

My chemical romance

Ginny Smith picks out six chemicals from her new book *Overloaded: How Every Aspect of your Life is Influenced by your Brain Chemicals* (Bloomsbury Sigma).

For me, one of the biggest appeals of the fields of psychology and neuroscience is their ability to answer what is, I think, the biggest question in science: why do we behave the way we do? It seems to me that the answer lies not in the wiring of our brains, but in the chemicals that bathe them. Because while the connections between neurons can and do change, this process is slow. This means it can't be responsible for the millisecond-by-millisecond changes we all experience: the split-second decisions, fluctuations in emotion and the temptations we encounter. Instead, these are all controlled by our brain chemistry. And, as it is our brain that makes us who we are, that means that we are controlled by this turbulent sea of neurotransmitters.

There are, of course, a huge number of chemicals that affect our brains and behaviour, but in this article I have picked six of my favourites, to give you a taste of their vital roles, and the complexity of the systems that use them.

1. Glutamate

It may not be the flashiest neurotransmitter, but glutamate is the workhorse of the brain. The most common neurotransmitter in the human brain, when glutamate is released by one neuron it travels across the gap (or synapse) and makes the next neuron more excitable. If enough is detected, the second neuron will fire, sending the message on its journey.

Glutamate is vital for learning. Repeatedly activating the same pairs of neurons, by revising a fact or practicing a skill, causes the neurons to change. The first neuron begins to release more glutamate in response to each signal, while the second undergoes changes which free up more receptors. Both changes improve the chances of the second neuron receiving the signal and continuing to pass it on each time the first neuron fires. They also increase the speed of the transmission. This is why once you have learnt something thoroughly, it is easier to recall it, and it feels like it takes less effort. It really is easier for your brain to activate these pathways, thanks to the power of glutamate.

Glutamate isn't all sweetness and light though. While it is vital for our brain to function, too much of the chemical can be toxic to the brain, so it is vital it is kept in balance. Sadly, boosting glutamate levels isn't going to help you remember where you left your keys!

2. GABA

Glutamate's counterpart is Gamma Aminobutyric Acid,



better known as GABA. This chemical has the opposite effect to glutamate; when it binds to receptors, it makes it harder for the neuron to send its signal. This makes GABA an inhibitory neurotransmitter. Neurons that use GABA, then, have a calming effect on the brain, reducing the activity of other neurons. This means they are important for sleep (GABA levels in the cortex are high during deep, slow wave sleep), and for counteracting stress.

GABA may also play a role in anxiety and depression. If the balance between glutamate and GABA is off, the brain can be overly excitable, leaving us feeling anxious. Some drugs which are being trialled for treatment-resistant depression, including ketamine and antiepileptic drugs, raise the levels of this chemical, which may, at least partially, explain their benefits.

In healthy people, yoga has been found to increase levels of GABA in the thalamus, and this correlates with reductions in stress and improvements in mood – something we could probably all do with at the moment!

3. Acetylcholine

Our brain has a huge job to do. Two of its most important responsibilities are taking in information from the world around us, and processing memories. But how does it know which to focus on at any point in time? This is where the chemical acetylcholine comes in.

When levels of this chemical are high, you focus on the external world, entering the perfect state to learn new things. After a while, however, acetylcholine levels drop, and your attention starts to drift – you might begin daydreaming, or thinking about what to have for dinner. When you are resting, acetylcholine levels in the hippocampus fall and internal circuits become dominant. This allows memories formed during focused wakefulness to be stored. The same happens when you are in deep sleep.

The right amounts of acetylcholine, at the right times, then, are vital to both create memories, and store them for the long term. This explains why drugs that block acetylcholine receptors, tricking the brain into thinking levels are low, can cause severe amnesia. People become unable to learn, their brains stuck in internal mode. These drugs can even cause hallucinations, possibly as a dramatic shift to focus on internal perceptions causes people to start ‘experiencing’ their memories, believing them to be real.

4. Serotonin

While it is undoubtedly one of the most important chemicals in the human brain, I have a love-hate relationship with serotonin, because of just how complicated its effects can be! When I started the book, I knew it would be important in my mood chapter, and that it would probably pop up in a couple of others. It turned out to be featured in 7 of the 8 topics I cover. And in each, it has a different effect.

