CAIE Psychology A-level

Biological Approach: Case Study

Canli et al. (2000) - Brain Scan and Emotions

Notes

Author: Remika Sirikulthada

Canli et al. (brain scans and emotions)	
Canli, T., Zhao, Z., Brewer, J., Gabrieli, J.D.E. and Cahill, L. (2000), Event-Related Activation in the Human Amygdala Associates with Later Memory for Individual Emotional Experience. *The Journal of Neuroscience*. 20, RC99	The Canli et al. study is based on the link between the amygdala and emotions. The experiment tested the connection between amygdala activation and emotions in long-term recall. This includes considering functional magnetic resonance imaging (fMRI).

Canli et al. (2000) a brain-scanning study looking at the **links between the amygdala and memory for emotional experiences**. Amygdala: An almond-shaped set of neurons located deep in the brain's medial temporal lobe. Shown to play a key role in the processing of emotions, the amygdala forms part of the limbic system.

Aims

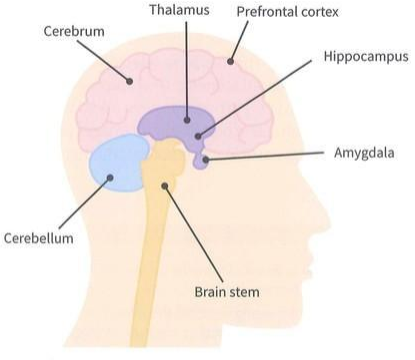
- This study aimed to show that **emotive images will be remembered better** than those that have a little emotional impact on an individual.
- The central questions addressed by this study were **whether the amygdala is sensitive to varying degrees of emotional intensity** elicited by external stimuli and whether the level of intensity will affect the memory for the stimuli.

Background

There are two types of medical scans:

1. **Structural:** Takes **detailed pictures** of the structure of the brain whereas functional scans are able to show activity levels in different areas of the brain
2. **Functional:** Functional magnetic resonance imaging (fMRI) is a **neuroimaging procedure** that uses MRI technology to **measure brain activity** by detecting changes associated with **blood flow**

A computer-generated image using fMRI can illustrate how the brain is working during different tasks. These specific scans allow a living brain to be seen without surgery. During the scan, patients are placed in a scanner that sends a strong magnetic field through their head. The magnetic field causes the nuclei in hydrogen molecules in the brain to spin in a particular way and so the scanner picks this us up. Because hydrogen concentrations vary in different parts of the brain, the scanner is able to create a very detailed picture of the brain.



2.2 Brain map

Over the last few decades, researchers have used fMRI scans to **identify areas of the brain that have specific functions**. Areas that have been shown to have a significant association with emotions and memory are the **subcortical areas** of the brain, including the **amygdala.**

The amygdala: An almond-shaped set of neurons located deep in the brain's medial temporal lobe. Shown to play a key role in the processing of emotions. It is also **responsible for determining where memories are stored** in the brain and **which ones are kept**.

Method (research method and design)

- This was a **laboratory experiment** as the environment in which the participants were tested was not comparable to everyday situations - the use of **fMRI scanners** limits the realism that can be introduced into a study.
- The participants had to lie down still while the measurements were being taken.
- The **independent variable** was the **intensity of the emotional arousal** to each of the **96 scenes** that were presented to each participant.
- Participants had to choose from **four buttons to indicate their emotional arousal** on a **scale from 0 (not emotionally intense at all) to 3 (extremely emotionally intense)**
- This experiment is an example of a **repeated measures design**: A research design that involves multiple measures of the same variable taken on the same or matched subjects either under different conditions or over two or more time periods.

IV Level of perceived emotional arousal	Not emotionally intense at all …		… Extremely emotionally intense	
	0	1	2	3
DVs	fMRI measure of amygdala activation			
	Memory of scene			

- There were two key measures of the dependent variable:
  - The first was the **level of activation of the amygdala** measured by the fMRI
    - during the first stage of the experiment when the participants were exposed to each of the 96 scenes.
    - during functional scanning, 11 frames were captured per trial, so for each of the 96 scenes there were **11 fMRI measures of neutral activity**
  - The second was the **measure of memory** when participants had to recognise the images **three weeks after the initial experiment.**

Procedure

1. During scanning, participants viewed a series of 96 scenes that were **presented via an overhead projector** and mirror so they could see it while still in the machine. All participants had given **consent** to be involved and were aware of the nature of the experiment.
2. The individuals operating the scanner were fully **trained** and competent in the safety arrangements that were needed to be followed during a medical scan.
3. The 96 scenes were from the **'international affective picture system' stimuli set**. For the scenes used in this study, average ratings for **valence** ranged from 1.17 (highly negative) to 5.44 (neutral). Valence, when discussing emotions, refers to the attractiveness (positive valence) or aversiveness (negative valence) of an event, object or situation.
4. The order of the scenes was randomised amongst the participants, **each picture was presented for 2.88 seconds**. There was an **interval of 12.96 seconds where participants viewed a fixation cross** and they had to indicate their emotional arousal by pressing a **button with their right hand.**

