The Scholar

COULD COMPUTER-DESIGNED DRUGS TARGET DEPRESSION?

The **Brilliant** Club

PLUS 24 NEW ACADEMIC ESSAYS FROM THE YOUNG SCHOLARS OF THE BRILLIANT CLUB

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Guest Editorial:
What Makes You Brilliant?

DR SAMINA KHAN,
DIRECTOR OF UNDERGRADUATE ADMISSIONS
AND OUTREACH, UNIVERSITY OF OXFORD

Are you one of the students turning their thoughts to the UCAS personal statement? This is a good time to make a start, as you've got the summer holidays to plan the 4,000 characters that will show you'd make a great student. Or do you still have some time to go before you need to think about UCAS? It's never too early to think about yourself, what inspires you, and what makes you brilliant.

I'm often asked what students should include in their personal statement, and what magic formula of words will win them a place: "What do I need to do? What boxes do I need to tick?" In fact, there is no checklist for achievements, and certainly no magic words or phrases that we look out for. Tutors at Oxford are only interested in your academic ability and potential: they want to see that you truly love your subject, and that you can demonstrate your interest, above and beyond whatever you have studied at school or college. It's not about the work experience you've had, or extracurricular activities you have completed, but about what you have learned from those experiences, and how they have helped you develop as a person and a student.

For example, I've heard about Medicine interviews with students who've had work experience placements in prestigious hospitals, and Art History students who've been lucky enough to visit galleries all over the world – but that's not what we look for. Tutors won't be impressed by your connections, or the stamps in your passport, but they will be impressed by how you've engaged with your subject. Some of the best Medicine interviews are not with students who have had flashy work experience, but with those who have engaged with medical issues in other ways. They've read up on the questions that interest them, watched related TV programmes and read relevant magazines. Art Historians can tour galleries around the world without ever leaving the school computer room, and they may be far more affected by their visits than other students who have been there in person. Writing about what you are interested in is a good place to start, and the articles in this journal are excellent examples of pupils engaging with their subjects well beyond the school curriculum. Reading young people's thoughts on unusual topics such as the impact of greenhouse gas concentration on a marine environment, which J. Lucking explores on p.14, makes the eyes of a scientist like me light up.

My passion for my subject – Chemistry – started in the classroom at my college in Leicester. My teacher, Mr Deacon, was so passionate about the history of chemistry, and how certain discoveries were made that he got me thinking about what discoveries I might be able to make. He also made the subject come alive for me, by explaining how Chemistry wasn't just about a theory to be studied in the lab, but about real world implications for materials, for making medicines, and for solving environmental issues. I started to read more about the subject, in books and journals and magazines. Before I knew it, I was hooked.

What inspires you about the course you want to study at University? Think about discussing it with your friends: what would you tell them? What have you read or watched or seen that has inspired you? Why was it interesting? What do you want to find out next? If you find this difficult, it might be time to think about whether or not you've really chosen the right course. If you find it easy, you have a long list of ideas to help you write your personal statement.

When you start to write, remember not just to list your achievements but show how they have affected you, how you have benefited, and what you'd like to learn next. Be honest about yourself and what has inspired you, whether that's been text books, museums and literature, or websites, podcasts and blogs. Be sure to tell the truth, as tutors might check later, so don't exaggerate and certainly don't make any false claims. Don't hold back either – this is no time for modesty. The tutors want to get to know you, and what makes you brilliant.

Good luck!

Dr Samina Khan
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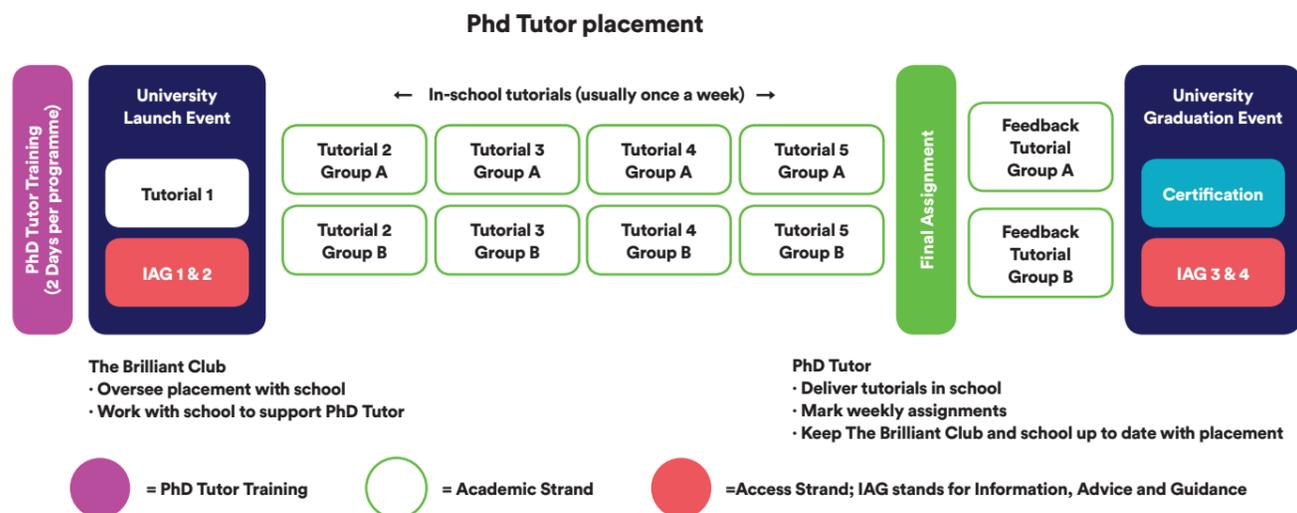
Introduction
WHAT IS THE BRILLIANT CLUB?

The Brilliant Club is an award winning charity that exists to widen access to highly selective universities for underrepresented groups by mobilising researchers to bring academic expertise into state schools. We aim to do this by recruiting, training and placing doctoral and postdoctoral researchers in non-selective state schools and sixth form colleges to deliver programmes of university-style tutorials to small groups of pupils. Through our programmes, pupils develop the knowledge, skills and ambition that help them to secure places at top universities.

The Brilliant Club is building a national movement to mobilise doctoral and postdoctoral researchers to engage with schools serving low HE participation communities. We are currently working with over 200 schools and colleges across the country, placing over 250 PhD tutors to work with more than 5,000 pupils. Our PhD tutors are placed in schools to deliver the Scholars Programme to pupils from Year 5 through to Year 12. As the diagram below shows, the programme consists of a series of tutorials, trips and assignments.

The programme represents an authentic university-style challenge for the young people that we work with. Key Stage 2 and 3 pupils are asked to produce 1000- and 1,500-word assignment respectively, which is often the longest piece of work that they have tackled so far in their time at school. By the time pupils reach Key Stage 5, they are asked to complete a 2,500-word assignment, which is at the same level as a piece of university coursework. Pupils receive marks at the key stage above their current level, and are marked in the style of university grades, gaining a 1st, 2:1, 2:2 or 3rd.

We are delighted to be able to showcase our pupils' work and celebrate their achievements in an academic manner and we feel that a journal of academic articles by young scholars is not only the ideal format, but also a natural fit given the charity's work. Publishing original work is an important part of academia and it is enthusing for us to introduce our pupils not only to the world of research but also to the next stages of circulation and response from the academic community.

In creating The Scholar, we have brought together what we feel are the most exciting and compelling of the hundreds of assignments submitted as part of the 2015 Scholars Programme. We hope that all pupils who completed the programme are proud of their achievements but, given the number and quality of assignments submitted, we think that the pupils whose work is included here can be especially pleased. As well as highlighting the achievements of pupils, we would also like say thank you to the PhD tutors, teachers and parents who supported them throughout the programme.

Phd Tutor placement

PhD Tutor Training (2 Days per programme)	University Launch Event	In-school tutorials (usually once a week) →				Final Assignment		University Graduation Event
	Tutorial 1	Tutorial 2 Group A	Tutorial 3 Group A	Tutorial 4 Group A	Tutorial 5 Group A		Feedback Tutorial Group A	
								Certification
	IAG 1 & 2	Tutorial 2 Group B	Tutorial 3 Group B	Tutorial 4 Group B	Tutorial 5 Group B		Feedback Tutorial Group B	IAG 3 & 4

The Brilliant Club
· Oversee placement with school
· Work with school to support PhD Tutor

PhD Tutor
· Deliver tutorials in school
· Mark weekly assignments
· Keep The Brilliant Club and school up to date with placement

● = PhD Tutor Training   ○ = Academic Strand   ● =Access Strand; IAG stands for Information, Advice and Guidance

News
OUR UPDATES: SUMMER 2015

The Latest from The Brilliant Club
At the end of the academic year 2014-15, we hope that all teachers, pupils and university students are relaxing and enjoying the summer holidays. It has been a busy year for The Brilliant Club, where the core staff has more than doubled in size, and we have begun work in new regions including the South West, North West and South Coast. This coming year will bring the charity's fifth birthday, and it is exciting to see our PhD tutors walking down the corridors of more schools across the country. At our last tutor training weekend, we struggled to fit them all into one photograph!

The third edition of The Scholar, the final edition of the first volume of our academic journal for young people, is a cause for celebration. We welcome our guest editor Dr Samina Khan, Director of Undergraduate Admissions and Outreach at the University of Oxford, who shares her thoughts on how to make your personal statement 'brilliant' on p.3. We also share with you the thoughts of a brand new PhD Tutor, Nataly Papadopoulou, alongside 24 essays from pupils who worked on Brilliant Club placements over the last term.

Thank you for continuing to read The Scholar, and we hope you have enjoyed this year's essays, problem sheets and analyses. We are looking forward to reading next year's submissions.

The Brilliant Club Annual Conference
The Brilliant Club Annual Conference in conjunction with King's College London took place on the 8th July 2015 and brought together teachers, pupils, university representatives and educationalists from all over the world to talk about best practice and solutions in widening participation. The title question was 'Where can we find solutions to break the link between household income and admission to the UK's highly selective universities?', and we looked far and wide for answers, with over 200 delegates and contributors from the education sector and beyond. Keynotes were given by Professor Les Ebdon of OFFA and the Rt Hon Lord Andrew Adonis, and breakout sessions were on topics ranging from international inspiration to parental engagement.

You can watch our livestream videos at http://www.thebrilliantclub.org/events-and-conferences/the-brilliant-club-conference-2015/ and join the debate on twitter using the hashtag #KCLxTBC15.

University Learning in Schools: Resources available for teachers
University Learning in Schools (ULiS) began life with a question: Could a partnership between researchers – who possess exceptional subject knowledge – and teachers – who possess the pedagogical experience – help improve student outcomes?

In 2013, The Brilliant Club, in partnership with Achievement for All 3As embarked upon a journey to explore this question by pairing five PhD students from King's College London, UCL, CERN and Warwick University with teachers from Lampton School and Haberdashers' Askes' Federation Trust. Their task was to create academic units of work for KS3 students in English, Geography and Physics in order to enhance teacher's subject knowledge and pedagogical skills, ultimately increasing pupil achievement in core subjects.

Funded by the Greater London Authority through the London Schools Excellence Fund, the project engages teachers with their own subject knowledge, whilst simultaneously allowing them to expand their understanding of a particular topic, guided by an expert who is performing cutting-edge, original research in that area. The initial evaluation suggests that the outcomes for teachers indicate some success in helping the teachers to be more confident with their existing subject knowledge, as well as increasing their desire to acquire new knowledge. Beyond this, the purpose of the project is to disseminate the units of work to as wide an audience as possible, so that they can be taught by subject-teachers across London and beyond. The second year of the project produced units covering a wide range of topics including Exoplanets, Literature of the Great North Road, Trauma and Memory in WW1 and An Introduction to Neuroscience. The units of work are staggeringly engaging and offer pupils the opportunity to explore unique and fascinating elements of Physics, English, History, Psychology (for science teachers), Mathematics, Computing,Biology, Chemistry, Religious Studies and Economics (for history/geography teachers). The units of work have been quality assured in the teachers' schools and then adapted and edited based on the experience of teaching the units. Feedback from both pupils and teachers has been incredibly positive so far.

If you would like to request any of the resources from the ULiS project to use, there is a form available on the blog page of The Brilliant Club website (scroll down to the section on ULiS). These will be sent to you via post, on a USB stick that contains all ten units of work. We would love to hear your thoughts on any of the units, so please do email to let us know about your experiences teaching them.

Guest Article
A LETTER FROM A BRAND NEW PhD TUTOR

By Nataly Papadopoulou, PhD researcher at the University of Leicester, and PhD Tutor in the Midlands region.

It all began as every typical day has done over the last two years of my life, the last two years being the start of my research journey as a Law PhD student, with email-checking. And there it was, an email from the Researcher Development Team of the University of Leicester introducing The Brilliant Club. The email invited those interested to attend an information session on Wednesday December 3rd, 2014 at 12pm. As usual a quick look at my agenda gave some bad news. Wednesday was already packed, with a reading group on autonomy, a debate on the Medical Innovation Bill and drinks with a lovely visiting Italian professor.

Could I still take my chance and apply without it? Much needed teaching experience, the opportunity to talk and disseminate my research, specialist training and some money on top of that? Yes please.

So I did some thorough research using The Brilliant Club website and decided that this was definitely for me. I was absolutely thrilled with the idea behind this lovely charity: helping high-performing students from low participating communities to develop the necessary skills, motivation and incentive to apply to highly selective universities. Although I grew up in Cyprus, a country which follows UK standards in general, I still had to use my ingenious friend Mr Google to learn about the UK education system and the problems therein.

The day after Christmas I sat down and started my application form, which can be found online at The Brilliant Club website. You can find literally everything online to support in filling your application and there is the 'Application Guidance' document too which is extremely instructive. To some extent the application is like any other application form: academic history, employment, personal details. However, there is also an interesting section entitled 'Assessment Questions', in my humble view the most challenging and interesting part to complete. A typical research nerd, I enjoyed exploring online a little bit more to complete it.

And then, exactly one month later I received an email inviting me to an Assessment Day. 'Never done this before, should be fun - or not…', I thought. One of the aspects of the Assessment Day was that we were given the task to prepare an eight minute mini-lesson on an aspect of our research, where two assessors would act as 14-year old pupils.

Brilliant idea – but how do I prepare for that? As I always do, I sat down and made… a plan. Then I asked my parents' advice as they are both teachers, and another friend who is also a teacher. The mini-lesson turned out to be the most fun part of the Assessment Day and as you are now reading this, you will have guessed that it went well.

The next step was the Training Weekend in May, which took place over two days, the first day in Warwick and the second day in London. If I was to describe the Training Weekend using one word that would be 'overflow', that is, an overflow of new things. I was generally overwhelmed by new information, new faces, new everything. And to be really honest, a bit panicked about my handbook which after the weekend. I had only two weeks to design it and get it into a workable form for my Year 12 students. With a busy start of May, a conference, a seminar, a family commitment and a thesis deadline… things looked impossible. But they were not. I had a tremendous time (with a bit of stressing out as well…) designing my course handbook, working in my research on assisted dying which is an extremely important subject in my view, and most importantly, putting everything into understandable and accessible language and form and practising my delivery style. I met wonderful people over the weekend, who were really happy to help me and share their experiences, and attended extremely useful workshops, or 'electives', on both days which gave me valuable tips. I am happy to say that this is only the beginning of the journey.

So here I am, one week away from delivering the first tutorial of my course, my very own course for Year 12 students, at the University of Nottingham Launch Trip. I will be able to meet all the Midlands PhD tutors and our Programme Officer again as well as the Lead Teacher and of course, my students for the first time!
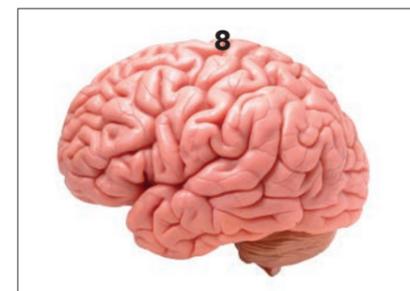
I am confident in saying that this is just the beginning of a lovely, meaningful experience. Until next time… with tutoring experiences to share too,

Nataly

IN THIS ISSUE
STEM Articles

WILL YOU REMEMBER THIS ARTICLE IN A YEAR?

I. Sherestha, supervised by E. Galliano

Abstract

This article investigates the nature of the highly interconnected processes of remembering and forgetting. After defining what memories are and presenting a famous case-study in the history of neuroscience, it introduces the three main theories that attempt to explain why people forget. Before presenting personal opinions and conclusions, the article showcases theories and experiments regarding the phenomena of infantile amnesia, inability to forget and voluntary misremembrance.

Body

Can you remember your childhood memories? How about what you ate one year, two months and three days ago? Or who you saw yesterday? Can you remember your first day at school/work? Can you remember important and tragic events of the past (such as 9/11)? Maybe you remember all of these; maybe you remember none. Or you may remember a few but not all, but why is that? If we are all human, why do some remember and some do not? Or how do we even remember?
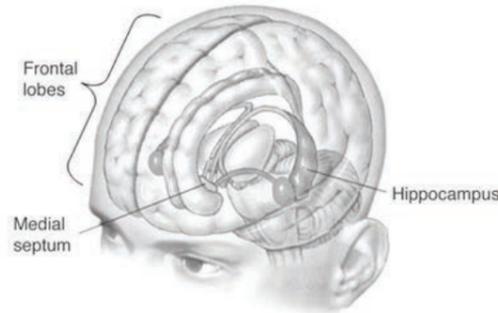

Fig.1: Hippocampus. Parts of this were removed from patient HM's brain.

What are memories?

Before we go into more complex information, let's get the basic information out of the way. Memories are created in the hippocampus (a brain structure) but not stored in the hippocampus. How do we know this? Well, there was a certain patient, Henry Molaison (known as patient H.M); he had epilepsy, which may have been caused by a head injury at the age of seven. The seizures were minor until the age of sixteen, and then he was referred to Dr William Scoville, in 1953. The doctor suggested to remove the part of Molaison's brain causing the seizures (a portion of the temporal lobe, including parts of the hippocampus from both sides of the brain; Fig.1), and Molaison agreed to the surgery. When he woke up he had extreme amnesia, he remembered things from his childhood and things about his family but not more current events (such as incidents leading up to the surgery). He also suffered from anterograde amnesia, which meant he could not form memories either. Dr Brenda Milner conducted an experiment with Molaison, in which she asked Molaison to draw a line between two outlines of a five-pointed star while watching his hand and the page in the mirror. Patient H.M was asked to do this several times on different occasions – though he did not remember doing the same activity before, his performance did improve. Milner concluded that there are multiple memory systems in our brains and that they are located in different parts of the brain. This was a huge step forward in neuroscience.

Why do we forget (in general)?

Diseases such as Alzheimer's affect the brain to stop people from remembering (like patient H.M.), but what about people without diseases? There are three main theories attempting to explain why people forget. The first one is the "decay theory" which suggests that memory fades throughout time if not retrieved or rehearsed frequently. However, one problem with this theory is that research has shown that even memories which have not been rehearsed (like long-term memory, an example would be the memory of your first day at school) can be stable. Thus, decay theory mainly affects short-term memory as it is weaker than long-term memory. The second proposed theory is the "interference theory". There are two types of interference: proactive and retroactive. Proactive interference is when an old memory gets in the way of a new memory (for example, when a teacher or a professor has a difficult time to remember names of new students as he/she has learned so many names, of other students, in the past). Retroactive interference is when new information gets in the way of an older memory (for example, when a teacher or a professor has a hard time remembering names of past students because he/she has learned so many new names) . Failure to store the information can also cause memory loss. Sometimes, we don't store the information we take in, or we fail to store it in long-term memory. It is said that our short-term memory can only store seven things plus/minus two things in thirty seconds, and after that it becomes more difficult. All of the theories presented so far do not take into account the individual's choice (free will). But the "motivated forgetting theory" does. This third theory involves voluntary suppression of memories, specifically traumatic memories. However this theory comes with a lot of controversy as it is incredibly difficult, if not impossible, to scientifically prove or show that the memory has been repressed.

Why do babies forget?

You may or may not *remember,* but earlier on in the article there was a question about your childhood memories. That question brings up an interesting topic: why can't we remember a lot, if anything, from our childhood even though our childhood was the time when there were no previous memories which got in the way of new memories. Well, neuroscientists Paul Frankland and Sheena Josselyn have a theory about this. They think that the rapid birth of many new neurons in a young brain blocks access to old memories (like retroactive interference). Humans are not the only animals that experience infantile amnesia: monkeys and mice also forget early childhood (Fig. 2). So scientists designed an experiment where they manipulated the rate at which hippocampal neurons were born in young and adult mice. The young mice with slowed neuron growth had a better long-term memory of their early memories, while the older mice with an increased neuron formation rate had memory loss.

Fig.2: Mice and monkeys also experience infantile amnesia, like humans.

What if we didn't forget?

Up to this point, I have given you a lot of information about why we forget, but there was a man called Solomon Shereshevsky who had incredible memory and never forgot anything. He could recite entire speeches, word for word, after hearing them only once! But all those memories proved too much, they left Shereshevsky in a state of mass confusion. He could not make decisions without considering/thinking about irrelevant details.

Forgetting 9/11?

Earlier on, there was a question relating to 9/11, and many of you may think you remember what happened on that day. A recent article called "A Feeling for the Past" informs us about the when-where-how surveys which were taken a week after 9/11 and in subsequent years and the summer of 2011 in New York City, Washington D.C. and five other cities. The results of the surveys were quite surprising: one year after the terrorist attack a survey showed that of the 3000+ interviewees only 63% were correct about the happenings of 9/11! Now there are a few reasons why people would forget such a vivid, tragic and shocking memory, but one reason (as mentioned before) might be the motivated forgetting theory. Many believe that the horror of 9/11 is what makes it so haunting but the terror might have been the thing motivating people to forget because they did not want to have such a terrible memory. So forgetting may not be convenient in several occasions, but it may be useful in some.

Conclusions

All of this information is quite a lot to take in, but it is also quite interesting. For me what makes the topic more interesting is that there is so much we don't know about memories and the brain. To go further, and if I had the chance in the future, I would like to research more about the placebo effect, and I would like to see if a person's willingness can overcome a disease or even a memory.

Bibliography

A. Billig (2014). Reasons We Forget Things and What to Do About It. Available: http://smallbiztrends.com/2014/11/reasons-we-forget-things.html. Last accessed April 2015.

I. Chen. (2012). A Feeling for the Past. Scientific American Mind. 22, 24-31.

K. Cherry. (No Date). Explanations for Forgetting. Available: http://psychology.about.com/od/cognitivepsychology/tp/explanations-for-forgetting.htm. Last accessed April 2015.

L. Davachi, D. Shohamy. (2014). Thanks for the Memories... Available: http://kids.frontiersin.org/article/10.3389/frym.2014.00023. Last accessed April 2015.

S. McLeod. (2008). Forgetting. Available: http://www.simplypsychology.org/forgetting.html. Last accessed April 2015.

A. Sneed. (2014). Why Can't You Remember Being a Baby? Available: http://www.scientificamerican.com/article/why-can-t-you-remember-being-a-baby/. Last accessed April 2015.

About the authors

I. Sherestha is a Year 9 pupil at Lampton School. He is very curious and interested in many topics, and he is currently trying to decide which one to study at university. Dr Elisa Galliano is a neurobiologist with a PhD in neuroscience. Thanks to a Sir Henry Wellcome Postdoctoral Fellowship she is investigating brain plasticity at King's College London.

PhD Tutor's note

The course "Mental maps and bicycle riding: how does the brain learn and remember?" was aimed at providing the pupils with an overview of the neurobiology of learning and memory, while making them reflect on the nature of the scientific process and its application in neuroscience. The pupils were asked to select a neurobiology-related topic of their choice, research it and explain it using the format of a popular science article. All twelve pupils enthusiastically embraced the challenge, chose diverse and engaging topics and produced high quality articles that were collected in the magazine "Phineas @ Lampton", which they shared with friends and family.

As stressed during the tutorials, a very important feature of modern science is a fair process of peer-review. With this spirit in mind, the Lampton pupils read each other's work, and shared constructive feedback. At the end of this process I.'s article has been democratically chosen by the group, which valued its clear structure and engaging style, its completeness and scientific precision. I fully endorse this decision, and wish to add that I. has shown during the whole program extraordinary resilience, enthusiasm and maturity beyond his years.

ANIMAL SOCIAL NETWORKS AND THEIR APPLICATION TO A SEABIRD ISLAND

F. Catchpole, supervised by L. Garrett

Abstract

This study explores the use of social network analysis to understand aspects of animal ecology and behavior. Firstly, a dataset containing information on grooming and aggressive interactions between individuals in a social group of Rhesus Macaques was used to investigate whether grooming patterns were influenced by social dominance. Results suggested that though there was some evidence of a link between dominance and grooming activity, further analysis would be needed to fully confirm this. Following this the application of social networks to a population of small seabirds was explored. Sooty Terns inhabit Ascension Island to breed and have been monitored through tagging individuals since 1987. This study proposes to use social network analysis to investigate whether sociality has an impact on egg and chick survivorship. It is my hypothesis that higher levels of sociality will decrease the risk of egg and chick predation.

Social Network Analysis in Animals

Social network analysis can be used to study behaviours of animals in groups, for example the grooming patterns of Rhesus Macaques *(Macaca mulatta)*. A study was conducted to observe a group of seven male, and nine female, wild Rhesus Macaques over six weeks. Observations were made as to how often each member of the group was groomed and how often they groomed others. Additionally, the number of aggressive and submissive fights involving each Macaque was recorded as a measure of dominance (data taken from Sade, 1972). Pajek software (specialist social network analysis program) was used to create a sociogram from the data collected (Fig.1).

Fig.1. Sociogram showing how often each Macaque was groomed by other Macaques and how often they groomed others, together with their dominance rank. Note that Macaque's names have been assigned for ease of analysis and were not included in the original data.

In the Macaque sociogram (Fig.1) the size of the node shows how dominant each monkey is; the bigger the node the more dominant. The colour of the node shows difference in sex; yellow indicates male, whilst green indicates female. Edges connecting nodes show grooming patterns; the thicker the edge the more frequent the grooming occurs. Arrows indicate who grooms whom; an arrow pointing to a node indicates that member is being groomed.
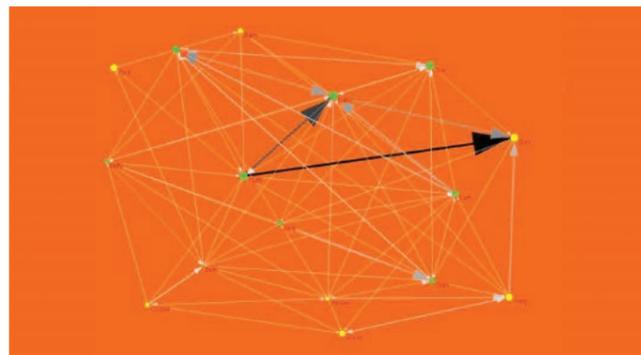

Table 1. The four most central monkeys in the Macaque network as shown by their degree of centrality.

The degree of centrality shows how central a monkey is to the network. The four individuals included in Table. 1 appear to be most central to the network, with Fluffy and Daisy having the highest degree values as they have the most edges connected to their node. The four most central Macaques are involved in the most grooming, either giving or receiving. The degree of centrality does not appear to relate to dominance as it takes into account both the giving and receiving of grooming. The most dominant Macaque, Bob (as he has the largest node, see Fig.1) does not groom any other Macaque. If only grooming received was taken into account in the calculation, degree of centrality values may indeed relate to dominance.

Study proposal to investigate whether sociality of Sooty Terns impacts levels of egg and chick predation.

Sooty Terns of Ascension Island

The social interactions of seabirds have long inspired the research of ecologists. Seabirds have a comparatively long life-expectancy, up to 30 years in the case of the frigate, which is the longest living of all wild birds (RSPB, 2012). They spend most of their lives at sea and 98% of seabirds are colonial. Unlike most birds, seabirds mature slowly, taking as long as seven years to reach sexual maturity. When matured most will flock to seabird islands to mate. One seabird that possesses all these traits is the Sooty Tern *(Onychoprion fuscatus)* (Fig.2).

Fig. 2. The Sooty Tern is a small pelagic seabird which breeds in huge colonies.

The Sooty Tern is a small seabird that breeds in large colonies of over 400,000 individuals. One population is found on Ascension Island, located in the South Atlantic Ocean. The population of Sooty Terns has decreased by 90% over the last 50 years, despite being considered 'least concern' by the International Union of Conservation and Nature (IUCN, 2015). It is believed that one of the reasons for this decline is increased predation from cats and rats introduced to the island by humans. Furthermore, it is thought that overfishing of large fish such as Tuna has caused a decrease in food availability for the Sooty Tern. The larger fish force smaller fish to the surface which are then caught by Sooty Terns. With fewer large fish, fewer small fish are attainable for the Sooty Terns. The drop in numbers is known as the Sooty Tern colonies on Ascension Island have been tagged with metal ID rings and have been monitored since 1987 by British military ornithological societies (Army Ornithological Society, 2015).

The Sooty Terns both benefit and suffer from living in a colony. The birds benefit from social living which involves the sharing of information such as the location of food sources and the most suitable nesting sites. Additionally, more birds in the colony results in superior protection from predators as there are more birds watching for potential danger.

However, living in a colony also makes the Sooty Terns more noticeable to potential predators, as well as increasing the competition for mates and food. Also, living in a colony results in the increased likelihood of the spread of disease and parasites, caused by frequent contact between birds.

Objectives

When studying colonies of Sooty Terns, or seabirds in general, Social Network Analysis can be used to explore the spread of disease and parasites as well as foraging practices and in the case of my proposal: predation.

I propose to study whether increased proximity of nests amongst Sooty Terns, and therefore increased sociality, will lower egg and chick predation. Research by other ecologists into how social interaction benefits different aspects of a bird's life has been carried out by Aplin et al. (2014) who found that social interactions in Great Tits explained subsequent foraging behaviour.

This research aims to determine whether differences in predation levels could be attributed to factors such as increased communication, for example, alert signals. This research would take place on Ascension Island as it is home to a colony of some 400,000 Sooty Terns.

I hypothesise that the birds that nest in high nesting densities per 100 square metres will suffer less egg and chick predation than birds that nest in low nest densities per 100 square metres. This might be because of the increased communication through signaling calls to alert others of the presence of predators.

Methodology

Areas occupied by nesting Sooty Terns of 100 m2 will be selected for its high density of birds; all the un-hatched eggs and chicks in this area will be counted at the beginning of the trial. A separate 100m2 nesting site will be selected for its low density of Sooty Terns. All the chicks and un-hatched eggs in this area will also be counted at the beginning of the trial. The method of marking the area will be a 100 x 100 m quadrat. It is likely that the high-density area chosen will be in the centre of the colony and the low-density area will be toward the outside of the colony. For this trial any Sooty Tern under the age of flying ability will be considered. All eggs counted will be marked and all chicks will be tagged with an ID ring.

After one week researchers will return to the area to count the numbers again. This process will be continued for four weeks. The data collected on predation will be converted into an average percentage survival rate per week. This will be done by dividing the number of marked and tagged eggs and chicks remaining at the end of the week by the numbers at the start of the week. The average will be determined by adding the four results for each site together and dividing by four.

Comparisons between sites selected can be drawn by using a sociogram. The nodes on each sociogram will represent each bird, the edges will connect all birds together and the thickness of the edge will be determined by how close birds are to each other. The high-density area will have thicker edges than the low-density area. Once a sociogram for each site has been drawn up, we can see whether the thickness of the edge correlates with the likelihood of the bird's nest being predated.

The data will be compared and whichever site has the highest percentage egg and chick survival will determine if increased vigilance due to social living is a survival advantage for the Sooty Terns.

Study Limitations

The areas covered are quite small, in comparison to the size of the entire colony. This may mean that the results are not an accurate reflection as they could be anomalies when considering the entire population.

There are practical concerns associated with marking every egg and tagging every chick in the area as this may be a time consuming process.

References

Aplin LM, Farine DR, Mann RP, Sheldon BC (2014) Individual-level personality influences social foraging and collective behaviour in wild birds. Proceedings of the Royal Society B 281: 20141016.

Army Ornithological Society (2015): Ascension Island. Army Ornithological Society, The organisation for military birders. Accessed at: http://www.armybirding.org.uk/what-we-do/ascension

IUCN (2015): The IUCN Red List of Threatened Species. Onychoprion fuscatus (Sooty Tern). International Union for Conservation of Nature. Accessed at: http://www.iucnredlist.org/details/22694740/0

RSPB (2012). Indoor Meeting - The history and natural history of Ascension Island. Moody-Jones,H. 12th October 2012. Accessed at: http://www.rspb.org.uk/groups/cardiff/reports/327962.

Sade, D.S. 1972. Sociometrics of Macaca mulatta: Linkages and cliques in grooming matrices. Folia Primatologica 18: 196-223.

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F. Catchpole is a Year 10 pupil at Cannock Chase High School. L. Garrett is a PhD student studying in the School of Biosciences at the University of Birmingham, focusing on the importance of social and genetic networks in a population of seabirds on Ascension Island.

PhD Tutor's note
I nominated the paper of F. Catchpole on 'Animal Social Networks and their Application to a Seabird Island' as it showed a real grasp of the potential use of social networks to further our understanding of animal ecology and behaviour. This study provides a clear and concise approach to the examination of a dataset provided to the student on Macaque social groups. F. quickly learned how to use a new and specialist computer program to analyse this data and has shown a high level of comprehension through his understanding of what his results showed. His work on relating this background knowledge to a novel system and species was most impressive, with clear objectives and hypothesis. He produced a feasible study design and well thought out suggestions for analysis, which was well beyond the level expected. This paper is well written and shows a lot of hard work and enthusiasm for the topic.

WHAT IS FAIRNESS?

I. Cookson, supervised by E. Konidari

Abstract

This essay attempts to answer the question: 'What is Fairness?' The concept is discussed in relation to two different contexts: The Paralympic Games and the Fairtrade Organisation. It is suggested that Fairness largely means provision of equal opportunity. However, it is argued that individuals' needs and merits need to be taken into account for achieving fairness beyond equality. The essay concludes that the overarching outcome of Fairness is happiness for all.

Body

In her article, "What Is Fairness?", Dr. Angie Hobbs, professor of the Public Understanding of Philosophy at the University of Sheffield, states that for her: "The most attractive interpretation is that each person is of worth and should have the opportunity -ideally an equal opportunity- to access goods, but most of the goods themselves will be proportionally distributed, according to need in some cases and merit in others" (Hobbs, 2010). I strongly agree with Dr Hobbs' interpretation of fairness because it means that nobody is excluded and people's personal circumstances are taken into consideration. For example, when "goods" such as education, food, healthcare or housing are made available, everybody should have an equal opportunity to access the "goods" but it is also important that opportunity be balanced with their needs and/or merits.

To illustrate the role of fairness in action I am going to take a closer look at two key subject areas whereby its complexities and intricacies are evident. Firstly, with regard to the subject of disability; an area that interests me in particular is the Paralympic Games. They were started by a man called Sir Ludwig Guttman who organised a sports competition in 1948 for World War II veterans with spinal cord related injuries. Four years later competitors from Holland joined the Games and the Paralympic Movement was started. The first Olympic style games took place in Rome during 1960 (Olympic Movement, n.d.). I really enjoyed watching the London 2012 Paralympics and I believe it is a fantastic example of the complexity of fairness. For example, for the one hundred metres sprint it would be unfair for a blade runner, a competitor with an amputated arm, a wheelchair user and somebody who is visually impaired to compete against one another because their disabilities affect their ability to perform and succeed in different ways.

Therefore, the IPC (International Paralympic Committee) have a system in place which ensures that winning is determined by skill, fitness, power, endurance, tactical ability and mental focus (Paralympic Movement, n.d.). These are exactly the same factors that athletes without disabilities use to succeed in their particular discipline. The process the IPC use is called classification and its purpose is to minimise the impact of impairments on an athletes sporting performance. Through classification it is determined which athletes are eligible to take part and how athletes are grouped together for competition (Paralympic Movement, n.d.). Unfortunately, being considered fair by all of the athletes is not always easily achieved.

After the London 2012 two hundred metres race, Oscar Pistorius complained to the IPC that the gold medallist, Alan Oliveira's running blades were too long and that he therefore had an unfair advantage. I can appreciate Pistorius' concerns that longer blades would equal fewer strides to cross the finish line. However, I believe it would be unfair to expect all competitors to wear blades that are exactly the same length or blades that make them all the same height.

This point demonstrates the importance and necessity of balancing the opportunity to participate along with an individual's needs and merits. This is further confirmed by Peter van de Vliet, the IPC's medical and scientific director, saying that "the formula that governed the maximum length of blades was complex and took into account various body measurements and height predictions" (BBC Sport, 2012).

Secondly, I would like to touch on the topic of Fairtrade. This is an excellent organisation that strives to support farmers, workers and employees that are not given the luxury of pleasant workplaces and working conditions. There are over 4,500 Fairtrade products that come in a wide range, from bananas to chocolate, sugar to coffee, beauty products to cotton and gold to flowers (Fairtrade Foundation, n.d.,a). Over 1.4 million farmers and workers and 1,140 producer organisations across the Fairtrade system make Fairtrade a worldwide known organisation (Fairtrade Foudation, n.d.,b).

In particular, I would like to focus on Fairtrade beauty products. The workers produce roughly 150 different body care essentials, so for example, when you buy Fairtrade body butter a fair amount of money goes to the small-scale farmers/workers in over 50 countries around the world such as Madagascar, Burkina Faso, Ghana and the Dominican Republic (Fairtrade Foundation, n.d.,c). As a result, instead of selling their product on the conventional market where they are at the mercy of large, greedy companies, the farmers/workers receive a better, more stable income, employment rights and benefits leading to improved livelihoods, improved housing and education programmes for their children and the promotion of health and safety in the workplace (The Brilliant Club, n.d) I consider this to be a very good example of how fairness can have a positive impact on the well-being of individuals, families, communities, countries and the world as a whole.

So to answer the question, what is fairness? I believe fairness is where everybody is given an equal opportunity to access something, such as leisure facilities, employment or higher education. The most important aspect of being fair, in my opinion, is that individual's needs and/or merits are also taken into account. This would then mean that people are not unfairly disadvantaged while people who already live comfortable lives, get an unnecessary share of whatever is on offer to them. Understandably, the process of being fair involves countless factors to be taken into consideration which, at times, can mean that not everybody's needs or opinions will be met or heard resulting in what some people will feel to be an unfair outcome.

In conclusion, I do not think it is any coincidence that one of Gretchen Rubin's twelve commandments from her book, *"The Happiness Project"* is, "to be fair and polite" (Gretchen, 2009:10). Along with commandment number ten, "do what ought to be done" and commandment number eleven, "no calculation"; not to think what is in it for me (ibid.). I think being fair is one of the most important aspects of being a happy and content person and it certainly helps others to feel happy and content too.

Bibliography

BBC Sport, 2012, 'Oscar Pistorius apologises for timing of Paralympics criticism', BBC Sport. Available at: http://www.bbc.co.uk/sport/0/disability-sport/19462059 [Accessed 10 April 2015]

Fairtrade Foundation, n.d.,a, 'What FairTrade does', Fairtrade Foundation. Available at: http://www.fairtrade.org.uk/en/what-is-fairtrade/what-fairtrade-does [Accessed 11 April 2015]

Fairtrade Foundation, n.d.,b, 'Map of Fairtrade Producers', Fairtrade Foundation. Available at: http://www.fairtrade.org.uk/en/what-is-fairtrade/producer-map [Accessed 11 April 2015]

Fairtrade Foundation, n.d.,c, 'Beauty Products' , Fairtrade Foundation, Available at: http://www.fairtrade.org.uk/en/buying-fairtrade/beauty-products [Accessed 11 April 2015]

Gretchen, R., 2009, The Happiness Project, New York: Harper Collins

Hobbs, A., 2010, 'What is Fairness?', BBC news. Available at: http://news.bbc.co.uk/today/hi/today/newsid_9079000/9079254.stm [Accessed 29 March 2015],

Olympic Movement, n.d., 'Paralympic Games', Official website of the Olympic Movement. Available at: http://www.olympic.org/content/olympic-games/paralympic-games [Accessed 9 April 2015]

Paralympic Movement, n.d., 'Introduction to IPC Classifications', Official website of the Paralympic Movement. Available at: http://www.paralympic.org/classification [Accessed 9 April 2015]

The Brilliant Club, n.d., 'What is Fairness?', London: The Brilliant Club

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I.Cookson is a Year 6 student at Acle St Edmund C of E Primary school. Eleni Konidari is a PhD candidate at the University of East Anglia. Her research explores the impact of nationalism on the educational experiences and aspirations of the Turko-Muslim minority group in Greece. The course was entitled 'What is Fairness?' and introduced pupils to philosophical concepts and approaches to answering this question.

