



## INSIDE

- Was the Russian Revolution a feminist revolution?
- Using the psychology of colour to help learning
- Is Lolita a postmodernist work?
- How viable is nuclear fusion as an energy source?



Issue 1 - July 2023

# Contents

Foreword	Simon Ross, Principal	3
<b>English Literature</b>		
Evaluate how relevant Poe's critical theories are to his poem 'Alone'.	<b>Aaron Strathdee</b>	4-7
To what extent is Vladimir Nabokov's <i>Lolita</i> a postmodernist text?	<b>Mahlaka Imran</b>	8-11
<b>History</b>		
Was the Bolshevik Revolution a Feminist Revolution?	<b>Sophie Fuller</b>	12-16
To what extent were ancient Roman (510 BCE - 476 CE) public health initiatives similar to those of the late modern era (1800 CE – present)?	<b>Archie Donoghue</b>	17-20
<b>Science</b>		
To what extent has cancer research developed over the last twenty years?	<b>Abbie Potter</b>	21-24
What is nuclear fusion and how viable is it as an energy source, both in the present and the future?	<b>Oliver Garratt</b>	25-27
To what extent would the scientific world be affected if dark matter was not real?	<b>Louie Dixon</b>	28-30
<b>Psychology</b>		
To what extent do mindfulness meditation practices improve psychological function and well-being?	<b>Katie Dodds</b>	31-35
To what extent can the psychology of colour help students in the learning environment?	<b>Zahraa Khan</b>	36-39

*Front cover image: 1918 Bolshevik poster calling on 'Women workers take your rifles'.*

# Foreword

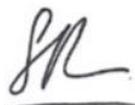
It is with great pleasure that I write the foreword to the Academic Journal. The scholarly, rigorous, and diverse work contained within these pages is a testament to the incredible students and teachers at Newcastle Sixth Form College.

The English education system is almost unique in the world, with its narrowing at age 16 to just 3 or 4 subjects, and accompanying heavy focus on end point assessment through high stakes external examinations. It is therefore a joy to see NSFC students revelling in the independent and wide ranging research contained in these articles. Students only one year on from sitting GCSEs have confidently investigated and analysed topics ranging from Nabokov to nuclear fusion; from public health to Edgar Allan Poe. In doing so, they have followed the curious drive that is at the heart of all powerful learning.

I would encourage students to read the work of their peers, particularly where

their research is in areas outside their own expertise and interests. Debate, discuss, disagree amicably and develop your understanding as you go! Visitors to the Sixth Form often comment on the vibrancy of a college which is as academic as it is inclusive, and where students aspire to ambitious and diverse destinations. Projects like this are a key part of making those aspirations real.

Finally, I would like to thank all those who have supported the students in their research whether they be teachers, support staff, friends, or family members. Particular thanks must go to Daniel Duggan, Stretch and Challenge Tutor, without whose efforts this journal would not exist.



Simon Ross, Principal

## **Evaluate how relevant Poe's critical theories are to his poem 'Alone'.**

**By Aaron Strathdee**

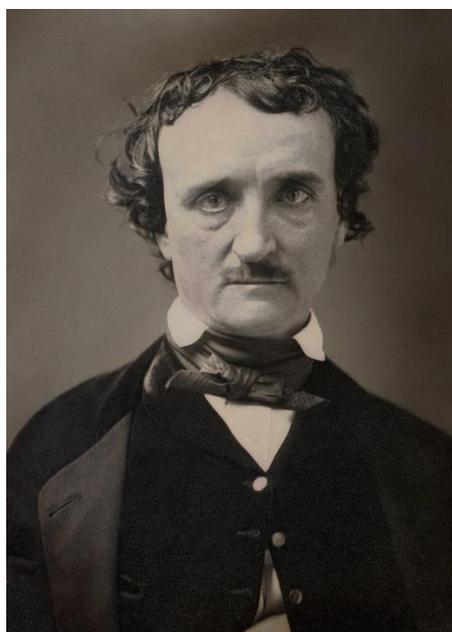
Edgar Allan Poe's poem 'Alone' (written in 1829, published posthumously in 1875) is shaped by a number of Poe's key literary theories. Poe (1809-1849) was a nineteenth-century Romantic writer and one of America's first major literary critics. The impact of his critical theories can be seen throughout his works and are further explained in his essays, such as, 'The Philosophy of Composition' (Poe, 1846). His main theory is 'unity of effect', the idea that a writer should first decide the effect they aim to create and then use their creative skills to achieve this effect throughout the poem. This informs Poe's other theories, such as the correct length and subject of a poem as well as the importance he attaches to beauty (Lybyer and Roberts, 2023). Although his autobiographical poem 'Alone', written seventeen years before his 'The Philosophy of Composition', explores Poe's feelings of isolation and depression during childhood and is valuable in illustrating how his theories impacted his earlier work, nevertheless, it contradicts some of Poe's later views. In particular, the poem lacks a literal closed environment, diverges from the topic Poe considered the most poetical, and has a shorter than ideal length.

'Unity of effect' is clearly evident in 'Alone', where the author's feelings throughout his childhood create a strong emotional response of loneliness and melancholy. This method of creating effect is described in Poe's essay 'The Philosophy of Composition'. He explains that he begins by first choosing the emotional response he wants to create and then decides between tone or plot to achieve this. Poe utilises techniques, such as pathetic fallacy, to achieve this tone. For example, the quotations 'stormy life',

'lightning', and 'cloud' present his childhood as depressing and difficult, causing the reader to feel sympathy. The reoccurring description of his childhood as a storm could also symbolise his anger at key events, such as being deserted by his father when he was very young and the conflict with his foster father, John Allan. Poe may be outlining the harmful effects the lack of a supportive father figure had on his childhood, thus encouraging parents to have more positive and supportive relationships with their children. However, this contradicts another of Poe's theories: poems should not be moral or allegorical as this does not appeal to the reader's sense of beauty (Poe, 1850). Through use of tone and imagery of nature, Poe achieves unity of effect, following his main literary theory. However, 'Alone' can be seen as in conflict with another of his theories and, therefore, limiting their relevance to his earlier poems.

Poe constantly emphasises the importance of beauty in poetry, stating "Beauty is the sole legitimate province of the poem" (Poe, 1846, 164) and used this to justify his opposition to didacticism in art; anything that only appeals to the intellect cannot, for Poe, create beauty or emotional response. Poe also aims to create a sense of melancholy, believing it to be "the most legitimate of all the poetical tones" and, therefore, the death of a beautiful woman is "the most poetical topic in the world" (Poe, 1846). Although the subject of 'Alone' is himself, Poe is still able to create an effect of both beauty and melancholy through his descriptions of nature, such as, "From the sun that round me rolled/ in its autumn tint of gold" (Poe, 1977, 526). Poe uses the beauty of nature to further emphasise the

sadness of his childhood, as although, the sun brought others happiness, he was unable to feel the same and instead focused on “the lightning in the sky” (Poe, 1977, 526). The equally beautiful description of the negative aspects of nature reflect how Poe is able to create works of art, such as, ‘Alone’ out of his negative experiences. The sense of beauty is further created through a regular rhyming scheme and rhythm which are commonly seen in Poe’s poetry and are important elements of lyric poems – poems that express the feelings and emotional reflections of a first-person speaker. Although ‘Alone’ doesn’t feature ‘the most poetical topic’ Poe’s critical theories are still relevant as it is both beautiful and melancholic, due to the contrast between his feelings of sadness and isolation with descriptions of beauty in nature.



**Edgar Allen Poe**

Another reoccurring theme in Poe’s work is the use of a closed environment. Although not discussed in any of Poe’s essays, it is a mechanism he uses to achieve unity of effect in many of his

poems and short stories (Lybyer and Roberts, 2023). For example, in ‘The Raven’ all action takes place in a closed room, which contributes to the unity of effect by emphasising that the narrator’s grief is inescapable and showing that, as a result of his loss, the narrator is isolated from his friends and family, exacerbating his mental instability. In contrast, the poem ‘Alone’ does not use a literal closed environment as it describes landscapes such as “the red cliff of the mountain” and the sky that are reminiscent of the descriptions of sublime nature often seen in romantic literature. However, a major theme in Poe’s work is madness and, in many of his works, the action takes place inside the narrator’s head. For example, in ‘The Premature Burial’ the apparently real events in the story actually take place only in the protagonist’s imagination. It could be argued that ‘Alone’ does use a closed environment as everything described takes place inside Poe’s head and the nature depicted in the poem is symbolic of the writer’s experiences and feelings, rather than external reality. For example, the quotation “From the torrent or the fountain” uses the different ways water can flow as a metaphor for how life can be experienced. The word ‘fountain’ has connotations of beauty and fun which may be reflective of how Poe views the ideal childhood. Conversely, the word ‘torrent’ shows how his own childhood was overwhelming. The fast-paced flow of the water implies that Poe was forced to grow up quickly because of the tragedy he experienced as a child, such as the death of his mother when he was two years old and the subsequent separation from his siblings. Overall, Poe does not use a physical closed environment in ‘Alone’, however, the poem still follows this theory by focusing on thoughts and feelings inside Poe’s head.

Length is another major focus of Poe's literary criticism. In both 'The Poetic Principle' (Poe, 1850) and 'The Philosophy of Composition', Poe argues that a 'long poem' doesn't exist and epic poems, such as 'Paradise Lost' (Milton, 1667) are better interpreted as a succession of shorter poems. Due to its length, Poe suggests the poem is "deprived...of the vastly important artistic element, totality, or unity of effect" (Poe, 1846, 164). Furthermore, Poe argues that a poem should be able to be read in one sitting as if more than one is required, the reader's daily life will disrupt the unity of effect and the writing will therefore not achieve the desired emotional response. 'Alone', being only 22 lines long, can be easily read all at once and therefore achieves the consistency of impact that Poe desired. However, Poe also explains that a poem can be too short, which results in a lack of "profound or enduring effect" (Poe, 1850, p232). In 'The Poetic Principle', Poe critiques Percy Shelley's poem, 'I Arise from Dreams of Thee', using it as an example of "the effect of undue brevity in depressing a poem" (Poe, 1850, p232). Poe argues that this poem is not as successful as Shelley's other works because it is too short to establish unity of effect (Poe, 1850). This, however, is contradicted in 'Alone', which is two lines shorter, suggesting it may also struggle to maximise the emotional impact. Nonetheless, an enduring effect is still created through the ambiguity of 'Alone' as the reader is left thinking about the symbolism used and what could have caused Poe to feel this way during his childhood. The ending of the poem gives no insight to the writer's future, heightening the sympathy the reader feels. The unity of effect is clearly achieved through the continuous emphasis on Poe's isolation. An example of this is the repetition of "I have not" and "I could

not" in the first six lines that immediately establishes the separation Poe feels from others because of not being able to relate to their positive emotions, leading to Poe feeling like an outcast. This theme continues at the end of the poem in the quotation, "the cloud that took the form (When the rest of heaven was blue)" (Poe, 1977, 526). The colour 'blue' represents the positivity he sees in others, while the 'cloud' isolates him from this, creating a dark, bleak atmosphere. Therefore, despite contradicting Poe's theories about the correct length of a poem, 'Alone', still achieves a profound and enduring effect due to the strong emotional response it creates in the reader.

