.

And as for the part in the article that states ‘It helps keep the person on track by blocking out competing emotions and distractions’: well, that part is correct for the amygdala.

Next part to look at. In this quote:

“"Individuals with a larger amygdala may be more anxious about the negative consequences of an action - they tend to hesitate and put off things," says Erhan Genç, one of the study authors, based at Ruhr University Bochum.”

Was he actually one of the authors of the main research this article is reporting on? Well, although Dr Pychyl is mentioned in the article, discussing the research he’s done over the years, he wasn’t one of the authors of this main study. Erhan Genç on the other hand, was:

The Structural and Functional Signature of Action Control

Caroline Schlüter, Christoph Fraenz, Marlies Pinnow, Patrick Friedrich, Onur Güntürkün, Erhan Genç Show less

First Published August 17, 2018 | Research Article | Check for updates

https://doi.org/10.1177/0956797618779380

Article information Altmetric 488

So that part is correct. Now, the next part is actually the main subject of the article:

“Dr Pychyl is optimistic about the potential for change. He said: "Research has already shown that mindfulness meditation is related to amygdala shrinkage, expansion of the pre-frontal cortex and a weakening of the connection between these two areas".”

Now, this is for the original research paper, as stated above, and not the one that is for this article of 264 brain scans. But, let's see if we can check it out, and see if there is shrinkage of amygdala, and expansion of the pre-frontal cortex.

Back to the website:

http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0064574

Yep, a lot of information but I'm only really concerned with numbers. However, I can't see any there. Sure, there are a few tables, but nothing tangible. So, the second paper:

http://journals.sagepub.com/doi/10.1177/0956797618779380

So, if you look at the figures on the left, you can see this one (originally you could see this, but now it's hidden unless you pay for it, so this is a snapshot of what it was when I looked earlier):

Table 2. Correlations Between AOD Score and Brain Volume in Each of the 42 Regions of Interest

	Gray-matter volume		White-matter volume	
Brain region	*r*	*p*	*r*	*p*
Cuneus cortex	.033	.592	−.032	.605
Lateral occipital cortex	−.043	.491	−.079	.205
Lingual gyrus	−.069	.264	−.099	.112
Pericalcarine cortex	.053	.393	.043	.489
Banks of the superior temporal sulcus	−.124	.045	−.098	.112
Entorhinal cortex	.101	.104	.079	.203
Fusiform gyrus	−.084	.174	−.085	.170
Inferior temporal gyrus	−.096	.122	−.126	.041
Middle temporal gyrus	−.138	.026	−.105	.089
Parahippocampal gyrus	.000	.996	−.091	.140
Superior temporal gyrus	−.073	.241	−.121	.050
Temporal pole	.048	.434	.035	.576
Transverse temporal cortex	−.137	.026	−.063	.311
Inferior parietal cortex	−.040	.515	−.064	.305
Postcentral gyrus	−.089	.151	−.135	.029
Precuneus cortex	−.076	.221	−.101	.105
Superior parietal cortex	−.050	.423	−.051	.412
Supramarginal gyrus	−.018	.777	−.055	.371
Orbitofrontal cortex				
Lateral division	−.080	.196	−.104	.093
Medial division	−.029	.640	−.083	.181
Paracentral lobule	−.099	.109	−.059	.343
Inferior frontal gyrus				
Pars opercularis	−.055	.376	−.024	.695
Pars orbitalis	−.092	.139	−.129	.036
Pars triangularis	−.089	.151	−.127	.040
Precentral gyrus	−.049	.433	−.041	.512
Middle frontal gyrus				
Caudal division	−.030	.627	−.090	.146
Rostral division	−.066	.286	−.065	.296
Superior frontal gyrus	−.074	.232	−.104	.094
Frontal pole	−.052	.398	−.081	.191
Cingulate cortex				
Caudal anterior division	−.086	.167	−.050	.424
Isthmus division	−.049	.430	−.095	.126
Posterior division	.013	.840	.009	.884
Rostral anterior division	−.058	.351	−.063	.309
Insula	−.093	.135	−.115	.064
Thalamus	−.112	.071		
Caudate	−.068	.275		
Putamen	−.038	.536		
Pallidum	−.042	.497		
Hippocampus	−.106	.087		
Amygdala	−.235*	.000		
Accumbens area	−.101	.102		
Ventral diencephalon	−.084	.175		
Corpus callosum			−.008	.893