PhD Tutor's note

It was hard to choose only one essay for The Scholar, as I received a few submissions of very high standards fulfilling all criteria for publication. I nominates I.'s because I found fascinating the insightful way she reflected on the Paralympic games she watched in 2012 to address her essay's question. Starting from an area of her personal interest she developed a well-structured argument demonstrating her critical thinking skills. Moreover, I was impressed by the creative and original way she opened and closed her essay.

GIVE AN EXAMPLE OF A GREENHOUSE GAS AND DISCUSS WHETHER INCREASES IN THE ATMOSPHERIC CONCENTRATION OF THIS GAS WILL IMPACT THE MARINE ENVIRONMENT

J. Lucking, supervised by N. Wager

Abstract

Carbon dioxide (CO²) is a long-lived greenhouse gas that accumulates in the atmosphere and causes global warming. Increases in the atmospheric concentration of CO² have been shown to negatively affect the marine environment by warming the oceans, causing changes in ecosystems as the distribution of species changes in response to warmer waters and coral bleaching. The ocean takes up CO² from the atmosphere and therefore an increase in the atmospheric concentration of this gas leads to more CO² entering the oceans. Higher concentrations of CO² in the ocean are causing ocean acidification and as a result leading to problems for species with shells and exoskeletons as the acid dissolves and weakens them. The ocean provides us with many important services such as fisheries, tourism and medicines. As ecosystems are disrupted these services may be affected, for example fish stocks may decrease. Unless more people become aware of these problems and start to change their ways, by reducing the amount of CO² that reaches the atmosphere from the burning of fossil fuels, these effects will worsen in the future and affect all life on earth.

Essay

This essay will discuss whether increases in the atmospheric concentration of CO² will impact the marine environment. To answer this question, the following essay will discuss long-lived greenhouse gases and the greenhouse effect, the increase in CO² in the atmosphere since the industrial revolution, warming of the oceans due to global warming and the impacts on species, the effect of global warming on weather patterns forming over the ocean, how CO² from the atmosphere is taken up by the ocean, that the ocean is becoming more acidic as it takes up more CO² from the atmosphere and the consequences this has on marine animals, impacts of a warming and more acidic ocean on humans, for example on fisheries, medicine, tourism and natural sea defences, what the future holds, and whether anything can be done to reduce these negative effects.

The climate of our planet is currently undergoing long-term change, increasing the temperature and altering the weather patterns due to increasing greenhouse gases in the atmosphere. The long-lived greenhouse gases consist of: carbon dioxide (CO²), methane (CH⁴), nitrous oxide (N²O) and water vapour. These gases are produced by both natural and human activities such as volcanic eruptions, respiration and combustion of fossil fuels. Fig. 1 shows how these gases prevent some of the sun's infrared rays from reflecting off the Earth and back out of the atmosphere into space and instead trap them within the atmosphere resulting in a gradual increase in the Earth's temperature – this is called the greenhouse effect. Infrared radiation is also given off by the Earth and ideally would pass through the atmosphere into space. However instead, some of it is trapped by the greenhouse gases and is readmitted in the Earth's atmosphere. During this essay I will be concentrating on the effect of CO² upon the marine environment. Since the industrial revolution the amount of CO² in our atmosphere has rapidly increased due to human activity. CO² emissions have caused a temperature rise of 0.6°C in the last century. The main cause of this sudden increase was the burning of fossil fuels, a very unsustainable source of energy.
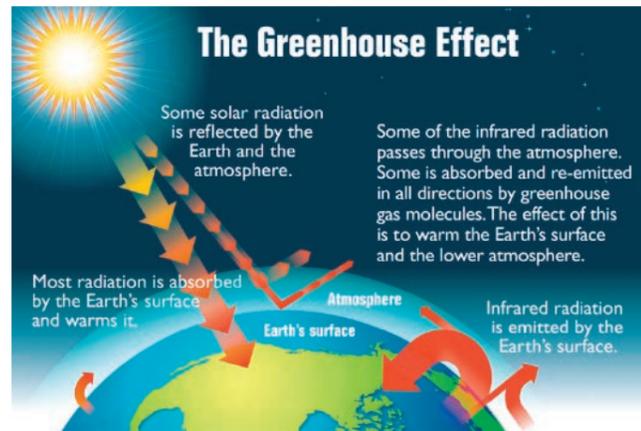

Fig.1: A diagram showing the greenhouse effect.

The rise in the temperature of the atmosphere is having an impact on the temperature of the oceans. The temperature of the oceans has risen by 0.1°C in the last century.[3] The oceans absorb some of the heat from the atmosphere and this is worsened by the albedo effect. The albedo effect states that the darker the colour, the more heat an object absorbs, and as some oceans can be very dark and murky they are likely to absorb a significant amount of heat.

Lots of marine species are affected by rising sea temperatures, one of those that is impacted upon most is coral. Corals are animals that live on the seabed, they make calcium carbonate skeletons and have a symbiotic relationship with small algae called Zooxanthellae. The coral and the algae depend on each other to live. The algae are primary producers and provide the coral with nutrients essential for its growth and development. These algae also give the coral its colour. When masses of these corals gather together they create a coral reef, one of the most biodiverse ecosystems in the world being home to over a quarter of the world's known marine species and supporting more species per unit area than any other marine habitat.[8] One of the ways the coral reefs are being affected by warming sea temperatures is coral bleaching. This occurs when the ocean heats to such an extent that the corals start to get stressed. When this happens, the coral expels the algae. A healthy coral has colour and once the algae leaves the coral it literally bleaches, becoming white and pale. Although reefs can recover, the coral usually goes on to die as its source of nutrients has gone and it therefore can't survive. On the Great Barrier Reef, sea temperatures have warmed by 0.4°C over the past century causing eight mass coral bleaching events in the last 25 years. In some cases the bleaching was followed by disease as the coral had been left vulnerable.[9]

The number of marine species that are dependent upon the coral reefs have declined as their habitat has slowly vanished. When corals are bleached, marine species, such as fish, eels and sea cucumbers that live in the coral reef are left vulnerable and defenceless to predators. They have no choice other than to flee and find a new home. They migrate north or south, nearer to the poles, where coral reefs have formed in the cooler waters (therefore less stress to the coral). For example, corals around Japan are moving northward at a rate of up 14km per year and reef dwelling fish around Australia have been found further south than ever before.[10] This may also result in bringing invasive species into an area. Invasive species are species that are introduced to a different ecosystem and can have negative effects such as outcompeting other species or predating on them, which in turn can affect the food chain/web and ultimately entire ecosystems.

Scientific research has identified that the main cause of the increase in power and duration of hurricanes is global warming. This is because hurricanes and tropical storms form and become larger and more powerful over warmer seas.[12] Greater storms can impact marine species, for example, in 2005 (a record hurricane season) scientists said that more than half of the coral reefs in the Caribbean were destroyed through consistent pounding of waves.[13]

Increases in carbon dioxide in the atmosphere lead to increases of CO² in the ocean, causing negative consequences on the animals that live there. Carbon dioxide enters the water directly from the atmosphere by the physical pump, also known as the solubility pump. This occurs when the concentration in the atmosphere is higher than that of the ocean and therefore the CO² dissolves into the ocean. Carbon dioxide in the ocean is then taken up by the biological pump, which is when phytoplankton in the ocean absorb the CO² through photosynthesis and bring it into the ocean. The CO² then travels through the food chain and into the deeper oceans by patrolling predators or when dead animals sink to ocean floor carrying CO² within them. As CO² concentrations in the atmosphere are increasing this is leading to a build up of CO² in the oceans, causing an increase in ocean acidity.

CO² in the ocean reacts with seawater forming carbonic acid. The carbonic acid then dissolves hastily to form H+ ions, which are an acid and also creates bicarbonate (HCO³−), which is a base. Another base, carbonate ion (CO32−), is naturally saturated within the seawater and can neutralise some of the acidity to create more bicarbonate. Carbon dioxide in ocean surface waters has increased over time and reacted with the seawater resulting in a decrease in both carbonate ion (CO32−) and pH in the seawater, increasing the acidity.[11] This is known as ocean acidification. As the carbonate depletes we get a decrease in aragonite and calcite, which are two calcium carbonate materials (CaCO³) essential to species that build shells or have exoskeletons, including corals. Both aragonite and calcite contain carbonate ions (CO32−), which are needed to build the shells of calcifying species. When the calcium carbonate depletes it severely affects calcifying species such as oysters, clams, shellfish and corals. Hydrogen ions have been estimated to have increased 29% since the industrial revolution and by 2100 the acidity of the oceans will have doubled or tripled. Research found that when a sea butterfly is placed in seawater with the same pH as is predicted for 2100, the animal's shell became weakened and deformed.[4] Similar effects would be expected to occur for other species with shells and exoskeletons. The increase in ocean acidity eventually has effects up the food chain. An example of this is a small zooplankton species called foraminifera. The foraminifera rely on calcite in order to build and maintain its shell. As their shells get weaker they become vulnerable and are eaten by predators, such as sea cucumbers, snails and crabs. As the amount of the foraminifera decrease these species will also decrease as they have no food, the impact escalates very quickly along the food chain disrupting the entire ecosystem.

However, the change in temperature and acidity in the ocean doesn't just affect marine species, it also has an impact on us, the humans! As the coral reefs become smaller and die, the millions of other creatures that live among it loose their habitats and also die or migrate away. This affects the fish and shellfish industry and local communities that rely on fish as a source of protein and to keep a healthy diet.

We also rely on the ocean as the source of important medicines, providing us with many natural medicines such as AIDS treatment, which we get from the Caribbean sea sponge,[11] possible cancer cures and drugs from a bryozoan, a tentacled, aquatic organism, the Caribbean gorgonian, a type of soft coral, has been used to make anti-inflammatory drugs and skate are helping to give us an insight into how to cure vision loss. Marine species could also be responsible for making painkillers and infection-fighting medicines as well as many other benefits, which haven't yet been found. However, we won't be able to find them if the warming oceans and lowering pH continues and marine species continue to decline. Species important to medicine might die out, resulting in people becoming more susceptible to diseases like AIDS and it could even escalate to the point where people were more susceptible to the common cold. All of this may lead to increase in human mortality.

The warming oceans and increasing acidity also affect the tourist industry. As the coral dies out there will no longer be the demand to visit places such as the Seychelles to dive and snorkel and experience the coral reefs. Tourism brings money into the economy and without the money local communities will suffer. As well as tourism the acidity and the warmth of the ocean also affects climate regulation. Research says that corals can affect their local climate by releasing a certain chemical called dimethyl sulphate (DMS), which can stimulate cloud formation, therefore providing local cover and cooling down the ocean. This is the corals negative feedback. In addition to the corals, phytoplankton also regulate the climate as they absorb the CO² from the atmosphere, reducing the heat-trapping greenhouse gas.

The change in ocean temperature and acidity affects flooding due to thermal expansion. When the ocean warms, water particles gain more energy meaning that the ocean expands. Coral reefs act as a natural sea defence lowering the waves and slowing the rate they move at by absorbing some of its energy. However, as increased ocean temperatures deplete the population of corals, natural sea defences will be destroyed and waves will become more powerful and erode our coast faster. This is escalated by thermal expansion as the waves become taller. Other examples of natural sea defences are sand dunes and saltmarshes. They both absorb energy out of the waves and the sea meaning that surrounding areas, including people's houses, are less likely to flood. However, as the waves become too powerful for them they slowly erode leaving coastlines more vulnerable. Gradually, as all of our natural sea defences wear away, we will have to spend money on artificial, manmade ones like seawalls and groynes, which can cost a fortune.

What does the future hold? Scientists from the Royal Society claim that: "If we continue to produce carbon dioxide at the current rate, future atmospheric carbon dioxide will be high enough to lower ocean surface pH to 7.8 by the year 2100". Scientists have done laboratory studies that suggest a pH about this low could dissolve coral skeletons and may cause reefs to fall apart.6 This would have a massive ecological, economic and social impact all over the world. By 2050 it is estimated that 95% of all living corals shall be wiped out due to warming oceans and ocean acidification.[5]

So can anything be done? Increasing CO² emissions and a build up of greenhouse gases in our atmosphere is the root of all these problems. It is therefore all our responsibilities to change our lifestyles and look to renewable sources of energy such as wind power, wave power and solar power. We need more countries and governments to start taking responsibility like Australia. "Australia's environment minister has conceded that years of neglect have contributed to a devastating drop in coral coverage on the Great Barrier Reef along the country's northeast coast."7 In response to this Australia vowed to restore the coral reef to its previous glory.

In conclusion, increases in atmospheric CO² causes climate change, including global warming, and is negatively affecting

the marine environment through increasing ocean temperatures and lowering pH levels. This is all mainly due to human activities such as industry, transportation and general use of energy, which requires the burning of fossil fuels. These changes to the oceans are affecting many different ecosystems, most noticeably the coral reefs through bleaching and causing pole-ward migration of marine species, thus affecting the distribution of marine species all over the world. This has an impact on humans, such as reducing local fish stocks, affecting tourism, sea defences and production of medicines. Unless more people become aware of these problems and start to change their ways these effects will worsen in the future and affect all life on earth.

Bibliography

1. J Welford. (2015). Answers to some climate change objections. Available: http://theindexer.hubpages.com/hub/Answers-to-some-climate-change-objections. Last accessed April 2015.
2. The Conversation. (2015). Why Climate Scientists Shouldn't Testify Before Congress. Available: http://www.science20.com/the_conversation/why_climate_scientists_shouldnt_testify_before_congress-152661. Last accessed April 2015.
3. National Geographic. (No date). Sea Temperature Rise. Available: http://ocean.nationalgeographic.com/ocean/critical-issues-sea-temperature-rise/. Last accessed April 2015.
4. K Van Dien, D Stone. (2013). The Effects of Ocean Acidification on Coral Reefs. Available: http://climateinterpreter.org/content/effects-ocean-acidification-coral-reefs. Last accessed April 2015.
5. R A Butler. (2005). Coral reefs decimated by 2050, Great Barrier Reef's coral 95% dead. Available: http://news.mongabay.com/2005/1117-corals.html. Last accessed April 2015.
6. Teach Ocean Science. (No date). How does climate change affect coral reefs? Available: http://www.teachoceanscience.net/teaching_resources/education_modules/coral_reefs_and_climate_change/how_does_climate_change_affect_coral_reefs/. Last accessed April 2015.
7. H Whiteman. (2012). Australia vows to reverse Great Barrier Reef's coral decline. Available: http://edition.cnn.com/2012/10/03/world/asia/australia-great-barrier-reef-coral/. Last accessed April 2015.
8. NOAA. (No date). Coral Reefs – An Important Part of Our Future. Available: http://www.noaa.gov/features/economic_0708/coralreefs.html. Last accessed April 2015.
9. Union of Concerned Scientists. (No date). Coral Destruction to Great Barrier Reef, Australia. Available: http://www.climatehotmap.org/global-warming-locations/great-barrier-reef-australia.html. Last accessed April 2015.
10. N Jones. (2011). Coral marches to the poles. Available: http://www.nature.com/news/2011/110121/full/news.2011.33.html. Last accessed April 2015.
11. NOAA. (No date). A Sea of Change. Available: http://www.noaa.gov/features/02_monitoring/ocean_acidification.html. Last accessed April 2015.
12. The Nature Conservancy. (No date). Climate Change Impacts. Available: http://www.nature.org/ourinitiatives/urgentissues/global-warming-climate-change/threats-impacts/stronger-storms.xml. Last accessed April 2015.
13. A Jha. (2008). Hurricanes and global warming devastate Caribbean coral reefs. Available: http://www.theguardian.com/environment/2008/jan/24/climatechange. Last accessed April 2015.

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J. is a Year 9 student at Fakenham Academy, Norfolk. PhD Tutor Natalie Wager is studying for her PhD at the University of East Anglia (UEA), focussing on the sea surface distribution and air-sea exchange of greenhouse gases.

PhD Tutor's note

J.'s essay was outstanding, incorporating research and ideas far beyond the scope of the course. Throughout this essay J. has demonstrated a strong understanding of the topic and produced a well-rounded essay describing whether increases in atmospheric CO2 impact the marine environment. J. clearly has highly developed skills enabling him to understand complex ideas and explain them to others in a written discussion. This example of J.'s work demonstrates his ability to succeed at any university he chooses in the future.

EXPLORING DIFFERENTIAL CALCULUS

A. Hussan, supervised by B. Oke

Abstract

Calculus is the mathematical study of change which was independently developed by Isaac Newton and Gottfried Leibniz in the 17th century. Differential calculus is the branch of calculus which deals with the rate of change of a quantity, and is used to determine instantaneous values.[1] The rate of change $f(x)$ with respect to x is denoted by $f^1(x)$.[2] Calculus is applied in a wide range of fields including architecture, astronomy, biochemistry, economics, engineering, healthcare, software development and more. Additionally, calculus enables statisticians to evaluate survey data better by allowing more accurate predictions for appropriate action.[3] In this project, I examined how differential calculus can be employed in finding maximum and minimum values of quantities. This is very important for many areas of modern life. For instance, a business man may be interested in knowing the price to sell his items in order to maximise profit. This work explores different applications of differential calculus, starting from the fundamental definition of function derivatives to their applications in some real life problems.

Section A – Problem Definition

Deep sea exploration of crude oil often involves transportation of the oil using large petroleum tankers. These tankers are used to move large quantities of unrefined crude oil from the point of exploration to refineries, where they are purified to obtain useful products. As the global demand for energy is increasing, an oil exploration company considers fabricating a cylindrical tank having a capacity of 1,000,000 m^3. They are interested in minimising the amount of material to use in manufacturing the tank. The surface area of a cylinder is given by the following equation:

A=2ϖrh+2ϖr^2   (1)

where r and h are the radius and the height of the cylinder, respectively. The capacity of the cylinder is given by:

ϖr^2h=1000000   (2)

The task is to find the radius and height of the cylinder that will minimise its surface area. To achieve this, I proceed as follows:

Solution:

From Eq. 2,

$$h = \frac{1000000}{\pi r^2} \quad (3)$$

Substituting h into Eq. 1 gives:

$$A = 2\pi r \frac{1000000}{\pi r^2} + 2\pi r^2 \quad (4)$$

$$A = \frac{2000000}{r} + 2\pi r^2 \quad (5)$$

The next step is to use the knowledge of differential calculus. I will find the first derivative of A with respect to   in Eq.5 as follows:

$$\frac{dA}{dr} = -2000000r^{-2} + 4\pi r \quad (6)$$

Therefore,

$$\frac{dA}{dr} = 0$$

Rearranging Eq. 7,

$$-2000000r^{-2} + 4\pi r = 0 \quad (7)$$

Therefore,

$$-\frac{2000000}{r^2} = -4\pi r$$

Therefore,

$$r = \sqrt[3]{\frac{50000}{\pi}}$$

$$r = 54.2\,m\,(to\,3\,s.f)$$

How do I know that the value of r obtained above will give a minimum surface area. The corresponding value of h can be obtained by substaining r into Eq.3:

$$\frac{d^2A}{dx^2} = -4000000r^{-3} + 4\pi \quad (8)$$

Then, I will substitute the value of r into Eq. 8:

$$\frac{d^2A}{dx^2} = -4000000(54.2)^{-3} + 4\pi$$

$$\frac{d^2A}{dx^2} = 37.2$$

Generally if:

$$\frac{d^2y}{dx^2} < 0; \quad we\ have\ maximum$$

$$\frac{d^2y}{dx^2} > 0; \quad we\ have\ minimum$$

Since

$\frac{d^2A}{dx^2} > 0$; it means that the value of r obtained above will give a minimum surface area. The corresponding value of h can be obtained by substituting r into Eq.3:

$$h = \frac{1000000}{\pi(54.2)^2}$$

$$h = 108\,m\,(to\,3.sf)$$

Therefore to get the minimum surface area the surface of the cylindrical tank the radius of the cylinder should be 54.2m and the height should be 108 m.

Section B - Other Applications

1. The equation below represents a curve C

$$y = \sqrt{x} + \frac{1}{x}$$

a. Find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$

b. Find the coordinates of stationary points on the curve
c. Determine the nature of the stationary points.

Solution
Section B

q1.
a) $y = \sqrt{x} + \frac{1}{x}$

$y = x^{\frac{1}{2}} + x^{-1}$

$\frac{dy}{dx} = \frac{1}{2}x^{-\frac{1}{2}} - x^{-2}$

$= \frac{1}{2\sqrt{x}} - \frac{1}{x^2}$

$\frac{d^2y}{dx^2} = -\frac{1}{4}x^{-\frac{3}{2}} + 2x^{-3}$

$= -\frac{1}{4(\sqrt{x})^3} + \frac{2}{x^3}$

b) $\frac{1}{2\sqrt{x}} - \frac{1}{x^2} = 0$

$x^2 - 2\sqrt{x} = 0$

$\frac{x^2}{\sqrt{x}} = \frac{2\sqrt{x}}{\sqrt{x}}$

$\frac{x^2}{\sqrt{x}} = 2$

$x^{\frac{3}{2}} = 2$

$(\sqrt{x})^3 = 2$

$\sqrt{x} = \sqrt[3]{2}$

$x = (\sqrt[3]{2})^2$

$x = 1.59 \ (3sf)$

$x = 1.59$

$y = \sqrt{x} + \frac{1}{x}$

$y = \sqrt{1.59} + \frac{1}{1.59}$

$y = 1.89 \ (3sf)$

$= (1.59, 1.89)$

c) $-\frac{1}{4(\sqrt{1.59})^3} + \frac{2}{1.59^3}$

$= 0.622 \ (3sf) > 0 \ (minimum)$

2. A baking tin is in the shape of a cuboid. The base of the tin measures x cm by $2x$ cm, and its height is h cm. The surface area of the cuboid is given by the following expression.

$$A = 2x^2 + \frac{12000}{x}$$

a. Use differentiation to find the value of x for which A is minimum
b. Find the minimum value of A
c. Show that the value of A is, indeed, minimum.

Solution

a) $A = 2x^2 + \frac{12000}{x}$

$A = 2x^2 + 12000x^{-1}$

$\frac{dA}{dx} = 2 \times 2x^{2-1} - 1 \times 12000x^{-1-1}$

$= 4x - 12000x^{-2}$

at the stationary point $\frac{dA}{dx} = 0$.

$4x - 12000x^{-2} = 0$

$4x - \frac{12000}{x^2} = 0$

$4x^3 - 12000 = 0$

$4x^3 = 12000$

$x^3 = 3000$

$x = 14.4 \ (3sf)$

b) $A = 2(14.4)^2 + \frac{12000}{14.4}$

$A = 1248 \ cm^2$

c) $\frac{d^2A}{dx^2} = 4 + \frac{24000}{x^3}$

$4 + \frac{24000}{1248} = 23.2 \ (3sf) > 0 \ (minimum)$

3. A closed plastic cylinder is used for making compost. The radius of the base of the cylinder and the height are r and h respectively. The total surface area of the cylinder is 30,000cm²
a. Show that the volume of the cylinder V cm³ is given by:

$$V = 15000r - \pi r^3$$

b. Find the maximum volume of the cylinder and show that your value is a maximum.

Solution

a) $A = 30\,000 \ cm^2$

$A = 2\pi rh + 2\pi r^2$

$2\pi rh + 2\pi r^2 = 30\,000$

$\frac{2\pi rh}{2\pi r} = \frac{30\,000 - 2\pi r^2}{2\pi r}$

$h = \frac{30\,000 - 2\pi r^2}{2\pi r}$

$V = \pi r^2 \times h$

$V = \pi r^2 \left(\frac{30\,000 - 2\pi r^2}{2\pi r}\right)$

$V = r\left(\frac{30\,000 - 2\pi r^2}{2}\right)$

$V = r(15000 - \pi r^2)$

$V = 15000r - \pi r^3$

b) $\frac{dV}{dr} = 15000 - 3\pi r^2$

at the stationary point $\frac{dV}{dr} = 0$.

$15000 - 3\pi r^2 = 0$

$15000 = 3\pi r^2$

$\sqrt{r^2} = \sqrt{\frac{15000}{3\pi}}$

$r = \pm 39.9 \ (3sf)$

$\frac{d^2A}{dr^2} = -6\pi r$

$-6\pi \times 39.9 = -752$

$-752 < 0 \ (maximum)$

$V = \pi r^2 h$

$V = \pi (39.9)^2 h$

$= 398942.3 \ (1 dp)$

4. Given that

$$y = x^3 - x^2 - x + 4$$

a. Find $\frac{dy}{dx}$

b. Write down the values of x for which $\frac{dy}{dx} = 0$

c. Classify the stationary points as either maximum, minimum or inconclusive
d. Find the corresponding values of y at the stationary points.

Solution

a) $y = x^3 - x^2 - x + 4$

$\frac{dy}{dx} = 3x^2 - 2x - 1$

b) $\frac{dy}{dx} = 0$

$3x^2 - 2x - 1 = 0$

$3x^2 - 3x + x - 1 = 0$

$3x(x - 1) + 1(x - 1)$

$(3x + 1)(x - 1)$

$x = -\frac{1}{3} \ or \ 1$

c) $\frac{d^2y}{dx^2} = 6x - 2$

$6\left(-\frac{1}{3}\right) - 2 = -4 < 0 \ (maximum)$

$6(1) - 2 = 4 > 0 \ (minimum)$

d) $y = \left(-\frac{1}{3}\right)^3 - \left(-\frac{1}{3}\right)^2 - \left(-\frac{1}{3}\right) + 4$

$y = -\frac{1}{27} - \frac{1}{9} + \frac{1}{3} + 4$

$y = \frac{113}{27}$

$\left(-\frac{1}{3}, \frac{113}{27}\right)$

$y = (1)^3 - (1)^2 - 1 + 4$

$y = 3$

$(1, 3)$

5. Given that $y = x^2 + 8x + 13$

a. Find $\frac{dy}{dx}$

b. Find the values of x at stationary points
c. Decide whether these points correspond to a maximum or minimum
d. Find the values of y at these points.

a) $y = x^2 + 8x + 13$

$\frac{dy}{dx} = 2x + 8$

b) At the stationary point $\frac{dy}{dx} = 0$.

$2x + 8 = 0$

$\frac{2x}{2} = \frac{-8}{2}$

$x = -4$

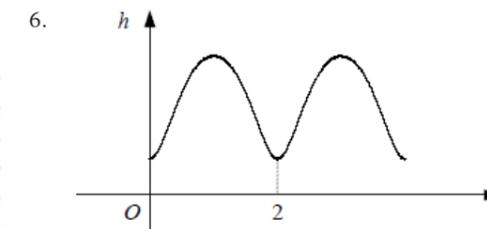c) $\frac{d^2y}{dx^2} = 2 > 0 \ (minimum)$

d) $y = (-4)^2 + 8(-4) + 13$

$y = -3$

$(-4, -3)$

6.

The graph above shows the height h cm of letters on a website advert t seconds after the advert appears on the screen. The height h cm is given by the following equations:

$$h = 2t^4 - 8t^3 + 8t^2 + 1$$

a. Find an expression for $\frac{dh}{dt}$

b. Find the rate at which the height of the letters is increasing when $t = 0.25 \ seconds$

Solution

a) $\frac{dh}{dt} = 8t^3 - 24t^2 + 16t$

$8(0.25)^3 - 24(0.25)^2 + 16$

$\frac{1}{8} + \frac{3}{2} + 4 = 2.625$

$= 2.625 \ cm/s$

References

1. http://www.merriam-webster.com/dictionary/differential%20calculus
2. http://www.bbc.co.uk/bitesize/higher/maths/calculus/differentiation/revision/1/
3. http://www.wyzant.com/resources/lessons/math/calculus/introduction/applications_of_calculus

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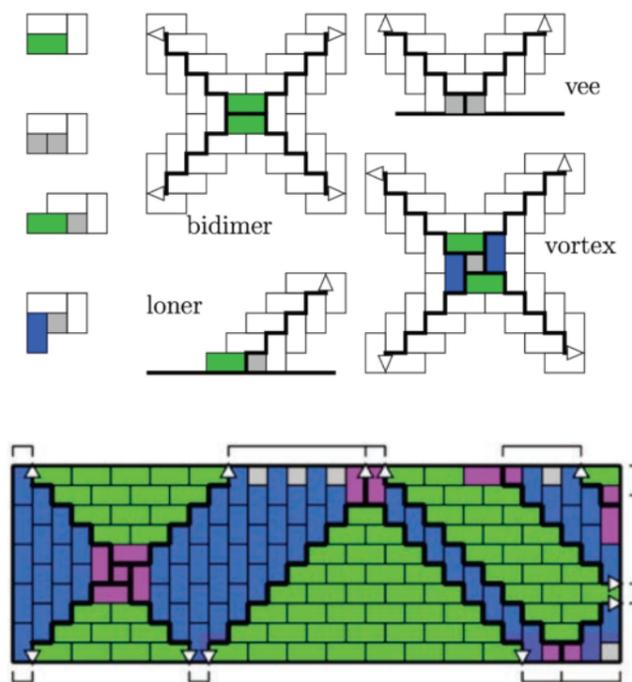
PhD Tutor's note
A. displayed an excellent knowledge of differential calculus. Her work showed that she is capable of applying differentiation formula to a wide range of algebraic functions and combination of functions with minimal errors. The equations are well laid out and the mathematical passages are put in a correct order.

HOW TO MAKE A MATHEMATICAL DISCOVERY: THE TATAMI RESTRICTION AT LARGE

K.Hancock, supervised by A. Erickson

Abstract

The Scholars Programme course *How to Make a Mathematical Discovery* guides pupils through the process of discovering and proving mathematical theorems in the context of locally restricted arrangements of tiles. After studying restricted arrangements of 1x1 monomino tiles and 1x2 domino tiles on rectangular grids, pupils apply the methods they have learnt in order to make mathematical discoveries with a different set of tiles and restrictions, collectively called tatami *restrictions*. They are asked to give a brief evaluation of various tatami restrictions, and then to narrate any discoveries that they have made about the 5-tatami restriction for arrangements of triangles and lozenges on the isometric grid. The two figures from the course material shown below are central to this Scholars Programme and provide some context for the article. The first is a summary of significant tile-arrangements that can occur on rectangular-grids, and the second is an example of monomino-domino tatami covering in which no four tiles meet at any point, and that uses all of the significant arrangements (up to rotation and reflection) shown in the first image.

Fig. 1.

Section 1 Introduction

We consider restricted arrangements of triangle and lozenge tiles on isometric grids. A tatami restriction is a restriction where certain numbers of tiles cannot meet at one point on a grid. This restriction can range from 2-tatami (where two tiles cannot meet) up to 6-tatami (where six tiles cannot meet) on an isometric grid. Fundamentally, the study of tatami coverings is discrete rather than continuous. The tatami-restriction creates 'forced' placements of tiles, so that the tiles do not violate or conflict with the restriction itself.

Section 2 Discussion of various tatami restrictions

Section 2.1 The 2-tatami restriction

The 2-tatami restriction is satisfied when two tiles do not meet anywhere on an isometric grid. This creates a pattern that is combinatorially uninteresting because it is too restrictive, as the tiles have to be isolated, so they do not meet at a point. Therefore, the isometric grid cannot be completed with this restriction because two tiles will meet at a point if they are placed beside each other. However, small grids can be covered with the 2-tatami restriction; in particular, a tile can be placed on a grid with space for one tile, so that the grid is completed without opposing the restriction.

Section 2.2 The 3-tatami restriction

The 3-tatami restriction is satisfied when three tiles do not meet anywhere on the isometric grid. Moreover, I think that this restriction creates a combinatorially uninteresting pattern because most large grids cannot be completed without creating a pattern where three or more tiles meet at a point. This is because there can only be two tiles meeting at a point in order to abide by the restriction and there would have to be four tiles meeting at a point in order to complete the isometric grid. Consequently, this restriction is too restrictive due to the fact that the whole isometric grid cannot be completely covered.

Alternatively, the grid can be completed if it has only one row because one row of tiles can be placed on such a grid so that only two tiles are meeting at a point. Thus, the restriction has not been violated; this is displayed in Fig. 1. The 3-tatami restriction is not as restrictive as the 2-tatami restriction because grids with only a single row can be completed.
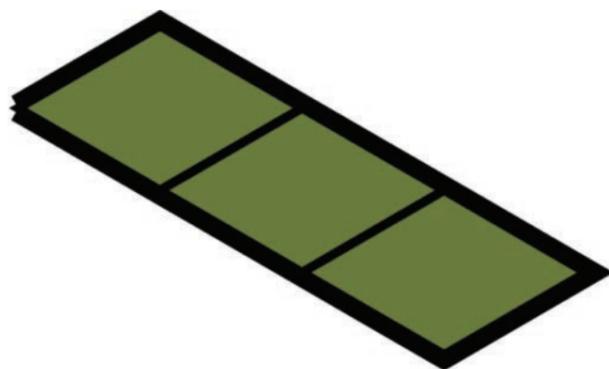
Section 2.3 The 4-tatami restriction

The 4-tatami restriction forbids configurations of tiles that have the following property: on the vertices of the isometric grid, four tiles meet at a point. Therefore, similar to the 3-tatami restriction, it is also quite restrictive, because certain large grids cannot be completed. For example, rays, an important structure in 5-tatami coverings (such as in Fig. 7), cannot be constructed without 4-tiles meeting at a point, so the grid is unable to be completed without opposing the restriction. This means that the tiles can only be placed on the grid when they are partially isolated from each other or they meet at a point with three or fewer tiles (such as in the centre of Fig. 7). However, they cannot be placed with four tiles meeting to complete the grid, as a violation will take place.

Section 2.4 The 5-tatami restriction

The 5-tatami restriction is combinatorially interesting because it allows a wide variety of patterns to be created without a violation of the restriction taking place. In addition, rays, shown in Fig. 6 and described in Erickson (2013), can be created by the continuation of certain configurations of four tiles meeting at a point, so that the isometric grid can be completed. Some of the tiles can then be flipped so that the ray has changed, but the violation has still not occurred. Therefore, I think that the 5-tatami restriction is the most interesting out of the restrictions I have discovered, because it is a restriction that allows many ideas to be fulfilled without conflicting with the restriction.

The idea of flipping a row is demonstrated via the coloured tiles in Fig. 2. Different rows from this isometric grid can be flipped, like the row shown, without the restriction being violated. A violation does not take place because only half of the ray is being flipped, so there is still a continuous ray that is similar to the beginning ray. This causes, in my opinion, the most fascinating restriction, because it is a catalyst for many designs to be created with different amounts of lozenge and triangle tiles included in the isometric grid. Additionally, in most cases the triangle tiles can only be placed on the outer rows of the isometric grid in order to abide by the tatami restriction, because there will be 5 or 6 tiles meeting at a point if the lozenge is placed away from the edge of the isometric grid. The triangle tile creates placements that are 'forced' and these placements create a circular design, so five or six tiles meet at a point, and this violates the 5-tatami restriction.
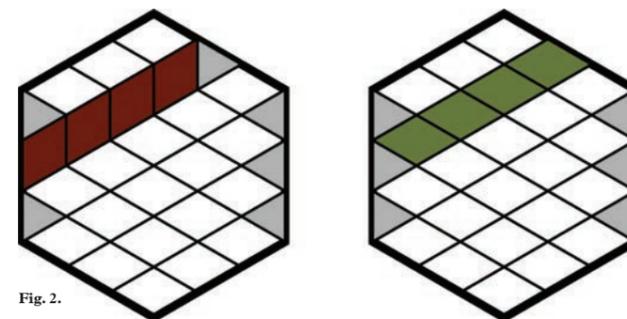

Fig. 2.

Section 2.4 The 6-tatami restriction

The 6-tatami restriction allows the most variety of patterns to be created without violating the restriction, as the only pattern that violates this restriction looks similar to a flower, with the ends of six tiles meeting at one point, as in Fig. 3. Moreover, this restriction is also combinatorially interesting because different designs can be created with a wide variety of patterns. Many such patterns that would otherwise violate the 2, 3, 4, and 5-tatami restrictions can be placed on the grid without violating the 6-tatami restriction. Therefore, this restriction is rather unrestrictive because almost every covering is possible. It can therefore also be argued that this makes the 6-tatami an uninteresting restriction, because almost any design is possible.

Section 3 Further Observations and discoveries

With the wording of the tatami restrictions, I began to wonder whether you could place four, five, or six tiles meeting at a point without violating the 3-tatami restriction. This is because the 3-tatami restriction only stated that three tiles could not meet at a point; it never specifically stated that four, five, or six tiles could not meet at a point because it would violate the restriction. Consequently, I began to draw some of the 4, 5, and 6-tatami violations to observe whether the restriction would be violated. After further observations, I realised that three tiles also meet at a point where four, five, or six tiles meet and that the 3-tatami restriction would probably also be violated; this can be visualised in Fig. 3. The coloured tiles represent three tiles that meet at a point on these violations. Therefore, the 3-tatami restriction is violated where four, five, or six tiles meet at a point. This illustrates the fact that a maximum of two tiles can be placed next to each other in order to abide by the restriction.
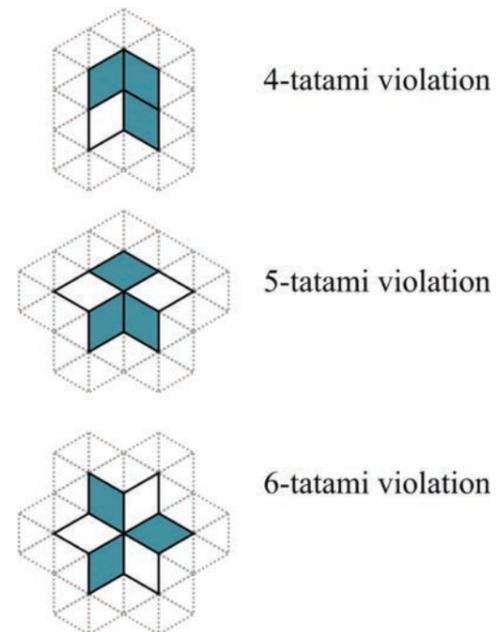

4-tatami violation

5-tatami violation

6-tatami violation

Fig. 3.

Theorem

The 5-tatami restriction includes a pattern that resembles a sodium chloride crystal.

Proof

The structure of a 5-tatami arrangement includes rays and has an organised appearance, such as where 4 lozenge tiles are placed at one point together. Placing the tatami tiles in an interesting way can create the illusion of sodium chloride crystal-like cube. This is demonstrated in Fig. 4.

The structure of this 5-tatami arrangement consists purely of diamonds, and they are placed so that four tiles meet at one point. These 4-tile arrangements are then placed in rows that are then rotated to fit inside the isometric grid. Moreover, this abides by the 5-tatami restriction because at most four tiles meet at each point of the grid and it also creates an illusion of a cube. Furthermore, this pattern is interesting despite the fact that it is simple and organised. This is combinatorially interesting because this pattern illustrates a local rule for the placement of individual parts needed to build something complex like a sodium chloride crystal.
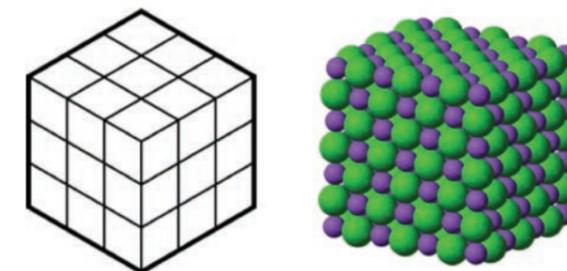
Fig. 4 and fig. 5. Sodium chloride crystal

Interestingly, the structure shown in Fig. 4 resembles the structure of a sodium chloride crystal, shown in Fig. 5. This is because the particles inside the crystal are fixed in rows and columns and the tiles in the pattern are also organised in rows that rotate, so they complete the isometric grid covering. The global structure of the 5-tatami restriction, in a way, echoes the structure of a sodium chloride crystal, perhaps because of a resemblance between the local rules of these structures; a local rule that emphasises the

strong relation between the tiles or particles are locally organised in a specific, orderly fashion to create

Fig. 6.

Fig. 7.