To conclude, by discussing Poe's literary theories in relation to 'Alone' their relevance is apparent, albeit to a limited extent. Unity of effect is achieved in 'Alone' through the subject, language, and the use of 'closed environment'. By doing so it elicits an emotional reaction from the reader. The effect achieved is both beauty and melancholy, reflecting Poe's ideas on the correct topic for poetry. This effect is not broken as the poem can be read in one sitting. However, 'Alone' does contradict some of Poe's theories as 'Alone' can be considered to have a moral and doesn't fit with the length criteria he later advocated. 'Alone' was written in 1829, seventeen years before the publication of 'The Philosophy of Composition', suggesting that Poe's views on literary criticism may have evolved after writing 'Alone', as well as reflecting his development as a writer.

### **Bibliography**

Lybyer, J. M., and Roberts, J.L. (2023). *CliffsNotes on Poe's Short Stories* <https://www.cliffsnotes.com/literature/p/pires-short-stories/edgar-allan-poe-biography>

Milton, John. (1667). *Paradise Lost*. (J.W. Lovell Company; New York, USA).

Poe, E.A. (1846). *The Philosophy of Composition*. 'Graham's American Monthly Magazine of Literature and Art', 28:163-167.

Poe, E.A. (1850). *The Poetic Principal*. 'The Union Magazine', 7:231-239.

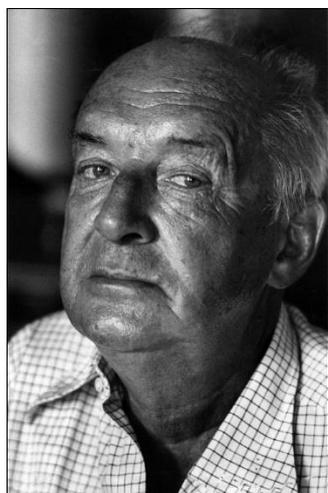
Poe, E.A. (1977). *Alone*. (Penguin Books: Kingsport, Tennessee, USA).

Poe, E.A. (2016). *The Raven*. (William Collins: London, United Kingdom).

## To what extent is Vladimir Nabokov's *Lolita* a postmodernist text?

By **Mahlaka Imran**

To understand Vladimir Nabokov's *Lolita*, and to understand postmodernism, requires us to isolate the two and pick them apart. To some, *Lolita* is a 'small masterpiece, an almost perfect comic novel' (Kirsch, 1958). To others, however, it is 'highbrow pornography' and 'disgusting' (Prescott, 1958). There is wide variance in how *Lolita* is perceived but this, arguably, marks it as a classic. Postmodernism can be defined as a 'set of critical, strategic and rhetorical practices employing concepts such as difference, repetition, the trace, the simulacrum, and hyperreality' (Stanford Encyclopaedia of Philosophy, 2005). Postmodernist literature can be seen as a protest to modernism, with its metanarratives and intertextuality. In *Lolita*, as this essay will show, Nabokov firstly makes use of fragmented 'narrative mastery' (Wetson, 2000), full of linguistic prowess and irony. Secondly, he employs a playful, unreliable, and morbid narrator. And thirdly, he makes use of broad intertextuality. As a result, it will be argued that *Lolita* bridges the gap between modernism and postmodernism and Nabokov belongs to both traditions.



**Vladimir Nabokov**

When it comes to the narrative of *Lolita*, Nabokov splits it into two components - a set of chapters each, full of 'balances, repetitions, and oppositions' (Triggs, 1988) where separating a story into two parts means exploring the very depths of it with new feelings and nuances and employing a layered structure. The former part of the novel can be said to be a self-centred narrative focus where the protagonist is introduced and explored, while the latter part goes into the depths of other characters and how their role interlinks with the protagonist. The narrative is framed by a foreword written by a third, fictional person who uses the alternative title of the 'Confession of a White Widowed Male', being referred to as a 'work of art' (Nabokov, 3). It is then established that by essence this is a confessional story, a testimony of some sin that has taken place, one of grandeur and great learning. It is posed in a conversational and frisky tone, a direct address to the jury, tugging at sympathy. It pleads a justification for predatory behaviour with the use of language and sentiment in a way that tries to subjectify a morally objective experience. Nabokov fulfils an almost epistolary function often associated with postmodernist literature whereby there is an induction of established documents composed by the protagonist inside the fictional world. In addition, *Lolita* also takes on the postmodernist obsession with recollection of the past, the 'visual memory' (Nabokov, 10) that is diverse and important for the narrator, becoming the primary tool for his storytelling, and canvassing the whole of his life. A first-person narrative is utilised by Nabokov, making the witty Humbert Humbert even more personal in a way that exemplifies his personal

characteristics and subtle quirks which cannot be carried on by another form of narration. However, it may be argued that it is not whether a writer chooses first person or not, it is more "the *emotional posture* you've taken toward your characters and sort of *narrative latitude* you desire." (Almond, 2011). Nabokov takes on an emotional posture that is upright in its decision to hand over emotional judgement to the protagonist, creating a humanity and morality befitting to himself, and by doing this, expanding the moral understanding of the reader. In doing so, he creates a character directly befitting postmodernism and the flexibility of interpretation.

When it comes to the 'artfully unreliable narrator', Nabokov 'works against the clock to tie up his narrative threads' (Moore, 71). He is able to manipulate time's chronological order of events to paint a picture that fits his own aesthetic sense. The term 'unreliable narrator' was famously coined by Wayne Booth in his seminal *Rhetoric of Fiction*. When a narrator is unreliable, there is a contradiction between his presentation of events and the objective reality of them. One learns to then read between the lines and conclude that the narrator is either withholding the true version of the story or is lacking the ability to tell it (Chatman, 149). Humbert Humbert's inability to retell memories with factual and impartial evidence suggests his unreliability. In his own words he describes himself "a murderer with a sensational but incomplete and unorthodox memory" (Nabokov, 57). When it comes to postmodernism, 'the idea of representation can no longer exist according to the traditional norms, in that there is no way to 'realistically' portray reality' (Lindas, 2013). Therefore, just like *Lolita*, for the postmodernists, reality becomes a more subjective experience,

selective and partial in its narration (Lindas, 2013). Nabokov then becomes a writer who can make a flawed protagonist and fashion him in order to fulfil postmodernist functions, further underlining the extent to which *Lolita* is a postmodernist text.

Intertextuality, or references to other texts within a text, is a term coined by Kristeva. Intertextuality is accomplished by using "direct reference, allusion, quotation, echo, plagiarism, collage, mosaics, palimpsest and others" (Pokrivčák, 20) and maintains that a text "cannot exist as a hermetic or self-sufficient whole, and so does not function as a closed system" (Worton and Still, 1991). The concept of intertextuality became common for the textological theory of postmodernism, admitting that interaction between the text and sign context serves as a fundamental condition for sense creation (Bezrukov, 2017). *Lolita*, holding some of the early postmodernist attributes, also holds evidence for intertextuality. Nabokov satirises pornographic novels by retaining a confessional tone, but withholding overtly lascivious and lewd descriptions, and incorporating a humorous, amusing energy. For example, 'Humbert Humbert had on his hands a large, puffy, short-legged, big breasted and practically brainless baba' (Nabokov, 217). While Nabokov retains physical descriptions often associated with erotic text, he also does it in a way that is in no form a serious regurgitation that fulfils a conventionally erotic purpose. He also holds an ironic repetition when it comes to satirising doppelganger stories, but this tool goes beyond just *Lolita* for Nabokov, and finds its way into some of his other works like 'Despair'. In *Lolita*, Nabokov creates a second conscience for Humbert with the name of 'Clare Quilty', described as 'a broad-backed man, baldish, in an

oatmeal coat and dark-brown trousers' (Nabokov, 246). It has been popularly noted that the name of Humbert Humbert sounds familiar in its association to William Wilson on an intertextual level, the story of the same name by Edgar Allan Poe. At the point where Quilty "refuses" to die, it may refer to Gogol's double story 'The Nose' (in which "a nose would not at first stick to its owner's face") (Appel, 62). *Lolita* is for Appel "a burlesque for the confessional mode, the literary diary, the Romantic novel that chronicles the effects of a debilitating love, the Doppelgänger tale, and in parts, a Duncan Hines tour of America by a guide with a black imagination, a parodic case study, and (...) 'a wicked imitation of many other...literary habit[s]'" (Appel, 58). *Lolita*, therefore, becomes a novel that is one of a kind in the way that it floats over the various genres of the concept of a book, fitting into the classical postmodernist ideals and going beyond itself as a singular text.

Nabokov believed that for a writer it is not important to be labelled or to belong to any literary school. Despite his insistence that "the reader has no business bothering about the author's intentions" (Dipple, 1988) many critics still struggle today to label him (Danglli, 2010). Nabokov, in his early works, retains modernist functions, like anti-realism, intellectualism, a rejection of the traditional literary orders, and general experimentation. While he holds modernism as his root in the course of his literary history, his later works, like *Lolita*, are replete with postmodernist attributes that include, as stated earlier, a rich, unique writing style, fragmented narration, an unreliable narrator, intertextuality, and irony. But while modernism views a story within an air of seriousness and meaning, postmodernism does away with this in order to build a

farce, an apathy towards a meaning, an acceptance of the internal conflict of a structure, and of the absurd. Nabokov, in his novel *Lolita*, successfully uses these postmodern sentiments and moulds them into his own conception of a story, qualifying him to express a postmodern identity.

### **Bibliography**

Almond, Steve. "POV: NBD." *In This Won't Take But a Minute, Honey*. Self-published, Harvard Book Store's Espresso Book Machine.

Appel, Jr. Alfred. "Introduction." *The Annotated Lolita. By Vladimir Nabokov*. (London: The Penguin Group, 2000).

Booth, Wayne C. *The Rhetoric of Fiction*. (Chicago: Chicago University Press, 1961).

Chatman, Seymour. *Story and Discourse: Narrative Structure in Fiction and Film*. (Ithaca, NY, and London: Cornell University Press, 1978).

Danglli, Griselda. "Vladimir Nabokov as a Bridge between Modernism and Postmodernism", Volume 3/1, 2010.

Dipple, Elizabeth "The unresolvable plot-reading contemporary fiction", (Taylor & Francis, 1988).

Lindas, Julie. 'Departmental Honours: Humanities Engaging with Postmodernism An Examination of Literature and the Canon', April 2013.

Nabokov, Vladimir. *Lolita*, (Penguin Books, 1995).

N. Bezrukov Birsk, Andrey. 'Intertextuality Reception In Postmodernist Discourse', VIII/2 2017: 263–271.

Pokrivčák, Anton, Pokrivčáková, Silvia.  
*Understanding Literature*. (Brno: MSD,  
2006).

Stanford Encyclopaedia of Philosophy,  
First published Fri Sep 30, 2005;  
substantive revision Thu Feb 5, 2015.

Still, Judith and Michael Worton Ed.  
*Intertextuality: Theories and Practices*.

(Manchester: Manchester University  
Press, 1991).

Triggs, Alan. *Humbert Rising: The Nature  
and Function of the Two Parts in Lolita*,  
(Jeffery 1988).

Weston, Elizabeth. *Narrative Mastery and  
Representational Violence in Vladimir  
Nabokov's "Lolita"*, College of William &  
Mary - Arts & Sciences, 2000.