Partly, this is because there are at least 14 different serotonin receptors. So neurons respond differently depending on which of these receptors sits on its surface. This means not only can serotonin have different functions in different brain areas, it can even have different effects within the same area.

Despite this, I have a soft spot for the chemical. Having the right balance in each brain area is vital for our brains to work optimally. It has a role in preventing us falling asleep during the day, helping us to use emotions to make decisions, and is linked to the obsessive feelings of early love. It can also ramp up or down pain signals, depending on which receptors are involved.

Then, of course, there are the links with mood and mood disorders. While the details of these are far from clear, there are lots of ways it might be involved – from helping us collect more positive information from our environment to acting as a growth factor, encouraging the birth and growth of new neurons in parts of the brain. Dysregulation in serotonin systems has also been linked to eating disorders, including anorexia, bulimia and binge eating.

5. Caffeine (adenosine)

It may not be a brain chemical, but I couldn't leave caffeine off this list because its effects on the brain chemical adenosine are why so many of us love it. During the day, adenosine builds up as a by-product of our

cells' metabolism. While we sleep, it is cleared away. So adenosine tracks how long we have been awake, and when we have had enough sleep.

When adenosine levels are low (e.g. after a good night's sleep), acetylcholine is released in the basal forebrain. This guides our attention towards external stimuli, making us feel awake and alert. When adenosine builds up, it prevents the release of acetylcholine, so we feel sleepy. Caffeine blocks the receptors normally triggered by adenosine, so our brains think the concentration is lower than it actually is. This means more acetylcholine is released making us feel more alert.

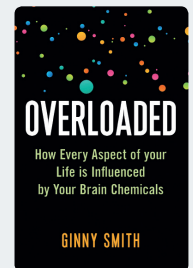
Unfortunately, we can develop tolerance to caffeine in just a couple of days. Once this has happened, you will feel more tired and sluggish before you have your coffee than if you had never drunk the stuff. All that first cup does is bring you back up to your natural baseline – although knowing this doesn't stop me reaching for a cup every morning!

6. Oxytocin

I couldn't write an article about the chemicals I love without mentioning the love chemical; oxytocin. First discovered to induce labour in pregnant animals and milk production after birth, scientists later found that oxytocin also helps animals bond with their offspring. We now know that the same is true in humans – parents with higher levels of the hormone have stronger bonds with their infants, and giving a parent oxytocin can boost activity in parts of their brain involved in empathy and reward.

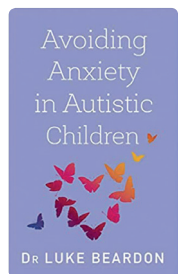
But it seems evolution has, in some animals, hijacked this system, and tweaked it to create pair bonds between adults. Evidence comes from prairie voles, one of few monogamous mammals. Unlike their promiscuous cousins the montane voles, prairie voles have receptors for oxytocin and a closely related molecule called vasopressin in the reward circuits of their brain. When they have sex, oxytocin is released, triggering these areas, so they learn to associate their partner with the rewarding effects of sex. That drives them to spend more time together. Block these hormones, and you lose the bonding effect. Humans too have receptors for oxytocin and vasopressin in a range of brain areas that have been linked to love, like the reward system and the limbic system. And oxytocin is released when you feel close to someone – either physically or emotionally, so it seems likely these hormones are vital for bonding in humans too.

So there you have it – my ‘greatest hits’ of brain chemistry. Of course, in a short article like this I can barely touch on the myriad of effects each chemical can have, and there isn't room to go into the fascinating stories of the scientists behind the chemicals – from the fighter pilot who revolutionised our understanding of sleep to the scientist who disobeyed her boss and discovered opioid receptors in the brain. But I hope you can begin to see the important role these tiny molecules have on all aspects of our life, and the incredible intricacy and complexity of the brain networks that use each one.