Section 3.1 The vortex

After studying the four essential configurations, loners, vees, bidimers, and vortices, for the beginning of a ray on a square grid with monominos and dominos, defined in Erickson (2013), I began to test whether the rays would begi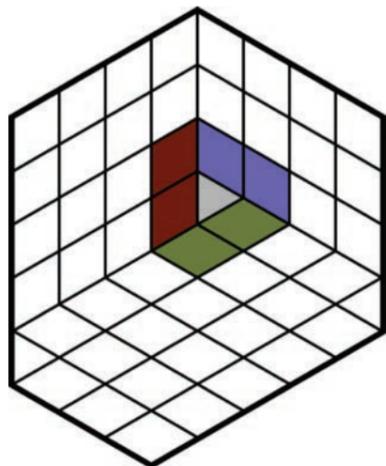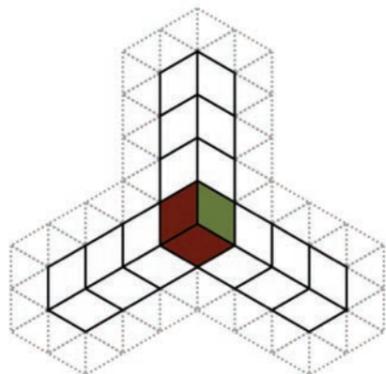n the same way on an isometric grid. I realised that a vortex could be used to start a ray on an isometric grid, where the starting point is a triangle and the surrounding ray is made up of lozenges. Furthermore, I based this discovery on the fact that the square-grid vortex starts with a monomino on a grid based upon monominos and dominos, so I realised that a vortex on the isometric grid would have to begin with a triangle surrounded by lozenges. This will mean that a grid can be successfully completed. Surprisingly, the vortex also abides by the 5-tatami restriction, so the 5-tatami restriction is, in my opinion, extremely interesting due to all the possible tatami coverings that can be completed without a violation. This means that the 5 tatami restriction is not very restrictive and it allows us to think about all the possible ways in which the tiles can be placed in order to create coverings that match the restriction itself. The configuration of a vortex on an isometric grid is shown in Fig. 6.

The coloured section demonstrates the beginning of the vortex rays, with the triangle surrounded by lozenges. As you can see, this is very similar to the vortex created on a grid with monominos and dominos (Editor's note: The configuration referred to is provided in the abstract). The properties of both of these grids are therefore very similar, and the configuration of the vortex can be adapted to the isometric grid.

Section 3.1 The triple bidimer

As the vortex could successfully be completed, I started to investigate an isometric way of creating a bidimer. I did this by placing two diamonds together like a bidimer and then beginning to create rays from the two diamonds. There could only be three rays created from the centre of the triple bidimer because of the isometric grid restricting the triple bidimer to three rays. This is due to the fact that the placement of another diamond is forced in the centre of the triple bidimer in order for rays to be created. Therefore, there are only three corners in which rays can be developed from, rather than four corners like in a rectangular grid. My idea is highlighted in Fig. 7.

The colour red illustrates my initial idea to create two lozenges and place them together like a bidimer on a rectangular grid, but I had to adapt my initial idea to fit the isometric grid. This is demonstrated by the addition of another diamond, which is green, to create a shape that is almost like a cube in the centre of the triple bidimer. As a result of the addition of a diamond, there could only be three rays developed from the corners of the starting shape. This is adaptation is based upon the bidimer that was created for the rectangular grid (Editor's note: The configuration referred to is provided in the abstract).

Section 4 Conclusion

In conclusion, the tatami restricted arrangements of tiles are in general a combinatorially interesting concept that frames many ideas and discoveries. Tatami restrictions range from being too restrictive to not very restrictive at all and that makes tatami, in my opinion, very interesting and a fascinating concept to investigate and make new discoveries on. The local rules that I have been investigating contribute to complex structures on a larger scale; for example, I learnt that most (unrestricted) arrangements of lozenge coverings form an 'Arctic circle'[1].

Tatami is the most fascinating part of mathematics that I have developed an understanding of so far, as the restrictions are almost like a foundation to discover many different things through existing objects and through mathematical prospects, like the 'Arctic circle'.

Bibliography

Erickson, A. T. (2013). Monomino-Domino Tatami Coverings (Doctoral thesis, University of Victoria, British Columbia, Canada). Retrieved from http://hdl.handle.net/1828/4902

About the authors

K. is a Year 10 pupil at The Academy at Shotton Hall in Peterlee, County Durham. A. Erickson completed his PhD on discrete mathematics in 2013 in The Department of Computer Science at The University of Victoria in Victoria, Canada.

PhD Tutor's note

K. Hancock's mathematical maturity far exceeds the expected level of her age group and the narration of her mathematical discoveries demonstrates a keen interest in the subject and intuitive understanding of the tatami arrangements. One of the challenges encountered in this subject area is the communication of complex ideas with precision; in the article, K. Hancock describes complex mathematical structures by combining diagrams, making comparisons to familiar objects, and effectively employing a wide range of descriptive vocabulary, including many words that were introduced in the Scholars Programme.

DESCRIBE ALZHEIMER'S, PARKINSON'S AND MOTOR NEURONE DISEASE AND COMPARE AND CONTRAST EACH CONDITION. DESCRIBE AND EVALUATE THE PROS AND CONS OF ONE OF THE NOVEL THERAPIES FOR THESE DISEASES.

M. Hui Qi Tan, supervised by P. Smethurst

Abstract

As the average age of the population increases so does the prevalence of neurodegenerative diseases. The most common forms these neurodegenerative diseases take are Alzheimer's, Parkinson's and Motor Neuron Disease which all affect the brain and/or spinal cord, and have devastating implications for the individual and family affected. These diseases are putting the economy and public health services under severe strain due to the lack of effective treatments and high costs of palliative care. We still have a long way to go to fill in the large gaps in our knowledge of these conditions and we desperately require effective treatments to alter the disease and improve the patient's quality of life. This essay will describe what is known about these conditions including: what the condition is, what the symptoms are, what some of the pathological features are and finally what treatments are available. Also covered here are the similarities and differences between these disorders, what stem cell therapy is and how it has potential use for modelling and treating these diseases. The ultimate aim here is to highlight the need for action and further research to investigate how these diseases work in order to develop effective disease models and treatments.

Introduction

With millions of people affected worldwide, neurodegenerative diseases have become much more prevalent in our current society, leading to researchers investigating ways to treat these ubiquitous diseases of the brain. Ranging from Alzheimer's Disease (AD) to Parkinson's Disease (PD) and forms of Motor Neurone Disease such as Amyotrophic Lateral Sclerosis (ALS), neurodegeneration or the death of neurones in the central nervous system are still under thorough research as to how these diseases affect people, and more significantly, what causes neurodegeneration itself. Despite the treatments and therapeutic methods available for other disorders in the world such as diabetes, there is still no finalised cure for any of the three major neurological diseases. 'Neurological disorders remain neglected and ignored…'[1] – their complexity in terms of their causes and complication in ways of treating the diseases mean that these heterogeneous disorders are still the cause of 4% of all deaths worldwide.[2] However, with the drastic improvement in medical technology – for example, the use of positron emission tomography (PET) – researchers are beginning to explore new novel treatments such as stem cell therapy, which creates hope that someday there will be an ultimate cure for all of the neurodegenerative diseases we are faced with.

Alzheimer's Disease

Alzheimer's Disease (AD) is a chronic neurodegenerative disease affecting over 40 million people worldwide, with the common symptoms being cognitive dysfunction and confusion. The progressive and incurable quality of this disease results in AD being the sixth greatest cause of all deaths in the United States alone.[3] Much like other neurodegenerative diseases such as Amyotrophic Lateral Sclerosis (ALS) – a common form of Motor Neurone Disease – AD is also linked to ageing, although other risk factors have also been believed to be a cause of the disease. Similarly to Parkinson's disease, one of the proposed factors linked to AD is the decrease in levels of a certain neurotransmitter that is essential in regulating specific bodily systems. In AD, it is believed that the decrease in the levels of acetylcholine (ACh) neurotransmitters found in cholinergic neurones in some parts of the central nervous system (CNS) are one of the causes of confusion and cognitive dysfunction – symptoms are evident amongst 20% of AD patients.[4]

As acetylcholine is vital in the transfer of electrochemical impulses between cholinergic neurones that enable cognitive processing, the decrease in this particular neurotransmitter means that cognitive ability is impaired. The progression of AD (with the progressive decrease in ACh) links to the deterioration in AD patients' cognitive ability. The scores for mild AD are nearly three times greater than that of severe Alzheimer's disease, reiterating how the lack of the acetylcholine neurotransmitter causes symptoms of AD to worsen over time.

A major cause associated with Alzheimer's Disease is the amyloid plaques between neurones in AD patients. The formations of these amyloid plaques are from parts of an amyloid precursor protein (APP), called beta amyloid, which are congested between nerve cells in the brain.[5] The insoluble plaques disrupt nerve signalling and the delivery of electrochemical impulses to neurones as synaptic transmission is prolonged. Both AD and PD involve the abnormality of certain protein structures – however, in PD, it is the abnormality in alpha-synuclein and its function that causes symptoms to occur. In terms of AD, another major cause of this disease is the neurofibrillary tangles in the brain that are a result of the abnormal structure of Tau, a protein that stabilises structures called microtubules which are fundamental for the transportation of nutrients between neurones. The microtubules are also essential for the signalling system between nerve cells. In a person without AD, Tau molecules bind to microtubules to form the necessary structures; in a person with AD, on the other hand, Tau molecules connect with more molecules of Tau which cause neurofibrillary tangles to develop within the neurones. This causes the degeneration of neurones in the brain as the neurofibrillary tangles disintegrate the microtubules. Indeed, the lack of nutrients being delivered to the neurones and the additional collapse of neuronal systems that control the transmission of signals can also cause neurodegeneration.[6]

The main difference that sets AD apart from PD and ALS is the area in the brain in which the neurological disease affects. The symptoms of each disease have a direct correlation to the parts of the brain or body that are affected. In AD, affected areas include the temporal lobes and the hippocampus in the brain; in PD, a region in the mid brain called the substantia nigra is affected; lastly, in ALS, the nerves and the muscles – in particular, the neurones extending from the brain to the spinal cord of the CNS – are affected. In AD, for instance, as elucidated in Fig. 2, brain atrophy (the shrinkage of the brain) is present as the whole Alzheimer's brain is significantly smaller in size in comparison with the normal brain. Researches have supported the findings of brain atrophy in AD patients, as they found that AD brains are 10% smaller in mass: the average adult brain being 1.3-1.4kg; an AD brain being 1.17-1.26kg.[8] Fig. 1 also depicts how the loss of glucose uptake (shown in the Positron Emission Tomography scan) in the upper and lateral sections of the brain have caused symptoms associated with those areas to occur. For instance, the frontal cortex and the temporal lobes, where the amydala and hippocampus are located, are areas of low glucose uptake. This helps to explain how AD patients have difficulty with learning and memory (as the hippocampus has been affected) and even speech production and word recognition since the Wernicke's area (in control of word recognition) and the Broca's area (in control of speech production) are located in the affected temporal lobes. The darker areas and gaps in the image of the AD brain also indicate enlarged ventricles, helping to explain how patients with AD have much more severe cognitive impairment (60% more severe) in comparison with those with milder cognitive impairment.[9]

Treatment of Alzheimer's Disease

Treatments available for AD are usually in the form of palliative drugs – the method which PD symptoms are also being alleviated by. Motor Neurone Disease (ALS, in this context), on the contrary, requires more experimental research and ways of treatment such as gene therapy. Drugs for AD depend on the severity or stage at which the disease is levelled at. For example, drugs such as Aricept® (Donepezil) and Razadyne® (Galantamine) alleviate certain symptoms of AD by increasing the levels of the acetylcholine neurotransmitter indirectly – the drug causes an enzyme called acetylcholinesterase to slow down its breakdown of the neurotransmitter. This, in turn, improves the rate of neurotransmission between neurones in the brain and hence, can (although temporarily) alleviate certain AD symptoms.[10] Other currently researched AD treatments include stem cell therapy, which involves using stem cells that differentiate into healthy neurones to replace the degenerated neurones in the brain. However, the fact that Alzheimer's Disease affects a wide range of neurones in various parts of the brain results in this potential treatment being a difficult approach.[11]
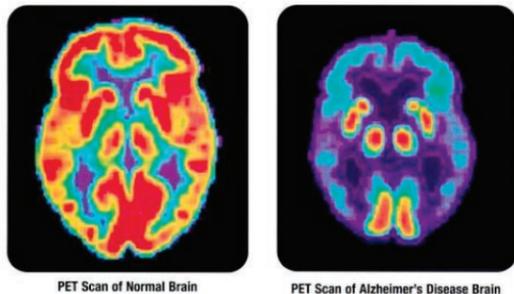

Fig. 2:   PET Scan of Normal Brain   PET Scan of Alzheimer's Disease Brain

Parkinson's Disease

Parkinson's Disease (PD) ranks the second leading neurodegenerative disease in the world, with an estimated 4 to 6 million people affected worldwide.[12] PD is progressive and affects movement, with symptoms extending from bradykinesia (slow movement) to more severe effects such as cognitive dysfunction in the later stages of the neurological disease.[13] Most cases of PD are idiopathic, although new research of PD has pointed to genetic factors such as mutated genes and abnormal proteins as causes of PD. Similarly to AD, PD is often linked with ageing as most cases occur after the age of 50 – it can, however, affect younger people under the age of 40; 'early-onset PD' accounts for 3-4% of PD cases, leading to researchers believing and gathering evidence that this shows PD can be genetically induced.[14]

Research has suggested the cause of PD to be the depletion in dopaminergic neurones in the substantia nigra (located in the mesencephalon/mid-brain) that causes a decrease in the level of the dopamine neurotransmitter in the brain. The symptoms of PD, like AD, directly link to the affected brain areas. In the case of PD, the degeneration of dopaminergic neurones that cause a depletion in the dopamine levels mean that the basal ganglia does not function at its most efficient rate – this leads to a change in the regulation of movement due to the impaired function of the basal ganglia. Thus, PD symptoms such as bradykinesia occur as those affected have no control of their movement.[15] This is of similar quality to both ALS and AD, since the majority of the effects are physical (like ALS) but simultaneously, 40% of PD cases involve behavioural or emotional changes such as anxiety and depression, which is also present in AD.[16] The suspected root cause of the degeneration of the dopaminergic neurones is genetics as researchers state that 1 in 10 of PD cases are caused by the genetic mutation of the GBA1 gene that controls the GCase protein which regulates alpha-synuclein production. The mutation of this particular gene means that the original function of its coded protein – the GCase protein – is impaired, leading to the accumulation of alpha-synuclein protein.[17] The abnormality of proteins being the cause of PD has also been emphasised through findings of lewy bodies in some PD patients. The lewy bodies are caused by the deposition of the alpha-synuclein protein in the substantia nigra of the brain that,

in turn, is suspected to be the reason for the progressive decrease in the percentage of dopaminergic neurones over time.[18] There is a decrease in the percentage of dopaminergic neurones linked with patient age. In comparison with normal ageing, where there is only a slight steady decrease in the number of dopaminergic neurones, those with idiopathic Parkinson's Disease (iPD) have already lost approximately 60% of the neurones by the time they are of old age, whilst those with early onset PD have lost even more (approximately 90%) of the dopaminergic neurones in an even shorter time scale.

Treatment of Parkinson's Disease

The available treatments for PD are very similar to those of AD, as they do not cure the neurodegenerative disease but their main functions are to help with symptoms of PD and improve the patients' quality of life. These palliative treatments for PD include drugs such as Levodopa (L-DOPA): a precursor for dopamine that acts on the brain by turning into dopamine, which is depleted in a number of PD patients. The drug performs the function of dopamine, although not necessarily regenerating any new dopaminergic neurones to replace those degenerated. A surgical method called deep brain stimulation enables some PD symptoms to be relieved as the surgical process changes electrical signals in targeted areas of the brain so that symptoms are not as disturbing in those affected.[19] PD is under much research to find ways to treat the chronic neurodegenerative disease and researchers are currently trying to use vaccinations to potentially alleviate PD symptoms and slow down the progression of the disease. Recent research of PD vaccinations include the Austrian company AFFiRiS A.G introducing a developed vaccine that would improve PD symptoms by targeting lewy bodies or alpha-synuclein protein deposits in parts of the brain. The vaccine is supposed to treat the deposits as foreign intrusive bacteria or viruses in the brain, therefore producing antibodies that will clear those protein deposits. However, this potential treatment is still in its early stages of development and hence, more research and testing is required to ensure that this vaccine is safe and efficient for use.[20]

Motor Neurone Disease

Motor Neurone Disease (MND) is a group of neurodegenerative diseases involving the death of motor neurones in the brain and spinal cord of the CNS.[21] Unlike AD and PD, there are four main forms of MND, the most common form being Amyotrophic Lateral Sclerosis (ALS) which affects both the upper and lower motor neurones in the body. In the context of ALS, the degeneration of motor neurones in the CNS disables the transmission of nerve signals to the effectors (muscles) that control voluntary movement, therefore leading to symptoms such as weakness and difficulty with movement due to the wasting of the muscles. The progression of ALS is rapid and impactful, with the life expectancy being 2 to 5 years after diagnosis, although up to 10% of ALS patients survive for over 10 years.[22] Research has stated that 90- 95% of ALS cases are sporadic; 5-10% is familial and related to the inheritance of certain faulty genes. Despite this, researchers are still investigating other possible causes of this disease such as environmental factors using past historical cases, and like AD and PD researchers, they are continuing their search and development for a cure to treat this fatal neurodegenerative disease that is taking away 2 in every 100,000 lives per year.[23]

Like AD and PD, some cases of ALS are genetically induced and are a result of mutations in genes that cause protein abnormalities. In ALS, the mutation lies in the SOD1 gene, which causes it to become toxic and fold irregularly. This leads to deposits of the protein accumulating and potentially disrupting signalling between neurones, meaning electrochemical impulses cannot be delivered to the motor neurones in the body; hence, the effectors cannot perform the voluntary action as there is no complete circuit in the transmission of nerve impulses. It is believed that the mutated SOD1 protein is a factor in the degeneration of the motor neurones in two ways: the sticky quality of the protein means that when they accumulate, they trap other good proteins (such as those helping with the cell functioning). Cells, therefore,

function poorly as they lack the fundamental proteins for efficient functioning. The second cause of neurodegeneration is that the accumulation of the toxic SOD1 protein prevents the disposal of waste (such as damaged proteins). This would cause deposits of toxic waste that could, possibly, end up causing neurones and cells to die.[24] The progression of the degeneration of motor neurones means that there is a visible difference in the motor neurone of an ALS patient and a normal motor neurone. Not only is the cell body structure much smaller and damaged in the ALS patient, but the muscle has also been wasted away, helping to explain muscle weakness in ALS patients, and difficulty with movement. Essentially, the related factors linked to the mutation of the SOD1 gene have not been fully confirmed or established: more research and investigation into the mutated genes is required to fully depict the genetic cause of ALS.

Another proposed but less established cause of ALS is the environmental factor. Environmental influence on ALS has been under much research, with many scientists debating whether ALS could be caused by exposure to toxins in the environment. This is very contradictory to other neurodegenerative diseases such as AD, where most of its causes link to abnormalities and depletions in proteins and chemicals in the body. ALS occurs mainly between the ages of 40 and 70.[25] This, however, is different in the proposed environmental cause of ALS by researchers studying the ALS affected veterans in the 1991 Gulf Wars. Researchers have shown that veterans in the 1991 Gulf Wars were diagnosed with ALS two times faster than the normal rate during the years following the war; those under the age of 45 were diagnosed three times faster than others of their age.[26] The suspected cause of this is exposure to toxicity during the war, as it may have had an influence on the ALS affected veterans. Studies have also depicted that only 3 out of 135 ALS veterans had a genetic cause for ALS – suggesting that the other remaining veterans must have contracted ALS from environmental influences, although this has not been confirmed nor finalised.

Treatment of ALS (MND)

Like AD and PD, there is no finalised cure for ALS. There are drugs such as Riluzole, an NMDA antagonist that works by targeting glutamate (an amino acid). This prevents an over production of the amino acid (which could be too toxic for motor neurones) and improves transmission of signals across synapses between motor neurones. Although it does not cure the neurodegenerative disease, it can extend the patients' lives by 2-3 months if effective.[27] Other potential options include gene therapy that allows supportive proteins to be made for nerve cells in areas where the protein is malfunctioning or of a deficient quantity. The prospect seems promising – however, without enough successful experiments and trials, gene therapy may not be safe or efficient for ALS.

Novel Treatments: Stem Cell Therapy
Embryonic Stem Cell Therapy (ESC therapy)

Embryonic Stem Cell therapy is when pluripotent stem cells derived from the inner cell mass of blastocysts are retrieved to differentiate into various cell types. Pros of this treatment include ESC's greater plasticity over other types of stem cells. Its pluripotent quality brings potential in curing diseases such as AD; its indefinite proliferation means that mass numbers can be acquired at the start of an experiment involving ESCs. Cons, on the other hand, revolve around the ethical issues associated with the use of ESCs for experimental purposes as this is thought of as unethical due to the ESCs being considered a human life. As ESCs are not retrieved from the patient's own body, risk of rejection is higher since the patient's body may destroy the 'foreign' stem cells. In addition to this, previous experiments with mice affected with PD showed that use of ESCs as a treatment induced brain tumours within 20% of the mice, which led to death. This raises questions as to whether the use of ESCs is completely safe and effective on humans.[28]

Adult/Somatic Stem Cell Therapy

Adult or somatic stem cell therapy is the use of multipotent stem cells derived from an adult body (most commonly from the bone marrow in the form of mesenchymal stem cells) to proliferate and differentiate into cell types of a specific lineage. Unlike other forms of stem cell therapies, the use of adult stem cells is more morally accepted. The cons, however, outweigh the pros. In terms of its positive benefits, adult stem cells have a lowered risk of rejection as the stem cells are derived from the patient's own body which counteracts any raised ethical objections. Researchers have also found that adult stem cells are found in many tissues in the body such as those in the brain, blood vessels, skin and liver[29] – therefore, they are easily located if needed for an experiment. The contradiction to this is that the stem cells are difficult to extract from the patient's body. For instance, the retrieval of mesenchymal cells results in slight destruction of the bone marrow. Furthermore, adult stem cells are not available in mass numbers, so stem cell therapy would be a more difficult approach since it would be hard to acquire enough of the cells for a specific purpose. The fact that adult stem cells are multipotent means that they are limited to differentiate into a specific lineage, restricting any universal use of the stem cells since it can only be used for specific treatments of degenerated areas in some parts of the body. Another major con associated with adult stem cells would be the increased likelihood of mutated genes in cells due to ageing. This could lead to unknown negative long term effects for patients.

Induced Pluripotent Stem Cell Therapy (iPSC Therapy)

iPSC therapy is a much more developed and modern form of stem cell therapy that involves the genetic reprogramming of cells from the body – such as skin cells – to become pluripotent and have the ability to differentiate into all cell types of the 3 germ layers of the body. The use of induced pluripotent stem cells are also morally accepted and not considered as unethical, as the stem cells are mainly derived from the patients' own body (such as skin cells). This newer form of stem cell therapy, although a potentially efficient treatment for neurodegenerative diseases such as AD, PD and ALS, has many cons to it due to its early stage in development. Despite the positive results that researchers have gained from trials, other side effects associated with iPSC therapy may not be evident yet – whether the treatment can be completely safe in the long term is still unknown. Another con associated with this particular form of stem cell therapy is that iPSC therapy could possibly be defective and cause unknown consequences, due to potentially unsafe factors such as the use of mutated cells or incomplete iPSC reprogramming.[30] Despite these given cons, induced pluripotent stem cells' pluripotent quality offers hope that these cells could potentially treat neurodegenerative diseases (for example, by differentiating into motor neurones for a patient with ALS/ MND). The use of iPSCs as a way of increasing the number of certain cells (that have been lost due to neurodegeneration) have been investigated by the study of Lacovitti. In this study, iPSC derived from mice fibroblasts were used to encourage and increase the numbers of different types of glia and neurones in rat brains[31] – although the efficiency of this particular experiment was high and other studies did support these results, they also found that the rats developed tumour-like cells in the long term.[32] This raises questions as to whether iPSC therapy is a safe and long lasting treatment for diseases and whether other dangerous side effects could occur after treatment. Overall, apart from stem cell therapy, induced pluripotent stem cells have many uses ranging from testing the effects of drugs to studying mechanisms of diseases to potentially cure them.[33]

Neural Stem Cell Therapy

Neural Stem Cell Therapy is a form of treatment that uses stem cells derived from the brain to differentiate into a range of glia and neurones, to replace those lost from degenerative diseases. A positive factor of this particular form of stem cell therapy would be the fact that is it less time consuming that iPSC therapy or other forms of stem cell therapy as the neural stem cells that are

retrieved are already specialised and prepared to differentiate into a specifically required cell type for a particular area; iPSC therapy requires a lengthier process of genetic reprogramming. Neural stem cells are also a potential treatment for symptoms of neurodegenerative diseases. For example, researchers have investigated that neural stem cells retrieved from a nine week old human foetus had differentiated into neural cells that improved cognition in aged rats.[34] This creates interest as to whether these neural stem cells could potentially improve the symptoms of cognitive dysfunction in neurodegenerative diseases. However, the drawbacks to this would be the limited lineage of neural stem cells. They can only self-renew or differentiate into different types of glia and neurones in the brain – hence, the neural stem cells cannot be used universally around the whole body, meaning certain diseases involving other parts of the body may not be able to make good use of this neural stem cell therapy. This form of stem cell therapy is also unlikely to treat diseases such as Alzheimer's Disease, as this particular neurodegenerative disease is widespread and involves lots of neurones and neuronal connections that would have to be replaced. The last con with neural stem cells would be its poor accessibility. These particular kind of stem cells are hard to access and extract for use as they are located in the brain – this would also mean that it would be difficult to use them in experiments and therapies since a large number would be needed at the start and the difficult accessibility of these stem cells would prevent a large number of the cells being gathered for an experiment.

Conclusion

Neurodegenerative diseases are fatal and impactful – despite the differences between the three major neurological diseases they all narrow down to one significant factor: the absence of an ultimate treatment to cure the diseases. Despite the various novel treatments that are present, such as stem cell therapy, the development of these treatments are not wholly complete nor are they fully understood to ensure high efficiency or a guaranteed cure for the complex neurological disorders. The fact that the full details on the causes of these neurodegenerative diseases still remain at large means that researchers are still constantly developing ways to potentially cure these life-threatening diseases using advanced medical technology that provides researchers with 'new insights'.[35] However, without full knowledge of how these diseases essentially occur, and the many drawbacks and cons of new novel treatments, researchers and scientists must take a more insightful approach to address these medical issues. These progressive diseases are still falling behind (in terms of improvements in medical research and treatments) in comparison with other major disorders in the world – reemphasising that much more needs to be done to help create an end to these life-changing neurodegenerative diseases.

References

1. The Lancet, The Lancet, 2012, 379, 287.
2. N. Pearce and H. Kromhout, Occupational & Environmental Health, 2014, 71, 594-595.
3. Alzheimer's Association (No date), What Is Alzheimer's ? Available at: http://www.alz.org/alzheimers_disease_what_is_alzheimers.asp. Last accessed April 2015.
4. Alzheimer's Association (No date), Sleep Issues and Sundowning. Available at: http://www.alz.org/care/alzheimers-dementia-sleep-issues-sundowning.asp. Last accessed April 2015.
5. BrightFocus Foundation (No date), Amyloid Plaques and Neurofibrillary Tangles. Available at: http://www.brightfocus.org/alzheimers/about/understanding/plaques-and-tangles.html. Last accessed April 2015.
6. H.-C. Huang and Z.-F. Jiang, Journal of Alzheimer's Disease, 2009, 16, 15-27.
7. ALS Association (No date), What is ALS? Available at: http://www.alsa.org/about-als/what-is-als.html. Last accessed April 2015.
8. L. Stannard (2009), Size of the Average Brain Vs. Size of the Alzheimer's Brain. Available at: http://www.livestrong.com/article/68021-size-average-brain-vs.-size/. Last accessed April 2015.
9. CBC News (2008), Alzheimer's patients have rapid enlargement of brain ventricles: study. Available at: http://www.cbc.ca/news/technology/alzheimer-s-patients-have-rapid-enlargement-of-brain-ventricles-study-1.731154. Last accessed April 2015.
10. Alzheimer's Society (No date), Drug treatments for Alzheimer's disease. Available at: http://www.alzheimers.org.uk/site/scripts/documents_info.php?documentID=147. Last accessed April 2015.
11. EuroStemCell (2014), Alzheimer's disease: how could stem cells help? Available at: http://www.eurostemcell.org/factsheet/alzheimer%e2%80%99s-disease-how-could-stem-cells-help. Last accessed April 2015.
12. Parkinsons.org (No date), Parkinson's Disease Information. Available at: http://www.parkinsons.org. Last accessed April 2015.
13. NHS (2014), Symptoms of Parkinson's disease. Available at: http://www.nhs.uk/Conditions/Parkinsons-disease/Pages/Symptoms.aspx. Last accessed April 2015.
14. L. Atkins (2002), Can you catch Parkinson's? Available at: http://www.theguardian.com/education/2002/apr/04/medicalscience.healthandwellbeing. Last accessed April 2015.
15. A. Mandal (No date), What is Parkinson's Disease? Available at: http://www.news-medical.net/health/What-is-Parkinsons-Disease.aspx. Last accessed April 2015.
16. E. McDermid (2015), Severe nonmotor symptom burden common in early Parkinson's. Available at: http://www.news-medical.net/news/20150605/Severe-nonmotor-symptom-burden-common-in-early-Parkinson28099s.aspx. Last accessed April 2015.
17. Parkinson's UK (2010), Stopping the build-up of alpha-synuclein. Available at: https://www.parkinsons.org.uk/sites/default/files/g-1403_schapira_plain_english_summary_nov14.pdf. Last accessed April 2015.
18. Lewy Body Society (No date), Lewy Body Disease Science. Available at: www.lewbody.org/science. Last accessed April 2015.
19. Parkinson's UK (No date), Deep Brain Stimulation. Available at: http://www.parkinsons.org.uk/content/deep-brain-stimulation. Last accessed April 2015.
20. M. Okun (2012), What about the new Parkinson's Disease Vaccine? What should I know? Available at: http://www.parkinson.org/Patients/Patients---On-The-Blog/September-2012/What-about-the-new-Parkinsons-Disease-Vaccine--Wh. Last accessed April 2015.
21. Motor Neurone Disease Association (No date), About MND. Available at: http://www.mndassociation.org/what-is-mnd/. Last accessed April 2015.
22. Frontline (No date), What's ALS? Available at: http://www.pbs.org/wgbh/pages/frontline/somuchsofast/etc/faqs.html#4. Last accessed April 2015.
23. ALS Association (No date), Quick Facts About ALS & The ALS Association. Available at: http://www.alsa.org/news/media/quick-facts.html. Last accessed April 2015.
24. ALS Association (No date), SOD1 (copper zinc superoxide dismutase 1) and ALS. Available at: http://web.alsa.org/site/PageServer?pagename=ALSA_SOD1. Last accessed April 2015.
25. International Alliance of ALS/ MND Associations (No date), What Is ALS/MND? Available at: http://www.alsmndalliance.org/what-is-alsmnd/. Last accessed April 2015.
26. R.W. Haley, Neurology, 2003, 61, 750-756.
27. R.G. Miller, J.D. Mitchell and D.H. Moore, Cochrane Database of Systematic Reviews, 2012.
28. D.A. Prentice (2004), The Real Promise of Stem Cell Research. Available at: http://www.leaderu.com/science/promisestemcell.html. Last accessed April 2015.
29. National Institutes of Health (No date), Stem Cell Basics. Available at: http://stemcells.nih.gov/info/basics/pages/basics4.aspx. Last accessed April 2015.
30. National Institutes of Health (No date), Stem Cell Basics. Available at: http://stemcells.nih.gov/info/basics/pages/basics10.aspx. Last accessed April 2015.
31. M. Wernig, J.P. Zhao, J. Pruszak, E. Hedlund, D. Fu, F. Soldner, V. Broccoli, M. Constantine-Paton, O. Isacson and R. Jaenisch, Proceedings of the National Academy of Sciences, 2008, 105, 5856-5861.
32. J. Cai, M. Yang, E. Poremsky, S. Kidd, J.S. Schneider and L. Iacovitti, Stem Cells and Development, 2010, 19, 1017-1023.
33. S.-I. Nishikawa, R.A. Goldstein and C.R. Nierras, Nature Reviews Molecular Cell Biology, 2008, 9, 725-729.
34. T. Qu, C.L. Brannen, H.M. Kim and K. Sugaya, Neuroreport, 2001, 12, 1127-1132.
35. The MRC Centre for Neuropsychiatric Genetics and Genomics (No date), Neurodegenerative Disorders. Available at: http://medicine.cf.ac.uk/cngg/research/neurodegenerative-disorders/. Last accessed April 2015.

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PhD Tutor's note

M.'s essay is an outstanding piece of work which exemplifies many of the qualities required for a high level scientific essay. The depth of knowledge, high level of research, the clear and accurate scientific communication and excellent presentation of data gave this essay the highest mark I have awarded so far. Indeed, this essay would easily achieve a high grade at university standards and is a remarkable achievement for a Year 10 pupil studying for their GSCEs.

A CANCEROUS TUMOUR ORIGINATES FROM A SINGLE NORMAL CELL. DISCUSS THIS STATEMENT USING NAMED EXAMPLES OF CELLULAR PROCESSES THAT MAY DIFFER BETWEEN A HEALTHY CELL AND A CANCER CELL

N. Ly, supervised by D. Foxler

Note: This essay will only refer to processes in eukaryotic cells in humans

Abstract

In 2011, 331 487 people were diagnosed with cancer in the UK[1] Cancer is a term that refers to a diverse range of diseases that result from the uncontrolled division of a single aberrant cell in the body. Uncontrolled division of the abnormal cell causes tumorigenesis. Depending on which genes the mutations have occurred and what sequence these mutations have occurred in an individual, cancerous cell can behave differently and effects can vary from a slight increase in fatigue to the tumour being fatal[2] Internationally, researchers are studying the molecular causes and effects of various types of cancers in hope to find a cure.

Characteristics of a healthy cell

A healthy cell has several distinct features that allow the cell to carry out its homeostatic function(s). One inherent feature of a healthy cell is that it responds correspondingly to cellular and environmental signals – including signals instructing whether a cell should undergo mitosis or initiate cell apoptosis when required.[3] A cell's ability to respond to cellular (and environmental) signals also contributes to its ability to differentiate (mature) into a specialised cell type – which most healthy cells do, though some naturally remain as undifferentiated stem cells to act as templates for specialised cells. Differentiated cells are better adapted to mediate specific processes in the body. Healthy cells are also self-regulating in that they have complicated systematic mechanisms that allow cells to remain healthy; they can usually repair defected DNA or otherwise perform prudent processes (like apoptosis) that will prevent DNA errors from affecting other cells or sites of the body. Normal cells possess proteins on their cell membrane that allow for cell adhesion which contributes to the overall function of tissues and organs[3] There are four different fates for stem or G0 (quiescent) cells to undergo: proliferation, differentiation, senescence (deterioration) or apoptosis.[4] The pathway that a cell undergoes plays a significant role in maintaining functioning interactions between other cells and the DNA integrity of an individual.

A healthy cell can become abnormal by acquiring a mutation within a tumour suppressor gene that negatively affects its ability to carry out its homeostatic functions. This can be caused by exogenous and endogenous agents that increase the likelihood of genetic mutations arising that predispose an individual to develop cancer. Some exogenous factors include:

-radiation (such as exposure to UV A and B by sunbathing for a prolonged time without sufficient application of sunscreen; exposure to X-ray radiation by receiving too many medical x-rays; gamma ray exposure from radioactive substances; and (debatably) microwaves, from prolonged mobile phone use)
-mutagens (e.g. chemicals in tar in cigarettes)
-free radicals (including superoxide radicals)
-some viral infections

High frequency radiation induces genetic mutations because of their high energy nature which breaks covalent bonds between atoms that compose the DNA structure. For example, a DNA strand break would be caused by the breaking of the covalent bonds between the phosphate group and deoxyribose sugar that make up the DNA backbone.

Some endogenous agents include:
· reactive oxygen species (generates DNA breaks)
· missing/excessive/mismatched DNA bases
· oxidative stress
· replication fork collapse

There are different types of mutations that can occur. Some examples are:
· single/double stranded breaks
· interstrand cross links
· base substitutions (missense)
· base mismatch
· pyrimidine dimers (formation of covalent bonds between two adjacent thymine or cytosine bases)

All these factors could compromise an individual's DNA integrity. DNA integrity is the maintenance of the DNA sequence in an individual's genome throughout their lifetime in order for the correct proteins to be produced. Maintaining genomic integrity is important because mutated DNA means that there is a change in the sequence of nitrogenous bases that codes for a gene. Every three bases (called codons) code for a specific amino acid. Therefore, if the base sequence changes, then the mRNA transcript will also change correspondingly, meaning that incorrect amino acid(s) are coded for during protein synthesis, perhaps changing the composition of the protein. Consequently, the protein's shape may change, which may impede its ability to carry out its homeostatic function(s). The growth of abnormal cells may lead to a tumour growth, which could lead to cancer. Still, an alteration in a base sequence does not necessarily mean that the amino acid sequence will alter. DNA integrity is only significant to the extent that the genome is functional and does not contain inherited mutations that predispose an individual to develop cancer.

Mechanisms that keeps cells healthy

The average human adult has 37 trillion cells in their body. In each cell there are 46 chromosomes, which contain 3 billion base pairs (1 billion codons), which code for about 20 000 different proteins. Theoretically, therefore, everyone should have a 37 trillion chance of developing cancer as it essentially only takes the mutation of one healthy cell to develop cancer. However, healthy cells have a network of interrelated mechanisms that help maintain DNA integrity from commonly occurring environmental stresses.

Healthy cells have a complex system of proto-oncogenes and tumour suppressor genes that encode a variety of proteins that regulate crucial cellular processes, including: cellular proliferation, growth inhibition (e.g. antineoplastic genes), DNA damage repair, and genes that mediate cell apoptosis (programmed cell death), differentiation and senescence. These proto-oncogenes and tumour suppressor genes all contribute to the body's natural system that helps maintain DNA integrity. A cell is stimulated to divide by signals from proto-oncogene growth factor proteins (e.g. RAS, WNT and MYC) when worn or damaged cells need to be replaced in the body.[5] It is vital that cell propagation is balanced with the number of cell death and differentiation to maintain cellular and internal stability within the body. Cells also proliferate when an organism grows.

The p53 gene ('the protector of the genome') is a significant tumour suppressor gene. Usually, healthy cells have a low concentration of p53 proteins because they are immensely unstable and easily degraded by the binding of the p53 negative feedback regulator MDM2, which forms an autoregulatory loop with p53 transcription

factors (the unbiquitin/proteasome pathway).[7] Since the p53 gene is the junction of several transduction pathways, it can regulate multiple cellular processes such as cell cycle arrest (see below), apoptosis, inhibition of angiogenesis and metastasis and DNA damage repair during the G1/S phase and G2/M checkpoints of the cell cycle. If no aberrations are detected after the G2/M checkpoint, the cell will be permitted to enter mitosis and then undergo cytokinesis to produce two daughter cells with identical DNA. However, if abnormalities like DNA damage (e.g. mismatched nucleotide pairing or extra or missing nucleotides), oxidative stress or the activation or increased expression of oncogenes (mutated proto-oncogenes) are identified, then stress signals are sent to p53 mediating proteins, for example ATM/ATR. P53 transcription factors are then activated and the expression increases, where p53 proteins then initiate the appropriate pathway to decide the cell's fate [7]

A single cell can divide into two daughter cells containing identical DNA - though not necessarily two daughter cells with identical intracellular proteins since cells naturally divide symmetrically (which is done mostly for rapid growth) as well as asymmetrically (often to sustain stem cell populations and mediate some growth).[9] A quiescent cell entering the cell cycle must prepare for mitosis during interphase, which is characterised into three significant phases: G (growth) 1, S (synthesis) phase and G (growth) 2. The main proteins operating the cell cycle are cyclins and CDKs (cyclin dependent kinases). CDKs are signal transferases, meaning they catalyse cellular signals by phosphorylation (adding phosphate groups to organic compounds) which causes a chain signalling pathway. Interphase synthesises all the cellular components needed to produce daughter cells, including duplication of the genome.