## **Was the Bolshevik Revolution a Feminist Revolution?**

**By Sophie Fuller**

The Bolshevik Revolution of October, 1917 saw leftist revolutionaries seize power from the unpopular Provisional Government. For the Russian population, it marked the final stage in the transition away from the former Tsarist autocracy towards a socialist state that promised freedom and equality. For women, the Bolshevik revolution was an opportunity for legal, social, and political empowerment to an unprecedented degree. A feminist revolution refers to a movement which seeks to create a society devoid of gender inequality. In suggesting that the Bolshevik revolution was a feminist revolution, the work of the Zhenotdel (the Women's Section of the Communist Party) will be examined in the first half, including the war on illiteracy and the legalisation of abortion. The significance of early Bolshevik legislation in achieving legal equality for Russian women will be considered in the second half, with an emphasis on the changing role of women within the family unit and the workplace. The later repression faced by women under Josef Stalin can be considered to limit the extent of which the October revolution was feminist.

However, the short-term progress made in the emancipation of women following the Bolshevik revolution undeniably set a universal benchmark which has had a long-term influence on the later feminist agenda of the twentieth century and an immense impact on the rights of the modern woman. Thus, the Bolshevik Revolution was a feminist revolution.

In 1919 Inessa Armand and Alexandra Kollontai established the Zhenotdel as a stimulant for political enlightenment designed to emancipate women from domestic slavery. The way the Zhenotdel aimed to do this was through educating

women who were previously excluded from accessing education, with a focus on women not from wealthy backgrounds. In central Asia, it was hoped that Muslim women could induce change in place of an adequate proletariat and, as a result, literacy campaigns were launched throughout the area. The bureau distributed propaganda among female workers which encouraged them to support the revolutionary process and to adopt the new Bolshevik way of life. For the first time, the government in Russia was clear in its commitment towards women becoming politically conscious and involved in society in the same capacity as their male counterparts. Through the Zhenotdel's war on illiteracy, the pre-revolutionary statistic which declared only 16.6% of women as literate increased to 42.7% (Total Literacy Rate, 2000) in the decade after the October Revolution. Literacy campaigns targeted women who were disadvantaged in terms of education through mobile libraries, literacy classes taught by voluntary teachers, and the declaration of education as universally accessible to both girls and boys. Notably, universities and other higher education institutions were opened to women and allowed women to pursue careers in fields, including medicine and engineering, which were previously dominated by men. The inclusion of women in higher education also meant that they were more likely to adopt the radical ideology which had spread amongst students before the revolution which, in turn, assisted women in becoming politically conscious.

The Zhenotdel served both feminism and communism equally in campaigning for the education of women. For women, education meant a step towards equality

and increasing independence from previous domestic confinements. It also symbolised a declining emphasis on the importance of wealth which had divided the experiences of women. For Bolshevik society, it meant economic advancement due to a more efficient workforce and a step towards the idealised Bolshevik society which stressed equality. Conversely, the political enlightenment was limited as the Zhenotdel opted to disband external women's organisations despite them often being set up by Zhenotdel workers. On one hand this can be considered to stray from a feminist agenda, however, the state endorsement of revolutionising women's status, especially through delegates' meetings, in which elected delegatki (women trained through apprenticeships to hold positions within government) attended and discussed women's issues, clearly disproves the claim that the revolution was not feminist. Perhaps, instead, the revolution can be considered censored in its feminist aspects, yet this does not disqualify that it made notable advancements in the education and political consciousness of women. Thus, the Zhenotdel's work in the war on illiteracy was part of a feminist revolution.



**Alexandra Kollontai**

The Zhenotdel also contributed towards the legalisation of abortion in Russia – a monumental decree which surpassed the societal changes that were occurring throughout Western nations. The official decriminalisation of abortion on 18th November 1920 by the Commissars of Justice and Public Health was, perhaps, the most notable factor which illustrates the Bolshevik revolution as a feminist revolution. The decree emerged as a solution to the high maternal mortality rates which had become a major health issue in Russia due to women being restricted from safely accessing the medical care they required. A controversial aspect of the decree was that it permitted abortion on social grounds in addition to medical justifications. Internationally, the decree was used as an exemplar for those who urged change elsewhere. For example, in Germany it was referenced during discussions concerning the removal of paragraph 218 of the German Criminal Code, which set out the punishments for abortion (Solomon, 1992). Furthermore, between 1927 and 1932, two public exhibitions

were held in Germany which showcased the accomplishments of public health in Soviet Russia. The decriminalisation of abortion is one of the most remarkable changes resulting from the Bolshevik revolution as Soviet Russia became the first country to legalise a medical practice now considered a human right. It was an unprecedented transition towards equality, and the greater bodily autonomy granted to women by the edict is a clear representation of the feminist revolution which occurred alongside the Bolshevik revolution.

In suggesting the October revolution drove female emancipation, Barbara Evans Clements gives particular focus to the Bolshevik party's rise to power which signified a concrete change in women's status before the law. The opposition to gender inequality was borne from an ideological standpoint: that gender oppression defied Marx's 'universal class' by dividing the proletariat. As such, the Bolshevik revolution triggered notable legal changes which were revolutionary insofar as they had a transformative impact on the status of women. A new Bolshevik constitution in 1918 saw women declared equal to men for the first time. This revoked the legal protection which enabled the oppression of women, such as the tsarist law which gave men the right to beat their wives. The constitution also enfranchised women and allowed them to stand for election as they could in Western nations. This was notable progress when considering the previous social backwardness of Russia in comparison to the West. In combination with the political enlightenment, this demonstrates that the revolution was a turning point in the perception of women who were previously regarded as decorative and lacking the masculine ability to have a meaningful impact on politics. Furthermore, the revolution

deconstructed marriage as a religious institution. Secularisation under the Family Code of 1918 meant that divorce was simplified and more accessible, particularly for women in violent and abusive relationships, thus granting further independence to women. The early legislation of the Bolsheviks was a watershed moment in the status of women in Russia as it revolutionised the family unit and revoked the laws which prolonged gender inequality. Hence, the Bolshevik revolution was undeniably a feminist one in terms of transforming the legal status of women.

This theme of female empowerment continued in the legislation passed regarding the workplace. In their 1919 political programme, the Bolsheviks declared their intent to "free women from the material burden of obsolete domestic economy" (Baggins, 2006). Realistically, the changes were not so much prompted by a genuine belief in the emancipation of women as a desire for the female endorsement of the new Bolshevik government and to enhance the efficiency of the workforce by uniting the proletariat. In disproving that this is a hinderance to a feminist revolution, it is crucial to consider that, regardless of motivations, the position of women in Russian society did change and left a long-term impact on the expectations of gender equality. The 1918 Labour Code drafted by Kollontai, the Commissar of Social Welfare, banned pregnant women from working overtime or nightshifts and allowed paid maternity leave before and after birth. The latter is particularly notable when considering that until the Sex Discrimination Act passed in 1975, pregnant women in Britain could be dismissed if they decided to take maternity leave. Furthermore, the Code allowed breastfeeding mothers regular breaks during their shifts to nurse their

children. For a workforce with a high percentage of female workers, this was particularly significant in easing the burden placed upon women who were expected to wield the double-edged sword of work and home. The 1919 Labour Code ensured equal pay for both men and women and, by the end of the year, the Zhenotdel had enforced a law which ensured one female delegate in the inspectorate of every enterprise, ensuring that businesses adapted to the needs of the women workers rather than simply disregarding them. The transformation of the workplace under the Bolsheviks is crucial in demonstrating the feminist revolution that took place in Russia as it improved the opportunities presented to women and eased the burden faced by those who were employed – both matters which had been previously neglected as a result of patriarchal attitudes.

In conclusion, the immediate aftermath of the Bolshevik revolution was undeniably a feminist revolution due to both the liberation of women from domestic slavery and the rights gained by women in Russia, many of which surpassed that of major Western nations. The latter is particularly striking when considering the historic cultural backwardness of Russia in comparison to the West.

Unfortunately, for Soviet women in the early twentieth century, much of the progress made in terms of a feminist revolution was repressed under the leadership of Stalin who desired a return to traditional family dynamics. Under Stalin, abortion was banned and numerous laws which granted basic human rights to women were revoked, including the 1918 Family Code. Nonetheless, the vast legacy of the Zhenotdel's work and the legislation enacted by the early Bolshevik government is undoubtedly significant. The precedent established under the Bolshevik government had a considerable

impact on the international debate concerning the 'woman question' and created a model of women that is strikingly like that of the modern era. Thus, the Bolshevik revolution can be considered a feminist revolution in both the short-term transformation of the status and rights of women in Russia and in its long-term influence on the feminist movement in the later twentieth century and the rights women possess in the modern era.

### **Bibliography**

Avdeev, A., Blum, A., Troitskaya, I. (1995) *'The History of Abortion Statistics in Russia and the USSR from 1900 to 1991'*, Population: An English Selection, 7, pp. 39 – 66.

Clements, B. E. (2012) *A History of Women in Russia*. Indiana : Indiana University Press.

Gaido, D., Baggins, B. (2006) *Political Program of the CPSU* Available at: <https://www.marxists.org/history/ussr/government/1919/03/22.htm> (Accessed: 28 May 2023).

Galili, Z. (1990) *'Women and the Russian Revolution'*, *Dialectical Anthropology*, 15(2/3), pp. 119-127.

Hayden, A. E. (1976) *'The Zhenotdel and the Bolshevik Party'*, *Russian History*, 3(2), pp. 150-173.

Hewes, A. (1920) *'Labor Conditions in Soviet Russia'*, *Journal of Political Economy*, 28(9), pp. 774–783.

Lauglo, J. (1988) *'Soviet Education Policy 1917-1935: From Ideology to Bureaucratic Control'*, *Oxford Review of Education*, 14(3), pp. 285-299.

Llewellyn, J., McConnell, M., Thompson, S. (2019) *Soviet Social Reforms*. Available at:

[https://alphahistory.com/russianrevolution/soviet-social-reforms/#To\\_liberate\\_women](https://alphahistory.com/russianrevolution/soviet-social-reforms/#To_liberate_women) (Accessed: 28 May 2023).

'*Political Program of the CPSU*',  
International Socialist Review, 22(4), pp.  
115-124.

*Sex Discrimination Act 1975*, c. 65.  
Available at:  
<https://www.legislation.gov.uk/ukpga/1975/65/enacted>.

Solomon, S. G. (1992) '*The Soviet  
Legalization of Abortion in German Medical  
Discourse: A Study of the Use of Selective  
Perceptions in Cross-Cultural Scientific*

*Relations*', Social Studies of Science, 22(3),  
pp. 455-485.

Sorrell, N. (2023) *Women, the family, and  
the Russian Revolution*. Available at:  
<https://socialist.net/women-family-and-the-russian-revolution/#> (Accessed 27  
May 2023).

Spring, M. (2018) 'Decriminalisation of  
Domestic Violence in Russia leads to Fall  
in Reported Cases', *The Guardian*, 16  
August. Available at:  
<https://www.theguardian.com/world/2018/aug/16/decriminalisation-of-domestic-violence-in-russia-leads-to-fall-in-reported-cases>.

## **To what extent were ancient Roman (510 BCE - 476 CE) public health initiatives similar to those of the Late Modern Era (1800 CE – Present)?**

**By Archie Donoghue**

### **Introduction**

With the Industrial Revolution came a surge in urbanization and population growth unlike any previous time in history. It sparked the need for innovative ideas about controlling public health across the continents, and the effects of this are still seen to this day; life expectancy of the average human being, for example, has increased by 149% globally since 1800 - an extraordinary statistic that increases each year (Roser, 2013; IMUS, 1988). To understand how our ideas about public health have developed, it is vital we look back to its origins in antiquity – specifically, ancient Rome – as this represented a foundation of thinking that was repeated and then surpassed in the modern era. This essay will compare modern public health initiatives to those of ancient Rome to discuss their respective effectiveness, knowledge, and structure before concluding on the similarities between public health today and ancient Rome, and why these are significant.