Putting autistic children at the centre

Avoiding Anxiety in Autistic Children: A Guide for Autistic Wellbeing
Luke Beardon
John Murray Press; £10.99



Approximately 70-80 per cent of autistic children are thought to experience anxiety. Luke Beardon's book, *Avoiding Anxiety in Autistic Children: A Guide for Autistic Wellbeing*, is an accessible and comprehensive guide for anyone who interacts with autistic children, written from an autistic perspective. Refreshingly, Beardon puts the autistic child at the centre of his writing, and therefore refers to them simply as children throughout. In comparison, non-autistic people are referred to as the predominant neurotype (PNT).

In line with the ethos demonstrated in his previous work, this book is based on Beardon's golden equation: autism + environment = outcomes. Beardon argues that the environment has to be changed to accommodate autistic children, rather than altering the child's behaviour to be more like the behaviour of the PNT. Therefore, autism should not and does not need to have such a strong link to anxiety, and the negative consequences of anxiety on the individual should not be inevitable.

Throughout, Beardon reminds the reader that although being autistic might put the individual at a disadvantage, being autistic is not wrong and that it is extraordinarily challenging to be autistic in a world that is not autism-friendly. For example, when a child is stressed because they want to interact but feel like they don't fit in, Beardon suggests addressing the situation by ensuring that the child is well informed about their own identity, and the PNT and others should understand and accept the autistic individual.

While this book is about anxiety in autistic children, there are elements that are relevant to many autistic adults. One author of this review, Kana, reflected that reading the book as an autistic adult was reassuring and comforting. There are also many parallels with Kana's own doctoral research investigating loneliness in autistic adults. Understanding the PNT, and increasing understanding and acceptance in others, may be important for autistic individuals throughout their lifetime in order to navigate the social world in a healthy and

realistic way, and to avoid loneliness.

Beardon's reflections on many years as both practitioner and researcher include many thoughtful (and sometimes humorous) examples based on true stories from the autistic community. These examples add real world context and insight into anxiety-inducing situations as experienced by each child. Beardon also provides alternative scenarios to show how changes to the environment can mitigate anxiety and its harmful outcomes. This practical advice about supporting autistic children is incorporated among chapters that address key topics, such as which education provision is best for each child, and what to say (or not say) when someone is anxious.

This thought-provoking book invites us to reconsider the harmful effects of practices and terminology commonly applied to autistic children; in doing so, we are reminded to reject a deficit-based model of autism and instead turn our attention to the myriad strengths that autistic children have to offer. Simply put, *Avoiding Anxiety in Autistic Children* provides a valuable learning opportunity to understand others' behaviours and become more compassionate to the people around us.

Despite the topic of anxiety and its harmful long-term consequences, the book remains optimistic throughout. Spoiler alert! Beardon ends book ends with: 'We can't stop a child from being autistic – but we absolutely can and should change the environment', emphasising the active role that readers could have. We were left feeling enthusiastic about advocating for autism and neurodiversity, and encouraged about the positive impact changes to overwhelmingly PNT-friendly environments can have for autistic children (and adults).

Reviewed by Maria Ashworth (PhD student), Kana Umagami (PhD student), Danae Malyan and Amber Pryke-Hobbes (placement students from the University of Kent), all of whom are researchers at the Centre for Research in Autism and Education (CRAE), UCL Institute of Education

Banishing toxicity at work

Toxic: A guide to rebuilding respect and tolerance in a hostile workplace
Clive Lewis
Bloomsbury Business; £14

Clive Lewis is a respected business psychologist with many years as a workplace mediator under his belt. One of the things that I really enjoyed about this book is that Lewis shares both his extensive practitioner experiences, and his more personal reflections and observations.

We know that diversity and inclusivity matter in organisations, ethically and in terms of business results. And yet our understanding of exactly how environments can become toxic and exclusive is often limited. This book is a guide to what

a toxic environment can look like and some of the constituent parts that come together to form that environment.

It is very readable, with lots of examples, and it is written in an accessible style. It provides theoretical underpinnings but is aimed at practice – and this makes it useful for managers and leaders regardless of their knowledge base. Each chapter ends top tips aimed at the three levels of organisational, line manager and employee. It also contains some practical guidance,

highlighting the value that Lewis places on having conversations, rather than relying simply on processes to reach resolution.