During G1 phase, replication organelles/components that aid in DNA replication are synthesised. Some significant enzymes are DNA:
- helicase - breaks hydrogen bonds between opposite nucleotides in double DNA strands
- polymerase - pairs nucleotides together using complementary base pairing
- primase - provides a origin of replication site for polymerase to begin polymerisation[11]
- single strand binding proteins - prevents the reformation of hydrogen bonds between DNA father strands after DNA helicase has unwound them[11]
- ligase – joins adjacent DNA strands (e.g. okazaki fragments)[11]
- gyrase – relieves DNA torsional strain[11]
- telomerase – caps chromosomes with telomeres, which are non-coding repeating DNA sequences (TTAGGG paired with AATCCC) that protect DNA codes in chromosomes. The division of cell have been linked to the shortening of telomeres, believed to be caused by aging.[11]

All these enzymes, as well as other components like pre-replication complexes (provides and origin of replication along the DNA strand), nucleotides and mRNA transcripts, are fundamental for the progression of the next stage, synthesis phase, where DNA replication is coordinated.
Next, the cell enters the G1/S checkpoint (the 'restriction point'), where the cell decides whether to irreversibly commit to enter S phase and the remaining stages of the cell cycle (healthy, undamaged cells) or enter cell cycle arrest (cells containing defected DNA). This is because in a healthy cell, the concentration of CDK2-cyclin E complexes rises exponentially between the transition of G1 to S phase. P27 proteins usually bind to and inhibit CDK4-cyclin D complexes.[12] But when CDK 2-cyclin E complexes phosphorylise p27 proteins, CDK4–cyclin D complexes are activated and phosphorylate Rb (retinoblastoma) proteins. Subsequently, the repressor HDAC (histone dacetylases) complex disengages with the phosphorylated Rb proteins that then bind with HATs (histone acctyltransferases) to unravel chromatin fibres, which allows for use of transcription factors encoding cell cycle constituents.[12]

However, when stressed DNA is present stressed signals from damaged DNA activate the ATM/ATR – CHK1/2 signal transduction pathway is initiated. ATM is activated when DNA damage is a double stranded breaks caused by ionising radiation and ATR is usually activated by UV irradiation and single stranded breaks (at the replication fork).[12] ATM/ATR phosphorylates CHK1/2 that then phosphorylates p53, which activates p21 and in turn inhibits the CDK2 proteins that are highly expressed during the G1/S transition phase. This means Rb proteins are hypo-phosphorylated, preventing the release of EF2-DP1 (which also codes for essential constituents required in DNA synthesis, such as cyclin A/E and Cdc25A) and binds with the repressor HDAC complex so HATs cannot – stopping the unravelling of chromatin fibres and therefore the rest of the transduction pathway.[12] The cell then enters into cell cycle arrest. If there is too much damage within the DNA that cannot be repaired the cell apoptosis pathway is initiated (cell suicide).

The G1/2 checkpoint -as well as the G2/M checkpoint- are important mechanisms that impede the proliferation of cells possessing impaired DNA, helping maintain DNA integrity. This is because preventing the propagation of cells containing aberrant DNA means that it is not inherited by daughter cells and hence further generations.

BRCA1 and BRCA2 are also important tumour suppressor genes that code for proteins that are part of a complex with RAD51 which is involved in the DNA repair response. One mechanism the three proteins are involved in is the repair of double strand breaks in DNA through homologous recombination. This works by nucleases degrading the 5' tailed strand of the broken DNA length at the site of the DBS, leaving the 3' single strand. The single strand then interacts with a intact homologous chromosome at the same region of the DSB to use as a template for new DNA synthesis.[14]

Cancer

Unlike normal cells, cancer cells divide uncontrollably. This characteristic also makes cancer cells undifferentiated because continuous proliferation means that there is not enough time for the cancer cells to mature. Cancer cells generally cannot repair lesions in DNA and do not posses molecules on their membrane that allows for cell adhesion – which causes metastasis and malignancy.[3]

Even though there are approximately 200-300 tumour suppressor genes that work in an interlinked system to prevent the proliferation of abnormal cells, cancer still affects 1 in 3 people. This is because in cancer, mutations occur in tumour suppressor genes and proto-oncogenes that negatively affect its ability to carry out homeostatic functions. The mutations may affect the behaviour of the tumour suppressor proteins by DNA sequence alteration. Since these genes code for proteins mediating the operation of mechanisms that help keep cells healthy (senescence, apoptosis etc.) and cell propagation and differentiation, the modification in the behaviour of any of these proteins could lead to the breakdown of these processes. Mutations in any of the DNA synthesis components genes may also have harmful effects as it may mean that DNA synthesis is unable to progress properly.

A mutation in the p53 gene causes an alteration in the base sequence. This may mean a transmutation in the amino acid sequence when p53 proteins are synthesised during protein synthesis. Consequently, the behaviour of p53 proteins may change, resulting in its dysfunction of its normal role in controlling crucial pathways like apoptosis and cell cycle arrest. Over 50% of cancers are partially caused by a mutation in the p53 gene.

When proto-oncogenes mutate, they can transform into oncogenes – which can promote the proliferation of the cell the proto-oncogene has mutated in, causing a neoplasm. This is because the mutation can cause a loss of regulation of cell propagation or increased enzyme activity the proto-oncogene codes for, causing uncontrolled growth. High expression of proto-oncogenes can also induce the transformation into an oncogene. Normally the oncogene needs to induce proliferation in a cell that also has a mutated tumour suppressor gene to cause the development of a neoplasm.

It is important to note that not all mutations are oncogenic because only mutations that affect the function of a protein may be a threat – some mutations are silent and some mutations are considered beneficial. Mutated genes that happen in non-tumour suppressing genes are usually repaired or eradicated by senescence or apoptosis. Furthermore, often cancer only develops once the body has obtained several mutations in these tumour suppressor genes and proto-oncogenes and considering only 1.5% of human DNA is actually protein-coding (some sections are non-coding introns, some telomeres). Also, it has recently been recognised that the sequence that these mutations have been obtained affects the behaviour of cancer cells as it also determines how mild or severe a tumour is.

Angiogenesis

Cells need oxygen and glucose for respiration, which releases energy for cells to function and survive. Oxygen and glucose (along with water, hormones, white blood cells, platelets, antibodies and other nutrients) is transported around the body to tissues via the bloodstream in the plasma. Oxygen is diffused through capillaries' permeable walls to reach nearby cells. This means that cells in closest proximity to blood vessels receive the highest concentration of oxygen and glucose and are therefore more likely to survive. The diffusion limit of oxygen of capillaries is around 70 µm (7 cell layers). The furthest cell layer away from the capillary is the most hypoxic. The abundance of blood vessels is a limiting factor of the amount of cells that can grow. Hence tumours growing away from blood vessels should experience hypoxia and cease from growth as the high metabolic demand from continuous division isn't supplied. However, there is a normal signalling pathway that can induce blood vessel growth which tumours use to continue propagating.

When hypoxia is detected by a cell, HIF1 is secreted, which is a transcription factor of the VEGF protein. VEGF is a protein that stimulatess blood vessel growth in the direction of the hypoxic cell(s). VHL –a tumour suppressor gene- is a negative regulator of HIF1, meaning the less VHL there is, the more HIF1 proteins there are and hence the more VEGF proteins. This means there is a higher rate of blood vessel growth stimulation.

However, if a mutation is present in cancer cells that prevents the normal function of VHL proteins, HIF1 is not regulated, which therefore causes uncontrolled blood vessel growth towards the developing tumour. The neoplasm becomes highly vascularised and is able to continue to propagate. Though, one advantage of a highly vascularised tumour is that if identified at an early enough stage, drugs can be introduced into the patient's bloodstream which may prevent tumour growth. It takes approximately 5 years for a single abnormal cell to proliferate into a neoplasm.

Bibliography
[1] http://www.cancerresearchuk.org/cancer-info/cancerstats/incidence/uk-cancer-incidence-statistics
[2] http://www.macmillan.org.uk/information-and-support/coping/side-effects-and-symptoms
[3] http://www.cancerresearchuk.org/about-cancer/what-is-cancer/how-cancer-starts/cancer-cells
[4] http://www.biochemj.org/csb/009/009.pdf(page 4)
[5] http://en.wikipedia.org/wiki/Oncogene
[6] http://biology.stackexchange.com/questions/21825/why-cant-neurons-undergo-cell-division
[7] http://p53.free.fr/p53_info/p53_Pathways.html
[8]http://www.genome.jp/kegg-bin/show_pathway?scale=1.0&query=&map=hsa04115&scale=1.84&auto_image=&show_description=hide&multi_query=
[9] http://www.sciencedirect.com/science/article/pii/S0092867408002080
[10] http://www.biochemj.org/csb/009/009.pdf(page 2)
[11]https://www2.le.ac.uk/departments/genetics/vgec/downloads/educators-over-18s/Replication,%20Recombination%20and%20Repair/1%20DNA%20replic%20and%20repair.pdf(page 5)
[12] http://www.biochemj.org/csb/009/009.pdf(page 9/19)
[13] http://lsresearch.thomsonreuters.com/static/maps/426_map.png
[14] https://www.youtube.com/watch?v=86JCMM5kb2A

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PhD Tutor's note

N.'s final assignment was of quality that would have achieved a high 1st class mark at university undergraduate level. The assignment was written in a very logical and coherent manner, and demonstrated her excellent understanding and knowledge of the course material. Furthermore, she demonstrated extensive further research and reading as exemplified by numerous extra case studies, and this was well documented in her bibliography.

HOW CAN NUTRIENTS AFFECT METABOLISM AND PREDISPOSE US TO DISEASE: A CASE STUDY OF ADDED SUGAR EFFECTS ON TYPE 2 DIABETES

P. Leckie, supervised by N. Pompa

Abstract

It is now understood that food and nutrients in our diet can have profound effects on our metabolism and health. Diabetes is a disease that is rapidly growing worldwide and that has been linked to sugar intake, but the evidence for this is still emerging and the mechanisms involved are still being discovered. Researched sources suggested sugar intake, particularly fructose, might be the cause of diabetes, either as a direct or a contributing factor by increasing fat deposits in the liver and/or leading to obesity. Evidence comes from experimental designs in animals and observational studies in different populations, but limitations to these studies and the lack of consensus on the exact mechanisms involved suggest more scientific research needs to be conducted in order to fully draw a conclusion on the subject.

Introduction:

Type 2 diabetes is a disease that, in the UK, is growing rapidly. It is estimated that about 3.8 million people have diabetes, with 630,000 suffering from type 2.[1] Diabetes is a condition that affects the pancreas, but in the case of type 2, insulin is not accepted by the cells in the bloodstream. This is called insulin resistance, the consequence of which can be a large accumulation of fats in the liver leading to 'fatty liver' and inflammation.[2] When insulin is not accepted, nutrients like glucose cannot be properly metabolised. Because of the amount of glucose left in the bloodstream, insulin tablets or injections must be taken in order for the body to absorb the glucose and to keep blood sugar levels under control. Currently, obesity is being held accountable for the growing diabetes rates, but could the problem be deeper? Sugar is a type of carbohydrate and added sugar specifically may be a factor that causes the disease. This is important because many of the foods we consume on a daily basis consist of added sugar. Being able to advise and educate the public about how their diet can affect their health will aid in the prevention of diabetes, especially when there are an estimated 11.5 million people in the UK at risk of type 2.[1] However, before we can do this we must first consider whether added sugar could be the main cause. Throughout my essay I will be investigating how added sugar affects the human body through type 2 diabetes, whether it could be one of the main causes of the disease and how it can be prevented or reduced.

Main Information:

An article written by *The Guardian* mentions an observational study which was carried out in 175 countries over 10 years.[3] The results of this investigation found that the larger amount of sugar available in a country, the higher the rate of diabetes among the population. Also, it was found that if a country was in contact with "excess sugar" for a long period of time,[3] a larger amount of people were diabetic. This suggests that, due to the amount of sugar available, a higher sugar intake does increase the risk of type 2 diabetes. However, there are also arguments by doctors and medical experts that sugar does not cause diabetes. One doctor states that "British consumption of sugar had declined 6% in the past decade, during which time the prevalence of diabetes has doubled",[3] suggesting that added sugar may not be the main cause but rather a contributing factor.

To search for my sources, I conducted a literature search for scientific articles on the effect of added sugar on type 2 diabetes. I performed a search on *Google* using keywords such as "added sugar" and "diabetes". When searching, I also typed the word "AND" in capital letters in order to find sources containing both keywords.

The first report from the University of Utah Healthcare states that added sugar is the main cause of diabetes.[4] In an experimental study, researchers compared a range of carbohydrates located in food and their effects on the body. From this it was found that added sugar, especially fructose, was extremely damaging in the case of diabetes. It is written that fructose causes a massive build-up of fat in the liver, which can lead to insulin resistance. To reduce the risk of developing this condition, the author suggests you can swap processed foods for more whole foods, "that have been processed and refined as little as possible and are free from additives and artificial substances".[5] Staying away from fizzy drinks is also beneficial due to the fact that extremely high amounts of added sugar are contained within them.

A scientific article from *Medical News Today* supports the ideas explained in the first report.[4,6] It describes that a study conducted on animals has the potential to give us clues to how a high fructose diet can afflict the body with diseases such as diabetes. Using lab mice, it was found that when they were given fructose it was metabolized by two enzymes: Fructokinase C and Fructokinase A.[6] Using this information, they found that both of the Fructokinase forms could be involved in causing obesity, fatty liver disease and insulin resistance. This evidence demonstrates that sugar could cause diabetes. The author writes that by decreasing the amount of fructose in our diets we can protect against metabolic syndrome, which is "a combination of diabetes, high blood pressure and obesity".[7]

The report from *Diabetes.co.uk*[8] states that consuming processed foods and/or fizzy drinks is the main explanation for type 2 diabetes. The daily calorie intake of a woman is 1940 calories, while for men it is 2250.[9] Researchers say that "25% of total daily calories is allowed as added sugar".[8] Experimental trials conducted showed that swapping "fructose-containing table sugar with glucose-only starch"[8] had positive effects on the subjects. One doctor states that the current levels of added sugar intake are "fuelling a worsening epidemic of type 2 diabetes".[8] They recommend that processed foods should be restricted and replaced with fruit and vegetables. By controlling the added sugar intake the risk of insulin resistance is reduced.

My final source is an article from *Best Health*.[10] The article begins by declaring that sugar does not directly cause diabetes but contributes towards a high calorie intake, causing weight gain and thus leading to obesity and type 2 diabetes. It states that in a study of 39,000 women "those who ate the most sugar did not have an increased risk for the disease".[10] Recently, experts have blamed "diets with a high glycaemic index".[10] This is a scale that classifies carbohydrates on the rate of their conversion to glucose within the human body.[11] It is a scale from 0 to 100, with higher value foods causing the most rapid rise in blood sugar.[11] As you consume foods that raise your blood sugar, more insulin is needed to process the sugar. Recurring "floods of insulin" mean your body is not as sensitive to it,[10] causing insulin resistance. Foods such as white bread and potatoes have a high glycaemic index, but there are also other sources of sugar that may cause diabetes. The article states that a new theory suggests that fructose could trigger insulin resistance as well.

The first article is written by *The Guardian*,[3] which is considered to be a quality newspaper, so information printed is deemed to be of a high standard of research. Additionally, the first of my scientific sources is an '.edu' site,[4] which illustrates that it is educational and can therefore be trusted to have been researched thoroughly. Furthermore, my second was written by an individual

with a PhD;[6] whilst my penultimate source was written by a medical site and was supported by strong research and evidence.[8] However, my final source does not have any indication that it was written by a medical professional.[10] Although good research has been conducted, evidence through studies is not explained thoroughly and the website appears to be a magazine, in which you can comment and discuss the topic, rather than a scientific report. Similarly, the study focuses on women, meaning it may not be very accurate because type 2 diabetes affects the male population as well.

My first three sources each support the ideas of one another.[4,6,8] They all conducted an experimental study, specified a particular type of added sugar that could be seen as the cause of type 2 diabetes and offered reliable improvements to diet in order to reduce the risk of developing the disease. In contrast, my final source focuses more on calories being the main cause of diabetes rather than sugar,[10] but there was some scientific research to support the argument. The news article does contain scientific evidence and statements from those in the medical field and since it is a newspaper, all material must be accurate to allow publication.[3] Though, it is limited to the amount of scientific information published since it is written for a general audience and must be easily understood.[6]

Conclusion:

Overall, through my research I found that added sugar, predominantly in the form of fructose, can have a damaging effect on a person's health and increase their risk of type 2 diabetes as well as other diseases. Furthermore, added sugar can be found in many items we consume on a day to day basis such as fizzy drinks and processed foods, putting us all at risk of taking in too much sugar and in danger of developing these conditions. The second source reports results from an experimental study that was conducted on mice.[6] This is a good method of investigation, as it enables us to explore the question in greater detail. It would have been more accurate if it was carried out on humans rather than mice; however this would be deemed unethical or dangerous depending on how the experiment was carried out.

Considering all of my research, I judge that my first scientific source is the most reliable because it is an '.edu' site, which is educational therefore information published is to a high standard and properly researched.[4] Furthermore the explanations are supported by an experimental study and statements from medical professionals. In contrast, I believe my final source is the most unreliable due to fact that it is a magazine and considered more tabloid than quality.[10] Though there is a mention of some scientific research, the study is not explained in a large amount of detail and it focused only on women, which is inaccurate as type 2 diabetes affects the male population also.

The news article is supported by scientific evidence from observational studies and medical researchers.[3] Moreover, *The Guardian* is thought to be a quality newspaper, meaning information published will be of a high standard and properly researched. Within the article both sides of the argument are displayed, showing a non-biased opinion of the subject, making it a reliable source.

After thoroughly analysing my sources, I believe that added sugar could be a prominent cause of type 2 diabetes due to the fact that both experimental and observational studies have been conducted in order to investigate the issue and there is strong medical evidence to support this. However, there are still statistics and data to suggest that it may contribute more to obesity, which then leads to diabetes, rather than directly causing the condition. In my opinion, more scientific research needs to be conducted in order to fully draw a conclusion on the subject.

References

1. Diabetes UK. (No date). What we do. Available: https://www.diabetes.org.uk/About_us/What-we-do/. Last accessed 30 March 2015.
2. Mayo Clinic. (2014). Nonalcoholic fatty liver disease. Available: http://www.mayoclinic.org/diseases-conditions/nonalcoholic-fatty-liver-disease/basics/definition/con-20027761. Last accessed 6 April 2015.
3. D Campbell. (2013). Sugar is behind global explosion in type 2 diabetes, study finds. Available: http://www.theguardian.com/society/2013/feb/27/sugar-obesity-type-2-diabetes. Last accessed 22 March 2015.
4. Office of Public Affairs. (2015). Sweet Nothings: Added Sugar Is a Top Driver of Diabetes. Available: http://healthcare.utah.edu/healthfeed/postings/2015/02/021015_cvarticle-sugar-diabetes.php. Last accessed 13 March 2015.
5. Google.com. (2015). What are whole foods? Available: https://www.google.co.uk/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=what+are+whole+foods. Last accessed 6 April 2015.
6. C Paddock. (2012). How Added Sugar In Diet Leads To Obesity, Diabetes - New Clues About Fructose. Available: http://www.medicalnewstoday.com/articles/242259.php. Last accessed 15 March 2015.
7. NHS. (2014). Metabolic Syndrome. Available: http://www.nhs.uk/conditions/metabolic-syndrome/pages/introduction.aspx. Last accessed 6 April 2015.
8. K Wood. (2015). Added sugar in processed food linked to type 2 diabetes. Available: http://www.diabetes.co.uk/news/2015/jan/added-sugar-in-processed-food-linked-to-type-2-Diabetes-98076040.html. Last accessed 15 March 2015.
9. Google.com. (2015). What is the daily calorie intake? Available: https://www.google.co.uk/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=what%20is%20the%20dail%20calorie%20intake%3F. Last accessed 8 April 2015.
10. M Wait. (2012). Does eating sugar cause diabetes? Available: http://rafhanclinic.blogspot.co.uk/2012/11/does-eating-sugar-cause-diabetes.html. Last accessed 8 April 2015.
11. Google.com. (2015). What is a high glycaemic index? Available: https://www.google.co.uk/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=what+is+a+high+glycemic+index?&spell=1. Last accessed 8 April 2015.

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P. is a Year 10 pupil at Swakeleys School for Girls. PhD Tutor Nara Elizabeth Lara Pompa is studying for her PhD at the Childhood Nutrition Research Centre, UCL Institute of Child Health, focussing on the use of body composition measurements in the nutritional management of paediatric patients.

PhD Tutor's note

P.'s essay was particularly well written and showed some deep understanding of the mechanisms by which nutrients can affect metabolism and cause disease, using sugar intake on diabetes as a case study to explore these mechanisms. She did not only summarise the evidence clearly, but did an outstanding job in assessing the reliability of her sources and critically appraising the evidence found, particularly the research study designs. She did a careful and critical evidence search and used a range of sources that allowed her to fully explore the advantages and limitations of each type of source in communicating scientific topics. This essay was clearly above the expected skills of her current year.

MEMORY IMPAIRMENTS IN ALZHEIMER'S DISEASE

P. Mensah, supervised by S. Buck

Abstract

Alzheimer's disease is a neurodegenerative disease that affects the brain. The most prominent cognitive symptom associated with this disease is memory impairment, and more specifically difficulties in encoding and storing new information. This is because the hippocampus, which is the brain region responsible for learning new information, is one of the first regions to be affected by the disease. As the disease progresses and spreads to other brain regions, other symptoms arise such as behavioural problems and speech impairment. There is no cure for Alzheimer's disease, but early intervention may help slow down the degeneration and compensate for the memory impairments.

Body

Alzheimer's disease (AD) is a chronic physical disease that affects the brain (Burns, 2009). It is neurodegenerative, meaning that its symptoms develop gradually and progress at an increased rate over time. It is also the most common cause of dementia, accounting for 60-70% of dementia cases (WHO, 2015). The disease's severe memory deficit is commonly associated with ageing since it most often begins in people aged 65 years or older, however, early-onset Alzheimer's accounts for up to 5% of cases (Ballard et al., 2011). In 2010, there were between 21 and 35 million sufferers of AD worldwide (Grober et al., 2009). The disease is said to affect around 6% of people 65 years and older. The exact cause of the disease is unknown. Although 70% of the risk is believed to be genetic, it is thought that other factors such as a history of depression, hypertension, and severe head injuries can increase a person's risk of developing the disease.

Early symptoms of AD are difficulties in encoding and storing new information. The disease itself can be difficult to diagnose since initial symptoms are often mistaken for normal ageing (Ballard et al., 2011). AD can be detected using tests such as the Free and Cued Selective Reminding Test which measures a person's memory under controlled conditions to ensure that a diagnosis of AD is not confused with normal age-related changes in cognition (Grober et al., 2009). Diagnosis includes medical imaging and blood tests to rule out other possible causes and an examination of brain tissue is needed for a definite diagnosis (NICE, 2015). There are no medications that have been proven to stop or reverse the progression of the disease though some may temporarily improve the symptoms (NIH, 2012). Behavioural problems or psychosis due to dementia are commonly treated with antipsychotics, but this is not recommended since it has little benefit and may even increase the risk of early death. The average life expectancy after diagnosis is three to nine years though the speed of progression often varies (Querfurth et al., 2010). As the disease progresses, problems with language, mood swings and loss of motivation can occur amongst other symptoms. Gradually, bodily functions are lost, ultimately leading to death. In 2010, dementia resulted in about 486,000 deaths (Lozano et al., 2012).

Progressive memory loss is the hallmark of Alzheimer's disease; the most common and noticeable deficit is the inability to acquire new information. Attention plays a key role in transferring information into long-term memory. Absent-mindedness means that the information is not stored, making it impossible for it to be retrieved later. Remote memories may be retained longer, often in great detail, since they are no longer reliant on the hippocampus which is the first part of the brain to be affected by the disease. However, as the disease progresses and spreads to other brain regions, long-term memory traces will eventually become fragmented and sufferers may have difficulty retrieving those (Lozano et al., 2012).

Declarative memory refers to memories that can be consciously recalled (Ullman, 2004). These are divided into two categories: episodic memory, which stores specific personal experiences e.g. what you ate for breakfast, and semantic memory, which stores factual information e.g. the meanings of words (Tulving, 1972). Non-declarative (procedural) memory is the memory for performing particular tasks e.g. knowing how to ride a bike. Declarative (episodic and semantic) memory impairments are seen in the disease's early pathology. The temporal lobe (which contains the hippocampus) and the prefrontal cortex are associated with the episodic memory system. Since hippocampus is one of the first brain regions to be damaged by the disease, the episodic memory system is the first to be affected. This results in difficulty remembering recent events but not earlier memories. The semantic memory system also involves the temporal lobes, as well as other brain regions within the cortex. As a result, sufferers display a loss of knowledge of objects in specific categories, such as breeds of dog. Eventually, they lose the ability to distinguish fine categories (e.g. seeing a particular breed of dog, but only being able to say "this is a dog"), but this inability gradually extends to more general categories (e.g. seeing a particular breed of dog but only being able to say "this is an animal"). Non-declarative memory is not affected during the disease's early stages since the cerebellum, a brain region associated with procedural memory, is one of the last to deteriorate. Working memory is the system responsible for attention, concentration, and short-term retention of information such as a phone number. This memory system involves the prefrontal cortex. Impairments to the working memory system can cause problems with attentiveness or the ability to accomplish multi-step tasks.

Cognitive changes in AD start with specific difficulties in encoding and storing new information (Pena-Casanova et al., 2012). This is because the hippocampus, the part of the brain responsible for learning new information, is one of the first brain regions to be affected by the disease. This results in an inability to encode new information. Attention is also a necessary component for effectively encoding events or information. Since sufferers experience absent-mindedness they are less likely to remember the details of an event (Holger, 2013). Memory consolidation, the next step in forming a memory, is the process of reactivating memories, allowing them to become resistant to interference. However, if the memory is not properly encoded, it cannot be consolidated and stored in the brain. A difficulty with recognition suggests that information was never encoded into the brain and, consequently, was not stored.

Synaptic plasticity, the ability of synapses to strengthen or weaken over time, is a crucial component of the memory process. Because the first lesions appear in poorly myelinated neurons in parts of the brain associated with memory such as the hippocampus, and because highly myelinated neurons are only affected during the last stages of the disease, it suggests that low myelinisation of neurons increases the rate at which they are lost (Hughes, 1958). Since the parietal lobe is one of the last areas to myelinate, it is especially vulnerable to factors capable of triggering AD. Loss of neurons and synapses results in a gross reduction in brain volume. Whereas in normal ageing brain volume reduces by no more than 0.4% per year, in Alzheimer's this number can be as high as 10% (Holger, 2013). Changes in neuroplasticity at brain synapses and loss of neurons

results in the degeneration of the temporal and parietal lobes as well as parts of the frontal cortex. Lesions in areas of the medial temporal lobe result in an almost complete inability to encode and store new information. The amnesic symptoms observed in AD are caused by atrophy of the hippocampus and amygdala since these brain regions are essential for acquiring new information as well as recalling previously learned information (Pena-Casanova et al., 2012).

During early-stage Alzheimer's, any symptoms or behavioural problems are quite mild and may not impact the everyday functioning of patients suffering from it. Sufferers may become increasingly absent-minded and find it hard to remain attentive. This could interfere with their ability to perform work since specific activities would take longer (Lozano et al., 2012). They may become confused in unfamiliar situations, causing them to feel anxious and as if they are losing control. During the middle stage, Alzheimer's patients may develop a noticeable speech impairment which affects how they communicate with other people, perhaps leading to them become more socially withdrawn. In the later stage of Alzheimer's disease, sufferers may become more aggressive and abusive. As the disease progresses, sufferers become increasingly dependent on other people (Thompson et al., 2007).

It is important to study and research about Alzheimer's disease because it enables us to fully understand the causes of this disease and other forms of dementia. Through this, we can find out how to prevent the disease and slow down the rate of progression. The average life expectancy after diagnosis is six years, but with proper research we can develop new and innovative treatments and medications capable of stopping or reversing the progression of the disease or even a potential cure (Querfurth, et al., 2010). In addition to this, a full understanding of the course of the disease means that sufferers and their carers can know what to expect, enabling them to make plans for their future.

Bibliography

Ballard, C., Gauthier, S., Corbett, A., Brayne, C., Aarsland, D., Jones, E. (2011). Alzheimer's Disease. Lancet, 377(9770):1019-31

Burns, A. & Iliffe, S. (2009). Alzheimer's Disease. BMJ, 338:b158

Grober, E., Ocepek-Welikson, K., Teresi, JA. (2009). The Free and Cued Selective Reminding Test: evidence of psychometric adequacy. Psychology Science Quarterly, 51(3), 266-282

Holger, J. (2013). Memory loss in Alzheimer's Disease. Dialogues in Clinical Neuroscience, 15(4), 445-454

Hughes, RJ. (1958). Post-Tetatic Potentiation. Psychological Reviews, 38(1), 91-113

Lozano, R., Naghavi, M., Foreman, K., Lim, S., Shibuya, K. (2012). Global and regional mortality from 235 causes of death for 20 age group sin 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet, 380(9859), 2095-129

National Institute for Health and Care Excellence. (2015). Dementia Overview. Dementia Pathway

NIH. (2010). More Research Needed on Ways to Prevent Alzheimer's, Panel Finds. National Institute of Aging.

Pena-Casanova, J., Sanchew-Benavides, GS., de Sola, S., Manero-Borras, RM., Casals-Coll, M. (2012). Neuropsychology of Alzheimer's Disease. Archives of Medical Research, 43, 686-693

Querfurth, HW. & LaFerla, FM. (2010). Alzheimer's Diseas. The New England Journal of Medicine, 362(4), 329-44

Thompson, CA., Spilsbury, K., Hall, J., Birks, Y., Barnes, C., Adamson, J. (2007). Systematic review of information and support interventions for caregivers of people with dementia. BMC geriatrics, 7, 18

Tulving, E. (1972). Episodic and semantic memory. Organization of memory, 381-403

Ulamnn, MT. (2004). Contributions of memory circuits to language: the declarative/procedural model. Cognition, 92, 231-270

World Health Organization. (2015). Dementia. Media Center

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PhD Tutor's note

P.'s work is of a high quality. It reflects her excellent understanding of the specific memory processes that are impaired in Alzheimer's disease, as well as the underlying neuroanatomy associated with these deficits. Her work is coherent, well-structured, and pleasant to read.

COULD COMPUTER-DESIGNED DRUGS TARGET DEPRESSION?

D. Ieronimou, supervised by M. Chikvaidze

Abstract

Duloxetine is a drug used for those who suffer from major depression.[1] It acts as an inhibitor and binds to sodium-dependent serotonin transporter proteins to stop serotonin (a neurotransmitter) from binding to the protein, temporarily keeping serotonin from being reabsorbed into the nerve cells in the brain, lightening our mood. Serotonin transporters are monoamine transporter proteins that transport serotonin from the synaptic cleft to the pre-synaptic neuron in the central nervous system; this way, it regulates signalling. A serotonin transporter will bind to a post-synaptic receptor and pump serotonin back in to the pre-synaptic cell.[2] When this happens, the good mood we felt as a result of serotonin being released ends. This has more of an effect on those who originally didn't have as much serotonin being released, leading to depression. For this reason, the drug Duloxetine is needed so that people with this mental illness can still carry out a normal life.

In this study, three dimensional (3D) structure of the unknown sodium-dependent serotonin transporter has been predicted, using computational modelling techniques, making it easier to understand the interaction with the drug Duloxetine. The properties of Duloxetine are also presented and suggestions made for designing a new drug based on Duloxetine but with fewer or no side effects.

Keywords: Active Site, Depression, Duloxetine, Molecular Docking, Molecular Dynamics Simulation, Neurones, Serotonin, Sodium-dependent Serotonin Transporter Protein.

Introduction

How does Duloxetine bind with a serotonin-transporter protein to ease the feeling of depression? Why is this so important? While the world's leading scientists are working on drugs to treat patients with diseases caused by pathogens or parasites such as HIV or cancer, it seems as though not as much attention is being paid to mental illnesses that are also very common. Just like any illness, depression (a mental illness) is something that can be very distressing for people who suffer from it and can cause harm to their social lives (which in our modern society is taken much more seriously and affects us more than it ever has), as well as the possibility of physical harm to themselves if they feel they can no longer cope. It is also important to realise that, as well as the biological factor, the social factor is also a big part of depression in most cases. Living in a first world society brings a whole new load of difficulties and challenges that many people in third world countries may not experience (that doesn't mean life for them isn't difficult), leading to certain mental illnesses e.g. depression. If these third world countries were to improve their economic state and turn into a society that is more like the one we live in today, wouldn't they then also face these same challenges and form these same illnesses?

For this reason, it is important to understand the biological processes within the body that cause such a disease now and try to develop a drug that is complimentary to the protein it binds to, for example, Duloxetine and a serotonin transporter, so that we can avoid these things from happening. To understand this, we must look at the structure of the sodium-dependent serotonin transporter and see how it is compatible with the Duloxetine drug molecule. This could be done by using powerful computers and a number of different computational methods, such as: modelling, molecular docking, molecular dynamic stimulations and molecular graphics.

This project predicts the unknown structure of serotonin transporter protein using computational modelling, and explores the chemical properties of the Duloxetine drug molecule, in order to understand its effects on our body and emotions.

This research is a small step forward aiming to make lives much easier and much happier for those suffering from depression. It is especially important now so that it won't be much of a problem in the future.

Background

Sodium-Dependent Serotonin Transporter Protein

This is a monoamine transporter protein that transports neurotransmitter serotonin from the synaptic cleft to the pre-synaptic neuron. It spans the plasma membrane twelve times. The 3D structure of this protein is unknown, however it is known that its main function is to regulate signalling via transporting serotonin molecules in the central nervous system. After serotonin binds to its post-synaptic receptor, the serotonin transporter pumps serotonin back into the pre-synaptic cell (Fig.1).[3] Depression has been suggested to be a result of a decrease of serotonin found in the synapse.[4]

Serotonin transporters use transmembrane ion gradients - Na^+, K^+ and Cl^- and internal negative membrane potential to transport serotonin. It transports 5-HT into nerve cells in the brain along with Na^+ and Cl^- while transporting K^+ out of the cell in the same reaction.[3]
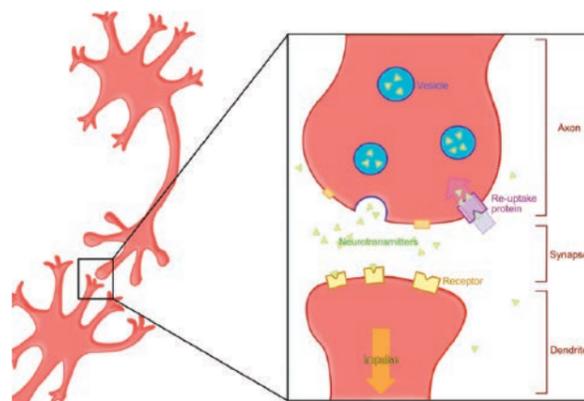

Figure 1: Neuron synapse during neurotransmitter re-uptake. Note that the process is slightly inefficient, as some neurotransmitters are lost in the medium between the neurons and hence, are not re-absorbed.

Its primary structure is made up of a chain of amino acids joined together by peptide bonds. This chain then starts to coil and fold to create its secondary structure made up of α-helices and ß-pleated sheets due to hydrogen bonds formed between hydrogen atoms in the amino acids. Its tertiary structure is its 3D structure. It contains hydrogen bonds, disulfide bridges (where a sulfur atom from a hydrophobic amino acid, cysteine forms a covalent bond with another cysteine on another part of the protein) and ionic bonds which are formed by oppositely charged amino acids being attracted to each other.[5]

Duloxetine

Neurotransmitters are chemicals in the brain that communicate information around our brain and body by relaying signals between neurons. The two types of neurotransmitters are known as inhibitory and excitatory. Inhibitory neurotransmitters balance our mood and help us keep calm, whereas excitatory neurotransmitters stimulate the brain.[6] Serotonin and norepinephrine are inhibitory because they balance and lighten our mood. However, when these neurotransmitters are reabsorbed (Fig.1), the "good mood effect" it had on us when it was released will stop. Duloxetine prevents this by disabling serotonin and norepinephrine from being reabsorbed in the nerve cell.

Figure 2: Structure of a Duloxetine molecule represented as a 3D ball model. It includes three rings (two of which are benzenes).15

Duloxetine is a drug; it is an organic compound mainly used to treat people with major depression. It has the molecular formula C18H19NOS with two combined benzene groups (Fig.2). It is a serotonin-norepinephrine reuptake inhibitor of serotonin and norepinephrine.[7]

Duloxetine will bind to the active site of a serotonin transporter, stopping serotonin from binding to the protein, inhibit the neuronal reuptake of serotonin. This temporarily keeps serotonin form being reabsorbed, causing the lightened mood effect to last longer.[8]

Why This Is Important

As well as diseases caused by pathogens, it is just as important to treat mental health problems. Today, we live in a society where the common cold is no longer as dangerous as it used to be. We can cure many diseases and we have a better understanding of how to live a healthy lifestyle. However, at the same time, we live in a society where we experience lots of different stressful situations and our mental state is constantly being pressurised by the norms of the society we live in. Some people cannot handle this pressure and break, developing a mental health problem.

A biological explanation for depression is that not enough serotonin and norepinephrine are being released, causing people to feel down. Major depression isn't just harmful for those who suffer from it but also those who are around that person. It can even lead to suicide. For this reason, it is important to make more drugs like Duloxetine and understand how it works so we can avoid feelings of despair and live happy lives.

Methods

There are many methods to find out about the structure of a serotonin transporter protein and seeing how it fits with Duloxetine.

Finding out a possible structure of the serotonin transporter protein was done by using the modelling tool, Swiss-Model (http://swissmodel.expasy.org) which is dedicated to protein structure homology modelling and uses different levels of complexity to try and create a model of a protein structure.[9] The actual structure of the serotonin transporter is very difficult to find and may not have even been discovered yet. This could be because it takes years to come up with a protein structure, experimentally. Serotonin transporter proteins aren't small so it could take even longer. The Swiss-Model tool was very useful to get an idea of the protein's 3D structure because it was quick and, although it may not be accurate, gave a potential structure to a protein with an unknown structure. Protein modelling allows you to visually look at all aspects of your protein; any anomalies can be adjusted so that the model is even closer to being accurate. This is a much faster method than experimentally trying to determine a protein's structure.

Research was also done by going on websites that held a lot of information about the protein and drug, as well as reading articles online. There is a great importance in looking up previous research done on serotonin transporter proteins; especially because there isn't much information on it. It was very helpful in providing a base for this project. Without the amino acid sequence of the serotonin transporter, a model of the possible 3D structure could not have been made.

Molecular dynamics could have also been used to stimulate the interactions between the serotonin transporter protein and Duloxetine using classical mechanics and a computer to show them interacting. Giving the atoms random velocities by artificially providing them with kinetic energy shows the motion of these atoms; these motions are then analysed. Using this method to analyse the dynamics of a serotonin transporter protein can help us understand more about the protein: its flexibility, movements related to its function and how it changes shape when it binds with serotonin or Duloxetine. Molecular docking (which tries to predict the structure of intermolecular complex formed between two or more constituent molecules) could have also been used.[10] Unfortunately, due to lack of data and equipment, this could not be done in this project. However, if it were to be done, what kind of results would have been observed? The protein could have been very flexible and able to bind with a wider range of molecules. If this were the case, it would be easier to try and design a more effective drug since not as much time and attention will be spent on the drug's structure. On the other hand, the protein may not be flexible at all so it will be important to focus on the structure of future drugs that can be made.

Results

Sodium-dependent serotonin transport molecule

A sodium-dependant serotonin transporter protein is made up of 630 amino acids and is mostly made up of helices (it has twelve transmembrane -helices.[11,12] A drug must be able to suit its structure so it is important to know how coiled and folded the protein is. This can help us have a better understanding of how Duloxetine can bind to the serotonin transporter.

According to 'UniProt' it has a 46% similarity with the sodium-dependent noradrenaline transporter which could be researched more and possibly give us a better idea of serotonin transporters since they are quite similar and perform similar functions in the body.[13]

Serotonin transporter protein leuT is also very similar to the sodium-dependent serotonin transporter protein, since they have similar amino acid sequences, so looking at its structure and interactions can also boost our understanding of the sodium-dependent serotonin transporter protein.

By typing up the sequence of a serotonin transporter into the Swiss-Model programme, three models, representing possible structures of the protein were created. The 3D structure of this protein is useful to see the possible interactions that can happen and create a drug based on those interactions.

If it was possible to zoom into these models to see their active sites, we could develop better understanding of the binding between the protein and other molecules which could ultimately help with the computational drug design.

Discussion

The most significant result found was the possible structure of the sodium-dependent serotonin transporter because it gave a visual 3D image of the protein, making it easier to study the serotonin transporter and try to (without using time consuming molecular dynamics) see how the Duloxetine drug molecule can fit and bind onto the protein. The image also confirmed that it is mostly made up of helices, which means these results are consistent with what was previously discovered about the protein. With this structure, it might be possible to create other drugs with fewer side effects than Duloxetine. For this, more specialised tools will need to be used and much more powerful computers. By using molecular dynamics and molecular docking we can create more drugs that fit with this structure and cure more people suffering from depression. Other possible structures can also be found by using the serotonin transporter's amino acid sequence.

The properties of Duloxetine are also very important findings since we already know that this drug works but it does leave some side effects. If a new drug based on Duloxetine can be made with very similar properties, such as polarity, number of rings, hydrogen acceptor count, with fewer or no side effects, it could improve the treatment of depressed patients and medicine. The worry of side effects will no longer be necessary and more people may be willing to be treated.

The results presented in this study, made it possible to understand the interaction between sodium-dependent serotonin transporters and Duloxetine, as well as proteins similar to serotonin transporters. Computer based drug design can be used in future studies, in order to find more powerful drugs using Duloxetine as a template and thereby target depression.