### **Literature Review**

'The Future of Public Health' by the US Committee for the Study of the Future of Public Health suggests the growth of scientific knowledge about the control of mass disease, alongside the acceptance of the public that their health is their responsibility to control, are the primary reasons for improved public health. Although the study explores these ideas thoroughly it, nevertheless, fails to offer a historical grounding. This is unfortunate as it could inhibit any meaningful conclusions.

In contrast, 'Greek Medicine Practice at Ancient Rome: The Physician Molecularist Asclepiades' by Luigi Santacroce Lucrezia Bottalico and Ioannis Charitos does provide a historical interpretation. The authors effectively describe the basis on which Greek medicine had its foundations, and how Greek Physicians acted in Roman systems of care. This includes a dive into the morality of the Greek physician Asclepiades and his views on the human body, as well as Galen and his opposing views after Asclepiades's death. This was because Asclepiades' views were primarily atheistic and deviated from the typical medical thinking in Rome at the time. However, this focus on Greek ideas does not effectively capture the diverse views during antiquity. In contrast, by looking at Rome as a whole, this essay aims to correct this.

### **Main Discussion**

Before addressing the state of knowledge at the time, we must explore the structures by which health was managed. Public health in Rome was politically regulated. 'Aediles' - elected officials - had responsibility over Rome's aqueducts, sewers, fountains, public baths, and the grain dole (a system of welfare which gave subsidized grain to Rome's poor). Similar roles existed in settlements across the empire, though varied from city-to-city. At its height, Rome was served by eleven major aqueducts, which varied in use from public baths and fountains to private use among the wealthy (Dembskey, 2009). This is where the Romans' reputation as skilled engineers flourished. The water supply is one of their crowning achievements, with advanced sewerage

and drainage, alongside effective town planning and even organized garbage disposal in cities. Physicians themselves trained as apprentices and were typically slaves put through training by their masters. Outside of serving the wealthy, physicians were well respected and could hold a variety of roles - which tended to stem from employment by city and municipal governments. This included working in a city-owned public hospital, controlling infection as a 'Community Doctor,' serving as a military surgeon on a campaign, and private practice. Some scholars have argued that most had to turn to private care, and while this will have been true before the arrival of the Greeks in Rome, accounts from respected physicians, such as Galen, suggest that in the imperial period, public healthcare was widely available (Tulchinsky, 2014; Santacroce, 2017; Karabatos, 2021).



**Aqueduct Pont du Gard, constructed in 50CE in the Roman province of Transalpine Gaul**

Nations of the late modern era would not reach this level of intricacy until the completion of reforms in the nineteenth-century, which were preceded by growing movements for sanitation reform across Europe and the United States as urbanization increased. Academics and

experts argued that it was the state's responsibility to ensure public health was properly regulated. States first appeased these requests through voluntary committees and hiring experts at the turn of the nineteenth-century, though these quickly became convoluted and were generally ineffective. They would later be consolidated, and given increased oversight and authority as most effectively seen in Britain, Canada, and France. In 1848, both Britain and France would pass key legislation establishing health authorities. The latter half of the century would see the creation of Sanitary Commissions in Britain and the United States, and extensive welfare reforms in Britain and Germany. These systems, once in place, would not see comprehensive reform until the aftermath of the second world war, when new public health initiatives were established across western Europe, such as the NHS and the national insurance systems in France and Germany. These initiatives form the core of modern public health management and are still in place today (Tulchinsky, 2014; IMUS, 1988).

When we compare the two eras, what stands out is that they are not dissimilar. Modern management is more convoluted, but that is more because of modern ideas about bureaucracy rather than public health itself. It is clear Rome was especially ahead of its time with structure. Ideas in the modern age only came about from the need for a healthy urbanized workforce, whereas in Rome, it was simply a consequence of an increasingly prosperous society. Despite this difference in motivation, both periods came to the same conclusion regarding the need for widespread organized public health initiatives.

However, Rome's attitude towards public health is notably different from that of the

modern period when we turn to the question of knowledge. Rome had very few academically inclined physicians, as outside of curiosity, there was not only little incentive, but dissecting a body was forbidden under Roman law. Treatment itself was limited to herbal remedies and philosophy and religion were just as much a part of treatment as observable symptoms. Most Roman medicines were based on the insights of Hippocrates – a Greek who argued for rest and balance of fluids - due to swathes of Greek physicians immigrating to Rome. While this aided in promoting general hygiene, rest, recovery, and exercise – core pillars of public health – it was typically ineffective in treatment itself. The best defence against the spread of disease that Rome had was its sewer system, which existed as early as 600 BCE (Karabatos, 2021, Santacroce, 2017). In terms of infection management, the Cult of Asclepius was founded in Rome in 293 BCE as a religious response to plague. This cult was based on Tiber Island, opposite the river bank of Rome and quarantines during pandemics would take place here, such as during the Antonine Plague in the second century, which would kill 7-10% of the Empire's population (Renburg, 2006; Littman, 1973).

Accordingly, where Rome stagnated and failed to change, countries in the modern era flourished. Over the nineteenth and twentieth centuries, the rising prominence of academia would have revolutionary implications for medicine. The use of statistics and documentation gave accomplishments a scientific basis. For example, when Edwin Chadwick did a survey of poverty in Britain he concluded in his 1842 report that the poor died on average 29 years younger than the wealthy, and that death due to poor living conditions was killing more Britons every

year than any military conflict the country had ever been involved in. This led to the creation of authorities which could regulate public health across Europe and the United States (IMUS, 1988; Morley, 2007). Through this, academics and physicians were given authority over public policy. This would allow for new systems of managing public health to be established. For instance, though considerably basic waste management systems previously existed in cities, it was in the mid-nineteenth century that engineers began redesigning these systems to become more efficient and accommodate their growing populations. In London, a committee of engineers led by Joseph Bazalgette would achieve this in 1865. Cities across the world would follow in the coming decades. Research showed that improving waste management significantly decreased mortality in diseases like cholera. In fewer than 80 years, dozens of key discoveries would be integrated into public health policy, including Hospital Structural Reform, Germ Theory, Aseptic Surgery, Blood transfusions and Antibiotics (Cook, 2001; Tulchinsky, 2014). The crowning achievement of these modern innovations would, however, be the global eradication of smallpox in 1980.

In light of the above, we can, therefore, observe significantly less similarities between the two eras. Rome's knowledge of physiology and transmission of disease was minimal, primarily because of religious considerations, so much so that the developments that signalled the creation of modern public health institutions were absent from Rome.

### **Conclusion**

In summary, both ancient Rome and modern societies concluded an organized, state-funded public health initiative was necessary, and benefited significantly from

this conclusion. Although both allocated a substantial number of resources to these initiatives, Rome would not come to any new discoveries, instead expanding public health through the construction of new facilities, rather than improving care in facilities that already existed. As a result, no revolutionary public health reform would reach Rome despite extensive welfare and sanitation. This is in contrast to the discoveries and projects which underpinned healthcare in the late modern era, which have improved sanitary conditions far beyond those which existed in Rome due to their widespread implementation. Rome had the basis for a contemporary system of public health, but lacked both the physiological and pathological knowledge to make those systems as effective as those that currently exist.

### **Bibliography**

Cook, G.C. (2001), 'Construction of London's Victorian sewers: the vital role of Joseph Bazalgette', *British Medical Journal*, 77(914).

<https://pmj.bmj.com/content/77/914/802>

Dembskey, E. (2009), 'The Aqueducts of Ancient Rome', *University of South Africa*, 52(4.5).

<http://www.romanaqueducts.info/aquapub/dembskey2009Rometxt1.pdf>

Institute of Medicine (US) Committee for the Study of the Future of Public Health (1988), 'The Future of Public Health; Chapter 3, A History of the Public Health System', *Journal of public health policy*. <https://www.ncbi.nlm.nih.gov/books/NBK218218/>

Karabatos, I., Tsagkaris, C. and Kalachanis, K. (2021), 'All roads lead to Rome: Aspects of public health in ancient Rome', *Le infezioni in medicina*. [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8805493/#b1-1124-9390\\_29\\_3\\_2021\\_488-491](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8805493/#b1-1124-9390_29_3_2021_488-491)

Littman, R. J., & Littman, M. L. (1973), 'Galen and the Antonine Plague', *The American Journal of Philology*, 94(3), 243–255.

Morley, I. (2007), 'City Chaos, Contagion, Chadwick, and social justice', *The Yale journal of biology and medicine*. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2140185>

Renberg, G. H. (2006), 'Public and Private Places of Worship in the Cult of Asclepius at Rome', *Memoirs of the American Academy in Rome*, 51/52, 87–172.

Roser, M., Ortiz-Ospina, E. and Ritchie, H. (2013), 'Life expectancy, Our World in Data'. <https://ourworldindata.org/life-expectancy>

Santacroce, L., Bottalico, L. and Charitos, I.A. (2017), *Greek medicine practice at Ancient Rome: The physician Molecularist Asclepiades, Medicines (Basel, Switzerland)*. Edited by G. Litscher. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5750616>

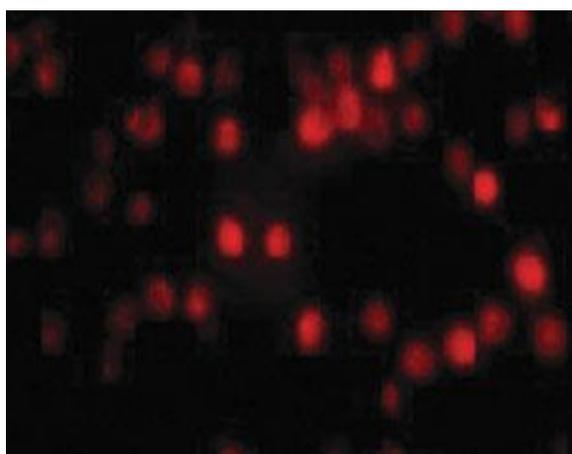
Tulchinsky, T.H. and Varavikova, E.A. (2014), 'A history of public health', *The New Public Health*. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7170188>

## To what extent has cancer research developed over the last twenty years?

By Abbie Potter

One of the most prevalent diseases in society today is cancer. The condition is caused by cells mutating and rapidly dividing. This causes tumours to form, which can be detrimental to the body and can spread to different organs. It is a deadly disease that has posed a large problem for many years and 'is a leading cause of death globally, according to the World Health Organization' (Masterson, 2023). Cancer killed 'nearly 10 million people in 2020' (Masterson, 2023) and is predicted that '1.9 million new cancer cases' (McDowell, 2023) will arise in 2023 in the United States alone. Accordingly, it is important we have research into how to treat this – to date incurable - disease. This essay will argue that, in particular, important advances in science and technology have ensured developments within cancer research over the last twenty years. It will do so by explaining and expanding upon specific advancements in cancer research.