This book shows that organisations can make changes to create a healthy working environment, and that this not only benefits the individuals within them, but also makes sound business sense.

Reviewed by Emily Hutchinson, Associate Editor (books), Director of Apply Psychology

Stories of family love

Deputy Editor Annie Brookman-Byrne and PhD student Laura Cox ask Professor Susan Golombok about her book *We Are Family: What Really Matters for Parents and Children* (Scribe).

Annie: Why is the idea that children need a mother and a father so pervasive?

In the 1950s and 60s, most people had a mother and a father. Back then, divorce was seen as scandalous and shameful, unmarried women who became pregnant were expected to give up their babies for adoption, and until 1967, male homosexuality was a criminal offence. The idea that children need a mother and a father wasn't questioned. Instead, the prominent psychological theories of the day – psychoanalytic theory and social learning theory – were based on the premise that mothers and fathers play different, but complementary, roles in children's development and adjustment, so a parent of each gender was seen as essential for children's wellbeing. Since that time, there has been a gradual acceptance of non-traditional families, but families with a mother and a father are still held up as the ideal.

Today, some people champion the traditional family for religious, cultural or political reasons, whereas others believe that children are more likely to flourish with both a mum and a dad. This is partly because the early investigations on non-traditional families focused on children who had experienced their parents' divorce, which was associated with difficulties for children. The research on new family forms, described in *We Are Family*, tells a different story. Studies of families with lesbian mothers, gay fathers, transgender parents, single mothers by choice, and families created by egg donation, sperm donation, embryo donation and surrogacy, show that the quality of family relationships matters more for children's social and emotional wellbeing than the number, gender, gender identity, sexual orientation or biological relatedness of their parents.

Laura: What impact do you think television and social media have on the wellbeing of different types of families?

As television and radio programmes such as *Eastenders* and *The Archers* began to include different kinds of families, I think it brought about a greater understanding and acceptance of family diversity, particularly for older audiences, as did soaps such as *Modern Family* and *Transparent*, which presented new family forms front and centre. Social media have also played a role, for example, by facilitating contact between donor conceived people and their donors and donor siblings, i.e. genetic half-siblings born from the same donor but raised in different families, which has generally been a positive experience for those who wish to find out about their origins.



On the other hand, while the Internet can be a source of information and support, it can also have the opposite effect through online bullying. Another downside of the Internet is that people are inadvertently finding out that they were conceived using donated eggs, sperm or embryos through genetic testing kits in combination with online genealogy databases such as Ancestry.com and 23andMe. All it can take is a saliva sample for someone to discover that they are not the genetic child of their parents, and who their genetic parents are. This can be a devastating discovery for those whose parents hadn't told them that they were donor conceived. A donor's own children, who may not know that their parent was a donor, can be identified in this way too, and may be shocked to be contacted by someone claiming to be their half-sibling.

Annie: Your research shows that 'children can flourish in all kinds of new family forms'. How did it feel to share your findings and ultimately change child custody outcomes?

It wasn't easy in the early days. My first study, which I began in 1976, was of children in lesbian mother families. At that time, lesbian mothers inevitably lost custody of their children to their former husbands as it was not considered to be in the child's best interests to remain with a lesbian mother. When I was called as

an expert witness in these custody cases, the barristers acting for the father would do their best to discredit the research. It was very frustrating. Slowly, however, the research began to be taken seriously, especially when an increasing number of studies came to the same conclusions.

By the millennium, lesbian mothers no longer lost custody of their children because of their sexual orientation, and, in 2008, the new Human Fertilisation and Embryology Act allowed both partners in lesbian and gay couples to be joint legal parents of children born through assisted reproduction. Our research on other kinds of new family forms has also contributed to policy and legislation in the UK and internationally. This has been one of the most rewarding aspects of our work. A current example is the Law Commission's ongoing review of UK legislation on surrogacy, which considered our research on children born through surrogacy in their deliberations on how to update the law.

Laura: In the book you talk about going all over the country visiting families as an early stage researcher. How did your

research methods evolve, and what was most effective for getting to the heart of what matters for families?