Bibliography

1. No author. (2009). Cymbalta (duloxetine). Available: http://www.netdoctor.co.uk/depression/medicines/cymbalta.html. Last accessed April 2015.
2. H. Allen. (2012). Duloxetine for mood and nerve disorders. Available: http://patient.info/medicine/duloxetine-for-mood-and-nerve-disorders. Last accessed April 2015.
3. No author. (No date). Mechanism of Action of the Serotonin Transporter. Available: http://web.williams.edu/imput/IVB3.html. Last accessed April 2015.
4. Członkowska, AI; Zienowicz, M; Bidziński, A; MacIejak, P; Lehner, M; Taracha, E; Wisłowska, A; Płaźnik, A (2003). "The role of neurosteroids in the anxiolytic,antidepressive- and anticonvulsive effects of selective serotonin reuptake inhibitors". Medical science monitor : international medical journal of experimental and clinical research 9 (11): RA270–5.
5. No author. (No date). Disulfide Bridge. Available: http://foldit.wikia.com/wiki/Disulfide_Bridge. Last accessed April 2015.
6. No author. (No date). What are Neurotransmitters?. Available: https://www.neurogistics.com/TheScience/WhatareNeurotransmi09CE.asp. Last accessed April 2015.
7. No author. (2013). Duloxetine. Available: http://www.drugbank.ca/drugs/DB00476. Last accessed April 2015.
8. Andersen, J; Kristensen, AS; Bang-Andersen, B; and Strømgaard, K (2009). "Recent advances in the understanding of the interaction of antidepressant drugs with serotonin and norepinephrine transporters". Chemical Communications, 2009, 3677-3692.
9. No author. (No date). Welcome to Swiss-Model. Available: http://swissmodel.expasy.org/. Last accessed April 2015.
10. E. Moman. (No date). Introduction to Molecular Docking. Available: http://www.utdallas.edu/~son051000/comp/EdelmiroMoman.pdf. Last accessed April 2015.
11. D. Canner. (2011). Serotonin Transporter. Available: http://www.proteopedia.org/wiki/index.php/Serotonin_Transporter. Last accessed April 2015.
12. No author. (No date). SLC6A4 Sodium-dependent serotonin transporter.Available: http://www.nextprot.org/db/entry/NX_P31645/structures. Last accessed April 2015.
13. No author. (2015). SLC6A4 - Sodium-dependent serotonin transporter.Available: http://www.uniprot.org/uniprot/P31645. Last accessed April 2015.
14. No author. (No date). MoIDB Listing Structures. Available: http://moldb.wishartlab.com/molecules. Last accessed April 2015.
15. No author. (2015). Duloxetine. Available: https://en.wikipedia.org/wiki/Duloxetine. Last accessed April 2015.

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D. is a Year 12 student at Cardinal Pole Catholic School in Hackney, north-east London. Dr. Mari Chikvaidze completed her PhD from combined faculties of Natural Sciences and Mathematics at Heidelberg University, Germany. Her research focusses on computational modelling of biological molecules.

PhD Tutor's note

D.'s final assignment was exceptionally well written and showed some deep understanding of complex concepts at the crossroads of biology, chemistry, mathematics and computing. I nominated her work due to its originality and creative approach, as well as academic rigour. I was most impressed by her passion for contributing to the field of computational biology by designing a novel protein and a corresponding drug for treating depression, a condition that can quickly take control of a person's life.

INTRODUCING LASSA FEVER

K. Charlton, supervised by O. Onianwa

Abstract

Lassa fever is a zoonotic viral illness that occurs in West Africa. About 5,000 people die from the disease yearly. It is caused by the Lassa virus and depends on the reservoir *Mastomys natalensis* (the multimammate mouse) for transmission to humans. Rodent-to-human transmission can occur through various means including the inhalation of virus-contaminated particles and ingestion of infected rodents. Human-to-human transmission occurs through exchanges of bodily fluids. Infected rodents may show no signs of illness. Symptoms in humans range from mild fever and headaches to haemorrhage, shock and deafness. The diagnosis of lassa fever includes the use of Reverse-Transcriptase polymerase chain reaction (RT-PCR) and serological techniques. Ribavirin remains the best treatment for the disease. There is currently no vaccine for disease prevention.

1.0 Introduction

Lassa fever, also known as Lassa Haemorrhagic Fever (LHF), is a zoonotic viral infection caused by the Lassa virus (LASV) in the region of West Africa. It is mostly spread by *Mastomys natalensis* (the natal multi-mammate mouse), and is usually transmitted through contact with faeces, contaminated food and clothes. Transmission can also occur through breathing in the virus from close contact. This occurs most commonly in poorer regions with bad hygiene. The virus attacks and takes over dendritic cells, which are part of our immune system and are very important for relaying information to our adaptive immune system, thus removing our vital ability to utilise our adaptive immune system effectively.

$$A = 2\varpi rh + 2\varpi r^{\wedge 2} \quad (1)$$

where r and h are the radius and the height of the cylinder, respectively. The capacity of the cylinder is given by:

$$\varpi r^{\wedge 2}h = 1000000 \quad (2)$$

The task is to find the radius and height of the cylinder that will minimise its surface area. To achieve this, I proceed as follows:

1.1) Lassa Virus

Lassa virus is a virus discovered in 1969 in Nigeria, West Africa when two women died from the disease in the town of Lassa, which the virus was named after (Centres for Disease Control and Prevention, 2014a). Lassa virus is an enveloped virus, meaning it is contained within a lipid (fat) layer. The virus binds with a target cell due to the protruding spiky proteins on the outer layer (Fig. 1).

1.2) Structure

Lassa virus is of the genus *Arenavirus* (family *Arenaviridae*), of which there are 22 recognised species. Members of the *Arenaviridae* are usually transmitted through rodents, each disease with its own particular rodent reservoir – except the Tacaribe virus which is symbiotic to bats (Gonzalez *et al.*, 2007). All *Arenaviridae* are spherical and encased in a fat membrane, which aids a virus to enter a host cell, and they often show host cell ribosomes in the viral particles (or virions), giving them a grainy look (Centres for Disease and Control and Prevention, 2013a). They are one of the most common causes of viral haemorrhagic fevers (Centres for Disease and Control and Prevention, 2013b).

1.3) Classification

Arenaviruses are split into two groups – Old World and New World (Fig. 2). The Old World *arenaviruses* include Lassa virus and Lymphocytic Choriomeningitis virus (LCMV) while the New World viruses include the Tacaribe virus (TCRV). There are eight viruses within the genus Arenavirus that cause viral haemorrhagic fevers (VHF) in humans. These include LCMV, LASV, Junin virus (JUNV), Machupo virus (MACV), Guanarito virus (GTOV), Sabia virus (SABV), Chapare virus (CHPV), and the Lujo virus (LUJV) (Centres for Disease Prevention and Control, 2013a).

1.4) Epidemiology

Lassa fever is a serious challenge in Africa as the rodent reservoir species is present all over West Africa and has a large potential to be used in bioterrorism (Centres for Disease Control and Prevention, 2014). Other countries that have been affected by the disease include Sierra Leone, Guinea and Liberia.

Direct contact with or exchange of bodily fluids with an infected person or rodents are the easiest ways of catching the disease. The most common period of infection is during the change between dry and wet season, in which social movements create close living conditions and poor hygiene creates many vectors for the disease. Roughly 300,000 cases are present each year in West Africa, of which 5,000 die, with up to a potential 59 million people at risk of developing the disease (Richmond and Baglole, 2004).

The presence of Lassa fever is detected by analyses of blood samples of people in 'at risk' regions and checking for antibodies corresponding to the virus. In Sierra Leone the prevalence of antibodies in blood is 8-52%, 4-55% in Guinea, and roughly 21% in Nigeria (Richmond and Baglole, 2004). Infection usually lasts between 1-4 weeks, and the fatality is about 1%. In severe infections the fatality rate is more similar to 15% (World Health Organisation, 2015).

2.0) Vector

As with most arenaviruses, transmission begins with rodents as the main vector. The Multi-mammate mouse (*Mastomys Natalensis*) (Fig. 3) belongs to the phylum *Chordata*, class *Mammalia*, order *Rodentia* and family *Muridae* (International Union for Conservation of Nature and Natural Resources Red List of Threatened Species, 2014). While Old World arenaviruses are associated with rodents of the subfamily *Muridae*, New World arenaviruses are associated with rodents of the subfamily *Sigmodontidae*.

2.1) Transmission

2.1.1) Rodent-rodent

Lassa virus is transmitted vertically (from mother to new-born, in a continuous cycle) amongst the infected multi-mammate mouse population, and horizontally – through the inhaling of aerosolised faecal matter (small particles in the air), through urine or other bodily fluid contact, and wounds.

2.1.2) Rodent to human

Rodent to human inoculation usually occurs because of contact with rodent faecal matter, but other routes are possible such as through cuts and bites, contaminated fomites like food, and ingestion of an infected rodent. Rodent-borne diseases

are extremely difficult to eradicate because of ever increasing rodent populations which are a consequence of high fertility. Decline in the number of larger animals that serve as predators or compete for resources further exacerbates the problem (*Young et al.*, 2014). It is little wonder why the spread of disease has not been controlled till this day. Lassa fever is very common in the endemic countries in West Africa, where humans have a diet largely based on catching and cooking rodents.

2.1.3) Human to Human
Horizontal transmission between humans is transmitted similarly, usually through wounds or sexual inoculation. It is uncommon for transmission between humans due to an increased level of hygiene than that of rodents.

3.0) Diagnosis and Symptoms
The mild symptoms of Lassa fever include: weakness, fever, headaches. The harsher, progressed symptoms of Lassa fever include: haemorrhage (bleeding), breathing problems, vomiting, pain in many areas, encephalitis (brain inflammation) and shock (Centres for Disease Control and Prevention, 2014f). Eighty percent of Lassa fever cases are asymptomatic, but one in five cases have very extreme issues where many organs are affected at once (World Health Organisation, 2015).

Symptoms of Lassa fever can be confused easily with those of Ebola, meaning some Lassa fever health clinics in Africa – especially in the countries having both Lassa and Ebola pandemics – are overwhelmed by patients who believe they have one disease when they have the other (British Broadcasting Corporation, 2014). Deafness is also a common complication. Deafness is often permanent, even after successful treatment of the viral infection. Death can occur in the first two weeks of the disease, due to multiple organ failure (Centres for Disease Control and Prevention, 2014f).

Lassa fever can be diagnosed in the early stages using the Reverse Transcription Polymerase Chain Reaction (RT-PCR). This is carried out using a thermal cycler (Fig. 4). This assay essentially replicates viral nucleic acid to allow scientists to identify them better. Serology is another method of detecting the virus in the blood of infected patients. Here an enzyme is used to identify Lassa fever antigens and specific antibodies produced in infected patients. These tests confirm the virus's presence (Centres for Disease Control and Prevention, 2014c).

4.0) Treatment
The most successful treatment for Lassa fever is the use of *Ribavirin* - an antiviral drug that prevents the virus RNA replication process. Care such as maintaining electrolyte balance, blood pressure, oxygen levels and fluid levels is also required if the illness is to be staved off effectively (Centres for Disease Control and Prevention, 2014h).

5.0) Prevention
Being in the majorly threatened endemic countries for Lassa fever greatly increases the risk of contracting the disease, alongside being in any area of Africa that supports the *Mastomys* genus of mouse (Centres for Disease Control and Prevention, 2014d).

The maintenance of good hygiene in human homes is very important. Food should not be left unmonitored or should be stored in rodent-proof containers. These discourage rodents from entering the home. Traps are also a good method of minimising rodent populations around households. Being in a hospital means generally there is little chance of infection, so long as standard safety and infection prevention measures are put into place.

There is currently no vaccine against the disease.

Bibliography
- British Broadcasting Corporation (2014), Ebola intensifies the struggle to cope with Lassa fever [online], available from: http://www.bbc.co.uk/news/world-africa-29868394 [Accessed: 3rd November 2014]
- Centres For Disease Prevention And Control (2013a), Arenaviridae [online]. available from: http://www.cdc.gov/vhf/virus-families/arenaviridae.html [Accessed: 17th June 2015]
- Centres For Disease Prevention And Control (2013b), Viral Haemorrhagic Fevers [online]. available from: http://www.cdc.gov/ncidod/dvrd/spb/mnpages/dispages/vhf.htm [Accessed: 17th June 2015]
- Centres For Disease Prevention And Control (2014a), Lassa Fever [online]. Available from: http://www.cdc.gov/vhf/lassa/ [Accessed: 4th April 2015]
- Centres For Disease Prevention And Control (2014), Lassa Fever Fact Sheet [online]. Available from: http://www.cdc.gov/ncidod/dvrd/spb/mnpages/dispages/fact_sheets/lassa_fever_fact_sheet.pdf [Accessed: 2014]
- Centres for Disease Prevention and Control (2014c), Lassa fever – Diagnosis [Online]. Available from: http://www.cdc.gov/vhf/lassa/diagnosis/index.html. [Accesses: 17th March 2015]
- Centres For Disease Prevention And Control (2014d), Lassa fever - Prevention [online]. Available from: http://www.cdc.gov/vhf/lassa/prevention/index.html. [Accessed: 17th June, 2015]
- Centres For Disease Prevention And Control (2014e), Lassa fever - Risk Of Exposure [online]. Available from: http://www.cdc.gov/vhf/lassa/exposure/index.html [Accessed: 25th March 2015]
- Centres For Disease Prevention And Control (2014f), Lassa fever - Signs and Symptoms [online]. Available from: http://www.cdc.gov/vhf/lassa/symptoms/index.html [Accessed: 25th March 2015]
- Centres For Disease Prevention And Control (2014g), Lassa fever - Transmission [online]. Available from: http://www.cdc.gov/vhf/lassa/transmission/index.html [Accessed: 25th March 2015]
- Centres For Disease Prevention And Control (2014h), Lassa fever - Treatment [online]. Available from: http://www.cdc.gov/vhf/lassa/treatment/index.html. [Accessed: 17th March 2015]
- Dobigny, G., Nomao, A., Gautun, J.-C (2002), A cytotaxonomic survey of rodents from Niger: Implications for systematics, biodiversity and biogeography, Mammalia 66(4): p495-523
- Gonzalez, J. P., Emonet, S., de Lamballerie, X., Charrel, R. (2007), Arenaviruses. Curr Top Microbiol Immunol. 315:253-288.
- International Union for Conservation of Nature and Natural Resources Red List of Threatened Species, 2014 (2014), Mastomys natalensis [online], available from: http://www.iucnredlist.org/details/12868/0 [Accessed: March 2014]
- Richmond, J. K. and Baglole, D. J. (2004), Lassa Fever: epidemiology, clinical features, and social consequences. BMJ. 327(7426): 1271–1275.
- World health Organisation (2015), Disease Outbreaks [online], available from: http://www.who.int/topics/disease_outbreaks/en/ [Accessed: 2015]
- World health Organisation (2015), Lassa fever fact sheet [online], available from: http://www.who.int/mediacentre/factsheets/fs179/en/ [Accessed: 2015]
- Young, H. S., Dirzo, R.., Helgen, K. M., McCauley, D. J., Billeter, S. A., Kosoy, M. Y., Osikowicz, L. M., Salkeld, D. J., Young, T. P., Dittmar, K. (2014), Declines in large wildlife increase landscape-level prevalence of rodent-borne disease in Africa, Vol.111 (May), p7036-7039

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K. is a year 10 pupil at Sir Christopher Hatton Academy in Wellingborough. Okechukwu Onianwa is studying for his PhD at the University of Nottingham, focusing on the topic 'The Detection of Novel Pathogens in Rodents and subsequent Assessment of their Zoonotic potential.'
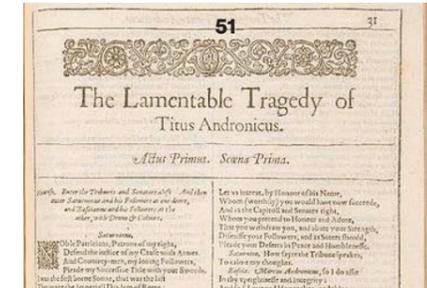
PhD Tutor's note
K.'s piece was quite well written. It presented essential information on the nature of lassa fever and its causative agent. K. also explained the challenges associated with the prevention and control of the disease. The sources of information for the article were also clearly recognised making it credible. His work was a great effort altogether and I am proud to have taught him within the short period.

IN THIS ISSUE
Arts and Humanities Articles

DOES ANIMATION TRIVIALISE THE HOLOCAUST?

H. Haq, supervised by V. Walden

Abstract

I strongly believe that it is offensive to represent the Holocaust in animation, as it gives the perception that the Holocaust is not a serious topic due to the comedic and childish connotations attached with the medium. In order to support my opinion, I will analyse some animations about the Holocaust. In my analysis, I shall discuss what makes the medium inappropriate by scrutinising the following animations: *Seven Minutes in Warsaw Ghetto* (Johan Oettinger 2010); *Lego Auschwitz* (Circle Productions 2011); *"Silence"* (Orly Yadin and Sylvia Bringas 1998).

The United States Holocaust Memorial Museum states that "The Holocaust was the systematic, bureaucratic, state-sponsored persecution and murder of six million Jews by the Nazi regime and its collaborators…" (USHMM: [ONLINE]). I have selected this powerful definition due to the simplicity and clarity it provides. The statement not only informs us what the Holocaust was, but also briefly highlights who the victims and leaders were during this horrific time in history. However, I do not fully agree with the statement that Dori Laub (a Holocaust survivor) makes when he claims that "the Holocaust is an event without a witness" (1992:82), given the reality that there were many witnesses, some of which are still alive and retelling their life-stories to future generations. In addition, the Nuremberg war trials widely documented evidence given by witnesses in the prosecution of major World War II Nazi criminals. In contrast, others may claim that Laub is suggesting that the Holocaust was so extreme and complex that no one person was the witness of the horror of the whole event. The fact that a simple statement like this can be interpreted in many ways shows why it is so important to be careful to convey the Holocaust in a manner that does not risk trivialising events and causing offence to viewers.

Many Holocaust scholars, survivors and artists have asked, "Should the Holocaust be represented?" and "How should it be represented?" Elie Wiesel states that, "Auschwitz is something else, always something else. It is a universe outside a universe, a creation that exists parallel to creation" (Wiesel 1989: [ONLINE]). This statement allows the reader to understand that Wiesel is firmly against any sort of representation of the Holocaust as he believes that "no one can now retell Auschwitz after Auschwitz." (ibid) Furthermore, Wiesel also claims that with the rising number of representations of the Holocaust, it is beginning to become a "fashionable subject" for film and theatre producers and television networks (ibid). In addition, with the increase of shows being produced, this Holocaust survivor claims that productions have "little history, a heavy dose of sentimentality…what counts is ratings and facile success." (ibid) This statement is shocking as Wiesel claims that producers do not care so much about the facts and history, but just want their films to be a big hit with the audience.

Animation can be defined as "the artificial creation of the illusion of movement in inanimate lines and forms…a film made by hand, frame-by-frame, providing an illusion of movement…" (Wells 1988:1). As with any other medium, animation requires the adoption of certain variables in order to keep the audience interested and to convey the subject matter. Examples of these variables are: the colour scheme and drawing styles; if an animation about the Holocaust uses bright colours and joyful songs in a scene where people were being put in the gas chambers then this would be perceived as being highly offensive, but it is possible that if illustrated using the correct mix, then such offence could, perhaps, be avoided. However, given the sensitivity of the topic, how could anyone be sure that they produced an animation with the right elements so as not to cause offense? This would be the case through the use of any medium; however, I believe that given the generally jocular and childish connotations related to this film form, the use of animation to describe the horrors of the Holocaust leaves it particularly vulnerable to causing offence compared to other media. These points clearly link to what Wiesel says about how film producers often neglect the sensitivity of this topic in general and solely focus on a successful production. The use of animation is an unusual medium for a highly sensitive topic and could be seen as a selfish attempt to capture a larger audience and to chase profit over public service.

Terence Des Pres considers the Holocaust to be sacred, therefore he believes that no representation of the topic should be inaccurate, rather it should be as "faithful as possible to the facts" (Des Pres 1988:220). In relation to Holocaust representation in general, producers do not always stick to the facts. For example, in animation, the target audience in general is a young age group, therefore the producers may need to change some of the key events of the Holocaust, just to meet their target audience's needs, which include scenes that are not too graphic, a need to hold short attention spans and use of simple language. This can go against what Des Pres has stated about the Holocaust being a "sacred event, with a seriousness admitting no response that might obscure its enormity or dishonour its dead" (ibid).

Although there was a lot of footage of the Holocaust, it can be said that producers often do not want to include it, as much of it was filmed by the perpetrators and the films show little evidence of the mass murder that took place. Furthermore, the atrocity images are problematic to use as they would shock the audience, hence producers who are unable to find enough suitable footage, would have to pay for actors to re-enact scenes from the Holocaust, pretending they were part of this tragic time in history. One advantage of animation is that it "can show us an unfilmed past and can enter the depths of human emotions" (Elowitz 2014: 219-222); however, I do not believe that animation can provide access to the depths of human emotions over other media, and in fact, given the attributes of animation noted above, it could even serve the opposite effect by further de-humanising victims by representing them with the use of pictures and fake characters. This could be considered even more offensive as these are the same people who had already been denied every human right and emotion, and they are now being depicted as cartoon characters.

Silence, is a short animated film, which uses a combination of photographs, videos and animation to represent the real life story of Tana Ross. Within her story, Ross covers "…her pre-war life, her capture and then her post-war experience in Sweden" (Victoria Grace Walden 2014: [ONLINE]). Unlike the majority of Holocaust animations, Ross expresses "her story through the juxtaposition of archive film and photographs, and cut out and cel animation" (ibid). She also uses a mixture of "black and white 'woodcut' style sequences" (ibid) to show her Holocaust memories, and uses coloured animation to show her life before war.

I strongly believe that this film trivialises the Holocaust as it uses unnatural movements between scenes such as the characters flying across the screen, as well as the choice of joyful sounds and music playing during the course of the film. On the other hand, some people may argue that music and the roughly sketched animation makes it seem more engaging to watch because, if such factors were taken away, then it could cause the viewers to lose interest and watch something else. Such arguments to sensationalise a sensitive topic in order to profit from viewership over content are unacceptable when we question how ethical and sensitive we are being towards the victims of the Holocaust and the horrors they endured. Theorists offer general ideas that agree with my understanding of the film, as

Barry Langford states that "the problematic notion of 'the Holocaust Film' as a genre raises ethical questions alongside critical ones" (Langford 2005: 265). Although this Holocaust survivor agreed to her experience being told through animation, it can be argued that it is difficult to portray complete sensitivity in any depiction of the Holocaust. This film shows why the use of animation, with its need to grab attention with unusual pictures and music, could cause ethical discomfort amongst other Holocaust survivors who may feel that the film trivialises the "attempted annihilation of European Jewry" (IWM 2000: 3) and I believe it makes this media a poor choice for communicating about the Holocaust.

Another Holocaust animation is *Seven Minutes from the Warsaw Ghetto*. This short film is about an eight-year-old boy, Samek, who dies in the Holocaust – the short animation connects with the audience emotionally as it uses an eight-year-old boy to tell its story. This short animation was directed by Johan Otteinger and was released on the 8th February 2013, and although the storyline may seem fictional due to the unrealistic animation style and the eerie silence from the characters, this film is based on a real event, however the large majority of the film is fictional. One can immediately note there is no use of voices within the animation and this can be interpreted to be offensive to some, due to the fact that it may portray the Jews as voiceless and thoughtless. Although others may state that the German soldiers do not speak either, I still find it offensive toward the Jews as the majority of the film is based on a Jewish family who stay completely silent and communicate only by facial and body expression. In addition, the animators decided to make all the Jews' skin cracked and broken. This clearly can be regarded as inappropriate as it portrays the Jews as not only internally broken (due to the fact that they do not speak), but they also look physically damaged as well. People may argue that the reality was that the Jews were suffering from the war in all ways possible, but I feel as though the physically cracked skins takes things a step too far despite possible arguments that anyone who could endure the Holocaust was stronger internally and externally than others who live in a more peaceful time. Terence Des Pres states, "Representations of the Holocaust shall be as accurate and faithful as possible to the facts and conditions to the event…no response that might obscure its enormity or dishonour its dead" (Des Pres 1988: 220). It is very clear that *Seven Minutes from the Warsaw Ghetto* does not take this advice into consideration, choosing expression and sensationalism over the duty to accurately inform about these historical events. While animation could be said to grab the attention of younger viewers and those interested in artistic productions, and educate them about this time in history, there is an ethical duty to be accurate about facts when the subject matter is this important. This argument also applies to *Silence,* which was based on a true story but also employs music and artistic licence to capture attention rather than to convey facts. As such, I firmly believe both films trivialise the Holocaust due to the use of animation.

In conclusion I believe that Holocaust animations always trivialise the Holocaust. Examples of the offence that these animations can cause can be seen in *Silence and Seven Minutes in the Warsaw Ghetto.* The producers of these animations have an ethical duty to report accurate information to their viewers, in order to respect and commemorate the people who lived through this horrific event, rather than produce animations about the Holocaust to capture attention, profits and ratings such as the use of flying people, joyful music and the portrayal of Jewish people as mute and physically damaged. In addition to these factors, one can also argue that an animation has childish and trivial connotations, therefore if such a medium is not conducive to representing a sensitive and serious topic like the Holocaust, it can only serve to trivialise it. Although people may claim that any film is open to offending victims and their families, I believe the characteristics of animation make it more likely to offend and trivialise the facts than any other media. As such, I firmly believe that it is offensive to represent the Holocaust though the use of animation and the use of other written, spoken and visual media would be more appropriate for conveying this topic.

Bibliography

Books:
Des Pres, Terrence (1988) 'Holocaust Laughter?' in Lang, Berel (ed.) Writing and the Holocaust. New York: Holmes and Meier.
Laub, Dori & Felman, Shoshana (1992) Testimony: Crises of Witnessing in Literature, Psychoanalysis, and History. New York: Taylor and Francis Group.
Yadin, Orly (2005) 'But is it Documentary?' in Toby Haggith & Joanna Newman (ed.) The Holocaust and the Moving image: Representations in Film and Television since 1933. London: Wallflower Press.
Wells, Paul (1998) Understanding Animation. New York: Routledge.
Langford, Barry (2005) 'Holocaust Film' in Film Genre: Hollywood and Beyond. Edinburgh: Edinburgh University Press.
Imperial War Museums (2000) The Holocaust. London: Imperial War Museums.

Journal Articles:
Elowitz, Jodi (2014) 'Seven Minutes in the Warsaw Ghetto: Representing the unimaginable through an animated film', in Short Film Studies Journal, vol 4 no 2, pp 219-222
Grace Walden, Victoria, 'Animation: Textural Difference and the Materiality of Holocaust Memory' (31st December 2014) http://journal.animationstudies.org/victoria-grace-walden-animation-textural-difference-and-the-materiality-of-holocaust-memory/

Newspapers:
Wiesel, Elie (1989) 'Art and the Holocaust – Trivializing Memory', in New York Times, June 11th 1989. http://www.nytimes.com/1989/06/11/movies/art-and-the-holocaust-trivializing-memory.html [accessed 31/01/2015]

Websites:
United States Holocaust Memorial Museum', 'Introduction to the Holocaust.' http://www.ushmm.org/learn/introduction-to-the-holocaust [accessed 31/01/2015]
IMDb 'Seven Minutes in the Warsaw Ghetto' http://www.imdb.com/title/tt2349803/ [accessed 29/03/2015]

Films:
Seven Minutes in the Warsaw Ghetto (2010) Dir. Johan Oettinger
Silence (1998) Dir. Orly Yadin and Sylvia Bringas

About the authors

H. is a year 9 pupil at Lampton School. PhD Tutor, Victoria Grace Walden is studying film studies at Queen Mary, University of London, focussing on the materiality of Holocaust moving-image memory.

PhD Tutor's note

H.'s work illustrates an original, intellectual response to a challenging topic. Not only has he managed to show the beginnings of an understanding of the Holocaust as a deeply complex topic of study, but in just five lessons, he also mastered a critical understanding of debates about Holocaust representation and animation. This is a much unexplored area, thus H.'s work contributes to a new field of research.

ASSESS THE TURNING POINTS DISCUSSED IN THIS COURSE AND DECIDE WHICH ONE HAD THE GREATEST IMPACT ON AMERICAN SOCIETY AND WHY

G. Lightfoot, supervised by H. Flynn-Piercy

Abstract

This paper offers a comparison of some of the main turning points in American History: The founding of America, the Civil War, the Civil Rights Movement and the election of the first African-American President. The author compares each turning point, assessing its significance based on the impact it had on American society, ultimately arguing that the Founding of America was the most important and had the greatest impact since without this none of the later turning points could have happened in the way they did. The paper provides insights into and analysis of the main documents written in the period, the Declaration of Independence, the Constitution and the Bill of Rights as a way to validate the significance of this turning point, concluding that not only did the Founding Fathers and these documents have a fundamental impact on the later turning points, but that their influence and these documents continue to define contemporary American society in many different ways.

Compared to the majority of other nations across the world, America as an independent country has had a relatively short history. However, throughout this time, many significant turning points have occurred, such as the Founding of the United States, the Civil War, the Civil Rights Movement and the election of an African-American president. The most important turning point in American history is the Founding of the United States, which included the creation of the Bill of Rights, the signing of the American Constitution and the congregation of the Founding Fathers because without it, none of the other American history would even happen since America as we know it wouldn't even exist. Even if they did, this would still be the most important because it set the foundations of all the ideals America is defined by, such as liberty, equality and freedom, whereas the other turning points just built upon it, perfecting these ideals by doing things like abolishing slavery (as in the Civil War) and protesting for equality (like in the Civil Rights movement). The Founding of America caused massive and perpetual effects on freedom, politics and society that still affect us today, and these are the themes this essay will be exploring.

The Founding of the United States had massive social effects. The Bill of Rights stated in the First Amendment that "Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof; or abridging the freedom of speech, or of the press; or the right of the people peaceably to assemble, and to petition the Government for a redress of grievances."[1] Madison, 1791, Amendment I) This was the first law in the history of America that granted free speech since beforehand (when America was ruled by the British monarchy) free speech was severely restricted by the laws put in place, such as seditious libel which made criticizing the government a crime; Larry Eldridge states that "there was no political free speech in seventeenth century America"[2] Eldridge, 1994, *A Distant Heritage: The Growth of Free Speech in Early America*). This act made America a worldwide symbol of freedom; Alexander Meiklejohn said it is "the most significant political statement which we Americans have made"[3] Meiklejohn, 1953, *'What Does the First Amendment Mean?'*). Not only was it the first law of free speech, but it was also the first spark that started the long lasting fire that symbolises the fight for equality because it was for the people, not just the rich and powerful. Furthermore, it was the first time a higher authority (e.g. The Founding Fathers: John Adams, Benjamin Franklin, Alexander Hamilton, John Jay, Thomas Jefferson, James Madison and George Washington) contemplated the attitude towards women's rights, slavery and religion; resulting in many laws being made that gave more freedom to these people. Lincoln's Gettysburg Address made large contributions to the equality of blacks by abolishing slavery at the end of the Civil War

but in comparison to the Bill of Rights, which gave rights to the majority of Americans, it doesn't come close. Even if the Founders had to reach a compromise to the argument between the Northern states (anti-slavery) and the Southern states (pro-slavery) which made black people viewed as 3/5 of a person and didn't allow them to vote, it still made them, nationally, 60% of a person even in the Southern states where previously they were not considered a person at all but property to be owned, traded or forced to manual labour (as well as other tasks) so their owners could gain a profit. The Civil Rights movement successfully won rights that blacks, women and homosexuals didn't have prior to the event. But without the Bill of Rights they would not have been able to protest due to there being no right of free speech creating a domino effect, meaning blacks would still be largely discriminated against and there would not be an African-American president in office. Without the foundations set by the Bill of Rights, the tall building of equality standing today would not have been built making it extremely significant.

Politically, the founding of the United States held a massive impact. The Declaration of Independence (drafted in 1776) is a document that told the British that the thirteen states that signed it no longer regarded themselves as part of the British Empire. This was an extremely important event; it was the first move America made down the path of independence, and it showed all nations that the greatest power in the world at the time, the British Empire, was not omnipotent. This could have inspired other nations to break off from the Empire, such as India in 1857 – they even share the same opening phrase in the preambles to their constitutions: "We the People…" Not only did the founding of the United States create the actual country as we know it today, but it made it a democracy with George Washington (America's first President) at its head. This was a gargantuan change from how America was run previously (by the British monarchy) since it allowed the people to have a vast amount of influence on the choices the government made, which is something America is renowned for today. It also meant that America no longer had a definitive ruler who decided which laws were acceptable, as this role was effectively passed onto the people. Furthermore, the documents created in this time (e.g. the Declaration of Independence, the Bill of Rights and the American Constitution) are still used today to justify the law; they are the first thing looked at to decide someone innocence or guilt, obviously meaning it holds a vast amount of reputation with the people of America and with the higher authorities or else they wouldn't allow it to be used in court. The Civil Rights movement gave more political power to black people, gays and women but without the founding of America, they would have no reason for political power since the monarchy of Britain would have ruled absolutely, and they wouldn't have had the right to free speech which allowed them to protest. The election of the first African-American president, Barack Obama, has shown that blacks, who were discriminated against and forced into slavery for decades, can reach the highest point in the country which raised aspirations for an entire ethnicity but without the Founding of America there would be no such thing as 'the President of America' because, as mentioned previously, the British monarchy would still rule. This shows how momentous the Founding of America was and also how it has affected us in modern times and does so to this very day.

The Founding of the United States and, more specifically, the Bill of Rights, set the fundamentals of freedom that all Americans (to this day) have access to, including freedom of religion, freedom of speech, a free press, and free assembly; the right to keep and bear arms; freedom from unreasonable search and seizure, security in personal effects, and freedom from warrants issued without probable cause; indictment by a grand jury for any capital or infamous crime; guarantee of a speedy, public trial with an impartial jury; and prohibition of double jeopardy. This lowered discrimination considerably since people were allowed to worship and say what they want, and made America a much more culturally diverse place since people who might have been in hiding or seeking refuge from discrimination would come there for safety. For example, large amounts of Jews emigrated from Germany, where anti-Semitic laws were in place, to America due to the freedom of religion. Also, it meant that the press was free, there was no government censorship in the news, so the people of America were told the truth, unlike in other countries where the government would censor certain things to make them seem superior to potential candidates that could take their place. This document, proposed by James Maddison in 1789 and created in 1791, has been used perpetually throughout American history in the fight for rights. Martin Luther King Jr. referred to "the magnificent words of the Constitution"[4] King, 1963, 'I Have A Dream') in the Civil Rights movement and Barack Obama uses the phrase "a Constitution that had at is very core the ideal of equal citizenship under the law"[5] Obama, 2008, 'A More Perfect Union') both for the same purpose: to make the people of America empathise with them, whether to get them to vote for them when they run for president or to contribute to the fight for rights. This is because the Constitution is so important, being the document that defines America as a country and is one of the first steps it took as a nation; it is almost considered holy by the people of America. In its entire existence, it has only been amended 27 times and none of the original 10 amendments have been changed in the slightest, which shows how sacred it is to American society even after 224 years.

The Founding of the United States was significant in many different ways, both in political and social topics; it also set the foundations of equality and freedom for all Americans, making it the most significant point in American history. The effects caused by this turning point are without a doubt the most momentous compared to the other turning points – they affected the entire world. Without it, the US wouldn't even exist so, theoretically, none of the other turning points mentioned would have occurred. This means it was the most important thing ever to happen, and in this essay you can learn why, and how much of a vast effect it had on the entire country. Even now, the sentiments used in the Founding of United States are continued – Martin Luther King Jr. (along with women, other blacks and homosexuals) used them in the Civil Rights Movement in their struggle to gain equality, and Barack Obama used them in his speech to gain support of the people and continues to use them today which just goes to show how monumental it was and how it continues to affect America and the entire world today.

About the authors

G. Lightfoot is a Year 9 pupil at Manor Community Academy. PhD Tutor Holly Flynn-Piercy is studying for her PhD at Durham University. Her research focuses on a comparison of the leadership styles and decision-making of contemporary American Presidents and British Prime Ministers and the constraints they face when attempting to enact change, with a specific focus on health care reform.

PhD Tutor's note

G.'s essay was excellent. He demonstrated an ability to compare, analyse and critique historical documents and events that went well beyond his current key stage. He displayed comprehensive knowledge of the question and was able to assess each turning point, discuss its significance and evaluate its impact on American society in a way that consistently validated his decision to choose the Founding of America as the most significant. He used both primary and secondary sources very successfully throughout the essay to support his arguments and was able to relate their significance to contemporary American society. Overall, this was a very impressive piece of work that clearly showed G.'s ability to construct persuasive arguments and write clearly and effectively, as well as demonstrating a consistently high level of learning and understanding throughout the course.

Bibliography

Madison, J. (1791) First Amendment in the Bill of Rights. Pennsylvania: Pennsylvania State House. Available from: https://www.law.cornell.edu/constitution/first_amendment (Accessed: 28th March 2015).
Eldridge, L. (1994) A Distant Heritage: The Growth of Free Speech in Early America. New York: New York University Press.
Meiklejohn, Alexander (1953) 'What does the First Amendment mean?' The University of Chicago Law Review 20(3): 461-479.
King, Martin Luther (1963) I Have a Dream. Washington D.C.: Lincoln Memorial. Available from: http://www.archives.gov/press/exhibits/dream-speech.pdf (Accessed: 28th March 2015).
Obama, Barack (2008) A More Perfect Union. Philadelphia, Pennsylvania: National Constitution Centre. Available from: http://constitutioncenter.org/amoreperfectunion/ (Accessed: 28th March 2015).

ANALYSING DIFFICULT POETRY

T. James, supervised by D. Castiglione

Abstract

When given a difficult poem, there are two types of people; one that will simply throw it away, and the other who will throw themselves into it. I am part of the latter group; I consider poems to always have an 'average' person behind them. In this assignment I will compare reviews on the difficulty of poetry in the style of a literature review and then analyse the poetic devices used to create meaning in Geoffrey Hill's poem, LXIV from *The Orchards of Syon* (see below for full text). After this, I wish to test the hypothesis that 'Poem with narrative are easier to understand than poems without', and to conclude by summarising the key ideas that have been displayed throughout the essay. The poem LXIV leaves a great deal to interpretation. Its thought-provoking nature created by enjambment, narrative and foregrounding to me personally advocates the thoughts of a lonely man with lost hope. The use of enlarged detail on specific inanimate objects at the beginning of the poem illustrates this point as it proposes the idea that the poet is trying to make the reader focus on something other than the character's problems. It also depicts an image of someone staring at the floor, an image conveying negative connotations and helping the reader to gain an idea of what the character's background could be like.

LXIV

This is my shoelace. That is bobbled clover.
Here's a youngish man embarks on I
am an old man now. Eximious 'STARRY' VERE,
lyric and futile. Sit here, Memory.
5   A trial playthrough: they could hardly tell
prelude from postlude, postlude from intermezzo.
You're right! Not clover; even more tenacious,
tight like plantar warts or splayed pseudopods
that gardeners gouge and burn from lawns. Let's think
10   around the nature of impasse: metaphysics'
biochemical mystery. Wisdom
conspires with unwisdom, in a phrase
the genius of the maker – slog-and-slang.
Fancy's not truth, even if truth's confined
15   to Imagination: STC's compunctions,
the last bit of The Tempest, ancient prayers
of intercession that are said to work.
Melville's predisposition stood at bay
to public humours. Through stiff metaphrase
20   the sad man breaking in his stupent heart,
his stupent heart hog-tied on Southport sands
for Hawthorne to excogitate. I'll name
my own late fancies Dream Children if not –
just for the shine on it – *Prospero's Farewell*.

A Literature Review

On the one hand, difficulty in poems can lead to a lot of interpretation. On the other, it can also lead to confusion. What makes a poem difficult, ultimately? Chafe stated that 'It is not only unfamiliar words, phrases, and locutions that may create some difficultly, but also the description of unfamiliar patterns of behaviour' (Chafe, 1991). This claim itself leads to some interpretation and could be seen negatively. Does this mean that the complexity of the poem alters the meaning to the reader? Looking further into this, I believe that the sole purpose of a poem is to initiate a thought, be it different to each person or not. The difficulty creates a depth that cannot be generated with words but only in the levels of a poem formed by obscure actions and characterisation. At the start of my selected poem, LXIV, the use of a shift in the type of personal pronouns complicates the view of the situation commencing. This allows readers to interpret the event in their own way whilst grasping what the poet initially meant when writing it.