In researching cancer, many charities have been established, such as Cancer



Research UK. This charity has helped raise awareness and funding for cancer research since 2002, including sponsored runs and other events. The funds raised goes towards different types of cancer research, with one of them being the

'European Prospective Investigation into Cancer and Nutrition' in 2003 (alternatively known as the EPIC study). Before this research, Professor Tim Key of the University of Oxford suggested that the evidence on the relationship between diet and cancer was 'nowhere near good enough' (Shields, 2021). For example, research before this consisted of asking individuals with cancer what their diet had been like over the years. This led to hugely unreliable and inaccurate results. In contrast, the EPIC study adopted a different, and more scientific and accurate, approach that consisted of blood tests and studying individuals over a 15 year period. Their diet and lifestyle were monitored to see how they changed over time, producing a solid dataset that could be used to draw useful conclusions about how cancer links to diet. Significantly, however, this study was produced due to 'improvements in technology' (Shield, 2021). Without such advancements of technology within the last 20 years, studies like this would not have been possible and, as a result, easy prevention, such as avoiding certain foods, would not be able to be considered. This highlights the growth in knowledge that was brought by this research into cancer, showing that it has developed greatly.

Later, in 2013, cancer research further progressed with improvements in technology, allowing researchers to detect cancer in a non-invasive way. Cell membranes on cancer cells are made up of

### **Daunomycin interacting cancer cells viewed with fluorescence microscopy**

different components when compared with healthy cell membranes, in particular, cancer-cell membranes have

been found to contain 'more anionic lipids than normal cells' (Potter, 2020, 1). This means that the cell surface membrane of cancer cells have an overall negative charge. Yoon-Bo Shim, from Pusan National University, has used this negatively charged cell surface membrane to develop 'a probe based on daunomycin, an anti-cancer drug that is known to interact strongly with anionic lipids' (Potter, 2020, 1). The detection of the cancer cells works by using a 'daunomycin-specific aptamer that is covalently bonded to a conducting polymer' (Potter, 2020, 1) that can bind to the cancer cells. An 'aptamer' is a 'short, single strand' (Zhang et al., 2019, 1) of DNA or RNA that can bind to specific targets with 'high affinity' (Zhang et al., 2019, 1). This means that electrochemical impedance spectroscopy and fluorescence microscopy can be used to detect where the cell-drug complex forms, meaning the location of cancer cells can be identified. This is a very important development because it is non-invasive, which means no other instruments are introduced into the body and increases safety. Detecting cancer in this way is a significant development because it is able to target and trace these cells, so that specific treatments can be allocated to combat their effects, with minimal consequences on healthy cells. This shows that the development of research has developed significantly due to the shift from monitoring diet and lifestyle in 2002 to having more technical ways to conduct research by 2013. The increased use of technology has, therefore, allowed for the expansion of ideas and drugs used to treat cancer.

By 2017 technology used to research cancer improved even further. One example of this is nanomachines, which can 'kill cancer and other diseased cells or

deliver drugs' (Urquhart, 2020). The team at Rice University in the United States have based the nanomachines that they use to treat and kill cancer on 'ultraviolet light activated molecular motors', which were previously made by Ben Feringa at the University of Groningen, Netherlands (Urquhart, 2020). This breakthrough allowed Feringa to receive the chemistry Nobel Prize in 2016, underlining its importance. The nanomachines can find their way to the cells that they are targeting and attach to them. They remain inactive until they are 'exposed to ultraviolet light' and then proceed to tunnel through cell membranes 'around 10nm thick in about a minute' (Urquhart, 2020, 1). The opening that these nanomachines caused lead to the cells falling apart and dying. The holes created could also be used to deliver drugs to the cells, which could also potentially kill the cells. Significantly, this development is an improvement because it allows cancer cells to be targeted more specifically without affecting healthy cells simultaneously. Even if some nanomachines go 'off target', light can be used to redirect them to the correct target, which means less healthy cells are destroyed in the process; this is a development since 2013. This is an important breakthrough because it may mean that cancer treatments are less likely to have a large physical impact on the patient, as they are not harming their healthy cells. This clearly shows that research techniques have developed with a more scientific and direct approach, as opposed to an earlier focus on maintaining health as discussed above. In addition, this marks an improvement since 2013, as at least insofar as there is now more control over the direction of the nanomachines and, as a result, it is more specific.

More recently, in 2022-2023, a development that has emerged is a biocompatible battery that starves cancer cells of oxygen. This battery can be implanted into the body and attack cancer cells by 'starving them of oxygen while also producing reactive oxygen species that help to suppress tumour growth' (Durrani, 2023). This means that cancer cells are less likely to cause a problem because they can't grow and spread around the body to different organs. Tumours can be more easily isolated due to the growth being suppressed, allowing for the tumour to be combatted. This is an important development because it is a step in the right direction of being able to treat cancer patients. The battery 'also appears to improve the efficacy of certain chemotherapy drugs that are activated by low-oxygen environments', meaning they can be used to enhance treatments that are already known to work. This is a development as it improves ideas that are already reliable and trusted. In mouse trials, the battery was shown to be very effective, reducing tumour size by '26% within a week' and increased to '90% decrease in tumour size when used in combination with hypoxia-activated prodrugs'. Although this is important, as it backs up the effectiveness of the battery, this may not lead to a viable treatment because it has only been seen to be effective on mice. Indeed, in clinical trials, it was said that there was 'unsatisfactory efficacy', which means that the battery does not work as well on human patients. Nevertheless, this is arguably still an important development as it allows other ideas to emerge so much so that without this idea other developments that stem from it may not occur.

In conclusion, cancer research has vastly developed other the past twenty years. Science and technology have increased in

influence, including the research of diseases. This technology has, therefore, allowed for the development of ideas into physical tools that can help address cancer. Scattered throughout recent history are examples of developments towards the cure of cancer, including the examples noted and many others, such as 'listening to cancer' using 'Raman spectroscopy' to examine the brain and then transforming 'the spectroscopic data into sounds' (Gomollón-Bel, 2020, 1). On the other hand, however, even with the large amount of research happening today, there is still no cure for cancer and, as noted above, many people die from it. Although this may suggest that cancer research hasn't developed, it is apparent that we have more knowledge about cancer today than we did in the past. Cancer research is important, now more than ever as the cases of cancer increase, which means the development of the research must grow at the same rate to combat it. According to Cancer Research UK, 'our research has contributed to more than 50 cancer drugs in use today' (Roberts, 2022, 1), which underlines the extent to which cancer research has evolved significantly in the last twenty years. Finally, the most significant development is the biocompatible battery as it can attack cancer cells, but also enhance the effects of chemotherapy at the same time. This is important because it means there is more of a chance that the cancer cells will be combatted and destroyed.

### **Bibliography**

Durrani, J. (2023) 'Biocompatible battery starves cancer cells of oxygen', *Chemistry World*. Available at: <https://www.chemistryworld.com/news/biocompatible-battery-starves-cancer-cells-of-oxygen/4017257.article> (Accessed: 04 June 2023).

Gomollón-Bel, F. (2020) 'Listening to cancer', *Chemistry World*. Available at: <https://www.chemistryworld.com/news/listening-to-cancer-/1017621.article> (Accessed: 04 June 2023).

Lynne Eldridge, M. (2023) 'Cancer cells vs. normal cells: How are they different?', *Verywell Health*. Available at: <https://www.verywellhealth.com/cancer-cells-vs-normal-cells-2248794> (Accessed: 11 June 2023).

Masterson, V. (2023) '6 new breakthroughs in the fight against cancer', *Vaccine Alliance*. Available at: [https://www.gavi.org/vaccineswork/6-new-breakthroughs-fight-against-cancer?gclid=Cj0KCQjww4-hBhCtARIsAC9gR3bQumqkFuGr7YtJABkcPp\\_ncJVbihndcffaSWr8ArBSAfQe7fw88qcaAnvVEALw\\_wcB](https://www.gavi.org/vaccineswork/6-new-breakthroughs-fight-against-cancer?gclid=Cj0KCQjww4-hBhCtARIsAC9gR3bQumqkFuGr7YtJABkcPp_ncJVbihndcffaSWr8ArBSAfQe7fw88qcaAnvVEALw_wcB) (Accessed: April 3, 2023).

McDowell, S. (2023) '2023 cancer facts & figures cancer: Incidence drops for cervical cancer but rises for prostate cancer, 2023 Cancer Facts & Figures Cancer, Incidence Drops for Cervical Cancer But Rises for Prostate Cancer'. Available at: <https://www.cancer.org/latest-news/facts-and-figures-2023.html#:~:text=In%20the%20US%20in%202023,about%201%2C670%20deaths%20a%20day>. (Accessed: April 3, 2023).

Potter, H. (2020) 'A new system for cancer detection', *Chemistry World*. Available at: <https://www.chemistryworld.com/news/a-new-system-for-cancer-detection/5879.article> (Accessed: 01 June 2023).

Roberts, K. (2022) '120 years of Discovery: 10 ways we've changed the story for people with cancer', *Cancer Research UK - Cancer News*. Available at: <https://news.cancerresearchuk.org>. (Accessed: 04 June 2023).

Shields, E. (2021) 'Europe's search for an anti-cancer diet', *Cancer Research UK - Cancer News*. Available at: <https://news.cancerresearchuk.org> (Accessed: 15 May 2023).

Urquhart, J. (2020) 'Nanomachines can bore cancer cells to death', *Chemistry World*. Available at: <https://www.chemistryworld.com/news/nanomachines-can-bore-cancer-cells-to-death/3007927.article> (Accessed: 01 June 2023).

Zhang, Y., Lai, B.S. and Juhas, M. (2019) 'Recent advances in aptamer discovery and applications, *Molecules* (Basel, Switzerland)'. Available at: <https://www.ncbi.nlm.nih.gov>. (Accessed: 01 June 2023).

## What is nuclear fusion and how viable is it as an energy source, both in the present and the future?

By Oliver Garratt

To comment on the viability of nuclear fusion as an energy source, we first need a rudimentary understanding of how it works. Nuclear fusion is the process in which atomic nuclei are combined, creating a larger nucleus and releasing energy. There are multiple reactions in which fusion can be achieved, the most researched being between two isotopes of hydrogen: deuterium and tritium. These differ from hydrogen-1 (the most common isotope of hydrogen), as rather than having just one proton, deuterium and tritium have an extra one or two neutrons respectively. When these two isotopes undergo fusion, they produce a helium nucleus and a neutron. However, the total mass of the helium nucleus and the neutron is less than that of the starting isotopes, so some energy is released. ( $E = mc^2$ , where E is energy, m is mass and c is the speed of light). This mass difference is caused by nuclear binding energy, which is the energy required to separate a nucleus fully into the protons and neutrons which make up the nucleus.



**The interior of a fusion reactor**

### Methods of nuclear fusion

There are currently two primary approaches that scientists are using to achieve nuclear fusion: magnetic confinement fusion and inertial confinement fusion (Bliss, 2022). Both methods need a large amount of input energy to overcome the electrostatic

repulsion between the different nuclei. In magnetic confinement fusion, the samples are heated to extreme temperatures until they become electrically charged plasma. These are controlled using strong magnetic fields in a doughnut shaped container until they undergo fusion. Inertial confinement fusion uses powerful lasers which heat and compress the sample inside a capsule.

### Viability of deuterium-tritium fusion

Deuterium-tritium fusion shows promise as an energy source, as it would be incredibly energy efficient. Each deuterium-tritium fusion reaction releases  $2.8 \times 10^{-12}$  joules of energy. Scaled up, if one tonne of deuterium fully reacted with tritium,  $8.4 \times 10^{20}$  joules of energy would be produced. This is roughly 29 billion times the energy that would be produced if one tonne of coal were fully combusted (Encyclopedia Britannica, 2023).