Note: For each region, the table shows the correlation between gray- and white-matter volume and score on the Prospective and Decision-Related Action Orientation Versus Hesitation (AOD) scale of the Action Control Scale (Kuhl, 1994). Correlations were controlled for sex and age. Bonferroni correction was applied with a factor of 42 to control for multiple comparisons ($p < .05/42 = .001$).
*$p \leq .001$.

Looks daunting, but if you look at the equation at the very bottom, there was 42 regions of interest. Looks like the 0.05 (or .05) is the alpha level.

“For each region, the table shows the correlation between grey- and white-matter volume and score on the Action Orientation During (Successful) Performance of Activities Versus Volatility (AOP) scale of the Action Control Scale (Kuhl, 1994). Correlations were controlled for sex and age. **Bonferroni correction was applied with a factor of 42 to control for multiple comparisons ($p < .05/42 = .001$). *$p \leq .001$."**

The Bonferroni correction is mentioned here:

https://www.aaos.org/AAOSNow/2012/Apr/research/research7/?ssopc=1

"The Bonferroni correction is an adjustment made to P values when several dependent or independent statistical tests are being performed simultaneously on a single data set. To perform a Bonferroni correction, divide the critical P value (α) by the number of comparisons being made. For example, if 10 hypotheses are being tested, the new critical P value would be α/10. The statistical power of the study is then calculated based on this modified P value.

The Bonferroni correction is used to reduce the chances of obtaining false-positive results (type I errors) when multiple pair wise tests are performed on a single set of data. Put simply, the probability of identifying at least one significant result due to chance increases as more hypotheses are tested."

So, the p value needs to be less than or equal to 0.001 for it to be of interest. And looking at the table above, it's the only one, being 0.000.

For the pre-frontal cortex, we need to look at the next table (again, snapshot only as site updated):

Table 3. Correlations Between AOD Score and Functional Amygdala Connectivity With Each of the 42 Regions of Interest

Brain region	*r*	*p*
Cuneus cortex	.034	.580
Lateral occipital cortex	−.026	.673
Lingual gyrus	.095	.124
Pericalcarine cortex	.045	.472
Banks of the superior temporal sulcus	−.013	.836
Entorhinal cortex	.035	.570
Fusiform gyrus	.017	.785
Inferior temporal gyrus	.074	.233
Middle temporal gyrus	−.006	.920
Parahippocampal gyrus	.005	.941
Superior temporal gyrus	−.057	.354
Temporal pole	.011	.860
Transverse temporal cortex	.042	.500
Inferior parietal cortex	.073	.242
Postcentral gyrus	.006	.926
Precuneus cortex	.132	.033
Superior parietal cortex	.075	.225
Supramarginal gyrus	.035	.567
Orbitofrontal cortex		
Lateral division	.008	.892
Medial division	.007	.914
Paracentral lobule	−.010	.873
Inferior frontal gyrus		
Pars opercularis	.019	.761
Pars orbitalis	.018	.771
Pars triangularis	.013	.831
Precentral gyrus	.044	.476
Middle frontal gyrus		
Caudal division	.076	.222
Rostral division	.127	.040
Superior frontal gyrus	.069	.267
Frontal pole	.096	.120
Cingulate cortex		
Caudal anterior division	.200*	.001
Isthmus division	.036	.562
Posterior division	.138	.026
Rostral anterior division	.057	.355
Insula	.058	.348
Thalamus	.032	.608
Caudate	.123	.046
Putamen	.074	.231
Pallidum	.062	.317
Hippocampus	−.099	.111
Accumbens area	.070	.259
Ventral diencephalon	.084	.173

Note: For each brain region, the table shows the correlation between functional resting-state amygdala connectivity with that region and score on the Prospective and Decision-Related Action Orientation Versus Hesitation (AOD) scale of the Action Control Scale (Kuhl, 1994). The correlation was controlled for sex and age. Bonferroni correction was applied with a factor of 42 to control for multiple comparisons ($p < .05/42 = .001$).
*$p \leq .001$.