Similarly, another difficulty faced within poetry is the meaning; difficult poems often have deeper meaning to them but it is not easily seen. Bernstein wrote that 'Readers of difficult poems also need to beware of the tendency to idealize the accessible poem. Keep in mind that a poem may be easy because it is not saying anything' (Bernstein, 2011). I believe this is true, since most poems that are not perceived as difficult do not allow the individual to think about the meaning. When the whole poem can be understood just by glancing through it, no real message is expressed. A true message is voiced through deciphering the language and context of the poem, leading to the reader's understanding of the poet's intention when writing it.

Prynne, in his review of difficult poems, voiced that it is worth pointing out that difficult ideas in poems are not always expressed in language that is also difficult; for example, William Blake in his *Songs of Innocence and of Experience* draws on language of almost child-like simplicity and yet his thought is sometimes profound and obscure (Prynne, 2010). This relates to LXIV in the part of the poem that talks about warts and weeds that gardeners hate (ll. 8-9). This is almost a childlike comparison that focuses on elements that are usually little likely to be associated with poems containing complex language. This device in a way could be seen as foregrounding as it enhances a certain part of the poem and overshadows what surrounds it. This section is therefore made more prominent as it differs from the rest. Prynne shows how difficulty in poems is not only created by complexity in language but by simple comparisons. This creates difficulty in Hill's poem as it complicates what readers perceived of the poet and makes them question what they already thought they knew about the characters present.

Overall, the real difficulty in poetry creates depth and true meaning that cannot be found in simple words alone. When a reader faces difficult poetry, it should be taken in their stride and be a mission to unwrap what is the core meaning to it.

Analysis

LXIV from *The Orchards of Syo*n by Geoffrey Hill contains many poetic devices all of which conspire to create an exquisite poem. I felt it was appropriate for me to choose this poem as it drew me in and the style of it connected with me.

One device used is caesura. This is when punctuation is used in the middle of a line; it is usually not seen in easier forms of poetry. LXIV contains caesura in many cases, one of which is in line 1 stating 'This is my shoelace. This is bobbled clover.' The full stop placed after the word 'shoelace' impacts on the way this line is read. I believe that this stresses the importance of the first line. This could be due to it being in first person, in contrast to most of the poem. The caesura emphasises this by making readers pause, leading them to think about what they have just read. The first section of this line is unusual; it draws the reader in and could confuse them. Caesura propounds this as it reflects the emotion created, helping the reader acknowledge a short voice. The use of caesura could almost be seen as supporting foregrounding due to the device helping the start boldly stand out from other lines.

Foregrounding is consistently used throughout the challenging poem and helps bring sections the poet thought were important into light and slightly shadow other parts. Lines 22-24 consist of foregrounding. The section 'I'll name / my own late fancies

Dream Children of not / - just for the shine of it - *Prospero's farewell*.' stood out, in my opinion, more than other sections; the use of names of other literary works connotes this. Foregrounding in this certain part is helped by the italic sections within it. This proposes the view of a modern day character throughout the poem and reinforces the narrative of the poem as well. Another way foregrounding is effective in the poem is by introducing an unfamiliar humorous tone that is not present in other sections, specifically the phrase 'just for the shine of it' has a mocking tone. This foregrounds the section that is important because the childish action of not caring is used, relating to previous line stating 'Here's a youngish man embarks on I / am an old man now.' This relation is created by the idea of aging, making the character seem carefree now that he is older. Also the use of a Biblical verse within this extract helps give a sense of the man's background allowing the reader to hypothesise the situation that is occurring in the narrative that is foregrounded.

Narrative within LXIV is not discretely hidden; it is in plain sight for the reader to notice. It is coached along by the use of characters. A man that is growing older, much to his disgust, advocates a narrative by creating a perspective that distances the character from the writer. The line 'the sad man breaking his stupent heart' continues this. The narrative is helped by the word 'stupent', meaning confused, allowing a story to be created and it implicitly suggests a background to the character, allowing readers familiarise with the poem as a whole. This perspective is also established when a first person view is used at the start and the end of the poem. Personal pronouns such as 'my' and 'own' encourage hypotheses about the relation between the characters. This can be interpreted as being a distant and unfamiliar relationship as the two first person sections are short and only show an on looking observation that never progresses to be any more intimate and can almost be seen as a stereotypical look on the character based on what the spectator grasps. This is suggested by the description of the man's personality not explained in much detail, implicitly or explicitly, during the poem, thus showing space between the existing individuals.

Hypothesis and testing

During my study of difficult poetry I have found that some challenging poems are harder than others. When I looked further into this I realised that there was one obvious point that made the poems easier to understand. Based on this point, I formulated my hypothesis that answers the research question I have been asking myself, what makes a poem difficult? The hypothesis I generated was that I believed that poems with a narrative were easier to understand than poems without one.

As my hypothesis needs to be tested, there is one way I consider to be more reliable compared to others. The method I would use would consist of twenty candidates that have no experience other than student GCSE level knowledge. The candidates would vary in age, allowing my results to be tested fairly as it uses a varied sample. I would then separate all candidates, forbidding them to talk to each other as the testing commences. This would then allow all participants to have an equal chance to interpret the poetry. They would then be faced with two different poems, one with a narrative thread, Hill's LXIV, and one without it. All candidates would be asked to read each poem and would be given a five minute time limit which they could use to gain a better understanding of the poem. After this time span, all twenty participants will be asked to rate the difficulty on a ten-point scale. This will then be repeated for a second time, with the other poem. When all the examinations have finished, the results would be collated and I would formulate an average. Hopefully, my results would support my hypothesis as I anticipated, showing a higher understanding of the poem with narrative than the one without. I believe that this outcome would be achieved because, based on my experience, I have found that a narrative often consists of characters that allow the reader to grasp their position and follow the poem as it seems more logically ordered.

When formulating my test, I would not use the thinking aloud method. This method is unreliable as it can lead to thought tangents and cannot always be followed when collating the results if the candidate did not have any interest with the test or was unable to understand the poem. It could lead to misinterpreted thoughts when assessing the data and would result in it being unfair.

Conclusion

Difficult poetry over years has become a phenomenon overlooked by many people. In spite of this, what truly makes poetry tricky is the beauty in it. Overall, complex language and obscure punctuation is the sole reason for a poem to be deemed as deceitful and complicated. Indeed, without throwing themselves into their language, it is hard for readers to see true meaning behind the unfamiliar words that are not easily translated. Throughout my essay, I have been able to study and decode challenging poetry to find how the style it is written in is incorporated into an implicit meaning. I have uncovered the real purpose of Geoffrey Hill's poem LXIV and found the normal man behind such elaborate language. After all, Hill is still a human that lives as we all do today, so there must be a meaning behind his poetry which is just waiting there for us to discover.

Bibliography

Bernstein, C. (2011). 'The Difficult Poem'. In Attack of the difficult poems. Chicago: University of Chicago Press, 1-6.
Chafe, W. (1991). 'Sources of Difficulty in the Processing of Written Language'. In Purves, C. Alan (ed.). The Idea of Difficulty in Literature. State University of New York, 7-22.
Hill, G. (2004). The Orchards of Syon. Washington D.C.: Counterpoint.
Prynne, J.H. 'Difficulties in the Translation of "Difficult" Poems'. Cambridge Literary Review, I/3 (Easter, 2010), 151–66.

About the authors

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PhD Tutor's note

While this year the overall quality of essays has been remarkably high, T's essay brings together rigour and enthusiasm in a way which is unmatched in the other essays. T. has insightfully written on a challenging poem by Geoffrey Hill, using a personal yet mature academic writing. There are several reasons to praise her achievement. First, she has begun with a topic sentence that is engaging for readers and relevant to the course; second, she has been able to detect a humorous tone in the poem that is far from obvious; third, she has discussed alternative ways of testing an hypothesis; fourth, she has independently found and accessed a valid bibliographical source that was not among those present in the handbook; and finally, she has arranged her ideas around one central and original argument: the relationship between linguistic difficulty and the integrity of the implied author behind it. What is more, her handling of technical terms is accurate and meaningful, and she has even made a remark on 'inanimate objects' in the poem that would fall under the remit of semantics, a specialised branch of linguistics.

TO WHAT EXTENT CAN FRANK O'HARA BE DESCRIBED AS A SPONTANEOUS POET?

N. Carr, supervised by R. Cran

Abstract

This essays explores the extent to which Frank O'Hara can be described as a spontaneous poet, suggesting that he combined a spontaneous response to a given situation with a more considered, structured response composed at a later moment, "in tranquillity". O'Hara, this essay argues, was more a spontaneous thinker than a spontaneous writer, recording snapshots of his thoughts or impressions in a spontaneous fashion, before writing a poetic review on that past course of events. Kenneth Koch remarked that "with O'Hara everything was an emergency because one's life had to be experienced and reflected on at the same time". In light of this, this essay shows that O'Hara's use of structure is what really allows the reader to openly comprehend the situation being memorialised, because they are left with such an unexplored torrent of emotion that they are made to piece together how the emotion was felt. The essay also explores O'Hara's performative nature in relation to the absence of punctuation in his poetry, as well as the significance of his social circle, and the wider socio-political context in which he was writing.

Essay

What is a spontaneous poet? Some believe that Frank O'Hara's uninhibited manner can be described as spontaneous, as he writes poems as he goes along, seemingly experiencing events and writing them about them then and there. His poems seem to be sparse; he doesn't go into much creative detail, but his brief description of scenery really paints a picture of his everyday life. He tends to write with no rhyme sequence and will capture one occurrence, writing about that subject in particular. O'Hara allows his lines to flow into the next as if he is casually writing down his day or explicit feelings, but can embed emotion within his writing. I will look at the context of where, when and how he wrote his poetry, investigating how he was able to write poetry without any previous planning by recording immediate snapshots of thoughts in a written abstract form, with little or no punctuation.

Before even looking at his poems, you can tell that the type of people he associated with greatly influenced his work. After the Korean War people were beginning to show more creativity again. The art of that time was changing and becoming more abstract, more modern. The friends he had were predominantly artists, not poets, so the desire to create something new was important. According to The Brilliant Club course booklet, abstract expressionist art was also a major influence, and the New York School Poets had strong artistic and personal relationships with artists such as Jackson Pollock and Willem De Kooning. O'Hara worked at the Museum of Modern Art, and took his inspiration from artists.[1]

His poetry could be considered ahead of its time, because it showed a minimalistic, simplistic approach towards creativity. He probably felt more at ease among his set of friends, because they were likeminded. As he was a homosexual, he may have had to hide who he truly was, even though it should have been easy to come to terms with it, but prejudice levels were higher in those times. He likely turned to poetry to express himself in a way that people would accept and be comfortable with. He really seems to enjoy mentioning his circle of friends in his poems, as if his career was simply a lot of witty irony shared amongst those he knew. As one critic has observed, "naming seems to have a special value for O'Hara, although O'Hara's poetry seems, at times, addressed to those who know or can recognise the names that are invoked".[2]

Within the first five lines of 'Poem (Lana Turner has Collapsed)', he manages to portray the varying perceptions of people, as he explains how "it started raining and snowing" and another person "said it was hailing"; this presents two points of view of how other peoples perspectives of what they witnessed varied, and even in a simple tale of one's day, can give a wider perspective after setting the scene. This also helps the conversational tone he shows when reading out his poems. His poems are described with the phrase 'I do this, I do that', to categorise his poetic 'flow' and how he can often tell a story as if he is having a conversation with you face-to-face, as in 'Naphtha', for example:

Ah Jean Dubuffet
when you think of him
doing his military service in the Eiffel Tower
as a meteorologist
in 1922
you know how wonderful the 20th Century
can be

The lack of punctuation after each line conveys the message that his poems are better to be enjoyed when read aloud; when he speaks his poems, you get an idea of where the punctuation may have been.

But how can a spontaneous poet use such developed techniques in a poem written right on the spot? Poems such as 'The Day Lady Died' – an elegy for the singer Billie Holiday – give the impression that his writing is not completely spontaneous, because the structure of these poems seems too thought through to have been written on the spot. The fact that his poems flow like a story helps him successfully portray his reaction to grief in his poem 'The Day Lady Died'. When he portrays his level of grief, every little thing is described intricately to resemble great significance, which gives you an insight into the raw emotion felt when in mourning because of his hyper-focus and attentiveness to every little aspect of his day. This is encapsulated by the lines:

it is 1959 and I go get a shoeshine
because I will get off the 4:19 in Easthampton
at 7:15 and then go straight to dinner
and I don't know the people who will feed me.

The poem and it's acknowledgement of routine also shows the way that the city shapes him as a person – this smoking, drinking ("and ask for a bottle of Strega"), wealthy city boy, this witty New Yorker, who clearly thrives within his home city. It is as if you are looking through his wallet, because you can gather from his poems that he is substantially wealthy and popular, and that he is free and there is far less for him to care about than the isolated, oppressed, tortured person he is mourning the loss of. His home environment has clearly helped him become a respected figure of the art culture that surrounds him, as shown by the use of references such as "NEW WORLD WRITING", "stroll into the PARK LANE liquor store" and "go back where I came from to 6th avenue". In 'The Day Lady Died', O'Hara's inability to state the name of the person he grieves for, Billie Holiday, shows that his freedom is juxtaposed with her isolation; before her death, she was practically tortured, simply because of the prejudice shown towards her gender and race. It is almost as if she is absent in the poem solely dedicated to her. Furthermore, Frank O'Hara may even have felt a connection with her situation, because his homosexuality was

likely a reason some found to discriminate against him, so he might have known what it was like to have intolerance shown towards him.

I think that O'Hara is a spontaneous thinker, as he sets a scene that must have been written in retrospect, but also partially written at the time he recollects it. In poems such as 'Poem (Lana Turner Has Collapsed)' and 'The Day Lady Died', he portrays the fact that he is reflecting back on a previous event, when he states his normal everyday routine and lets this flow into the sudden alarming occurrence that befalls him. It is him remembering what has happened, not something happening now, in the moment, and him writing it there and then. In 'Lana Turner Has Collapsed', his description of the weather gives us the impression that he was looking back on a past experience, as he has had the time to ask someone else what the weather was like.

But is he a spontaneous thinker, or a spontaneous writer? I think that, perhaps, it is the poetic thoughts that are spontaneous and not the writing itself, and that the obvious reflection is his actual poetic writing. Even though his ideas may come to him spontaneously, in the end he still writes them as something of a poetic review on that past course of events, embodying his friend Kenneth Koch's view of his approach to life: "with O'Hara everything was an emergency because one's life had to be experienced and reflected on at the same time".[3]

In his preface to the *Lyrical Ballads,* Romantic poet William Wordsworth said that "poetry is the spontaneous overflow of powerful feelings: it takes its origin from emotion recollected in tranquillity".[4] This can relate to Frank O'Hara's poetry, because more effort is put into the recollection of the event, than the experience during the actual event.[5] "Recollected in tranquillity" may mean that someone is reminiscing, focusing on the intense emotions felt during that event, but in a calm, average environment, later on. Shawn Rider argues that "the 'spontaneous overflow of powerful feelings' leaves an individual incapable of articulating the true nature and beauty of the event", which I think means that without romanticising, without going into any detailed information, the poet's use of structure is what really allows the reader to openly comprehend how they would see the situation, because they are left with such an unexplored torrent of emotion that they are made to piece together how the emotion was felt.

Frank O'Hara is spontaneous to the extent that his thoughts are spontaneous, so his immediate response is to write. The event or incident he is writing about may be a recollection, not something that is unfolding in front of him. His poems were often written on scraps of paper. According to John Ashbery, he was dashing the poems off at odd moments—in his office at The Museum of Modern Art, in the street at lunch time or even in a room full of people—he would then put them away in drawers and cartons and half forget them.[6]

It was as if he had a compelling level of spontaneity, which made him immediately want to write about the event. In contrast, someone who is not a spontaneous poet would plan carefully on how they would structure and approach the subject. It seems O'Hara's spontaneity is naturally triggered and no matter what environment he is in, he can write a poem, whereas someone lacking spontaneity would need a specific environment where their creativity could thrive and they could effortlessly express it. His writing is spontaneous in the way that it is practically jotted down. This may be why there is a lack of punctuation in his writing, because you can add punctuation where you want to when you are reading it out. Although, as I mentioned in my first paragraph, there may seem to be no sequence in his writing, he is seemingly capturing a snapshot of his thoughts, a recollection of something in the past, which he is stating here and now. His poems often revolve around different emotion-evoking events, which are brought to life by the atmosphere he observes and implants into his work.

His biography at poetryfoundation.org notes that "he devised an idea of poetic form that allowed the inclusion of many kinds of events, including everyday conversations and notes about New York advertising signs".[7] The more I explore the structure of Frank O'Hara's poems, the clearer it becomes that his spontaneity gives his poetry the impact that distinguishes him from other poets of the 1960s.

Bibliography

1 Rona Cran, "'everything continues to be possible': the poetry of Frank O'Hara" (The Brilliant Club, 2015), 11.
2 Frank O'Hara American Literature Analysis, 2006 (http://www.enotes.com/topics/frank-ohara/critical-essays) [Accessed April 2015].
3 Kenneth Koch, quoted in Homage to Frank O'Hara, ed. Berkson and LeSueur (Bolinas: Big Sky, 1978), 206-7.
4 William Wordsworth, 'Preface' to Lyrical Ballads (London: Longman, 1805),
5 Shawn Rider, 'Wordsworth and Coleridge: Emotion, Imagination and Complexity', http://www.wdog.com/rider/writings/wordsworth_and_coleridge.htm [Accessed April 2015].
6 John Ashbery, introduction to The Collected Poems of Frank O'Hara, ed. Donald Allen (University of California Press, 1995).
7 'Frank O'Hara', http://www.poetryfoundation.org/bio/frank-ohara [accessed April 2015].

Ashbery, John. Introduction to The Collected Poems of Frank O'Hara, ed. Donald Allen (University of California Press, 1995).
Cran, Rona. "everything continues to be possible': the poetry of Frank O'Hara" (The Brilliant Club, 2015).
Frank O'Hara American Literature Analysis, 2006 (http://www.enotes.com/topics/frank-ohara/critical-essays) [Accessed April 2015].
'Frank O'Hara', http://www.poetryfoundation.org/bio/frank-ohara [accessed April 2015].
Koch, Kenneth. Quoted in Homage to Frank O'Hara, ed. Berkson and LeSueur (Bolinas: Big Sky, 1978).
O'Hara, Frank. The Collected Poems of Frank O'Hara, ed. Donald Allen (University of California Press, 1995).
Rider, Shawn. 'Wordsworth and Coleridge: Emotion, Imagination and Complexity', http://www.wdog.com/rider/writings/wordsworth_and_coleridge.htm [Accessed April 2015].
Wordsworth, William. 'Preface' to Lyrical Ballads (London: Longman, 1805).

About the authors

N. Carr is a Year 9 student at Forest Gate Community School. R. Cran completed her PhD at University College London, focussing on collage in twentieth-century art, literature, and culture.

PhD Tutor's note

I nominated this essay for publication in *The Scholar* for a number of reasons. It is detailed, full of personal insight and original thought, and shows genuine engagement with the poetry and with the context in which O'Hara wrote. The author's understanding of O'Hara's work is thorough and her response insightful – her realisation that O'Hara is simultaneously a spontaneous poet and a reflective one is outstanding. The essay demonstrates original research, and effectively uses a range of external sources and wider reading to support the ideas raised and to draw out the arguments made. The analysis is thoughtful and appreciative of the importance of structure and linguistic choices to shape meaning and navigate emotion through poetry. As a whole the essay is well-structured, focussed throughout, and answers the question in ambitious, varied, and coherent prose. Best of all, it was a sheer pleasure to read.

FEDERAL INTERVENTION AND NOT CIVIL RIGHTS PROTEST BROUGHT ABOUT THE CIVIL RIGHTS REVOLUTION. DISCUSS.

A. Collins Frisby supervised by E. Folwell

This paper explores key events of the Civil Rights movement, including the integration of Little Rock Central High School in September 1957, the Freedom Rides of 1961 and Mississippi's 1964 Freedom Summer and suggests that civil rights protest was more important than federal intervention in bringing about the Civil Rights Revolution. The paper opens by contextualising the Civil Rights movement, providing a brief overview of life under Jim Crow. Through in-depth analysis of three case studies, the results of the non-violent direct action protest of civil rights activists and the actions of the federal government are explored. This analysis highlights the significant but complex and often contradictory result of federal intervention. Too often, the actions of Presidents and federal officials resulted in a backlash from white Southerners opposed to racial change. The paper draws on a range of primary sources, including the diaries and memoirs of activists, files of the Federal Bureau of Investigation and Presidential addresses to conclude that civil rights protest was more important in bringing about the Civil Rights revolution.

After more than a decade of civil rights protest, President Lyndon B. Johnson passed the historic Civil and Voting Rights Acts in 1964 and 1965, guaranteeing the rights of all Americans, black and white. This essay will show that direct action protest brought about more racial change than federal intervention. Direct action protest brought about more racial change because it actually confronted the racist views of others and showed the determination to gain equality. However, in this essay, I will also show that federal intervention played a part in bringing about racial change, such as guards being issued on several occasions to protect protesters from the violence they faced. The three case studies which this essay will explore are the Little Rock Crisis in 1957, the Freedom Rides in 1961 and the Freedom summer which took place in 1964. In the case of the Little Rock crisis, it was the perseverance of the students that showed the white American citizens they would not give in. However, there was federal intervention in the form of troops protecting students that helped this instance. The courage of the Freedom Riders and their determination to carry on their protest – despite facing horrific violence –pressured the government and finally resulted in federal intervention and produced racial change. Finally, during Freedom Summer, the sacrifice of the lives of three civil rights activists brought much attention to the civil rights movement, significantly helping with the cause.

Nearly one hundred years after the Emancipation Proclamation that abolished slavery was issued by President Abraham Lincoln, there remained inequality and an obvious divide between races. During the following years in Southern states, freed slaves suffered in an unequal world and faced violence, segregation and oppression. "Jim Crow" law kept them separated from white Americans barring them from facilities such as restaurants, public restrooms and theatres. Black Americans often faced mobs and lynching, illustrated in the protest song *Strange Fruit* by Billie Holiday. *Strange Fruit* illustrates the brutality and inequality that black Americans faced. It shows how black people are treated inferior in the South by being hung and lynched. This is shown in the lyric "southern trees bear strange fruit", in which black people are the "strange fruit". The singer of the song, Billie Holiday, captures the horrific scenes of violence towards the black Americans. One example of this is the line *"the bulging eyes and twisted mouth"*, showing the strong imagery of these acts. African Americans were deprived of privileges that white Americans had and they faced horrific abuse in society. They were treated as inferior just because of their skin colour. This is why the civil rights movement was needed.

During the continuing segregation of black and white Americans, the US Supreme Court issued the historic *Brown vs Board* ruling in 1954, which called for desegregation of all schools throughout the nation. Following this, nine black students applied for a previously all white school in Little Rock (the capital city of Arkansas), causing the Little Rock Central High School integration crisis. Riots and protests broke out following their acceptance into the school and the nine students faced a battle every day to receive their education.

An extract from *Warriors Don't Cry* by Melba Patillo Beals, one of the Little Rock Nine shows how she faced much difficulty while attempting to get her education. Beals says "the two of us narrowly escaped a rope- carrying lynch mob of men and women shouting that they'd rather kill us than see me go to school with their children", showing how strongly white Americans felt about black Americans receiving equal education. Despite the segregation within schools being ruled as unconstitutional, people still continued to discriminate. This made it harder for black Americans to have a say but still it could be seen as a step forward in the civil rights movement. Beals' recollections provide an insight into one of the student's view of the crisis and how she felt about the protests. Furthermore, it shows how African Americans in the Deep South were still treated as inferior as they were prevented from entering the previously all-white schools. Beals demonstrates the day to day struggle the students felt and even though they were allowed into the school they were still not treated the same as the white students. The actions taken by the students attending the school did bring about racial change, to an extent. Even though there was an achievement in allowing black students into white schools, there were still widespread protests about the issue. The students were still presented with many difficulties when at the school and many people's view on the discrimination of black citizens did not change.

A statement by President Dwight Eisenhower, on 21 September 1957, shows the President supporting the desegregation of schools and asking people to support this decision: "all parents must have a sympathetic understanding of the ordeal to which the nine Negro children who have been prevented from attending Central High School". Eisenhower is in favour of allowing the black children into the high school and asks the parents of the white children to support this view as well and to treat them with respect. At this time, this would be completely against the norm in the South, as for many years black Americans were discriminated against. Eisenhower presents black people in a completely different way to previous media representation of black people when he referred to the "dignity and… restraint" with which the Little Rock Nine and their parents conducted themselves. From other sources such as the character of Jim Crow, we can see that black Americans have been presented as crude and monstrous, whereas the President illustrates black people as collected citizens who are attempting to lead normal lives. Eisenhower did not do enough to support racial change and was not very positive towards it, leaving it too late to take any action; especially to prevent the protests. The President did not bring about racial change, as he was not too enthusiastic about supporting the Supreme Court ruling, and did not take any action before the Little Rock crisis. Despite this he sent the 101st Airborne to accompany the Little Rock Nine into the school, helping them get through the infuriated mobs. Even though federal intervention helped the students get into school, they could not protect the black students from bullying and discrimination and could not change the white students' minds on integrating their school.

Overall, in the case of the Little Rock Nine, non-direct action protest brought about more racial change. This is because the students stood up for their rights against any that opposed them and showed their determination to go to school, as shown in the extract from Melba Patillo Beals. Even though there was some federal intervention – in the form of the 101st airborne sent by President Eisenhower – it was not enough to stop the students from being subjected to discrimination. The students showed the citizens of Little Rock (and the South of America) that they were not going to give in, whereas the President did not do enough to ensure the safety of the students and support the desegregation.

Many in the Deep South were opposed to integrated transportation, and attempted to stop any black Americans travelling with white Americans. Despite a 1946 Supreme Court ruling in the case of *Morgan vs Virginia* that outlawed segregation on interstate bus travel, the states of the Deep South continued to enforce local segregation laws. In May 1961, a group of thirteen black and white civil rights activists launched the Freedom Rides, which were bus rides through the Deep South to protest the segregation of interstate buses and terminals. The riders set off from Washington DC with the goal of reaching New Orleans in Louisiana. During their rides, they were met with violent mobs and riots. However, this also gave more recognition towards their cause due to the coverage throughout the media.

In Alabama, the Freedom Riders were met with intense violence. Images of the aftermath of the violence show how protestors were badly wounded after facing mobs. This shows one danger of the rides was that the people who was against racial change – seeing black Americans as inferior – would attempt to stop the Freedom Riders, resulting in them being wounded and maimed. African Americans were still being met with violence despite their legal right to travel this way. This shows how the views of many white Americans about segregation, particularly in the Deep South, had not changed or little progress had been made in racial change as they were still being opposed by other Americans. The benefit of the rides was the recognition in the media, promoting the acts to the public and showing that the government was not helping racial change by not protecting the activists. President Kennedy was seen negatively due to the violence shown on the news and in the media. In desperation he made a deal with the governors of Alabama and Mississippi, resulting in the arrests of the activists illegally and out of the sight of the public. This made people question President Kennedy's contribution to racial change after finding out about the arrests; provoking him and the government to intervene. Even though the protestors ignored Attorney General Robert Kennedy's call for a cooling off period, President Kennedy was impelled to give the Freedom Riders more protection. As a consequence, Robert Kennedy's deal with Mississippi Governor Ross Barnett ensured protection for the activists from violence, but instead they faced arrest and imprisonment in incredibly poor conditions in Mississippi's Parchman Penitentiary prison. However, this was very beneficial as the media were portraying the activists as victims, potentially helping to change people's views on racial equality and to support the freedom rides. Many more people joined the freedom riders' cause as they saw the violence.

An account of life in Parchman Penitentiary, Mississippi by John Lewis shows what the freedom riders had to go through. In the account, he says "so all of us-seventy-five guys, black and white, because during that period you had students, professors, ministers coming in from all parts of the country to continue the Freedom Ride.[19]" Showing that despite the punishment of prison, people were still supporting and joining the freedom rides to stand up for racial change. This is a great benefit of the freedom rides because it promoted the cause to everyone, encouraging people to participate in the solidarity of the movement. The more people who joined in, the more people felt comfortable stepping up. The growing number of people in the freedom rides gave those who supported it but were afraid of the consequences, the courage to participate. The Freedom Riders continued to protest despite major setbacks – they did not just give in. However, despite the growing number of supporters, there were many who still opposed them. Furthermore, the Freedom Riders who continued to join the cause were put in prison too. Lewis' account provides first hand evidence of how the protestors continued to protest even while in prison, undeterred by the punishments it

may bring. This is shown by the protest songs sung by the imprisoned Freedom Riders, such as 'We Shall Overcome.' It demonstrated the power of nonviolent direct action to achieve racial change, even able to remain nonviolent when their lives were in danger. These songs demonstrate the will power the freedom riders had and the desperation to complete the journey to show the strength of the civil rights movement.

Overall, the freedom rides were very beneficial in producing racial change, despite the dangers faced by the activists. In response to the freedom rides, the Interstate Commerce Commission (ICC) – a federal agency – banned segregation on Interstate travel which also covered facilities too. The struggle to end segregation on interstate travel was long. Three years after that first freedom ride, the Civil Rights Act of 1964 was passed, outlawing segregation in public facilities in all states of America. The Freedom Riders contributed to this outcome as they demonstrated the resistance and determination of the people fighting for racial change and helped to encourage more people to support the civil rights movement.

Freedom summer was a campaign launched in Mississippi in June 1964, attempting to register as many African-American voters as possible. In Mississippi, most black Americans were excluded from voting: at the start of Freedom Summer, only 6.7% of African Americans in Mississippi were registered to vote. The Freedom Summer volunteers faced constant abuse from Mississippi's white population. These violent attacks included beatings, arson, false arrest and the murder of at least three civil rights activists from the Ku Klux Klan, police and even state and local authorities. Direct action protest brought about more racial change than federal intervention during Freedom Summer because the protesters demonstrated to the people of South America the persistence of the civil rights movement and illustrated the powerful emotions behind it.

The diary of Freedom Summer volunteer Jinny Glass demonstrates the determination of the civil rights activists who took part in freedom summer and the growing strength of the civil rights movement. Glass describes the journey she takes to go to Mississippi to join in with the event of the Freedom Summer: "They all realise that at any minute some cracker could drop a bomb in the window and that would be it. But they sing 'We shall overcome' and other freedom songs". This represents the strength of the activists and the bravery they face the situation with. Glass portrays the activists as heroic and admirable. It shows her belief that the civil rights activists would bring about meaningful racial change. This is a contrast to the opinions of the artist Nina Simone in the song *Mississippi Goddam* where it is implied that she feels little progress is being made for racial change. However, the most significant aspect of Freedom Summer was not explicitly mentioned by Glass in her diary or acknowledged by Nina Simone. It was, in fact, the very act of white northern college students helping back southerners that ensured Freedom Summer gained national attention and recognition. The impact of the white students travelling from the north was big. Hundreds of reporters came to Mississippi in order to get coverage of the campaigners and their goal. This meant that many people saw the non-violent campaign in the media. Campaigning to register black Americans to vote was a big step forward for racial change because their vote gave them the chance to have a say. By seeing white young Americans helping black Americans it shows that the future generation is supporting racial change, which implies a better future. However, the campaigning of the white students was not very successful. This is because approximately 17,000 residents applied but only 1,600 of the completed applications were accepted. This shows that despite the amount of supporters and recognition, they still were not able to get many registered to vote. This shows the suppressed voices of the black Americans. However, there were some positive results of Freedom Summer, as the volunteers were able to get some of the residents registered to vote.

During freedom summer, three civil rights activists went missing, later to be revealed that they were murdered. The Mississippi burning FBI case files show how at 10:30 pm on 21 June, Chaney, Goodman and Schwerner were released and drove off in the direction of Meridian in a blue station wagon. By pre-arranged plan,

KKK members followed. The activists were never seen again. This shows that even the police were intolerant of black Americans. It also indicates the severity of the violence the civil rights activists faced; just by peacefully protesting they were murdered. It shows the danger of taking part or supporting protests. The murders captured the attention of the country and really highlighted the brutality of such acts, emphasizing the need for racial change. Many Americans were captivated by the horrific details of the murders, as the search for the bodies and the culprits continued. Americans all over the country were shocked by the killing of civil rights workers and the brutality they witnessed on their televisions. Freedom Summer "raised the consciousness of millions of people to the plight of African-Americans and the need for change". The murders of the three men outlined to the country the reality of racial discrimination. The impacts of these murders were huge as it enforced the need for more to be done to protect the rights of black Americans. However, none of the accused was sentenced for murder. Following years of court battles, seven of the 18 defendants were found guilty – including Deputy Sheriff Price – but none on murder charges. One major conspirator, Edgar Ray Killan, went free after a lone juror could not bring himself to convict a Baptist preacher. This shows the frailty of the law that one person can refuse to convict someone based on their religion – despite the wrong they have done. It also shows the lack of justice for the murdered protesters as none of the defendants were charged with murder and they had to find a way around it in order to convict them. The murders of the civil rights activists did help to bring about racial change as it brought the extremity of the situation to the attention of the public. The murders "galvanised the nation and provided impetus for the passage of the landmark Civil Rights Act of 1964 on July 2" which shows how the murders were beneficial to the civil rights movement even at the cost of three lives. Freedom summer really captivated most of the country and brought to light the need for equality.

In this essay, I have argued that civil rights protest produced more racial change than federal intervention and therefore was more important. Through exploring three case studies I have shown that while federal intervention was important, it did not have the same impact as civil rights protest. Civil rights protest was more effective because it showed more emotion and perseverance, illustrating the need for change. As well, it produced more recognition and response, like the case of the freedom summer, than federal intervention. However, in the case of the Little Rock Crisis federal intervention, in the statement by President Dwight D. Eisenhower, caused anger in the white Americans. During the Freedom Rides, it was the strength and passion of the riders that helped bring about racial change. This can be seen by the persistence of the freedom riders and how they carried on despite being badly hurt. On the other hand, even though they had protection from state law enforcement, they were wrongly arrested in Jackson, Mississippi. This shows that federal intervention was not implemented for the whole journey and left the Freedom Riders defenceless. In the case of Freedom Summer, it was the voices of the protesters that helped to bring about racial change, as seen in the diary of Jinny Glass. As well as this it was the sacrifice of the three activists that brought much needed attention to the cause. Freedom summer saw little federal intervention that brought about racial change despite the help of police investigators to try and get justice for the murdered men. In the instance of the Little Rock Crisis, it was the persistence of the students and their determination to receive their education that helped bring about racial change. Despite the students receiving protection from troops, the President did not do enough to support the movement and protect the students while they were within the school. Overall, throughout the essay, the three case studies show that direct action protest had a greater impact and helped to bring about racial change more than federal intervention.

Bibliography

'Jim Crow Laws', Martin Luther King Jr.: National Historic Site, http://www.nps.gov/malu/learn/education/jim_crow_laws.htm (accessed 29 March 2015)

Holiday, B., Strange Fruit, (1939)

Patillo Beals, M., Warriors Don't Cry: A Searing Memoir of the Battle to Desegregate little Rock's Central High School, (New York: 1994), p.2

'Eisenhower on Little Rock', The National Archives, www.nationalarchives.gov.uk/education/resources/civil-rights-in-america/eisenhower-little-rock (accessed 29 March 2015)

'Who is Jim Crow', Ferris State University, http://www.ferris.edu/jimcrow/who.htm (accessed 29 March 2015)

'This Week in Peace History', http://www.jazzforpeace.org/makinghistory.html (accessed 4 April 2015)

'Armed troops escort African American students from Central High School in Little Rock, Arkansas', 1957, Library of Congress, http://www.loc.gov/pictures/item/00651647/ (accessed 6 April 2015)

'Morgan v. Virginia', 1946, PBS, http://www.pbs.org/wnet/jimcrow/stories_events_morgan.html, (accessed 26 March 2015)

'Arrests in Jackson, Mississippi', Civil Rights Veterans, www.crmvet.org/tim/timhis61.htm#-1961frides (accessed 28 March 2015)

'Freedom Ride', History Learning Site, www.historylearningsite.co.uk/freedom_ride.htm, (accessed 28 March 2015)

'New York Rider Relates Harrowing Tale of Life in Maximum Security', Jackson Daily News, 21 June 1961, http://www.1960sailors.net/ShilmanArticle1961.gif, (accessed 28 March 2015)

Smith Holmes, M., 'The Freedom Riders: Then and Now', Smithsonian Magazine, February 2009, http://www.smithsonianmag.com/history/the-freedom-riders-then-and-now-45351758/?no-ist, (accessed 28 March 2015)

Lind, D., 'Rep. John Lewis on the time he was sent to prison for using a 'white' restroom', 7 July 2014, http://www.vox.com/2014/7/7/5877957/rep-john-lewis-memories-of-a-mississippi-prison-during-the-freedom, (accessed 28 March 2015)

Seeger, P., We Shall Overcome, (1960)

'Freedom Summer campaign for African American voting rights in Mississippi 1964', Global Nonviolent Action Database, http://nvdatabase.swarthmore.edu/content/freedom-summer-campaign-african-american-voting-rights-mississippi-1964 (accessed 29 March 2015)

Simone, N., Mississippi Goddam, (1964)

'Freedom Summer', CORE-Online, www.core-online.org/History/freedom_summer.htm (accessed 29 March 2015)

'Freedom Summer (1964)', Martin Luther King Jr., Encyclopaedia, Stanford University, http://mlk-kpp01.stanford.edu/index.php/encyclopedia/encyclopedia/enc_freedom_summer_1964/ (accessed 29 March 2015)

Freedom Summer articles, http://articles.philly.com/keyword/freedom-summer, (accessed 29 March 2015)

'What was the 1964 Freedom Summer Project?', Wisconsin Historical Society, http://www.wisconsinhistory.org/Content.aspx?dsNav=N:4294963828-4294963805&dsRecordDetails=R:CS3707, (accessed 4 April 2015)

Spears, E., 'Memorializing the Freedom Riders', Southern Spaces, 29 June 2009, http://southernspaces.org/2009/memorializing-freedom-riders, (accessed 4 April 2015)

Eyes on the Prize Map, PBS, http://www.pbs.org/wgbh/amexeyesontheprize/story/05riders.html, (accessed 4 April 2015)

'22 September 1961: Interstate Commerce Commission Bans Segregation in Interstate Travel Facilities', Today in Civil Liberties History, http://todayinclh.com/?event=icc-bans-segregation-in-interstate-travel-facilities, (accessed 28 March 2015)

Glass, J., 'Mississippi Diary: 7-25 August 1964', University of Southern Mississippi: Civil Rights in Mississippi Digital Archive, http://digilib.usm.edu/cdm/ref/collection/manu/id/8523, (accessed 29 March 2015)

'A Byte out of History: Mississippi Burning', 26 February 2007, FBI, http://www.fbi.gov/news/stories/2007/february/milburn_022607, (accessed 29 March 2015)

Daniels, P., '"Strange Fruit": the story of the song', 8 February 2002, World Socialist Website, https://www.wsws.org/en/articles/2002/02/frut-f08.html (accessed 29 March 2015)

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A. is a Year 10 pupil at Cannock Chase High School. Dr. Emma Folwell completed her PhD at the University of Leicester in 2014. Her research explores the War on Poverty, white opposition to the Civil Rights Movement and the rise of new conservatism in Mississippi between 1965 and 1972.

PhD Tutor's note

A.'s work is of an outstanding quality. The essay is a joy to read. It displays an excellent level of understanding of some complex issues and events, which are sensitively described in a fluid and engaging style. One of the most impressive aspects of the essay is the sheer amount of work A. has put in, shown in the quantity and quality of independent research. A. has found some really interesting primary sources and provides thoughtful analysis of these sources, weaving this analysis with a well-constructed and fascinating narrative. The depth and sophistication of the analysis of the consequences of direct action protest and federal intervention A. provides is exceptional, supporting a nuanced and sustained argument. Our Brilliant Club tutorials were the first time most of the students at Cannock Chase High School had engaged with the Civil Rights Movement or US history. Their great enthusiasm for and interest in American history and the movement made our tutorials really dynamic and enjoyable, so many thanks to all of them!

TITUS ANDRONICUS: A PLAY FOR THE 21ST CENTURY?

D. Bodur, supervised by G. Miller

Abstract

This essay seeks to establish whether Shakespeare's *Titus Andronicus* has any relevance for a 21st century audience. Through a detailed analysis of the way in which the play dramatizes race relations, gender inequalities, violence, war and social disintegration, it will conclude that there are more similarities than might be expected between the society depicted in Shakespeare's most gruesome and bloody Roman revenge tragedy and Britain in 2015. Drawing analogies between the treatment of marginalized characters such as Aaron and Lavinia and modern instances of race hate crimes and honour killings, this essay interrogates how far society has progressed in the past 450 years.