However, an issue with deuterium-tritium fusion presents itself when you take into account the cost of the reactants.

Approximately 99.972% of natural hydrogen is hydrogen-1 and approximately 0.028% of natural hydrogen is deuterium (Schimmelmann and Sauer, 1970). Only trace amounts of tritium exist naturally, found in the upper atmosphere. This is produced by cosmic ray bombardment. This scarcity of tritium has caused it to have a price of \$30,000 per gram, a major roadblock in the viability of deuterium-tritium fusion (Clery, 2022). Fortunately, there is another method other than cosmic ray bombardment to produce tritium. During deuterium-tritium fusion, a high kinetic energy neutron is produced. If this neutron collides with an atom of lithium-6, it is absorbed and the particles are rearranged into one atom of helium and

one atom of tritium. This process releases energy so would make the deuterium-tritium fusion process more efficient as well as providing fuel for the reaction. Lithium is a relatively common element, and can be found in ocean water as well as rocks, however extraction is currently quite slow. There is, in theory, enough lithium to reach future demand, including use in batteries, however significant investment would need to go into developing the lithium mining industry (World Nuclear Association, 2022). It is worth mentioning the recent breakthrough in December 2022 where net energy gain was achieved for the first time. Inertial confinement fusion was used to deliver 1.8 MJ of energy to a sample of the hydrogen isotopes, which released 2.5 MJ of energy. This is a significant breakthrough, however it should be noted that to achieve this input, 500 MJ of energy was given to the relatively inefficient lasers, for them to only produce 1.8 MJ of light energy (Allen, 2022).

### **Viability of proton-boron fusion**

Proton-boron fusion has the advantage over deuterium-tritium fusion in abundance of fuels. Whereas tritium is very rare, boron is very easy to mine. The difficulty arises when attempting to overcome the electrostatic repulsion of the fuels. Boron has 5 protons in its nucleus whereas deuterium and tritium have one, so takes a lot more energy to be fused with a proton. Deuterium-tritium fusion requires temperatures of approximately 100 million kelvin, however proton-boron fusion requires temperature of approximately 1.5 billion kelvin. Proton-boron fusion also has significantly lower power density so would require much more fuel to be viable. However, research for proton-boron fusion is still in its early stages with scientists only recently observing magnetic confinement fusion between boron and a proton for the first time (Cartlidge, 2023). Ultimately, deuterium-tritium fusion is so

significantly more researched that it is unlikely proton-boron fusion will be commercially viable first.

### **Risks of fusion**

There are few real risks with using nuclear fusion as an energy source. As both proton boron and deuterium-tritium fusion only produce neutrons and inert helium, there is no long-lasting radioactive waste produced. Helium is a depleting resource as it is light enough to escape the earth's gravitational field, so if the helium were harvested from fusion, the process would become more cost efficient.

As a very limited amount of fuel (just a few grams) is used in the fusion process at one time, it is impossible for an uncontrolled reaction to occur. As soon as the fuel runs out, the fusion process stops, so there is negligible risk of an explosion in the reaction chamber. Tritium is radioactive, and has a half-life of 12.3 years, but under normal operation, a fusion reactor would have 1000 times less radiological impact than background radiation. Even in a worst-case scenario, the radiation released would not be significant enough to evacuate populations living near a reactor (ITER, 2023). The radioactivity of tritium itself is not a significant issue, as when it undergoes beta-decay, it only releases a single beta particle with very low energy and no gamma radiation. This beta particle is not dangerous as it cannot penetrate skin and only travels 6mm in air (Nuclear Power, 2021).

There is also very little risk to the workers of a fusion plant. If all the cooling systems were to fail, the temperatures inside the reaction chamber would not exceed or reach the melting point of the confinement barrier, under any circumstances (ITER, 2023).

## Conclusion

To conclude, nuclear fusion is currently not viable as an energy source, however with more research it does show promise for the future. If it were to become viable, it would most likely be deuterium – tritium fusion, as this is the more researched and developed method, but it is also possible that another method would have a breakthrough. Additionally, it is a large investment to create a fusion plant, as there are many expensive pieces of equipment, which may deter energy companies. For inertial fusion to be viable, laser technology needs to become more efficient, allowing for less inputted energy to provide the same result. The development of high temperature superconductors would improve the efficiency of magnetic confinement fusion, as less energy would be required to cool the magnets. As nuclear fusion is a constantly developing field with many upsides, it seems probable that it will play a significant role in the future of energy, but without significant investment in multiple stages of the process, it is unlikely that it will be used commercially within a few decades.

## Bibliography

Allen, M. (2022) 'NET energy gain marks breakthrough for Fusion Research', *The Engineer*. Available at: <https://www.theengineer.co.uk/content/news/net-energy-gain-marks-breakthrough-for-fusion-research> (Accessed: 01 June 2023).

Bliss, D. (2022) 'Many scientists see fusion as the future of energy – and they're betting big', *National Geographic*. Available at: <https://www.nationalgeographic.co.uk/sc>

[ience-and-technology/2022/10/many-scientists-see-fusion-as-the-future-of-energy-and-theyre-betting-big](https://www.nationalgeographic.co.uk/science-and-technology/2022/10/many-scientists-see-fusion-as-the-future-of-energy-and-theyre-betting-big) (Accessed: 29 May 2023).

Cartlidge, E. (2023) 'Proton–boron fusion passes milestone', *Physics World*, 36(4), pp. 7–7.

Clery, D. (2022) 'Fusion power may run out of fuel before it even gets started'. Available at: <https://www.science.org/content/article/fusion-power-may-run-fuel-even-gets-started> (Accessed: 22 May 2023).

Schimmelmann, A. and Sauer, P.E. (1970) 'Hydrogen isotopes'. Available at: [https://link.springer.com/referenceworkentry/10.1007/978-3-319-39193-9\\_326-1](https://link.springer.com/referenceworkentry/10.1007/978-3-319-39193-9_326-1) (Accessed: 22 May 2023).

Encyclopædia Britannica (2023) 'Nuclear fusion'. Available at: <https://www.britannica.com/science/nuclear-fusion> (Accessed: 15 May 2023).

ITER (2023) 'Safety and Environment, ITER'. Available at: <https://www.iter.org/mach/safety> (Accessed: 31 May 2023).

World Nuclear Association (2022) 'Lithium - World Nuclear Association'. Available at: <https://world-nuclear.org/information-library/current-and-future-generation/lithium.aspx> (Accessed: 31 May 2023).

Nuclear Power (2021) 'Tritium - h-3 - radioactive nuclide of Hydrogen', *Nuclear Power*. Available at: <https://www.nuclear-power.com/glossary/tritium/> (Accessed: 12 June 2023).

## **To what extent would the scientific world be affected if dark matter was not real?**

**By Louie Dixon**

Physics is the science that models how the world works. However, most of physics was originally based on assumptions and later based on experimental evidence. This includes all the fundamental laws of ideal gases, such as, Boyle's Law, Charles's Law, and Gay-Lussac's Law. All these laws state that there are linear relationships of direct or inverse proportionality among the pressure, volume, and temperature of gases. However, they are laws that are approximations based on assumptions and experimental evidence. Gases do not follow such constraints on their functions at temperature and pressure conditions. Indeed, everything we have observed with instruments in space 'accounts for 5% of the contents of the universe' (CERN #1, 2023), meaning the rest of it is a big assumption. This essay will be discussing dark matter and its effects on the scientific community and will suggest that assumptions regarding dark matter are a hypothesis.

It is apparent that dark matter, unlike normal matter, does not interact with the electromagnetic force. This leads to it not being able to interact with light (not reflecting, emitting, or absorbing light). Accordingly, dark matter is almost impossible to explain through the standard model. This challenge means that there has yet to be undeniable verification of dark matter in the scientific community. Consequently, it has only been inferred through what is thought to be the gravitational effect that it has on normal matter. The galaxies in our universe rotate at such speed that the gravity generated by all their 'matter' should not be enough to keep themselves from being forced apart. This is why

scientists have theorized dark matter, something that 'cannot be seen' but still adds mass to these galaxies. At an estimate there is up to six times more dark matter compared to visible matter; it makes up an approximate '27% of the universe' (CERN #1, 2012); this has been proven to a 2% degree of accuracy using fluctuations in the cosmic microwave background. Even knowing all of this, the question of 'what is dark matter?' is still very prevalent. As stated before, we are still not sure. However, a hypothesis which is supported by many is that dark matter is devised of theoretical 'supersymmetry particles' and 'supersymmetry is an extension of the Standard Model that aims to fill some of the gaps. It predicts a partner particle for each particle in the Standard Model' (CERN #2, 2019). This helps to explain masses of particles that would otherwise not make sense in most theories.

In 1998 researchers Adam Riess, Saul Perlmutter and Brian Schmidt (Riess et al, 2009) both found and explained the existence of 'dark energy'. They found this by measuring the expansion of the universe only using explosions of white dwarfs (Riess et al, 2009). While dark matter has been theorized due to its need for mass (so galaxies do not get torn apart), dark energy pushes said galaxies apart. Once again by using CMB, we know that this 'dark energy' makes up an approximate '68% of the universe' (CERN #1, 2012). Dark energy causes this repulsion because it is evenly distributed throughout the universe and repels itself. This means that as the universe expands there is an exponential acceleration of the universe.

Now that we have established ideas of the hypotheses of dark matter and dark energy, we now need to think why it is in place and why it is the most supported hypothesis in the scientific community. Initially, however, there are problems. Firstly, if galaxies were surrounded by halos of dark matter, then their 'bars' (bright rod-shaped regions of stars) would slow down. However, the bars have been shown to not slow down and stay fast (Banik, 2022). This falsifies the standard model with evidence. From this it may be thought that this hypothesis isn't perfect and this would arguably be correct. However, no hypothesis is 100% correct. But when comparing 'dark matter' to its alternates it is, in my opinion, the best theory. If we then compare this to other theories, we can think about what a backup would be if dark matter remains unproven or is proven to be false. One of the most well-known of these alternatives is 'MOdified Newtonian Dynamics' (MOND). This was theorised in the 1970s alongside that of the dark matter theory by the Israeli physicist Mordehai Milgrom (Scarpa, 2006). Due to stars being found to move too 'quickly' in galaxies, Milgrom proposed that inertia for acceleration below that of ' $a^0 = 1.2 \times 10^{-8}$  (cm s<sup>-2</sup>)' does not follow the projection of Newtonian Dynamics. This was derived from galaxy rotation curves fit (Begeman, 1991). This means that when using  $F=ma$  at a planetary or solar system scale there is no issue, however, MOND states as we model larger than this, we must change the rules that acceleration follows. The MOND acceleration for gravity 'a' can be compared to the Newtonian acceleration  $a^N$  through the equation  $a^N = a\mu(a/a^0)$  "The interpolation function  $\mu(a/a^0)$  admits the asymptotic behaviour  $\mu=1$  for  $a \ll a^0$ , so to retrieve the Newtonian expression in the strong field regime, and  $\mu=a/a^0$  for  $a \ll a^0$ " (Scarpa, 2006). This, then, warps

the value for gravity, but can make it fit the standard model.

When using MOND, it is very simple in comparison to dark matter because there is no need for an addition of extra particles, there is only a slight change in the gravitational force. It also does not suffer from the overproduction of satellites like dark matter. However, it has many more imperfections compared to dark matter. The slight modifications to gravity that are necessary for MOND to work make it hard to explain motions of galaxies in certain situations. As we know MOND modifies gravity, and these types of theories find it troubling to explain the growth of the universe and the CMB. Even with how well MOND-like theories can explain a lot, there is none that can account for every observation that dark matter explains. This means that for MOND to explain all interactions, dark matter would still have to be in the model. All of these things make MOND a much weaker theory than dark matter (even though it still has many correct aspects), as well as it not being able to explain a lot of data that has been found in the past fifty years.