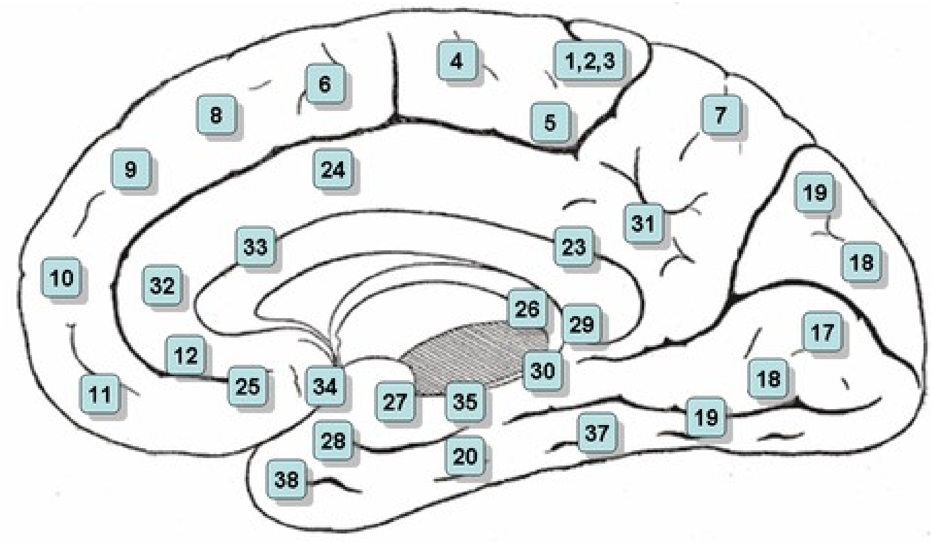
Again, same equation is used, and the only one that is of interest is at 0.001 (or .001). That is the Cingulate Cortex – Caudal Anterior Division

So, is this the pre-frontal cortex? Well, it certainly lies in the middle of the pre-frontal cortex, caudal in medical terms means the tail or hind part. That's not to say that this is an area located at the bottom part of the brain, but it can mean the bottom area of the pre-frontal cortex. Anterior is used to describe parts of the human body with regards to anatomy.

Now, without delving too deep and losing you completely, in (I know) Wikipedia, we can look at the Brodmann area. This is all the sections of the brain, in numbers. We're interested in 24:

https://en.wikipedia.org/wiki/Brodmann_area

This is the Ventral anterior cingulate cortex. And as you can see in the picture, it's located in the pre-frontal cortex:



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So, my findings from this article. It's an interesting one that I've looked at, learnt quite a bit about the human brain I never really new about. I would say it's 50/50. Sure, they got an abbreviation wrong, partially. But they got a few other things correct. However, in the article it said that dACC that was the main area in question, but it's actually the vACC. Again, I named it that to keep with the naming convention. It may not be actually that, it's the ventral ACC.

It also mentions that it's the shrinking of the amygdala and expansion of the pre-frontal cortex. Well, from the numbers in the actual research paper, and by delving into some of the naming, yes it's correct.

So, like I say, it's 50/50, which is a shame as I would have liked them to get certain parts of it correct. Add to the fact that the only research paper they included as a direct link was not even for this article, but for a previous study. That's not good in my opinion.

Anyway, please leave any feedback on this article, and as always, it's been a pleasure to research this one ☺