It has been four hundred years since William Shakespeare penned his last play, yet he is still one of the most iconic and revered dramatists and his plays form part of the national curriculum in 65% of countries across the globe. The language he uses is rich, the characters are multi-faceted and many of his themes - love, treachery, honour, bravery and political intrigue - still resonate today. The play, *Titus Andronicus*, is somewhat relevant to today's society, for in this day and age we face many similar hardships. The play covers several significant themes which include race and religion, attitudes towards women and revenge, conflict and violence. Exploring these themes will help us gain a better understanding of the play and will also help us decide whether *Titus Andronicus* is a play for the 21st century.

In *Titus Andronicus,* the related themes of race and religion are central to the dramatic action. Shakespeare clearly makes a contrast between which characters are seen as villains, and those who are not. It is clear to see that anyone who is not white European is seen as evil. Act 4 Scene 2 is filled with many racial slurs towards an innocent mixed-raced child. When the nurse presents Aaron and Tamora's love child she declares it a "devil" (4.2.66). This shows the mercilessness of the Romans as they discriminate against a baby because of his race. Aaron is also always addressed as "Aaron the Moor", which shows that he is only labelled by his colour. In the play he also faces derogatory racial slurs, being called "irreligious" (5.3.120) and "barbarous" (5.1.98). The idea that Aaron the Moor "believest no god" (5.1.71) gives more reason for the Romans to discriminate against him. He, unlike them, is not a Christian. Moreover at the end of the play Marcus holds up the baby to the crowd for them to witness Aaron and Tamora's sinful acts as he is the mixed-race product of their adulterous affair. Marcus holds the child like he is a petty object, not worthy of being treated like a human being. As Pamela Mason explains, in the Elizabethan period "the colour black was associated with the demonic".[1] Shakespeare portrays Aaron as evil incarnate and we are left to infer that Aaron is the devil's advocate or even the devil himself.

Throughout all of Shakespeare's plays Aaron can be seen to be one of the most enigmatic characters penned. Relating him to modern day society, it is evident that the seeds of racism and white supremacy still remain. For instance, organisations like the Ku Klux Klan kill people, torture people, kill minorities and create fear and paranoia due to their race. In addition to this Aaron can also be compared to Shakespeare's Richard III because, although he is responsible for vile acts, he is also charismatic and witty. For an audience this can be extremely seductive. Aaron's witty behaviour is shown through his puns, for instance when he is addressed as "Aaron the Moor" he reacts with the humorous quip "more or less" (4.2.54). This is particularly timely because on the 26th of March, Richard III

was finally buried at Leicester Cathedral, which may lead people to reevaluate Richard as a historical figure and Shakespeare's interpretation of him. Aaron, like Richard III, is presented as a leader and dominator. For example when Chiron and Demetrius declare that the baby must be killed, Aaron convinces them that they are of the same blood and "brother by the surer side" (4.2.128). This results in Chiron and Demetrius showing mercy upon the child and sparing its life - even though it is black. However, as Pamela Mason suggests, "Shakespeare complicates an audience's evaluation by giving Aaron a parental role" (p. 71). Richard III, on the other hand, orders the murder of children. The role of Aaron and the related themes of race and power continue to have relevance for a 21st century audience. However, although there are still examples of discrimination, the fact that Obama, who is mixed-race, has been elected as president of the United States of America shows us how far we have progressed since the Elizabethan Era.

Titus Andronicus presents a society with misogynistic attitudes towards women. Shakespeare constructs the two contrasting characters Lavinia and Tamora to show how Rome was a patriarchal society. In the play, Tamora fills a role that was considered to be unacceptable: a passion-driven female villain. The character Tamora threatens the pre-eminence of the male characters. Lavinia also threatens patriarchal power when she disobeys her father and refuses to marry Saturninus. In spite of Titus's orders, her brothers believe that she should be able to marry whomever she chooses and help their sister elope with Bassianus. As a result, Mutius is killed by his father. Lavinia's disobedience towards her father has dire consequences. However, even after marrying Bassianus, she is still treated like a belonging, and is now just Bassianus's wife. In Act 2 Scene 3, when Marcus asks Lavinia, "Where is your husband?" (2.3.12), the word "your" suggests that she belongs to him, like asking a slave "where is your master?". Later in the play Lavinia is completely deprived of her speech when she is brutally raped and her tongue cut out and hands cut off. Lavinia is silenced, both literally and metaphorically, reflecting the position and power of women during not only the Roman setting of the play, but also the Elizabethan Era in which it was written. The enactment of her rape shows the vulnerability of women. They are only seen as sex objects, reduced simply to their bodies.

Until 1928 women did not have the same rights as men did to vote. However, change rarely comes without a price, an organisation called the Suffragists was founded in 1897 and was led by Millicent Fawcett and the Suffragettes in 1903. Whereas the organisation Suffragettes protested violently by smashing windows and chaining themselves to railings, the Suffragists were a non-violent group who wrote letters. In 1928 Emily Davison was killed by the king's horse while trying to protest. Nevertheless does this mean that in order to get noticed one must be killed? For example in *Titus Andronicus*, Lavinia is not noticed until she is brutally raped and still then Marcus's soliloquy is the centre of attention.

Tamora differs from Lavinia for as Lavinia becomes more powerless, Tamora goes from helpless prisoner to the most powerful woman in Rome -as empress. When we first meet Tamora, she is automatically portrayed as a villain for she is a Goth. However, the audience sympathises with her as she wants to take revenge on Titus for killing her son. Unlike Lavinia, Tamora uses her sexuality and manipulative behaviour to seduce the new emperor, Saturninus, and declares "If Saturnine advance the queen of Goths, / She will a handmaid be to his

desires" (1.1.336). Here Tamora uses seduction in order to become empress, showing us that she is willing to do anything to gain power to carry out her revenge against Titus. However, after this we lose any sympathy we had for Tamora when she orders her sons to rape Lavinia. This brutality towards another woman complicates an audience's response to Tamora. Why would a women afflict something upon another woman knowing how it feels to be helpless? Within the play Tamora has brought Rome by not only cheating on her husband, the emperor, but by cheating with a black man and by giving birth to his baby. The nurse declares that she has brought "shame" (4.2.61) to Rome and Tamora orders the baby to be killed, showing that she is as ruthless and as barbarous as the Romans. Attitudes expressed towards Tamora and Aaron's relationship can be compared to Othello and Desdemona's interracial relationship in Shakespeare's *Othello*. Othello is blamed for practising "witchcraft" (1.3.65) by Desdemona's father, Brabantio, who refuses to believe that anyone would fall in love with a Moor willingly. The interconnection of power and race is also a common element in these two plays. However, in *Othello*, Iago uses the powers of rhetoric to fuel Othello's jealousy, whereas in *Titus Andronicus*, power is a political tool.

Lavinia happens to become a victim of Tamora's plan for revenge. However, by facilitating the rape and mutilation of Lavinia, Tamora creates the motivation for Titus's counter-revenge upon Tamora. Both Tamora and Lavinia can be seen in many modern day women; Tamora as an independent and passion driven female and Lavinia as a victim. During the final scenes of *Titus Andronicus*, all the women are dead and we are left with a society without women. Could this end in disorder and destruction? Is Shakespeare trying to show us that a society without women would be revenged upon itself? Though it may be ideal at the time, there are always consequences.

The play, *Titus Andronicus*, consists of 14 killings, a rape, a mutilation and an act of cannibalism which shows that conflict, violence and revenge is central to the play. One of the clearest illustrations of sexual violence is Lavinia's rape and mutilation. When Lavinia is raped it is out of revenge by Titus for Titus sacrificing her son, Alarbus. This is where the unending cycle of revenge begins. Within the play we can see that revenge does not respect religion or the law, making the audience doubt the beliefs of the Romans who are Christians (although they do not behave in a Christian way). Although we can see why Tamora wishes to avenge her son's death, we cannot see any reasons why Aaron desires revenge. From the quote "Vengeance is in my heart, death in my hand, / Blood and revenge are hammering in my head" (2.2.38-9) we can see his native nature for revenge.

Unlike Aaron, Titus has a reason to desire retribution. His daughter is brutally raped and his two sons condemned for a murder they did not commit. This drives Titus to what some people may think is madness. From this we can see how vengeance can transform a character throughout the play. Later in Act 5 Scene 3, Titus himself can be seen as inhumane, as he kills his defiled daughter so that she "should not survive her shame" (5.3.40). To a certain extent the audience may believe that Titus's reasons are justified because Lavinia has been defiled and traumatised by the rape. Therefore Titus is putting his daughter out of misery by killing Lavinia who witnessed her husband, Bassianus, being killed. She has also been made mute by Chiron and Demetrius. On the other hand, Titus has been driven mad by his woe and sorrow, and the killing of Lavinia may be interpreted as an act of madness driven by his desperation for revenge. This could be seen as a form of honour killing, which links to the 21st Century where both male and females from certain non-western societies can be killed for taking on traits of western culture. However isn't honour a positive word, where respect should be manifested? So how can killing your own daughter be considered as an honour? As an audience watching *Titus Andronicus*, we might also struggle to understand this contradiction inherent in the concept of killing for honour.

To some extent, the many themes explored throughout *Titus Andronicus*, can be related to the 21st Century. Speaking for myself I believe that it *is* a play for the 21st Century as we can relate to the many emotions generated by the cycle of events within the play. The play also includes historical context in the Roman setting, which can be educational for many children and adults. Shakespeare's plays are still studied in school and colleges and this is because the language is very sophisticated and the themes are timeless. Through his dramas, Shakespeare teaches us about the human condition, and makes us aware of the dangers within our own society. If *Titus Andronicus* shouldn't be taught then why should history?

Bibliography

Mason, Pamela, Othello: Cambridge Student Guides (Cambridge: Cambridge University Press, 2002)

Shakespeare, William, Othello, Arden Shakespeare Third Series, ed. By A. J. Honigmann (London: Arden Shakespeare, 1997)

---, Richard III, Arden Shakespeare Third Series, ed. by James R. Siemon (London: Arden Shakespeare, 2009)

---, Titus Andronicus, Arden Shakespeare Third Series, ed. by Jonathan Bate (London: Routledge, 1995, repr. London: Arden Shakespeare, 2003)

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D. is a Year 10 pupil at Nightingale Academy in Edmonton aiming to study maths, economics, statistics and either physics or engineering at A-Level. She aims to study at one of the Russell Group universities, with a particular ambition to apply to Oxford. D. made the following comment on completion of this course: 'This experience allowed me to try different things that are out of my comfort zone and has encouraged me to always believe in myself'. Gemma Miller is studying for her PhD at King's College London, focussing on childhood and futurity in contemporary performance of Shakespeare.

PhD Tutor's note

D. submitted a sophisticated and academically rigorous answer to a difficult question, displaying interpretive and analytical skills beyond her years. I was particularly impressed with the way in which she contextualised her essay by drawing comparisons with other plays in the Shakespearean canon and situating the play within a larger historical framework. She demonstrated an advanced capacity for independent research and original thinking that will take her far in her future studies. and sustained argument.

HOW USEFUL IS JOSEPH CAMPBELL'S MONOMYTH AS A TOOL FOR LITERARY CRITICISM?

B. Butler, supervised by A. Al-Hafidh

Abstract

This essay explores the relevance of Joseph Campbell's 'Monomyth' as a tool for literary criticism in a variety of different literature types. It begins by outlining the Monomyth as a literary theory and its origins in Campbell's book and is followed by a discussion relating to plot, character and genre. Alternative literary theories, as well as a variety of different books and films are drawn upon to support the discussion of how useful the Monomyth is when used as a tool for literary criticism.

The 'Monomyth' is a literary theory created by Joseph Campbell, that all myths have the same fundamental structure, this is described within Campbell's book, *The Hero with a Thousand Faces*. The Monomyth contains seventeen stages, which can be arranged into different orders, which in theory forms the outline of the plot of every mythical story (see appendix 1). However, this theory can be applied to modern day literature. The core of the pattern follows: Separation (the separation from the hero's normality to the unknown), Initiation (where the hero undergoes challenges and adventures) and Return (in which the hero returns home with newly acquired knowledge). This theory has many advantages and disadvantages as it can be applied to a variety of different medias, such as books, films and music, and has different uses for each which I will be exploring throughout this essay in order to conclude how useful the Monomyth is as a tool for literary criticism.

To begin, the Monomyth fits into some modern literature, an example of which is the book and film trilogy *Divergent*. This story shows the protagonist living in a futuristic and dystopian world which they have to navigate through in order to find where they belong within it and eventually find home and freedom. The Monomyth applies very well to this story as Tris the main character is firstly separated from her known normality following her call to adventure: seeing the way others live when choosing her faction. After separating herself she is implanted into an unknown world where she must pass three stages of initiation. On her way through she has temptations guiding her away from her goal along with more trials. After she achieves the ultimate boom section of the Monomyth, when she discovers what she has been searching for, she crosses the return threshold with the ability to master both her previous life and newly discovered freedom. As this trilogy fits the Monomyth perfectly, the tool can be viewed as a useful device as it gives the reader an understanding of the pattern of events, however, the Monomyth has a strong focus towards a traditional, male, mythical hero, while the protagonist in *Divergent* isn't. This therefore shows how the Monomyth has the fault of having such a strong gender preference. Subsequently, an alternative literary theory *The Heroine's Journey*, could be seen as more appropriate to this story as this follows a journey specified to a female.

When exploring the usefulness of Joseph Campbell's Monomyth, it must be considered that the theory was created for Western Mythology. It was written with known heroic beings in mind, such as Jesus and other religious figureheads. Furthermore the Monomyth was written from his place within the world and social hierarchy therefore the motif for each story would be common. However this could be seen as an element of bias and therefore the Monomyth is less likely to apply to a diverse culture.

It can be argued that the Monomyth is suited better to certain genres of literature, making it a more useful tool depending on where it is applied. For example, in many adventure and action books the plot may fit my pattern of the Monomyth as there is often an obvious hero and quest. Moreover, the Monomyth may be recurring to form a cyclical pattern; an example of which is *Harry Potter* where his life could be classed as a Monomyth as well as the individual stories told in each book. On the contrary, the Monomyth cannot be applied to most fairytales and fables. For example, the Monomyth cannot be applied to the fairytale *Cinderella* as there are no obvious separation, initiation and return stages to the story, and *Cinderella* would not be classed as a traditional hero. This is common within other children's literature and shorter stories, therefore making the Monomyth an unhelpful tool within this genre. Moreover, the Monomyth is not suitable for any story with an undesired ending for the hero, for example within the film *Stranded*. This film concerns a group of friends who together take a boat to sea, jump off the boat and are unable to get back on. Many of the protagonists die and the true ending to the story is undiscovered as the reader is unaware of the fate of the remaining characters. Therefore there is no hero and it misses a substantial number of sections in the theory. Contrastingly, this could be viewed as a positive aspect as a tool within literary criticism as it is useful to explore what doesn't fit the Monomyth as this displays how literature is varied. In many cases it is beneficial for the hero to not undergo The Hero's Journey, as a key component of this is for the hero to have a self-transformation, which contradicts the idea of the hero becoming a master of two worlds. Therefore a story where the hero undergoes a transformation is not necessarily a better story (Not Everything Is A Hero's Journey – James R. Hull).

Archetypal characters are clearly shown within The Hero's Journey, these display each character in relation to the Hero, in contrast to other theories, which describe characters by their function in the story. Many argue that the archetypal hero has become outdated. Lord Raglan is a theorist who wrote a list of character traits found in mythical heroes and called this *The Hero of Tradition*. This literary theory places an emphasis on character, stating that the more characteristics a person beholds, the more of a hero they are. Within mythical content, this can be useful as many of the characters apply to the specifications; however, this theory is not as relevant in modern day literature as there are more untraditional heroes arising. As illustrated in the children's book *Matilda*, the character Matilda, is an example of an untraditional hero as she is young, female, studious and humble. There is nothing obviously special about her to begin with and she doesn't comply with any of the traits mentioned by Raglan, giving evidence of how his theory is outdated and others may be too, including character archetypes found in The Hero's Journey.

As a tool, the Monomyth has a different degree of usefulness within different cultures. As it was created for Western Mythology, it has more use here. A common critique of the theory is that it undermines native culture as it categorises literature into a single pattern and therefore the theory could be viewed as too vague as all cultural content is lost. Contrastingly, many argue that the Monomyth is too strict and limits an author's creativity. Neil Gaiman is an author who believes that a disadvantage of the Monomyth is the danger of being forced into it once it is known, and preferably you could 'accidentally wind up creating something that falls into this pattern'. This links to the idea that it makes literature predictable and less varied as authors are aware of the pattern and it becomes

limiting. On the other hand the concept of The Hero's Journey could be beneficial to authors as it creates a clear outline to create a structured story.

A positive aspect of the Monomyth is its malleability to suit different types of literature, not only books and films but also music, television advertisements, dance and real life situations. To begin, within music, the Call to Adventure stage could be interpreted as a mysterious tune from a foreign instrument or within dance it could be interpreted as a change in the tempo, expression or style of dance. An example of this is within the ballet *The Nutcracker,* Clara sees the Nutcracker Doll and this could be seen as the Call to Adventure. Following this she has help mending the doll from the magical Drosselmeyer; the Supernatural Aid. The Road of Trials and Ultimate Boom could be seen as defeating the army of mice and becoming the Master of Two Worlds once returning home from the Land of Sweets. Because of this the Monomyth can be seen as a useful tool in this media.

Other disadvantages of the Monomyth come from Feminist and Marxist perspectives. From a Feminist view point the theory would not be seen as useful due to it being based around a male hero therefore not applicable to literature regarding females. Additionally it could be seen to glamorize the male heroic doings and undermine the reasons behind them and is objectifying for the females within the story who are perceived only as a temptation or love interest, displaying a misogynistic theory (Traditional and Tragic Heroes: Using Archetypal Analysis to Introduce Students to Critical Lenses – Victor Malo Juvera). A Marxist could argue that it is wrong for the hero to come from a privileged background as described in Lord Raglan's theory. Within history, belief systems belonged to upper classes and were perceived as normal for them, thus they could dispute that the 'Supernatural Aid', 'Atonement with the Father' and 'Rescue from Without' stages of the Monomyth are exclusive to upper classes (Traditional and Tragic Heroes: Using Archetypal Analysis to Introduce Students to Critical Lenses – Victor Malo Juvera).

Alternative theories to Joseph Campbell's Monomyth have been created to challenge his ideas. One of these is called *The Shapes of Stories* by Kurt Vonnegut (see appendix 2). This theory could be more useful than the Monomyth as it shows an outline of different kinds of stories, which provides a suggestive shape in contrast to the inevitable plot created by Campbell's theory. These explore stories in a thematic way where they are categorised into shapes on a graph to demonstrate how the protagonist undergoes ups and downs. Although this carries less detail, due to the differentiation between story themes it could be applied specifically in order to show examples of literature that definitely fit, instead of the nature of the Monomyth carrying examples that might fit a few stages but not others causing the tool to be too inperspicuous.

Another theorist named Vladimir Propp had the idea surrounding character functions. This is another method of literary criticism by creating seven *dramatis personae* that together form the story. This could be a more useful theory than Campbell's as it explores more than just who the character is in relation to the hero as it surrounds their purpose. This could consequently be a more useful tool as it avoids the inclusion of unnecessary characters.

To conclude, I have explored the uses of Joseph Campbell's Monomyth and evaluated that it can be a more useful tool when applied to literature from certain cultures and genres. This is due to the vague outline of the Monomyth and cultural bias within it, along with archetypal characters, which are outdated in modern literature. However, the Monomyth is a key feature within Western mythology and in cases can be a useful tool for authors as it applies to many different types of literature. Overall I believe that the Monomyth isn't a useful tool as there are so many stages that the structure becomes indefinite and it is uncertain whether something truly fits or not. This makes it harder to use as a tool for literary criticism as the Monomyth is too ambiguous.

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PhD Tutor's note

B's essay was submitted for consideration as it was an absolute pleasure to read. It demonstrates a very mature understanding of the Joseph Campbell's Monomyth, as well as a wide range of other key literary theories and I felt as though it really stood out as a piece of academic writing. B provides very relevant examples in relation to the Monomyth and I thoroughly enjoyed the discussion on 'Matilda,' breaking the stereotype of the archetypal hero. In addition, this essay includes a large amount of extra research and the student has clearly taken the time to investigate further into the Monomyth. Overall I feel that this is an extremely well written essay and it reads beautifully; the overall structure has clearly received a lot of careful planning and the essay has a very natural flow.

IN THIS ISSUE
Social Sciences Articles

HOW DO VARIOUS MEDIA PORTRAY GENDER ISSUES IN THE MIDDLE EAST?

K. Collins Greenslade, supervised by R. Farnum

Abstract

This essay critically compares and contrasts how gender roles in the Middle East are presented in various media. Particular focus is given to the portrayal of male feminists, a group rarely discussed in either Western or Middle Eastern news. Stories from a variety of sources originating from the United Kingdom, United States, and the Middle East will be used to show how the same issue is presented differently across regions. This comparison will be used as a case study to consider the greater issue of media bias in society.

Body

The main source of information on current events for people is the media. Whether in the form of newspapers, news reports on the television, or online reports the media influences the way in which we perceive the world. Factors influencing news articles include the writer of the report, the newspaper in which it appears and the country from which it originates. The opinions and information presented may vary, despite the story being based on the same event that has occurred, due to the amount of bias from the opinions of the reporter and the general direction of opinions from the newspaper. If a newspaper is considered a credible source, then it is more likely to be considered as a source that produces a correct unbiased opinion. However, it is difficult to find an unbiased article and more often than not, the media reports what it feels is a worthy article and can manipulate the facts to give their opinion of the story more evidence without lying. This is particularly clear when stereotypes are discussed, especially stereotypes of gender, as these change dramatically depending on the policies and opinions that the newspaper follows. Ideas surrounding the Middle East are particularly biased, as stereotyping about gender in the Middle East is very extreme and Western newspapers have strong opinions on what gender equality is and means. Bias within the media is an issue because the majority of people do not read further into the truth of the newspapers, as we are led to believe that these newspapers only report the truth. However, it is possible to make the information have an opinion in it without presenting information that is false, and so we are influenced by the way that the media talks about the world around us and all its issues.

The topic I have chosen to cover, believing that it is infrequently discussed, is the way that gender in the Middle East is presented. I will place an emphasis on the men of the Middle East, as men are usually presented as women's oppressors. Although this is sometimes the case, rarely are the men from the Middle East who believe that women deserve equality talked about. Women from the Middle East are often talked about being forced to do things (e.g., wearing a hijab, whereas in many cases the women believe that they should wear it and it can be a personal choice). While I do believe that women are frequently oppressed by men and that some views presented by the media are correct, I also believe that some men are unfairly presented. In modern Western society, the media tells us that women are equal to men. In reality, major inequalities remain (in, for example, working environments regarding pay, representation in leadership positions, and stereotypes of gendered careers), but because we are told by the media that our society is equal and have our own stereotypes about gender and gender equality, when we look at other cultures, we often see them as oppressing women. This judgment can go both ways: people in the Middle East often believe the same about our culture, seeing women in the West as being oppressed (for example, by gendered fashion trends and advertising pressures). There are, without doubt, restrictions on women in both societies, and many women could speak of the unfairness in which they are treated, but in the media, virtually all women in the Middle East are presented as being too weak and scared for their lives to try to change things, or attempting protests but failing, whereas men are presented as being violent oppressors who don't want to see change in their society. Throughout the media, some sources are seen as more credible, but even these sometimes show bias on these subjects. I believe this issue must be further discussed so that people can make their own decisions about the actual state of gender equality currently in the Middle East.

A recent gendered issue occurring in the Middle East was the murder of Farkhunda in Afghanistan after being accused by a group of men of burning pages of the *Qur'an* (Islam's holy book). There were many protests in the capital of Kabul over her death, and it was talked about in the media all over the world. On the 19th March 2015, a group of men "beat a 27-year-old religious scholar named Farkhunda to death, threw her body off a roof, ran over it with a car, set it on fire and threw it into the Kabul river nearby". [1] The president of Afghanistan called for an investigation into her death; it is currently believed that she was falsely accused. Following her death, there were large protests by both male and female protesters, including some where people wore masks of Farkhunda's face and another led by a group of men wearing burkas (long black robes generally covering everything but the eyes) as a protest for women's rights. International Women's Day was celebrated 8th March 2015; between these two events, there was a good amount of media coverage around these issues causing many people to become divided on the subject of equality and whether it has been achieved by societies within the Middle East and all over the world.

Whilst researching this topic, I discovered a blog talking about a group of Afghan men protesting in Afghanistan. An article by *The Telegraph* on this event briefly introduces the group of men, who were protesting for women's rights by wearing blue burkas. The newspaper linked this to the upcoming International Women's Day. The article also discussed how the men wanted to do this to understand how women felt every day and talked about how they "carried signs reading: 'equality', and 'Don't tell women what to wear, you should cover your eyes'. [2] The article also discussed how women in Afghanistan were "forced" [2] to wear burqas when they were out in public, and went into a brief amount of detail about how the men's protest was received by the public. It gave reasons against the protest by the public and reasons for by the group of men that staged the protest. The newspaper that wrote this article, *The Telegraph,* is UK-based and is known for being fairly conservative, and so does show some bias. The bias is not extreme, and you are able to separate the truth from the opinion, but it does help to check with other newspapers as subtle opinions can alter the way that we view an event that has occurred. This newspaper is overall known for being quite reliable, even if only compared to other newspapers. This particular article was written by Radhika Sanghani, a regular writer for *The Telegraph* and its "Telegraph Wonder Women" section. The majority of her articles are about feminism and why our planet needs more equality for the different genders. This suggests that the article is more for the protests than against, and thus a biased article. This article also includes the phrase "for many people, has come to symbolize the suppression of women" when talking about the burqas that the men wore in protest. This suggests that the newspaper believes that the burqas are a symbol of oppression, which is an extremely biased view. The use of "for many people" [2] makes it seem less biased, as the writer is acknowledging that not everyone sees it this way; however, I believe that this shows the writer's true opinion, and this bias informs the rest of the article and how she chooses to present information.

The second article I will discuss is about six women killed in Afghanistan for joining the police. It talks about how the women of Afghanistan have been treated since the Taliban took over and how women are viewed within the country. It focuses on how policewomen are seen as dishonorable to their families, and how they are beaten and abused by men, including fellow police officers. This article is featured in the *New York Times,* a newspaper based in New York, USA. It is a slightly leftwing newspaper but is considered a mainly credible source. The article was written by Alissa J. Rubin with input from Lynsey Addario, a well-known photojournalist with her own website and published book who is known for "photographs, features and breaking news focused on humanitarian and human rights issues across the Middle East, South Asia, and Africa" [3]. While both contributors have experience and knowledge of similar issues around the world, the article appears to be quite biased, speaking of the issue of the female police officers in Afghanistan in a tone supporting the women rather than as a neutral tone. Opinions from both sides are presented, but the side and opinions of the women is dramatically more biased. Phrases such as "Taliban curse" [5] when talking about how things changed when the Taliban came to power highlight the author's views about the events that took place. Most of the words and phrases used make the reader feel sorry for the women; this is a running theme throughout.

The last article that I found to answer my question was titled "Thousands march in Kabul over mob killing of woman". This article also covers the death of Farkhunda, the Afghan woman murdered by a group of men after "being falsely accused of burning a Quran" [4] and the protests that took place within Kabul. It is an article featured on the *Al Jazeera* website, a news broadcaster based in Qatar (a country within the Middle East on the Persian Gulf). *Al Jazeera* is owned by the government of Qatar and does show bias towards certain political groups. The article does not tell you who wrote it, possibly suggesting that it was written by a group of journalists that collectively wrote the article by putting together all of the information that they had discovered on the issue. This could mean that it is more reliable because it is a collective of opinions and information, or it could mean that it is more unreliable, authored by a very biased and/or untrained writer. The article includes interviews with many of the protesters, who were both male and female, but does not interview anyone that was against the protest. I believe that the article was written in either Afghanistan, the place that the article talks about or Qatar, where *Al Jazeera* are based, but as the article does not have a byline, it is unclear where the article was written from or with which background. The article does repeat the word "brutal" throughout, suggesting that the author or authors do not agree with what took place. They also use the word "bitter" to describe the election campaign that took place, where the president "promised to champion women's constitutional rights, end corruption and bring peace". [4] This is also a biased opinion which could change the way that people view the president.

These three articles have been written in three different countries by three different newspapers, each with different biases, although all three are considered as giving authoritative knowledge to the public. They all show bias, though you are still able to pick out the factual events from the opinion. The articles all talk about different, but similar issues; however, they present them in different ways. They all give opinions about gender equality, even if these opinions are not clear, as the reader may have to read into the articles before they find the bias. *The Telegraph* presents the men who protested by wearing burkas as men who believe that both genders should be equal and talked about how they were wearing them for the upcoming International Women's Day. The article talked about how the men wanted to understand how women felt in everyday society and this article gave opinions from men who were against the protest, minimising its bias by presenting multiple views, but did not go into much detail. It showed men as wanting to protest but did not give any quotes from women who agreed with what the men were doing; instead only giving opinions of those who were against it. I was unable to find any news of this by an American newspaper on the first two pages of searching for it on *Google,* and the only other mention of this event was a one-sentence mention in *Voice of America* when discussing International Women's Day. After this point the articles became irrelevant to the issue. The article written by *The New York Times* shows women as only wanting to be equal and does not give examples of women stating that they think a woman working for the police is wrong, other than an elderly women in one of the police women's family. It portrays men as being cruel and violating the women, and although these events did occur, they only include a short quote from one man with the article stating "Colonel Mirakai, who supports having more policewomen, sighed. 'The police commanders I work with say: "We don't need them to work with us until noon and go home; instead of female police, send us male police."' he said, alluding to the reality that many women have to leave work early to care for their families". [5] *The New York Times* article portrays women as not having power over their own lives, whereas the article by *Al Jazeera* talks about men and women protesting alongside each other, and has an equal number of male and female for arguments. However, it only mentions the men who murdered Farkhunda as being against the protests.

Male feminists are thus barely mentioned at all in most articles on gender issues in the Middle East. However, my finding that male feminists are not talked about by the media could be because it is a relatively new concept. This idea was brought up when I interviewed a male feminist and Kurdish (a minority ethnic group) Iraqi, Ayaz. He gives talks on feminism and when asked about the frequency of the portrayal of male feminists from the Middle East, he stated "I only know a few male feminists in the Middle East and there is little media about male feminism overall. Male feminism is new to the region. Even female feminism has not yet developed here in its own Eastern version – it is overly influenced by Western values and Western models of feminism. So for this reason, perhaps, male feminism is still in its infancy. Certainly there are many men who support better treatment of women overall and less violence and better laws, for example. But few men have challenged those power structures that keep women in their places. Perhaps because in many Middle East countries coming out of the Arab Spring, even men are not protected fully by the laws and suffer greatly from ongoing corruption and injustice". All of these reasons could be the reasons for why male feminism is rarely covered by the media, especially if feminism in the Middle East is still in its "infancy". However, Ayaz clearly has strong opinions on the matter. When asked why he believes gender equality is important, he talked of the overall effect total gender equality could bring: "With true gender equality, where women had full access to her human rights for safety, employment, shelter, education and health care, women would live longer and more productive lives. They would contribute more to their families and communities. As a result their children would also be healthier, their marriages would probably be better and their overall quality of life and well being would improve". This shows that even if gender equality is still a new concept, there are men from the Middle East who feel very strongly about the equality of all genders – yet this is rarely talked about in news coverage.

The way that men and women in the Middle East are portrayed by newspapers varies, with factors such as the country it was written in, the political views of the newspaper and the methods of research and fact-finding influencing content and presentation. *The Telegraph* portrays men and women in the Middle East as being unequal, and possibly deteriorating

further: "Progress for women's rights has been made in recent years, but human rights organizations are worried that much of that is now being undone" [2]. The article goes on to suggest that men are divided on the issue, including a quote from a man who asserted that "I wouldn't let them [women] go out without one [a burka]" [2]. *The New York Times* presented women as wanting change and trying to make things equal, but as struggling to carry on against the number of men who are against them. This makes it sound like the situation in Afghanistan is not good for women and this also supports the article by *The Telegraph*. The third article, also focused on Afghanistan, makes women seem independent, standing up for their rights. While this is at first glance similar to *The New York Times* piece, the article from *Al Jazeera* makes it sound like large groups protest about women and how they are treated regularly, while *The New York Times'* writing suggests that this is a rare thing. The article by **Al Jazeera** also implies that the government was trying to make rights for the better for women, something that the other two articles did not address. All of the articles are quite biased, but they are all considered credible despite the fact that they let their own opinions get in the way.

Each of the articles explored above examines a slightly different topic and they differ in the way that they present their story, but all are trying to inform their readers about what is happening with men and women in the Middle East. Each of the articles presents gender equality, especially the pieces from the UK and America. This could be because the media has been influenced by their government's decision to go to war in Afghanistan. These countries may also present gender in different ways, as they are predominantly Christian countries and so view Islamic countries in a different way to how other Islamic countries would generally see them. In the West, we have been taught that our society has gender equality. But our society may seem for many others around the world like their society – or worse – in terms of gender relations and power. Given the way everyone has been brought up, the media along with schools and parents socialise gender relations and assumptions about other cultures in us. The media has a large impact in all of these places, because it is not only our main source of information locally but also our primary way of finding out what is happening in the world. I think that the way in which the news presents its facts can change the way we see the world, and that if we do not critically read everything we see, we can be persuaded by the newspaper to unquestioningly believe what they write and thus adopt their biases and stereotypes. This means the media has a huge amount of power as a trusted, credible source. Thanks to this course, I am going to read more critically and try to think about things from the perspective of the people written about. I have enjoyed looking into the way that the media portrays various issues, as I believe it is something that people do not talk about enough. Overall, this exercise has taught me to not just look at an event from one person's point of view or the mainstream presentation in the news. Ayaz and other people in the Middle East have an entirely different perspective on and knowledge about gender relations in that region than the ones I have regular access to through Western media outlets. I believe it is important for us to fully consider these multiple perspectives when dealing with complex issues. We would be a more informed society if the media were to present these nuances with less bias, be it implicit or explicit, in reporting trends.

Bibliography
[1] Associated Press in Kabul. The Guardian 23 March 2015. "Afghan protesters march to demand justice for woman killed by mob". http://www.theguardian.com/world/2015/mar/23/afghan-protesters-demand-justice-for-woman-killed-by-mob-farkhunda
[2] Sanghani, Radhika. The Telegraph 6 March 2015. "Afghan men wear burqas to campaign for women's rights". http://www.telegraph.co.uk/women/womens-life/11453879/Afghan-men-wear-burqas-to-campaign-for-womens-rights.html
[3] Addario, Lynsey. "Bio". Accessed 21 June 2015. http://www.lynseyaddario.com/info/bio/
[4] Al Jazeera Agencies. Al Jazeera 24 March 2015. "Thousands march in Kabul over mob killing of woman". http://www.aljazeera.com/news/2015/03/afghanistan-kabul-farkhun-da-march-150324134214403.html
[5] Rubin, Alissa J. The New York Times 1 March 2015. "Afghan Policewomen Struggle Against Culture". http://www.nytimes.com/2015/03/02/world/asia/afghan-policewom-en-struggle-against-culture.html?_r=0

Appendix: Author's Email Interview with Ayaz, a Kurdish Iraqi Male Feminist, April 2015

K.: Why is gender equality important?

Ayaz: Gender equality is equal treatment of women and men in laws and policies, and equal access to resources and services within families, communities, and society at large. With true gender equality, where women had full access to her human rights for safety, employment, shelter, education and health care, women would live longer and more productive lives. They would contribute more to their families and communities. As a result their children would also be healthier, their marriages would probably be better and their overall quality of life and well being would improve. Less obviously though, if equality was not such a struggle over limited rights, women and men might get along better and most certainly women and women relationships would improve without constant competition for the best education, the best jobs, the best husbands. Frankly, equality and constant competition among men has the same negative effect and is the root of the power struggles behind families, communities and nations in conflict.

K.: Do you think male feminists portrayed by the media are talked about enough?

Ayaz: I only know a few male feminists in the Middle East and there is little media about male feminism overall. Male feminism is new to the region. Even female feminism has not yet developed here in its own eastern version – it is overly influenced by western values and western models of feminism. So for this reason, perhaps, male feminism is still in its infancy. Certainly there are many men who support better treatment of women overall and less violence and better laws, for example. But few men have challenged those power structures that keep women in their places. Perhaps because in many Middle East countries coming out of the Arab Spring, even men are not protected fully by the laws and suffer greatly from ongoing corruption and injustice.

About the authors
K. is a Year 9 pupil at Hayes School. Rebecca L. Farnum is studying for her PhD at King's College London in Geography focussing on environmental peacebuilding in the Middle East and North Africa.

PhD Tutor's note
This assignment asked students to choose a topic interesting to them and compare how it was represented differently in various media outlets. K. did a fantastic job over the course of her tutorials and profiled her learning incredibly well in this essay. I was particularly impressed by K.'s initiative in conducting her own interview (via monitored email) with a self-identifying Kurdish Iraqi male feminist. She synthesises both her primary data and various sources of secondary data well for a coherent and critical yet personally informed consideration of complex questions of gender and global politics.

ARE HUMANS SELF-INTERESTED OR SYMPATHETIC?
S. Miller, supervised by F. Morett

Introduction
In this essay, I argue that humans are self-interested, not sympathetic. In doing so I rely on Bernard Mandeville's psychological theory of universal self-interest, and I make a contrast with David Hume's combined psychological theory of sympathy and self-interest. The analysis and evaluation of these two theories is done by using three criteria for choosing among competing scientific theories, namely inductive support, simplicity, and *experimentum crucis*. And I also use modern day examples from within society.

Discussion. Part I
Mandeville explains how all animals are self-interested and only care about pleasing themselves, but are split into two varying severities. Mandeville (1) argues that "all untaught animals are only solicitous of pleasing themselves" and that "naturally" they follow "the bent of their own inclinations", doing so "without considering the good or harm" that others may receive. Mandeville believed that you cannot persuade or teach anyone to go against their "natural inclinations" to "prefer the good of others to their own".

Some people may say that you can persuade someone to go against their own inclinations, however when you look deeper, people only change out of self-interest. For example, a businessman's sister told him that what he was doing was selfish and that he should become a charity giver. If that man didn't become a charity giver he may lose his relationship with his sister and regret not giving to charity. So by giving to charity he receives the emotional gain and love from his sister, therefore changing out of self-interest.

All animals have to be self-interested to survive. If an animal does not hunt for food, shelter and dominance, it will die. So "naturally" it does follow "the bent of its own "inclinations" (1). This leads me to another point. I have observed that self-interest is misunderstood. When describing an act of self-interest we seem to portray it in a negative way, but I argue it is not. It is not selfish to act in self-interest, it is natural and vital for survival. Therefore, when animals "naturally" follow "the bent of their own inclinations", that is not negative, nor are they selfish, without their self-interest they could not exist. As a result, this proves my claim, because every person living on this planet must be self-interested.

Also, the feelings of serenity, contentment and happiness derived from acts of charity are almost impossible to avoid, so is that self-interest? I believe that if someone does something or an incident occurs without your input that makes you feel those feelings, that is not self-interest. However, if you commit an act in order to receive those feelings, you are doing so in the interest of yourself, out of self-interest. Now, as we know that in every person there is self-interest, we can disprove the aspect of sympathy. When we think of a "sympathetic" act, we usually think of charity giving, be that money, food or clothes.

David Hume believed that there were two strands of human nature, 'benevolence' and 'self-love'. We can refer to 'benevolence' as sympathy. We know an example of 'benevolence' that Hume (2) uses when he says that "from him the hungry receive food, the naked clothing, the ignorant and slothful skill and industry". The man giving to others may be considered by Hume and others to be sympathetic, but I believe he did what he did for the personal gain that he'd receive. People he tells or who see him giving charity will praise him and his

pride will be fed. He will get a good feeling from giving to charity, meaning he is likely to do it again.

Mandeville (1) argues that "the moral virtues are the political offspring which flattery begot upon pride". This means that when we behave well, our pride is fed. We are praised and flattered because of what we have done, so much so that the personal gain we receive from committing an act outweighs the sympathy involved in the act itself. Alternatively, people may believe that if someone gives to charity anonymously and discretely, then they're truly sympathetic. However, if that person hadn't given to charity they may feel an emotional loss such as guilt and regret, so by giving to charity they feel a kind of emotional gain. As a result, 'truly sympathetic' acts are disproved on the grounds that they are done for the gain that the performer of the act will receive.