The fundamentals haven't changed. I was originally trained in interviewing families for research by Sir Michael Rutter and his team at the Institute of Psychiatry in London. This approach involved in-depth and flexible questioning of parents and children to produce detailed information about relationships and family life, followed by the coding of the information generated by the interview according to a standardised coding manual. This allowed quantitative data to be produced not only from what was said, but also from how it was said, paying attention to non-verbal cues such as facial expression and tone of voice. Although the focus of the interview changes from study to study, depending on the type of family being investigated, the overall approach, which has proven to be a reliable and valid way of assessing family relationships, remains the same.

Today, we also use observational assessments of parent-child interaction, as these tell you something different about family relationships, and, combined with interviews, produce a more all-round assessment of family functioning. Although I was brought up very much in the quantitative tradition, when I moved to Cambridge in 2006 to direct the Centre for Family Research, I met researchers who studied families using qualitative methods. I learned from them the value of combining approaches, as they each address different kinds of questions to produce a more nuanced picture of family life.

Perhaps the biggest change has been in the tools we use. When I started out, there were no sat navs or mobile phones, and I had to cart a cumbersome reel-to-reel tape recorder around the country with me. I was dependent on public phone boxes if something went wrong, and the maps I used to locate families were of the paper variety. It's hard to imagine now, but not only did we not have laptops, we didn't even have personal computers. The methods we use today may be no more reliable or valid, but they certainly make life a whole lot easier!

Annie: Sharing the 'stories of love' in your book seems really important. I was fascinated to read about families like my own, especially as I have no friends with a similar family structure. Speaking to children about their thoughts, feelings and experiences has always been an important part of our research. One of my favourite studies was an investigation of the school experiences of children with same-sex parents, conducted in collaboration with Stonewall. The children told us that their classmates sometimes made negative comments that were

distressing, such as 'that's so gay' as an insult. When children saw others being picked on because they had lesbian or gay parents, they didn't feel able to be open about their own family.

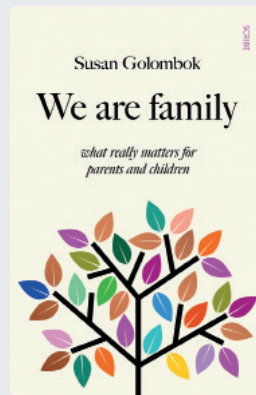
What I particularly liked about this study is that the children themselves came up with ten recommendations for schools. These included: teachers shouldn't assume that everyone has a mum and dad; different kinds of families should be talked about in school; families like theirs should appear in the books that they read and the films that they see; and schools should clamp down hard on homophobic bullying, something that doesn't always happen. Many schools have taken these children's concerns on board, but, sadly, some schools are thwarted in their attempts, as happened in 2019, when protests against teaching children about families with same-sex parents erupted outside primary schools in Birmingham.

Although one aim of the book was to discuss the issues and research findings relating to diverse family forms, a more important ambition was to let the families speak for themselves. I think that one reason why some people are so prejudiced is that they don't know much about families that differ from their own. When they hear their stories, they realise that although they may seem different, in terms of family life, they are essentially the same.

Laura: There are many aspects of family forms to both build on and investigate for the first time. If you were starting as a new researcher today, what would you focus on?

The early studies of each new family form focused on comparisons with traditional families because of the assumptions that had been made about them. Today, the more interesting questions relate to factors associated with variability in outcomes for children in different kinds of families. For example, how does stigmatisation affect children with LGBT parents? What protects children against the negative effects of stigmatisation? And how can schools be more inclusive and supportive? For children born through third-party assisted reproduction, what are their thoughts and feelings about their egg, sperm and embryo donors, and surrogates?

Also, because of the concerns that have been raised about new family forms, studies have generally examined whether the children are at risk for psychological problems. However, the differences that have been identified between new family forms and traditional families have generally pointed to more positive outcomes for new family forms. Now it's time for research to focus on the benefits rather than the deficits in parent-child relationships and children's psychological wellbeing.



Read *Laura Cox's review of We Are Family online*

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