With this knowledge about MOND, we can see that if dark matter cannot be observed we will have to break down the current cosmological model, due to the fact that even though MOND is a separate hypothesis some parts still rely on dark matter. It would significantly affect the current scientific community, and many more would be looking for a new/ better alternative because without dark matter many things fall through. However, it could be seen as a good thing if dark matter is proven to be impossible as it would lead to many new discoveries (being a discovery in itself) and could also possibly lead to a more accurate model of

the universe that would look completely different to the current model. Consequently, if dark matter is proven to be false it would have both positive and negative effects (nullifying years of research), causing a paradigm shift leading to science and scientific discovery being the most productive.

### **Bibliography**

CERN #1- *Dark matter* (2012) *CERN*.

Available at:

<https://home.cern/science/physics/dark-matter> (Accessed: 04 June 2023).

CERN #2- *Supersymmetry* (2019) *CERN*.

Available at:

<https://home.cern/science/physics/supersymmetry> (Accessed: 04 June 2023).

Riess, A. (2009) 'Dark energy',

*Encyclopedia Britannica*. Available at:

<https://www.britannica.com/science/dark-energy> (Accessed: 04 June 2023).

Scarpa, R. (2006) 'Modified Newtonian Dynamics'. Available at:

<https://arxiv.org/ftp/astro-ph/papers/0601/0601478.pdf> (Accessed: 04 June 2023).

Begeman, K.G., Broeils, A.H. and Sanders, R.H. (1991) *Extended rotation curves of spiral galaxies : Dark Haloes and modified dynamics.*, *NASA/ADS*. Available at:

<https://ui.adsabs.harvard.edu/abs/1991MNRAS.249..523B/abstract> (Accessed: 04 June 2023).

Banik, I. (2022) 'Dark matter may not exist: These physicists favor of a new theory of gravity', *SciTechDaily*. Available at:

<https://scitechdaily.com/dark-matter-may-not-exist-these-physicists-favor-of-a-new-theory-of-gravity/#:~:text=The%20problems%20with%20dark%20matter&text=The%20bars%20rotate%20over%20time,observed%20galaxy%20bars%20are%20fast.> (Accessed: 04 June 2023).

## **To what extent do mindfulness meditation practices improve psychological function and well-being?**

**By Katie Dodds**

Mindfulness meditation practices have existed for thousands of years, originating in Buddhism. The practice was first outlined in the Buddhist text 'Satipatthana Sutta' in which the Buddha tells his followers to be aware of their minds and bodies while 'eating, drinking, chewing, tasting, savouring . . . in walking, in standing, in sitting, in falling asleep' (Dhammananda, 1982, 6). However, the practice was unfamiliar to the western world until the work of Jon Kabat-Zinn (1990). Kabat-Zinn, after learning meditation techniques from several ambassadors of the Burmese School of Meditation, strived to bring the practice to the United States to be used for medical purposes for the first time in the west. He produced a programme called 'Mindfulness-Based Stress Reduction' (MBSR). This included all the same techniques and teachings he learned in Burma, but was made easily accessible to a western audience with little prior knowledge of mindfulness meditation ('Mindfulness', 2019). His efforts were rewarded as his book, *'Full Catastrophy Living: Using Wisdom of Your Body and Mind to Face Stress, Pain and Illness'* sold hundreds of thousands of copies and has been cited in over 11,000 scholarly works. MBSR is now offered in more than 740 hospitals, clinics, and stand-alone programs worldwide, but how exactly does the practice work to produce such results and are there any downsides to the practice? This essay will argue that mindfulness meditation certainly has empirical evidence to prove its usefulness, however, how it is conducted is vitally important in ensuring no potentially severe side effects are experienced.



### **Avoiding ruminative thought patterns**

The practice of mindfulness meditation encompasses focusing attention on the experience of internal thoughts, emotions and bodily sensations and simply observing them as they arise and pass away. This is reflected in the name of the traditional form of mindfulness meditation, Satipatthana Meditation; Satipatthana meaning 'to keep attention inside' ('Mindfulness', 2019). Many different mechanisms are involved in producing the benefits of mindfulness meditation, one of those being attention regulation. Many meditation traditions emphasize the importance of keeping attention on a single object, most often the breath; a typical instruction for mindfulness meditation being to "Focus your entire attention on your incoming and outgoing breath. Try to sustain your attention there without distraction. If you get distracted, calmly return your attention to the breath and start again" (Smith & Novak, 2003). When doing this, one disregards distractions, such as memories or thoughts of the future, in favour of focusing on the meditative object. This is referred to as executive attention and is one of the three attention

networks proposed by Posner and Petersen (Hölzel *et al.*, 2011).

Mindfulness meditation's ability to help practitioners focus may be at least partially explained by its relationship with the default mode network (DMN). The DMN is a set of brain regions that are most active during both passive tasks that don't require active thought, as well as during tasks that require one to recall memories or imagine the future (Buckner, 2013). This is what allows us to ruminate about regrets and fears, therefore causing us stress, and is often referred to by Buddhists as the 'monkey mind'. During an interview for an episode of the Netflix series 'The Mind, Explained', Buddhist monk Bhante Saranapala describes mindfulness meditation as the practice of bringing your attention back to the present moment when you notice yourself slipping into the past or future; therefore taming the 'monkey mind' ('Mindfulness', 2019).

This activity can be seen in brain scans, such as in a study during which an fMRI scan was used to compare the brain activity of 20 experienced meditators and 26 controls while in a meditative state compared to while doing an active cognitive task. They found that expert meditators showed lower levels of activity in the DMN compared to control participants during meditation compared to another active cognition task (Garrison *et al.*, 2015). This supports the idea that repeated practice of mindfulness meditation can improve our ability to focus on the present moment and avoid ruminative thought patterns that may lead to increased stress and anxiety. This knowledge could be very useful in the treatment of those with depression, anxiety and addiction among other disorders which have been linked to increased DMN activity. This shows the

value of implementing mindfulness-based treatments for these disorders.

### **Emotional control**

However, the benefits of mindfulness meditation extend beyond the ability to avoid ruminative thought patterns as it has also been shown to greatly improve emotional control. Emotional regulation refers to the alteration of ongoing emotional responses through the action of regulatory processes (Hölzel *et al.*, 2011). One cognitive neuroscience model of control (Botvinick *et al.*, 2001) says that control is instigated by a process that compares current behaviour with a goal state. Essentially, the brain recognises that what we are currently doing will not lead us to our desired goal, telling us to control and change our behaviour accordingly. This is referred to as a 'transient affect' and acts as a 'control alarm' and tells us when we need to exert control over our behaviours.

This is comparable to mindfulness meditation's practice of monitoring our own minds and identifying when our minds have wandered away from the present and being able to bring it back. It, therefore, makes sense to say that practicing this skill of monitoring and changing thoughts would translate to increased executive control and, therefore, emotional regulation. A model put forward by Teper, R. *et al.* suggests that the present moment awareness and acceptance fostered by mindfulness meditation is what helps to improve executive control. This allows us to pay attention and notice transient affects and change our behaviour accordingly (Teper, Segal, and Inzlicht, 2013). It stands to reason that this increased emotional control that mindfulness meditation offers could be useful in helping those with psychological disorders, such as depression and bipolar disorder, as they

are associated with reduced capacity for emotional regulation.

The effects of the practice on emotional control are shown in a study by Kral, et al. (2018). The study used a group of long-term meditators with an average 9081 hours of practice in primarily mindfulness meditation, a group of short-term meditators who had just completed an 8-week mindfulness-based stress reduction (MBSR) course and a control group who had never meditated before. They used fMRI scans to monitor activity in the amygdala of each participant. When shown pictures of negative, upsetting imagery, the long-term meditators were shown to have reduced activity in their amygdala. Additionally, when compared to the control group, the short-term meditators showed increased connectivity between the amygdala and the ventromedial prefrontal cortex (VMPFC), a region involved in emotional regulation (Kral, T.R.A. *et al.*, 2018). This gives empirical evidence for mindfulness meditation's impact on emotional control.

### **The side-effects?**

However, with meditation's implementation as a viable treatment option for things such as depression, anxiety and addiction, comes the question of side-effects. All treatments have side-effects which are important for patients to be aware of before they decide to begin treatment. However, information is less clear when it comes to treatments like mindfulness meditation. Some studies have reported adverse effects of mindfulness meditation programmes such as increased anxiety, traumatic re-experiencing (Goldberg et al., 2021) and even more severe events, such as, psychosis (Joshi et al., 2021), causing the safety of such practices to be called into question. However, before we can determine whether or not mindfulness

meditation can cause adverse effects, we must first look at what is and is not an adverse effect in the context of mindfulness.

Mindfulness practices, such as the mindfulness-based stress reduction (MBSR) programmes widely used in hospitals and treatment centres, seek to foster an increased awareness and acceptance of present emotions and sensations. It, therefore, means that patients will likely become more aware of physical and emotional discomfort following MBSR programmes. On the surface this may seem like an adverse effect of the practice, however, it is a fully expected and important part of achieving the positive effects of meditation (Binda et al., 2022). Being able to sit with your negative emotions and sensations and simply observe them without judgement, rather than turning to maladaptive techniques to distract yourself from them, is one of the key skills learned from mindfulness meditation. Therefore, increased awareness of these negative feelings is necessary to learning how to healthily cope with them. All cases of more severe adverse effects, such as psychosis following mindfulness meditation, describe very intensive (many hours per day with few breaks) or long-term practice, which does not align with the structure of MBSR programmes which are typically once a week for around 8 weeks with sessions 2-3 hours in length. The sessions are fully guided by a teacher who is trained to deal with patients with histories of poor psychiatric health and trauma and can adapt the sessions to each patient's needs (Binda et al., 2022). It is, therefore, important we don't generalise adverse effects of unguided, intensive mindfulness to the MBSR programmes used as treatments. Although there are risks with meditation, in most cases these can be addressed by

ensuring meditation is guided and not highly intensive, meaning the practice should still be considered a viable treatment option.

### **Conclusion**

In conclusion, mindfulness meditation and programmes inspired by it, such as MBSR, have been shown to be effective in helping people escape anxiety-inducing, ruminative thought patterns by encouraging patients to focus on a present sensation. This is shown not only by qualitative data from patients, but also data from brain scans. Its effect on executive control and, by extension, emotional control, makes it a useful tool when treating disorders, like depression and bipolar disorder, which are characterized by a lack of emotional regulation. However, with the potential risks associated with the practice, the presence of a trained teacher is integral to ensuring patients are fully guided and the programme can be adapted to avoid unnecessary triggering of patients with a history of trauma or psychosis.