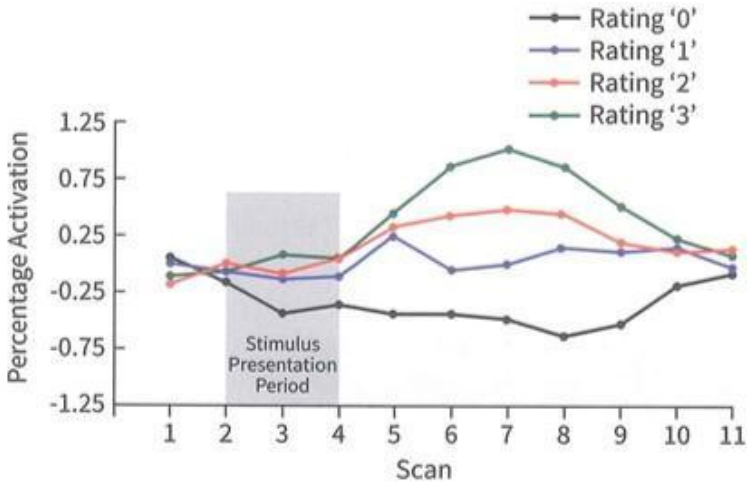
5. To measure activity in the brain, fMRI data were collected by a 1.5 Tesla fMRI scanner which was used to measure blood-oxygen-level-dependent contrast. Contrast imaging is a method used in fMRI to observe different areas of the brain which are found to be active at any given time.
6. **Three weeks after** the first stage, participants were tested in an **unexpected recognition test** in the laboratory. During this, they viewed all the **96 previous scenes and 48 new scenes** - known as foils. (Foils: An unknown or unseen object that is used as a control when testing a participant's memory.) Participants were asked whether they had seen each scene before and for images they judged as previously seen, the had to report with either full certainty 'remember' or if they felt less certain 'know'.

Participants

- **Ten right-handed healthy female volunteers** were scanned.
- Females were chosen because it was believed that they were more likely to report intense emotional experiences and show more physiological reactions to the stimuli.

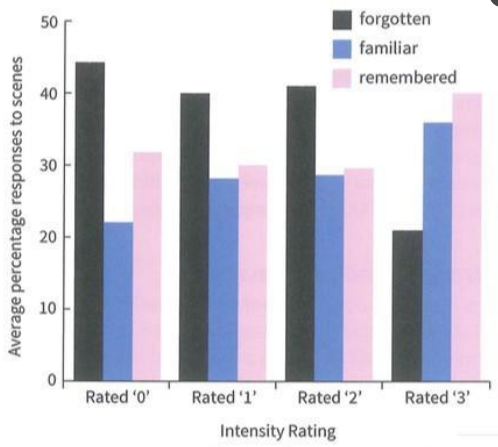
Results

- Participants' **experience of emotional intensity** in the present study **correlated well with average ratings of emotional valence and arousal**
- Participants **ratings of emotional intensity reflected equally well the valence and arousal characteristics** of the stimuli



2.4 Graph showing average amygdala activation in response to scenes that were rated in emotional intensity from 0 (least intense) to 3 (most intense)

- Amygdala activation correlated with higher ratings of individually experienced emotional intensity (as seen in the graph above). This provides evidence that **amygdala activation is related to the subjective sense of emotional intensity** and that the **participants' perceived arousal is associated with amygdala activation.**
- The follow-up memory task showed that memory performance was significantly improved for scenes that were rated with higher emotional intensity (3) than scenes rated with low emotional intensity.
- Scenes that were rated 0-2 had similar distributions to forgotten, familiar or remembered.
- Scenes that were rated 3 were recalled much better.



2.5 Average percentage of scenes forgotten or rated as familiar/remembered at the three-week unexpected recognition task

- Little amygdala activation was found when viewing a picture rated as highly emotionally intense where participants forgot the stimulus, but intermediate and high amygdala activation was associated with a participant's later report of familiarity or confident recognition.

Conclusions

- Canli et al. concluded **that the more emotionally intense an image is, the more likely it will be remembered**
- This provides evidence which explains why people remember emotionally intense experiences well.
- Moreover, the level of **arousal** a person is under could **affect the strength** of a memory trace.
- The amygdala is sensitive to individuals who experienced the emotional intensity of visual stimuli with activity in the left amygdala during encoding being predictive of subsequent memory.

