

understand and hopefully prevent vulnerability to neurodegenerative disorders. Brain development and brain maturation use glucose via the process of aerobic glycolysis. Day-to-day brain activities use the rest of the glucose supplies for fuel. Over the years, the glucose fraction used for aerobic glycolysis decreases and levels off by the time we get to our 60s.

In a recent study, researchers carried out positron emission tomography scans measuring oxygen and glucose utilisation in the brains of 121 women and 84 men, aged from 20 to 82 years. They determined the fraction of glucose used for aerobic glycolysis in various parts of the brain as a measure of brain metabolism. Using a machine-learning algorithm, they determined the relationship between age and brain metabolism and compared their findings between men and women.

Women's brain appeared 3 years younger than those of their male counterparts, and this difference was present regardless of age, including in younger subjects (in their 20s). The researchers aim to carry out further studies to examine whether women's younger brains can explain why they experience less cognitive decline than men.

Goyal M. S., Blazey T. M., Su Y., et al (2019) Persistent metabolic youth in the aging female brain. *Proceedings of the National Academy of Sciences*, 116, 3251–3255.

### 'Extremism means extremism'

Extremists with violent behaviour towards the 'other' exist in various forms. Western extremists attack Muslim minorities or others who disagree with them, and Muslim extremists carry out terrorist activities against the West or others. Both groups claim the moral right to do so.

In a series of studies, social psychologists demonstrated that perceived inter-group threat is a common driving force in the psychology of out-group hostility. They studied a total of 705 Muslims and 522 non-Muslim Westerners in three groups and seven cultural contexts: non-Muslim Westerners, Muslims in Western societies and Muslims in the Middle East.

They found that the more individuals in each group felt that the other group was a threat to their culture, traditions, norms, values and way of life, the higher their hostility. This attitude was the same in all subjects, irrespective of whether they were Westerners or Muslims, living in the West or the Middle East.

Symbolic and realistic threats had the same effects. A meta-analysis of all the studies showed that symbolic threat was most strongly associated with inter-group hostility, and that individuals with high religious group identification experienced higher levels of threat.

These findings go some way towards explaining such extremist inter-group hostility, but the issues surrounding violent inter-group actions are far more complex.

Obaidi M., Kunst J. R., Kteily N. S., et al (2018) Living under threat: mutual threat perception drives anti-Muslim and anti-Western

hostility in the age of terrorism. *European Journal of Social Psychology*, 49, 670–670.

### To act or not to act?

Being treated unfairly causes anger and a wish to take revenge. Some of us act on our anger and punish the culprit, and some don't. Are these differences in our actions reflected in our brain activity and, if so, what are the areas involved?

Researchers in Geneva, Switzerland, examined the relationship between feelings of anger and revenge and brain activity. They devised an economic inequality game aimed at triggering a sense of injustice and anger and offering the possibility of revenge. Twenty-five subjects were recruited to play with two other players, who were pre-programmed (the participants were unaware of this). One of the players was friendly, offering the participant financial interactions and sending nice messages, while the other player made sure to multiply only his own profits, going against the participant's interests and sending annoying messages.

All subjects underwent magnetic resonance imaging (MRI) of the brain throughout the three phases of the test to identify the areas activated in the process of playing the economic game.

In phase 1, the participant was in control and able to choose which profits he shared with the other two, and it was observed that in general participants were fair with the other players.

In phase 2, the participant was in the passive position of receiving the decisions of the other two players, one of whom was acting in a provocative and unfair way; the participant was asked to rate his anger in response to this, on a scale from 0 to 10. During this phase, MRI activity was observed in the superior temporal lobe and the amygdala (the latter is generally associated with feelings of fear); the higher the level of anger as rated by the subject, the stronger the activity in these areas.

In phase 3, the participant was back in control and was given the choice to penalise the other two players. Most of the participants remained nice to the fair player but took revenge on the unfair player. However, 11 of them also remained fair to the unfair player. This allowed the researchers to look at differences in brain activity between those who took revenge and those who did not. They found that the greater the activity in the dorsolateral prefrontal cortex (DLPFC) during the provocation phase, the less the participants punished the unfair player. By contrast, lower activity in the DLPFC was associated with more pronounced revenge on the unfair player.

The DLPFC is the executive power of our brains, the area that regulates our actions in response to our emotions. The more our DLPFC is engaged, the more control we can exert on our actions, at least according to this paradigm.

Klimecki O. M., Sander D. & Vuilleumier P. (2018) Distinct brain areas involved in anger versus punishment during social interactions. *Scientific Reports*, 8, 10556. doi:10.1038/s41598-018-28863-3.

## Editorial

- 51 **International comparison of the work-related stressors experienced by psychiatrists**  
M. Henderson and M. Abbas

## Thematic Papers

- 53 **Psychiatry trainee stressors in a postgraduate psychiatry training centre in India**  
Bharathram Sathur Raghuraman, Manamohan Nataraj and Lakshmi Shiva
- 56 **Working in psychiatry in Malta: a personal view**  
Rachel Taylor-East
- 58 **Sources of stress in the practice of psychiatry: perspective from the Arab world**  
Rudwan Abdul-AI
- 60 **Current challenges for psychiatry in Greece**  
Nikos G. Christodoulou and Konstantinos Kollias

## Country Profile

- 62 **Mental health services in the Philippines**  
John Lally, John Tully and Rene Samaniego

## Mental Health Law Profiles

- 65 **Mental health legislation in the Philippines: Philippine Mental Health Act**  
John Lally, Rene M. Samaniego and John Tully
- 68 **Mental health legislation in Botswana**  
J. Maphisa Maphisa

## Special Paper

- 71 **Services for adults with intellectual disability in Aotearoa New Zealand**  
Jane McCarthy and Mhairi Duff
- 74 **Pandora's box**  
Eleni Palazidou

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'The Aquarium', HM Prison Grendon, Silver Award for Painting 2017

Image courtesy of Koestler Arts.

Koestler Arts runs the annual Koestler Awards for arts in criminal justice. The charity aims to encourage people in prisons, secure hospitals, detention settings and on community sentences or probation to participate in the arts, and to share that talent with the public. Over 3,500 people take part annually. Each entrant benefits from recognition for their work and feedback. They can also win cash awards, be exhibited, or published, and apply for arts mentoring.

Koestler works in partnership across the UK to present one UK exhibition at Southbank Centre annually, as well as regional and national shows. It will present an East of England programme at Snape Maltings, Suffolk from 1 – 31 August 2019 and a UK programme at Southbank Centre, London from 19 September – 3 November 2019. Volume 2 of the charity's poetry anthology Koestler Voices will be published in September 2019.

[www.koestlerarts.org.uk](http://www.koestlerarts.org.uk)