### **Bibliography**

- Binda, D.D., Greco, C.M. and Morone, N.E. (2022) 'What are adverse events in mindfulness meditation?', *Global Advances in Health and Medicine*, 11.
- Botvinick, M.M., Braver, T.S., Barch, D.M., Carter, C.S. and Cohen, J.D. (2001) 'Conflict monitoring and cognitive control.', *Psychological Review*, 108(3), pp. 624–652.
- Buckner, R.L. (2013) 'The Brain's default network: Origins and implications for the study of psychosis', *Dialogues in Clinical Neuroscience*, 15(3), pp. 351–358.
- Dhammananda, K.S. (1982) *Satipatthana Sutta: The foundation of mindfulness*. Kuala Lumpur: Buddhist Missionary Society.
- Garrison, K.A., Zeffiro, T.A., Scheinost, D., Constable, R.T. and Brewer, J.A. (2015) 'Meditation leads to reduced default mode network activity beyond an active task', *Cognitive, Affective, & Behavioral Neuroscience*, 15(3), pp. 712–720.
- Goldberg, S.B., Lam, S.U., Britton, W.B. and Davidson, R.J. (2021) 'Prevalence of meditation-related adverse effects in a population-based sample in the United States', *Psychotherapy Research*, 32(3), pp. 291–305.
- Hölzel, B.K., Lazar, S.W., Gard, T., Schuman-Olivier, Z., Vago, D.R. and Ott, U. (2011) 'How does mindfulness meditation work? proposing mechanisms of action from a conceptual and Neural Perspective', *Perspectives on Psychological Science*, 6(6), pp. 537–559.
- Joshi, S., Manandhar, A. and Sharma, P. (2021) 'Meditation-induced psychosis: Trigger and recurrence', *Case Reports in Psychiatry*, 2021, pp. 1–4.
- Kral, T.R.A., Schuyler, B.S., Mumford, J.A., Rosenkranz, M.A., Lutz, A. and Davidson, R.J. (2018) 'Impact of short- and long-term mindfulness meditation training on amygdala reactivity to emotional stimuli', *NeuroImage*, 181, pp. 301–313.
- 'Mindfulness' (2019) *The Mind, Explained*, series 1, episode 4. Netflix, 12 September.
- Smith, H. and Novak, P. (2003) *Buddhism: A concise introduction*. New York: HarperCollins Publishers, Inc.
- Sumter, M.T., Monk-Turner, E. and Turner, C. (2009) 'The benefits of meditation practice in the correctional

setting', *Journal of Correctional Health Care*, 15(1), pp. 47–57.

Teper, R., Segal, Z.V. and Inzlicht, M. (2013) 'Inside the mindful mind', *Current Directions in Psychological Science*, 22(6), pp. 449–454.

## **To what extent can the psychology of colour help students in the learning environment?**

**By Zahraa Khan**

The understanding of colours and their role in psychology has been a topic of interest for many researchers, such as Johann Wolfgang von Goethe, who published one of the first books on colour psychology. He believed colours could create certain emotions and talked about the meanings of different shades throughout his book *Theory of Colours* (Popova, 2021). Colours have been found to have a powerful influence on mood, concentration, cognitive responses, and even physiological reactions (Cherry, 2022). The use of colours has been beneficial in many fields, such as, marketing and artistry (Clark-Keane, 2022). However, this article will be focused on the influence of colours on academic achievement, including the impact on cognitive responses as well as its benefits to children with learning disabilities.

### **Memory and attention**

The Multi store model of memory proposed by Atkinson and Shiffrin (1968) states that there are three stores of memory: the sensory store, short term memory, and long term memory. A key element in coding information into the short term memory is via paying attention. When paying attention to a piece of information we are focusing our minds to process and store this information. Therefore, the more attentive we are to a detail of information, the more likely we are to store this information for a longer period of time.

Farley and Grant (1976) found in their study on attention and cognition that coloured multimedia presentations retained more attention than non-

coloured multimedia presentations. From this they concluded that colours have a greater effect on attention and memory than plain text. This could be significant for teachers as implementing colours into PowerPoints and worksheets could ensure students remain focused during the lesson and gain optimum benefit.

In contrast to the above findings, there have been some studies that have found that the theory of colour may have been misinterpreted and, in actual fact, is based on levels of contrast. McConnohie (1999) conducted a study in which he presented alphanumeric figures, which were in black, to the participants through a slideshow with three background colour conditions; white, blue, and green. He expected to find similar retention rates for all three conditions, presuming that colours have a positive impact on memory. However, the results demonstrated that the slides with the white background resulted in higher retention rates, both in immediate and delayed recall tasks. This result contradicts the previous studies as it was initially found, as noted above, that colour had a positive effect on memory and retention rates. However, this study proposes an alternative perspective that memory may be based on higher levels of contrast in colour as opposed to specific colours improving memory. This would explain why black on white resulted in higher retention rates.

However, not only may contrast be preferable to colour, but colour - in so far as it is red - may hinder learning. This hypothesis was tested in one of six experiments in which 71 US college students were presented with either a

green, black or red participant number before taking an exam. The results showed that the students presented with a red number decreased by a significant 20% in comparison to those presented with a black or green participant number (Elliot et al, 2007). This research demonstrates that colours can have an influence on individuals, based on the context they are used in. Often in an educational and academic context, the colour red is associated with mistakes and failure. Therefore, seeing the colour red before taking an exam could make a student feel anxious and distressed, hindering their performance. This research could also raise awareness to teachers to reverse this impact by disassociating the colour red with failure through alternating between different colours when marking assessments and exams. This could have a positive effect on an upcoming exam as students are likely to look over previous assessments they have taken throughout the year when revising. Therefore, removing red from the context of failure could help students feel confident and enhance their performance.

### **Reading rates and coloured overlays**

One significant impact of colour is its effect on reading rates as well as its ability to help students with learning difficulties, most famously with dyslexia and autism, develop their reading skills. Many disorders that affect reading abilities are commonly associated with visual stress and discomfort and research has shown that around 5-20 percent of school aged children experience visual stress when reading (Wyman, 2013). A condition of visual stress can refer to overwhelming brightness of a page when reading, eyes becoming fatigued, and can also include letters appearing to move or blur on the page. Coloured overlays are claimed to

reduce visual discomfort and improve symptoms commonly related to these disorders, such as reading rate, accuracy, and fluency. Research has also shown that the use of coloured overlays has not proven that specific colours improve reading rates. Rather there is a generalised impact of colour with many individuals choosing different coloured overlays yet achieving similar outcomes.

A case study that investigated a young boy J.G (Ludlow and Wilkins, 2009), who was diagnosed with autism, used a triangulation of methods to study different factors that influence his symptoms. One of these was the use of coloured overlays on his reading rate and fluency. J.G was given a choice of different coloured overlays and was permitted to choose based on his preference as well as clarity. He proceeded to pick a blue coloured overlay out of preference and a purple for clarity. He was then administered the rate of reading test and the overlay chosen for clarity produced the best results. They conducted the test four times with different colours as well as a condition with no overlay and found that the purple overlay led to a 35% increase in reading rate in comparison to no overlay. This demonstrates that coloured overlays have been a significant aspect in improving symptoms of autism and likewise other related disorders that influence reading skills. J.G was later prescribed glasses with coloured lenses and showed further improvements in other situations and tasks.

However, many studies have found that they do not have significant impacts on learning. Iovina et al (1998) found that there was no significant differentiation in improved reading rates between individuals with a learning disability and individuals without a learning disability when using colours in the form of an

overlay. Ritchie et al (2011) also conducted a similar study to that of J.G's case study noted above and found that when measured by the reading rate test or the global reading measure there was no immediate benefit when using overlays. Nevertheless, despite the use of overlays being considered highly controversial, they are increasingly being used within school environments as well as workplaces to help individuals with learning difficulties.

### **Classroom environment**

Another way in which the colour theory could be applied to enhance learning is through implementing colours to produce a positive environment for studying and revising. Studies have shown that certain colours have been found to maintain concentration and are beneficial to be used in work and study environments.

A case study that took place in Sri Lanka (Hettiarachchi et al, 2017) included an investigation into the effect of classroom colour on a child's primary school learning. It contained 213, 7 year-old boys studying in grade 2 in Columbo who were each assigned into different coloured classrooms which were otherwise identical. They concluded, from questionnaires by both students and teachers, that students who were exposed to orange and yellow classrooms, developed skills that were associated with mathematics and those exposed to blue classrooms significantly improved in artistic skills and creativity. This study supports the theory that exposure to colour in the classroom environment directly influences development of academic skills and found that certain colours also correlated with specific primary school skills.

This study may, however, be critiqued as it is both androcentric and ethnocentric as

it only contained boys who were all from Columbo and, therefore, may not represent other students making the study less representative and useful to support the Colour Theory model. It may also be argued that children of a young age are more fascinated by colours around them linking back to the multistore model which suggests attention is a key element in encoding information. Therefore, this may suggest that children are more easily influenced by colour in comparison to high school students. This argument would then propose that age may be a factor in how impactful colour is on learning and could question the credibility of colours improving learning as an overall statement. Nevertheless, primary school learning is just as essential as secondary education to intellectual development, if not more so. If this can be implemented in a primary school environment it has the capability to boost a child's academic potential as they will enhance their foundation skills for fundamental core subjects, like mathematics and English, which will benefit them in further education.

In conclusion, although the colour theory is a controversial topic and there is much research to still be done, current psychological research has shown colours to be a great benefit to educational achievement in regard to both cognitive responses as well as regulating mood when used in the correct way. While acknowledging the controversy in the literature, colour in the form of overlays has also been incredibly helpful for many individuals with learning difficulties relating to visual stress. Moreover, education systems could further improve student's achievement if they implement colour into their everyday environment.

### **Bibliography**

- Kendra Cherry, Mse. (2022) 'Can color affect your mood and behavior?', *Verywell Mind*. Available at: <https://www.verywellmind.com/color-psychology-2795824> (Accessed: 25 June 2023).
- Popova, M. (2021) 'Goethe on the psychology of colour and emotion', *The Marginalian*. Available at: <https://www.themarginalian.org/2012/08/17/goethe-theory-of-colours/> (Accessed: 25 June 2023).
- Clark-Keane, C. (2022) '8 ways to use color psychology in marketing (with examples)', *WordStream*. (Accessed: 25 June 2023).
- Sternberg RJ. 5th Ed. Belmont (BE): Wadsworth Cengage Learning; 2009. *Cognitive Psychology*.
- Farley FH, and Grant AP. 'Arousal and cognition: Memory for color versus black and white multimedia presentation'. *J Psychol*. 1976;94(1):147-150.
- McConnohie BV. Unpublished doctoral dissertation. Johnson Bible College; 1999. 'A study of the effect of color in memory retention when used in presentation software'.
- Elliot, A. J., Maier, M. A., Moller, A. C., Friedman, R., & Meinhardt, J. (2007). 'Color and psychological functioning: The effect of red on performance attainment'. *Journal of Experimental Psychology: General*, 136(1), 154-168.
- Wyman P. '5 best reasons colored overlays help overcome dyslexia symptoms'. 2013.
- Ludlow AK, Wilkins AJ. 'Case report: color as a therapeutic intervention'. *J Autism Dev Disord*. 2009 May;39(5):815-8.
- Iovino I, Fletcher JM, Breitmeyer BG, Foorman BR. 'Colored overlays for visual perceptual deficits in children with reading disability and attention deficit/hyperactivity disorder: Are they differentially effective?' *Journal of Clinical and Experimental Neuropsychology*. 1998;20(6):791-806.
- Ritchie SJ, Della Sala S, McIntosh RD. 'Irlen colored overlays do not alleviate reading difficulties'. *Pediatrics*. 2011;128(4):932-938.
- Hettiarachchi, Anishka & A.S, Nayanathara. (2017). 'The Effect of class room colour on learning with reference to primary education: A case study in Sri Lanka'.