Strength vs Weaknesses - Methodological Evaluation

High internal validity	One strength of the study Canli et al.is that the study has high **internal validity**. This is because there was a **standardized procedure** and **high levels of control,** for example there was a bite bar (with dental impression) for each participant which was used to minimise head movement. This **enhances the validity** of the findings as a **cause-and-effect relationship** can be established.
High controls	- Bite bar (with dental impressions) was used to minimise head movement = made activation maps from the fMRI scans more accurate. - Randomised order of images = minimise order effects. - Looking at fixation cross (to ensure direction of gaze) = without this participants may have looked around and this would've been a confounding variable. - Normative rating of images for valence and arousal from IAPS. A strength of Canli et al.is that there were high levels of control. For example the study included **bite bars** (with dental impressions) which were custom made for each participant. This control was implemented to minimise head movement which made the activation maps taken from the fMRI scans more accurate. Without this control the participants may have moved their heads thus affecting the results taken from the scan and this could have evolved into a **confounding variable.** This control, as well as the others, increases the internal validity of the findings as we can be confident it was the IV affecting the DV as there are fewer confounding variables affecting the results.

Reliability	Standardized procedure: - Images that had certain arousal levels for each experiment - How long images shown for - Breaks between images A strength of Canli et al.is that there were **high levels of standardisation**, keeping everything the same so the investigation was consistent. For example, each image shown to the participant was randomly presented and only shown for a period of 2.88 seconds. Also, it is important to note that because a new experiment was conducted for each participant, the researchers could have carried out **10 sets of experiments** with the **exact same standardized procedures**. This means that the exact same experiment can be conducted again and checked for the reliability of the results (the results showed that participants were more likely to remember emotionally intense images due to the increased amygdala activity which occurs during encoding and how that correlates to better memory later). Therefore, it is far **more likely that results will be replicated** on subsequent occasions when research is standardised, which means that the **data reflects a meaningful pattern** and was **not a one-off chance result.**
Ecological validity	A **limitation** of Canli et al.is that it has **low ecological validity**. This is because participants were asked to lie in a fMRI scanner which reviewing images and they had to indicate their emotional arousal by pressing a button. Because the participants were placed in the scanner, they may have felt pressure and just being placed in a scanner while observing images is not something they would normally do in real life and therefore the task lacked in **mundane realism**. It is mentioned in the article that emotive images were shown, for example an image of a crying child. If one were to see a crying child in real life, they would also hear the crying and perhaps see the child's body language and thus be affected. In the experiment, the still image removes sensory aspects and may not be as **affective** as in real life, thus experiments affecting the results. Therefore, the results of the study may only be **generalised with caution to a real-life setting**.
Ethics	- Potentially mentally stressing images - as a limitation. - Strength - there were no significant ethical issues.
Generalisability	A limitation of Canli et al.is that it has **low population validity**. This is because participants in the study were **10 right-handed females** and are n**ot representative of the wider population** since none were males or left handed. This presents a gender bias, more specifically a **gynocentric bias**. It may be that males may not display the same behaviour because men are less likely to report intense emotional experiences (Shields, 1991) and also show less physiological reactivity in concordance with valence judgement compared to females. Therefore, the results of the study **may only be generalised to men with caution.**
Quantitative data	Run statistical analysis - a strength ANOVA statistical test Quantitative data is more objective and less susceptible to researcher bias
Repeated measures design	Strength - overcame the problems of previous research

Issues and Debates

Application to real life

1. Advertisements
    - More likely to remember adverts with have high emotional intense stimuli
    - The advertising agents can use Canli et al.'s results for to **create more effective advertisements**
        - Ethical responsibility = advertisers must use a level emotional intensity which is justifiable
            - Ethical sensitivity needs to be considered
2. Schools - educators
    - Positive emotional experiences make students more likely to remember content they are studying

Nature vs Nurture

Nature	Nurture
- Amygdala is part of the human physiology - **Not under our conscious control** and can shape people's behaviour	- Trauma research - Amygdala becomes more sensitive when children experience trauma e.g. explains angry outbursts - PTSD - Environment can shape our amygdala

Interactionist approach

- **Middle ground** of nature and nurture
- There is evidence that we need to consider both

On the one hand, the Canli et al. (2000) study supports the nature side of the nature vs nurture argument. This is because the amygdala is already part of the human physiology, located deep in the brain's medial temporal lobe. As a result, the way the amygdala functions is not under one's conscious control and therefore it naturally shapes the way people will behave. However, it may be more realistic to argue that this study has a interactionist approach, seeing as nurture may also play a key role; as **one's environment can shape the way the amygdala functions.** For example, Bonne et al.(2001) has demonstrated that there is a **decrease in the bilateral amygdala in PTSD patients**. Thus, it can be concluded that the study provides **evidence for both sides of the argument** and both nature and nurture need to be considered.