I believe that there are varying levels of self-interest, as did Mandeville. He believed that the (1) "whole species" is divided into two classes, each class being "true representatives of their sublime species". One consisting of "abject, low-minded people" who have "no aim higher than their private advantage". The other class is made up of "lofty high-spirited creatures" who are not "sordid" or "selfish", who despise "whatever they had in common with irrational creatures [the first class]". Both classes are ones of self-interest but "the first class by more degrees". I think this is true, because we can consider businessmen and people like the members of 'Dragon's Den'. If we imagine a scale of self-interest, they would be at the top because they care only about their wealth and success, by investing money and by picking up and dropping employees. They could be compared to a charity giver. As said earlier I think that people give to charity for the gain that they will receive, whether that be abolishment of regret, pride or flattery.

The level of self-interest in charitable giving is hard to gauge, because if a rich person gives a huge amount of money, which is only a small percentage of his or her wealth, is that better than if a very poor person gives a little amount, which is a high percentage of his or her wealth. The rich person will receive more emotional gain because they gave a higher amount. As we can observe, the levels of self-interest of the business man and charity giver are different.

Three criteria can be used for choosing between Mandeville's psychological theory of universal self-interest, and the combined theory of self-interest and sympathy from Hume. Fernando Morett (3) explains that 'inductive support' is "the number of positive instances collected supporting a hypothesis or claim". From source four we know that an *experimentum crucis* or crucial experiment is a "crucial experiment" used to "demonstrate the true character of a hypothesis or claim", "one positive instance seems to be enough". From the textbook (4) we know that "many philosophers of science and scientists" believe "it seems better to choose theories postulating fewer causes. Therefore, simpler theories should be chosen over their more complex rivals".

When it comes to 'inductive support', Mandeville is a clear winner. From source eight we know that (3) "unlike Hume, Mandeville does consider whether statesmen, patriots, mothers, friends and lovers act because of self-interested motives such as being flattered, adored and glorified". Again from the same source (3) we know that Mandeville's observations and surveying are more reliable because "he discusses different

social groups" and proves instances of "sympathy" such as, "cardinals, nuns, friars, mendicant orders, mothers, soldiers, kings, ministers and members of the court" wrong, therefore proving his theory correct. Also, every person on this earth commits undisguised, visible acts of self-interest, so finding a negative instance of a person committing no visible acts of self-interest and only acts appearing to be sympathetic will be impossible.

Alternatively, Hume would disagree because he believed that the proving wrong of Mandeville's theory relied on (3) "the existence of acts of disinterested benevolence and humanity motivated by sympathy", which Hume claimed is a "natural component of the human mind". We cannot use inductive support to prove Hume's theory because his theory doesn't allow us to distinguish between sympathetic and self-interested psychological motivations on acts that are identical on the outside. As a result of people's varying personalities and inclinations, not all instances will prove positive, because some people may appear universally self-interested and others may seem people of self-interest and sympathy.

Mandeville's theory cannot really be considered as one supported on an experimentum crucis, because you do not need one outstanding experiment to prove his theory to be the right one, that is already done with the wide inductive support he provides. Using *experimentum crucis* when evaluating Mandeville's theory would perhaps be an idle decision. Hume's theory however, could use an *experimentum crucis* to prove his theory, because an *experimentum crucis* relies purely on one outstanding positive instance. Morett (3) explains that 'inductive support' is often "considered insufficient to decide the controversy between Hume and Mandeville", as a result just because Mandeville does not use *experimentum crucis* effectively to prove his case it does not mean Hume's theory is the winner.

Simplicity is hard to use when comparing Mandeville's and Hume's theories, because both theories are made up of two branches, Mandeville's varying levels of self-interest and Hume's 'benevolence' and 'self-love'. However, I have come to the conclusion that as Mandeville's branches are both of self-interest – just varying levels – and Hume's branches are completely different, Mandeville's theory is simpler. Therefore, Mandeville's theory is one of simplicity as it has one aspect to it, 'universal self-interest'. There are no exceptions or anomalies. In contrast, Hume believed that his theory was simpler. As Morett (3) explains, Hume argued "the 'selfish-theory'" "is more complex because it uses 'very intricate and refined reflections'". Also, from the same source (3) we know that "Hume actually criticises simplicity as a criterion". Mandeville was proven correct when using these three criteria as "Hume achieves a lower score than the psychological theory from Mandeville".

Discussion. Part II
There is a big difference between self-gain, self-pity and self-interest. Self-gain is similar to self-interest, in that you personally gain from your actions and that you go about actions intending to receive the most in your own interest. Self-pity is a method that can be used in self-interest to provoke sympathy. Self-pity is the excessiveness of being absorbed in the negatives within yourself.

There are alternative interpretations that different people can form. Some people may interpret one of Mandeville's comments to mean that humans are stubborn, because Mandeville says (1) "it is not likely that anybody could have ever persuaded them". This statement implies the possibility of persuasion, therefore meaning human resistance against that persuasion could be interpreted as stubbornness. Clever acts of flattery and tribute can overthrow stubbornness, therefore prompting the act that you desire from others.

Mandeville explains how he believes that there are two classes

within universal self-interest. Some philosophers may interpret Mandeville as arguing that the two classes are so different, so the second class may be interpreted as less self-interest and more sympathetic.

Businessmen and women could alternatively be interpreted as having varying levels of self-interest within themselves as they may have two sides to them; business and home life. At home they may act very differently to how they do at work.

Supporters of Hume's theory would disagree with my statement that "just because Mandeville can't use experimentum crucis effectively to prove his case it doesn't mean Hume's theory is correct". They would believe that as *experimentum crucis* provides a negative light on Mandeville's theory and a positive light on Hume's theory, Hume's theory must be correct. Hume uses *experimentum crucis* to back-up his theory as a short cut, because he couldn't gather enough cases of evidence. As a result of the competition with Mandeville's theory, Hume looked for an easy, inexpensive way to prove his case experimentum crucis.

Similarities that can be found between Mandeville's and Hume's theory are that they both believe in the techniques used in self-interest. Mandeville (1) explains that "flattery must be the most powerful argument", later describing it as "artful". Mandeville also explains, "the moral virtues are the political offspring which flattery begot upon pride", meaning that when we behave well, our pride is fed, we receive praise and are flattered. We are good purely because of what we receive in return. Hume describes us using other techniques to get what we want "while all of us, at bottom, pursue only our private interest, we wear these fair disguises, in order to put other off their guard". This similarity can link with 'A Christmas Carol'. On the basis that everyone is self-interested, a horrible, miserable self-interested person will receive little in return from others whereas a kind, happy self-interested person will receive more in return from others. In 'A Christmas Carol' Tiny Tim, Bob Cratchit's disabled son, goes about self-interest the 'smart way'–self-interest via mutual help. Although disabled, he is happy and generous to others, meaning he has a higher chance of people liking him. Tiny Tim is fighting the possibility of social exclusion because he is different, so a cheerful personality is a clever option. His method worked as in the end his father, Bob Cratchit, sacrificed a whole day of pay to stay at home for Christmas. In the film he said, "Tim, I'm to have the whole day off tomorrow, the whole family can be together". Tiny Tim acts the way he does to avoid social exclusion.

Mandeville would believe that Scrooge, from 'A Christmas Carol' is purely self-interested because of the way he treated his employees and people in general. He would believe that Scrooge giving the turkey to the Cratchit family, wasn't an act of sympathy, it was one of self-interest as Scrooge needed to repay the Cratchit family and only gave the turkey because of the emotional gain he would receive and the fact that the ghosts told him to. Hume would believe that Scrooge's act of giving the turkey was sympathetic, as he was not obliged to give the turkey and he gave it so that the Cratchit family would gain. This and similar actions set the moral foundations of charity in Britain; where it is now considered important.

Many differences can be found between the two theories. Take human mourning for example. Hume would believe that you mourn out of sympathy for the dead. Whereas from a psychological and sociological perspective, Mandeville would believe that you may mourn so you do not feel the regret afterwards from not doing so and you feel a connection with those mourning also. This theory is hard to use when evaluating the mourning of animals. However, one of the few animals that does mourn is a chimpanzee, our closest animal relative - so maybe they mourn for the same reasons that Mandeville proposes. If chimpanzees mourn for those reasons, then maybe it's the same for elephants and other animals that mourn.

Mandeville would believe that soldiers are self-interested because they go to war to gain skills and to receive emotional gain. Soldiers receive food, clothes and shelter, as well as earning money. Hume would disagree as he believed soldiers go to war to fight for their country, in an act of sympathy.

Under the concept of 'benevolence' Hume says, (2) "the ties of love are consolidated by beneficence and friendship". Mandeville would disagree that the act of marriage is one of sympathy or 'benevolence' as he believed that you go into a marriage for the emotional gain you receive personally.

Hume would consider priests and nuns providing "emotional help and comfort to the poor and the rich" sympathetic. Whereas, we read from Morett (3) that Mandeville believed they did it out of self-interest "to ensure a place in heaven and veneration on earth". This also applies to the 'Good Samaritan'. Although it may appear that the Samaritan was sympathetic, his story got into the bible, for the purpose of showing others how to behave, so that they'll be able to go to heaven. The 'Good Samaritan' may have committed his kind act, under the belief that he would be able to go to heaven and for the emotional gain he would receive.

We know that Mandeville believed that the royal courts were self-interested as they "rob the publick" "despite being named and employed to serve the public interest" (3). Hume however would believe that due to their serving of the public they were benevolent and sympathetic.

Here is another thing to consider: A self-interested person knows what makes them happy, so they'll know how to make others happy. This may suggest that sympathy is possible, however you perform the act of doing something to make someone else happy, to make yourself happy, that is to say, for the gain that you will receive.

Conclusion
I have found that the sources I have been using are reliable, because as well as sourcing them from the textbook I have researched online to confirm the reliability of them. Many of the sources are what a philosopher has directly said, a primary source. Other sources are other philosophers' interpretations and comments on what another philosopher has said, a secondary source.

This essay may be subject to bias, but very little. As a result of myself not being a businessman, nor a dedicated charity giver, nor a religious believer, nor a politician, nor a soldier, I can step back and realise that the acts people perform can be interpreted in different ways, and form my own conclusion that we are universally self-interested. My view is not altered by any religious beliefs or relations to givers of "sympathy". However, it may be considered that there is some bias in my argument because people have different opinions. Also, influences within my nurture may affect the way I view things. For example, if I were a giver to charity I would tell you that I give as an act of sympathy, giving to the people that need it, therefore disproving universal self-interest and introducing the possibility of truth within David Hume's or another theory.

In sum, I believe that Mandeville's theory of "Universal Self-Interest" from 'An Enquiry Into The Origin of Moral Virtue' is correct and that all humans are self-interested, not sympathetic.

Bibliography
1. Bernard Mandeville (1732) 'An Enquiry Into The Origin of Moral Virtue' in The Fable of Bees: or, Private Vices, Public Benefits.
2. David Hume (1777) 'Of Benevolence and Self-Love', in An Enquiry Concerning the Principles of Morals
3. Fernando Morett (2014) 'The Vera Causa Principle In 18th Century Moral Psychology', forthcoming in Causes and Consequences, 2015, Rom Harré and Fathali Moghaddam (eds).
4. Fernando Morett (2014) Philosophy: Are Humans Self-Interested or Sympathetic?, Textbook, The Brilliant Club.
5. Ryan McMaken (2014) 'Correcting Scrooge's Economics' Mises Daily, 2014
6. Howard Baetjer Jr (1988) 'Ebenezer Scrooge and The Free Society', The Freeman.

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PhD Tutor's note
S. produced an outstanding essay. The two most outstanding aspects are: 1) the extension and scope of the analysis with wide and highly diverse evidence, 2) the detailed and sharp discussion with an excellent comparative analysis. Furthermore, she did a very attentive analytical reading of the arguments identifying crucial premises. The essay demonstrates that she thought long and hard on the issues at stake taking a position and producing a very solid argument in support. Her essay demonstrates a solid commitment to independent thinking and honest self-reflection of her own ideas.

EXPLORE AND EVALUATE WHY RESEARCH INTO RELATIONSHIPS IS IMPORTANT

F. Nicholson-Lailey, supervised by D. Pearson

Abstract

This essay explores why research into our relationship with 'the home' is important. The article begins by exploring what the home means and how relationships with the home can vary depending on the individuals involved. It considers areas of 'the home' that can cause conflict, how the home can change through the physicality of its contents, the people and the emotions contained within the space. Relationship support and maintenance of the home is considered through decorating the home. The relationship with the home is also explored through what it might be for homeless individuals. The piece concludes by considering how the home is a feeling or a concept, a relationship with a particular space or meaning, which can change and differ. Research serves to illuminate the nuances of these varying meanings.

Body

In this essay I hope to discuss, not romantic or family relationships, not the relationships we have with animals or with co-workers, or even with ourselves, but the relationships we have with our homes. By studying this kind of relationship, we can understand the importance of the home and the stability it provides (which has a significant effect on our mental health, our physical health, and the relationships we have with the rest of the world). What most people seem not to observe when analysing the connection between a person and their home is that it encompasses many of the features of more obvious relationships. For example: monogamy, biographical context, and socio-cultural/temporal context. The home can also affect the course of relationships between people and other people, which is why they are one of the most important places in nearly everyone's lives.

One of the irritating truths for any social sciences researcher is that almost everything is subjective; the same can be said for individuals' perceptions of a space. For instance, as an experiment, I asked two family members to list all the words they associated with the word 'home', and while one replied: 'family, comfortable, warm, loving, safe,' the other responded: 'safety, warmth, rest, chores, bills, quiet.' The words themselves, and their prioritisation, shows that the concept of 'home' means very different things to different people; something which could be influenced by biographical context (for example, upbringing) and by temporal context (for instance, the meaning of home today is different to its meaning in 1950). This experiment was conducted on a larger scale as well (*Time Inc.*, 2015), and confirms my point. So we can establish from this that the idea of home is truly just an idea, and the saying 'a house that is a home' is simply describing the emotions and ideals we project onto spaces. Some might argue that what makes a home is the person living in it, that their presence is more important than any personal possessions or decorations. As shown by Klinkenborg (2012), this can have a huge impact on people visiting the homes of deceased relatives or friends because that presence is gone and so the home almost loses itself. Perhaps the most interesting definition of a home comes from Veryln Klinkenborg (2012): 'a place we can never see with a stranger's eyes for more than a moment'. This quote may not be more accurate than those found in 'What Does Home Mean to You?' (*Time Inc.*, 2015), because everyone's definition of 'home' is true to their beliefs, but it is more general and states that home is simply the most familiar place to us. The article from which this quote comes (Klinkenborg, 2012) also explores the idea that we need homes simply to organise our perceptions of the world; home acts as a sort of no-man's land in which to gather yourself

and be completely ordinary; this contradicts the common idea that, to most, home represents a kind of paradise. However, this doesn't mean that our homes aren't special. On the contrary, the decoration of our homes is perhaps the most subtle way of expressing our personality and our past. This links in neatly to the theory that our memories and our personal thoughts are what make a house into a home. An emotional article by Peter Mountford (2015) perfectly illustrates how our childhood and the familiar artefacts of our parents' home can leak into our adult life. Obviously in Mountford's story it was intentional, but that isn't always the case, and this can sometimes help us by making us feel more comfortable and bringing back fond memories. However, romantic partners, and occasionally children, can be overwhelmed or irritated by the constant presence of parental souvenirs, perhaps seeing it as an attempt to recreate childhood memories instead of focusing on present relationships. But other people's perceptions of a 'home', as well as our own, are completely subjective and so we can't really draw any solid conclusions from interviews; this makes researching this particular type of relationship quite difficult, but by carrying out this research, we can better understand the types of environment we feel comfortable in and use that to our personal advantage.

But the home isn't just an opportunity for decoration; it has to be maintained, and this can cause tension within a relationship. While throughout history it has been taken for granted that a 'woman's place' is in the kitchen, modern society sees 14 million women employed (Dugan, 2014). Yet 'eight out of ten married women are said to do seven or more hours of housework a week – the equivalent of an entire working day' (Hennessy, 2013). While one would assume that this has a negative impact on women's happiness and well-being, which in a lot of cases it does (Gordon, 2014), it ultimately puts a lot of strain on a relationship, but according to a recent study 'the divorce rate among couples who shared housework equally was around 50 per cent higher than among those where the woman did most of the work' (Samuel, 2012). To summarise, when women do the majority of the housework, they're miserable, but when the chores are evenly distributed the relationship loses its spontaneity and collapses. But it's not just romantic relationships that suffer under the burden of housework. University students sharing living spaces offer the perfect example of conflicts centred around cleanliness. These kinds of issues usually arise in the 'storming' stage of a relationship (Anon., 2015) when newly-established cleaning routines are being forgotten about. Of course, the problem with non-romantic cohabiters is there isn't necessarily the level of trust and understanding that is an essential feature of more intimate relationships, and so delicate issues such as hygiene are usually avoided until there is an explosion of conflict. But an article examining the behaviour of students sharing accommodation (Kansas State University, 2012) suggests that there could be biological factors to consider. For example, the heightened sense of smell in females, or the structure of men's and women's eyes that causes sensitivity to different things. However, the issues of cleanliness and housework, in romantic and other types of relationships, is essentially about communication and has very little to do with the home. But what of those at the other end of the cleanliness spectrum? A biographical account by David Mcglynn (2014), describes how an obsession with cleaning, in this case because of biographical influences stemming from childhood, can isolate you from your family and alienate the people around you. But again, these issues aren't about the home itself and are more about the people in it. This suggests that homes are mere vehicles for human experience.

However, homes also act as a sanctuary for most people, providing a peaceful and familiar place and an opportunity to be alone and have time for yourself. Therefore, it can be especially distressing when someone new encroaches upon this sacred space. An example of this could be a child reacting to a step-parent/sibling moving in, or a parent whose child brings home a new partner. Judith Gille (2013) describes this situation and the conflict it caused between her and her daughter and the psychological effect of not having a space to yourself; it limits your ability to relax and to gather your thoughts which, if prolonged, allows stress and frustration to build up – something which makes maintaining any kind of relationship very difficult. It is situations like these that cause us to behave more like wild animals, protecting our territory (our home), and this can produce feelings of hostility towards the newcomer, whether we realise it or not. Homesickness is another common sensation that is experienced by those who perceive their home to be less accessible to them, for example, young adults leaving home for the first time (Ho D., 2010). These kinds of discoveries, gained from research, can help us to better understand how to manage transitions in our lives and how to cope with change.

Relationship maintenance is something of a disputed matter; some believe that you have to 'work at it', that magazine articles and activities and trust exercises hold the key to a harmonious relationship; others think that if you have to 'work at it', if you have to make an effort just to get to know each other, then your relationship simply can't be successful. But how do you maintain your relationship with your home? Sarah Beeney and Kirstie Allsopp think they know the answer. Home improvement magazines and programmes are in ready supply, but is upholstery really the way to make your home a better place? If you consider why you must cultivate a relationship between two human beings, you begin to understand that, in order for the relationship to grow and adapt to the challenges of society, you are constantly improving yourselves and learning who you are. The same can be said of our relationships with our homes. Of course, there is always the element of 'keeping up with the Joneses' and the perpetual desire to stay level with the technological advances of society and the latest gadgets that those around us acquire. But if there is an emotional problem in your household, usually it has less to do with the building itself and more to do with its inhabitants. Therefore, improving the decorations in your home might make it more aesthetically pleasing and comfortable, but this might not resolve the issue surrounding the emotional discord in the atmosphere; this links us back to the concept of our homes merely being canvasses on which we project our emotions and memories. However, by understanding our connections with our homes, we can better adapt them to make our lives, and those of the people we love, much easier.

But what of those who have nowhere to call 'home'? Homeless people are very much part of society and they divide public opinion in many ways. However, what are the effects on the people themselves? Dominique Harrison-Bentzen, a student from Preston, spent a night on the streets in order to raise money for a homeless man who had offered her his last change to pay for a taxi, and in the process, learned a lot about the challenges faced by homeless people, including the inability to sleep and subsequent exhaustion (Harley, 2014). One element that is quite often overlooked when considering what a home is, is the element of control and freedom it gives its inhabitants; as shown by Maslow's Hierarchy of Needs (McLeod, 2007), the home features in the first two levels ('Physiological' and 'Safety'), which both encompass comfort, protection and stability. This research highlights how basic a home is and what an effect it has on our well being; it also reaffirms the need to tackle the issue of homelessness.

To conclude, 'home' represents something very different for everyone. As we age, the home becomes less of a paradise and more of a task. However, some argue that home is never a paradise, it is simply what is normal (Klinkenborg, 2012). A home affects a great deal of our relationships, as human nature

dictates that we automatically make judgements about people based on the way that they live. Though we don't always notice, biographical and socio-cultural/temporal contexts are what decides the aesthetic appearance of our home; it can become a museum of our past or transform into what magazines say it should look like. It provides stability and control and a place where so many memories are recorded that they simply morph into one singular feeling, and that is the feeling that we like to refer to as 'home'. But the understanding of this feeling, and therefore how to maintain, cultivate and preserve it, only comes through research into how we make our houses into our 'homes'.

References

Anon. (2015). Forming, Storming, Norming and Performing. Available: http://www.mindtools.com/pages/article/newLDR_86.htm. Last accessed 11th April 2015
Dugan, E. (2014). Number of women in work in Britain hits record high – but figures show the gender pay gap is growing too. Available: http://www.independent.co.uk/news/uk/home-news/more-women-have-jobs-in-britain-than-ever-before--that-figures-show-the-gender-pay-gap-is-rising-too-9139154.html. Last accessed 7th April 2015
Gille, J. (2013). The Messy-Kitchen, Parking-Spot War. Available: http://www.nytimes.com/2013/09/22/fashion/the-messy-kitchen-parking-spot-war.html. Last accessed 7th April 2015
Gordon, B. (2014). Why are women still doing most of the housework?. Available: http://www.telegraph.co.uk/women/womens-life/10621402/Why-are-women-still-doing-most-of-the-housework.html. Last accessed 6th April 2015
Harley, N. (2014). Homeless man 'overwhelmed' after student raises thousands for him. Available: http://www.telegraph.co.uk/news/newstopics/howaboutthat/11299834/Homeless-man-overwhelmed-after-student-raises-thousands-for-him.html. Last accessed 13th April 2013
Hennessy, P. (2013). Fifty years of feminism – but it's still women doing the housework. Available: http://www.telegraph.co.uk/women/womens-life/9962977/Fifty-years-of-feminism-but-its-still-women-doing-the-housework.html. Last accessed 7th April 2015
Ho, D. (2010). Homesickness isn't really about 'home'. Available: http://edition.cnn.com/2010/HEALTH/08/16/homesickness.not.about.home/. Last accessed 12th April 2015
Kansas State University (2012). Cleaning conflict? What happens when roommates, romantic partners have different levels of tolerance for housework left undone?. Available: http://www.sciencedaily.com/releases/2012/07/120724114707.htm. Last accessed 7th April 2015
Klinkenborg, V. (2012). The Definition of Home. Available: http://www.smithsonianmag.com/science-nature/the-definition-of-home-60692392/. Last accessed 3rd April 2015
McGlynn, D. (2014). Please Forgive My Spotless Home. Available: http://www.nytimes.com/2014/11/30/fashion/modern-love-please-forgive-my-spotless-home.html. Last accessed 7th April 2015
McLeod, S. (2007). Maslow's Hierarchy of Needs. Available: http://www.simplypsychology.org/maslow.html. Last accessed 11th April 2015
Mountford, P. (2012). How I Came to Live in a Chair Emporium. Available: http://www.nytimes.com/2015/01/18/fashion/modern-love-how-i-came-to-live-in-a-chair-emporium.html?rref=collection%2Fcolumn%2Fmodern-love&_r=0. Last accessed 7th April 2015
Samuel, H. (2012). Couples who share the housework are more likely to divorce, study finds. Available: http://www.telegraph.co.uk/news/worldnews/europe/9572187/Couples-who-share-the-housework-are-more-likely-to-divorce-study-finds.html. Last accessed 7th April 2015
Time Inc. (2015). What Does Home Mean to You?. Available: http://www.realsimple.com/magazine-more/inside-magazine/your-words/home-meaning. Last accessed 3rd April 2015

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PhD Tutor's note

The course from which this final assignment comes from is based on family, couple, and social relationships. It focused on how the individual and socio-cultural contexts impact upon relationship experiences with family, friends, and in intimate relationships. The content included focusing on time and space within relationships, communication in relationships, and relationship support. F.'s essay brilliantly flipped the question on its head in an unexpected way which still brought the course material together. It was an outstanding piece of critical thinking and writing, and has thus been submitted to *The Scholar* for that reason.

CRITICALLY EVALUATE THE OPTIONS AVAILABLE TO A COURT WHEN SENTENCING A YOUNG PERSON WHO IS GUILTY OF COMMITTING A STREET ROBBERY (ROBBERY OF PERSONAL PROPERTY) AS DEFINED BY THE THEFT ACT (1968)

M. Açıkgöz, A.Booth

Write a pre-sentence report to a judge critically evaluating your chosen court order.

Dear Mr Justice Flaux,

This report will examine the various responses available and which one is most suitable to the case in question. The young offender committed personal robbery which, as a criminal act, is defined as taking or attempting to take a person's valuables by means of force or fear with the intent to permanently deprive (HM Government, 1968). The general elements of robbery are the taking of personal property or money from the person, the use of force, lack of consent from the victim and the young offender's intention to steal. The offence does not need to be premeditated. I will critically evaluate the options available by outlining the welfare/justice debate, nature/nurture debate and rehabilitation/punishment debate. I will then come to a conclusion by proposing a court order sentence.

The young offender in question is a young person - at 16 he is at the prime age to commit an offence. His parents separated when he was aged 11 due to years of domestic abuse.

The principle argument is that the welfare needs of the young offender are mostly educational. He did not receive adequate moral guidance and was not educated to manage his emotions. A child's source of moral guidance is usually from their parents and/or teachers, but neither were made available to him due to his domestic situation and having been expelled from school at an early stage in cognitive development (at the age of 13). Because he missed out on the positive social influence from school, the only friends that he has have a bad influence on him. He has not been provided with healthy relationships, which is a vital welfare need. This means that the sole emotional support he receives is from his mother. This is not always ideal for a young male - a fatherly figure is more preferable, however he is estranged from his biological father and his relationship with his step-father is strained. Due to his parents being separated after many years of domestic abuse, the young person grew up witnessing violence and aggression. If a child grows up as a witness to domestic abuse and they do not feel safe and secure in their own home, this can lead to many negative emotional effects. To witness domestic abuse as a child is now recognised as 'significant harm' in recent legislation (HM Government, 2010). The effect on the child who witness domestic abuse may be that they develop aggressive tendencies, have problems in school or social life, and begin to abuse alcohol. The young offender demonstrates all of these.

One of the issues with the young person's offence behaviour is that it was at night. This is an aggravating factor along with the fact that there were three young offenders and two victims, therefore the offenders clearly had the upper hand and took advantage of that. Another issue is that their attack appeared to be vaguely organised and there was no known return of the property. The issue of public safety that needs to be considered is that, in this case, the public is in a 'vulnerable' position. The young offender has repeatedly shown violent and abusive tendencies in fighting with others, no doubt causing injury, both when he was in school and when he goes out drinking at weekends. Despite these factors, I support the welfare argument, because if the young offender's welfare needs had been fulfilled, there would be no need for justice. It is also much more expensive to imprison a young offender than to rehabilitate

them, aside from being less effective. The cost of one young person per year is approximately £100,000 (Prison Reform Trust, 2014).

In this instance, the nature versus nurture debate is a controversial one as there is evidence for both. One might argue that due to the violence and aggression to which the young offender has grown up a witness, he has become conditioned to see force as a way to get what he wants. Because of the problems the young offender experienced in his home life, it could be argued that he did not receive the necessary attention as a child, so misbehaved in order to get the attention he desired, which carried on further when his two younger half-sisters were introduced. His drinking and fighting indicate that he may also be lacking a supportive social circle, so he did not have any kind of role model to influence him in a positive way. On the other hand, it could be argued that he inherited his father's temperament, which has proven to include aggressive tendencies. There is no single cause of violence and aggression but we know certain factors which increase the chance of its occurrence. Psychological studies that have been conducted have shown that aggression may be biological due to the genes we inherit. The Office of Juvenile Justice and Delinquency Prevention list specific risk factors in the development of delinquent behaviour. These include child abuse and family disintegration, economic and social deprivation, low neighbourhood attachment, parental attitudes condoning law violating behaviour, academic failure, truancy, school drop-out, lack of bonding with society, fighting with peers and antisocial behaviours in early life.

As the young offender may have inherited a proneness to being aggressive, he could be more susceptible to mental illness. Learning from the violent behaviour he witnessed could mean that he is this way in his nature. In addition to this, education could be a nature-related unmet need, as it is an inherited trait to have low intelligence and poor cognitive skills. In the offence, these unmet welfare needs have contributed greatly - in moral guidance and education in particular. If the young offender does not understand the world and the consequences of his actions and does not know a healthy way to find a solution to his problems, then who is to blame but society and poor parenting? Mental health, which is a nature-related factor, also provides a contribution to the aggravating factors in this offence. A young person of such aggressive disposition most likely inherited a reactive temperament, and this can cause the amount of force used to increase dramatically. Out of these nature and nurture factors, we can attend to most. Firstly, the offender, if re-homed, could potentially learn moral guidance from his new guardians (who must provide him with a supportive environment in which to be rehabilitated), or he could possibly attend therapy to help with moral guidance and relationship-building. Therapy could also help with mental and emotional health; a therapist could help him with his aggressive temperament with either guidance or medication. One factor we cannot attend to is education; as the young offender is at the age to be attending college, he has missed out on three years of education, meaning that college is most likely an option which is closed to him. As low intelligence/poor cognitive skills are an inherited trait, there is nothing that can be done to help this or change this.

There are various orders available to the court for this case, the main ones being rehabilitation or social exclusion. Rehabilitation, according to Raynor and Robinson (2009), works to reform the person in terms of changing their attitude to what they have done. This is clearly the more humane solution, as it is integrating the young offender back into society by teaching him morals and ways to deal with his problems in a safe way which does not harm anyone, all with his fully informed consent. It will educate him about his actions and their implications and consequences, and teach vital decision-making skills. His interest in repairing used bikes may imply that he has skills, which could be used as a rehabilitation method. Rehabilitation would be suitable because it is his first real offence and may therefore effectively minimize the likelihood of further criminal activity while he is still a minor. It is a safe way for him to get his life back on track. Whereas placing the offender in a secure estate may well cause his mental health issues to get worse. This is due to the dangerous nature of life in social exclusion, which is also ineffective and costly. In 2013 it was found that over 60% of criminals on short-term prison sentences reoffend, therefore it is questionable as to whether the expense of imprisonment is worth it since the goal of punishment is to deter people from offending. The May/June 1997 issue of Juvenile Magazine raised the question of what happened to prevention. It cited a 1996 report from RAND Corporation which indicated that 'early intention programs' can prevent as many as 250 crimes per £1 million spent while the same amount spent in prisons would prevent only 60 crimes a year. The same issue told us that putting young offenders in adult prisons leads to more crimes, higher prison costs, and increased violence, not to mention placing them in danger from the adult prison population, citing studies by Jeffrey Fagan and Michael Baizerman. Prisons are gradually becoming over-crowded and custody is used excessively by juveniles and young adults. This suggests that crime levels are rising and prison is simply becoming insufficient, however there is the controversial claim that crime falls when more offenders are put in prison. During the 1980s the Tory government pursued an anti-prison policy, and during the early 1990s Britain saw a cut in prison population by approximately 10%. This meant that crime rates reached a historic peak which caused the policy to be reversed. This shows that prison does in fact work, but merely to reduce crime rates and not to deter people from offending or reoffending.

I would sentence the young offender in question to a 12 month Youth Rehabilitation Order, to be served in the community. I think that this sentence will prevent him from reoffending more effectively than placing him in a secure estate because often the amount of violence, physical/mental abuse and gang activity influences young offenders to become more involved in criminal activity, and therefore reoffend. 75% of offenders who go to prison reoffend within 12 months of release back into the community (Prison Reform Trust, 2014). Rehabilitation would address the young offender's welfare needs because it would teach him valuable moral lessons and about the consequences of his action, including victim impact. The counselling would aid in the management of his anger and controlling his alcohol abuse. It would be hoped that the counselling would also provide the emotional support which he did not receive and out of it would come positive and healthy relationships which would also provide him with moral support. It is not guaranteed that rehabilitation will be successful as the young offender may choose not to co-operate or give his consent, which is generally the most difficult part in juvenile rehabilitation. However this can be overcome by educating the young offender on the consequences of his crime. In addition to this, the unmet welfare needs of the young person are known, which makes recovery and rehabilitation easier. Although either rehabilitation or punishment could have a positive effect on the young offender, neither is guaranteed.

Best Regards,
M. Açıkgöz (Social Worker)

Bibliography

HM Government (1968). Theft Act 1968. London: HM Government.
HM Government (2010). Working Together to Safeguard Children. A guide to inter-agency working to safeguard and promote the welfare of children. London: HM Government.
Prison Reform Trust (2014). Prison: the facts. Bromley Briefings Summer 2014. London: Prison Reform Trust.
Raynor, P. and Robinson, G. (2009). Rehabilitation, Crime and Justice. 2nd ed. Basingstoke: Palgrave Macmillan.

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M. Açıkgöz is a Year 10 student at Heanor Gate Science College. Allan Booth is a PhD student at the University of Nottingham in the School of Sociology and Social Policy. Allan's research is about the working relationship enacted between Social Workers and young males who offend. The focus is specifically on the breakdown and repair of engagement during face-to-face interactions.

PhD Tutor's note

The essay asked the students to take the role of a Social Worker and write a pre-sentence report to suggest a sentence to a judge that would prevent a young offender from reoffending. I put forward M.'s essay because she approached an emotive issue from a balanced perspective of each the three debates on; Welfare/Justice, Nature/Nurture and Rehabilitation/Punishment. The presentation of M.'s argument was eloquently written through which she expertly used enough words to get over her points. A lot of people tend to overstate emotional arguments. With M.'s work, it was perfectly enough.

HOW COULD DEMOCRACY BE IMPROVED IN BRITAIN?

S. Browne, supervised by M. Goodwin

Abstract

The essay considers whether Britain can truly be said to enjoy 'rule by the people'. The author identifies a number of weaknesses in British democracy such as low turnout, weak political knowledge among voters, and the difficulty of holding democratically elected politicians to their promises. The essay makes a number of recommendations to improve British democracy including lowering the voting age, making greater use of referendums, and penalising parties for breaking their promises.

Democracy is a word derived from the ancient Greek 'demokratia' (*Demos* meaning people and *Kratos,* power or rule). However what is the extent to which the people really rule? What if the people are not ruling at all? Democracy in Britain could perhaps be improved if everybody knew what democracy truly was and not just associate it with the right to vote as that is only one of the many factors that allow democracy to be defined as rule by the people.

Throughout this dissertation I will be addressing these points in the following order: The fundamentals of Politics (democracy in particular) being taught in primary schools of Britain, Parties not being allowed to run for the next general election as a consequence of negligence to promises and reforms towards the public, increasing participation in British democracy, increasing control over politicians once elected, rules on who is eligible to vote, the option of 'no vote' on voting ballots and the stigma of politicians all being the same. In response to the question I think democracy can be improved in Britain by uniting politicians with the public. This is a key recommendation as instead of dehumanising politicians in the sense of viewing them as an entity, we should realise that no two worlds can work without the other and that they must co-exist together. In order to reach equilibrium we need the other. We must first accept this so that it can catalyse prosperity. Additionally it is a question that holds great significance and that is worthy of thinking about because what we do today will always leave a ripple in the river of tomorrow. Improving the errors now can create a better, improved future for Britain for future generations.

After reading and examining Plato's story 'The Ship of State' I instantaneously came to the conclusion that Plato was saying: how can a ship work when the crew (which can be perceived to be politicians) are so blinded by the inner drive to rule, demolishing whatever and whoever comes in their way? How can democracy work if the foundation it is set upon is so undemocratic? D Robertson, writing in 1986, stated that: "Democracy is the most valued and also the vaguest of political terms in the modern world" (Robertson, 1986). Some people could believe this to be certainly true and so also believe this needs to be improved. This can happen by allowing politics to be introduced into primary schools. By teaching school children and helping them to understand what kind of society they are born into and to decide for themselves through education and nurturing what sort of society they would like to live in. Providing such knowledge can only be beneficial in preparing them to be citizens in a representative democracy because the children are the future. By teaching them to understand the fundamentals of politics now from an early age and adding to that fundamental knowledge later, they can be more willing to vote and contribute to this democracy in Britain, thus improving it.

In a 2012 article, Whiteley reports on an experiment where: "In 2002 compulsory lessons on citizenship were introduced into secondary schools in England...The findings are that citizenship education had a positive impact on three key components of civic engagement: efficacy, political participation and political knowledge. This suggests that the reform is likely to help offset some of the trends in civic participation among young people." (Whiteley, 2012, 513)

This source evidently favours my argument of allowing politics to become a part of the national curriculum, it is evident that this reform can only be beneficial. The study of fundamental Politics in these schools have aided in political knowledge and with this new knowledge, if occurring in schools all over Britain it will allow Britain to be improved because collectively more people are now becoming more knowledgeable in the field of democracy in Britain.
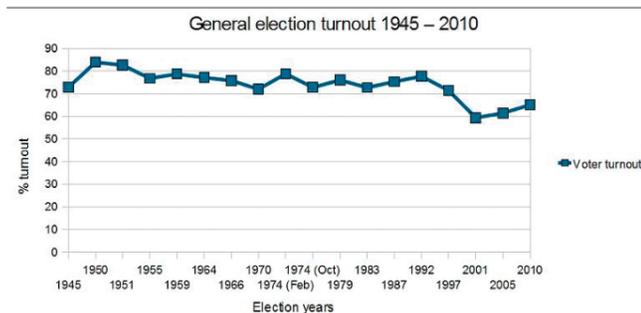

Fig 1

In 2001 the vote at the general election declined significantly and then never found itself rising at this same significance. Why? Perhaps there is a profound voter apathy amongst British citizens because they are now disillusioned and somewhat frustrated that the promises made to them in the times of the upcoming elections were not then fulfilled. In addition to this, another explanation for a growing number of people feeling politically apathetic is because amongst those who don't vote the poor are amongst the largest representative group, and the main parties focus on those of middle incomes (University of Nottingham, 2011). The concerns of politicians have now in turn caused voter apathy because those less fortunate have been forgotten and so have lost the desire to vote for someone who has neglected them because they- the two main parties- do not speak about issues that concern the poor. A vote that enabled a political party to come into power and also allowed their leader to be prime minister has now been forgotten.

An idea to improve this nuisance is to allow British democracy to ensure to the public that if they are unable to fulfil the promises they made before they were appointed to power, then that same party will be unable to run in the next general election. Controversial as it may seem, it could eradicate any element of false hope and therefore further assure the public that the promises made to them will be honoured. It is likely that there would be disagreements and consequences to this proposal such as, if they are unable to run in the next election how can there be a judgement of whether that same party has learned and changed over the course of the interval years.

The argument of 'nobody is perfect' comes into play and solving the problem is not excluding those who have done wrong. However I also believe that limits would need to be put into place and rules adhered to. These limits could be that there has to be a substantial amount of promises neglected or a significant amount of facts and figures that show Britain's 'welfare' has declined during that political party's time in power. Similarly it is understandable that there would be people who would automatically disagree or perhaps dislike this idea therefore to persuade them I would reply that if we as a nation put our feet down they will tread more lightly in the future and know that they cannot do the same things as they have done before without retaliation. Therefore out of my two identified criticisms (Politics not taught in schools and parties neglecting promises) I believe parties neglecting promises is the most important and should be taken into strong consideration amongst any other suggestions as a method of solving, or improving British democracy. This new element can be introduced using the media. Since the media is such a powerful force in the 21st century it is logical to present these ideas this way as nearly all of Britain has access to various forms of media.

Democracy is about more than universal suffrage and a good democracy requires more than this. I imagine that a good democracy would have a real sense of parliament and politicians working together with the public to destroy the imaginary line that divides our world from theirs. It is feasible that the fact that I can imagine such a democracy shows that I have already subconsciously decided for myself that the democracy we live in is not a prime example of a good democracy. Furthermore, democracy is about the people ruling, but in this system the people only elect someone to rule rather than ruling themselves. Citizens of a democratic society should be more directly involved to solve this problem. The democracy we live in is only a segment of many. Representative democracy is not the only type of democracy that exists. If we enforced some of the characteristics of a participatory democracy there could be a possibility of improving the representative democracy we have; a reformed representative democracy, if you like. In practice this would mean that we as a society can enforce characteristics of a participatory democracy and positives of this would include: "create opportunities for all members of a population to make meaningful contributions to decision-making, and seeks to broaden the range of people who have access to such opportunities." (Wikipedia, 2015) A form of participation that ensures the government and citizens working together could be to introduce referendums into British democracy. Referendums are an opportunity for members of the public to make their opinions known to the government. This can help Parliament decide whether to pass new laws. The views of the public are always taken into account when Parliament passes a law. In California they are famous for their multiple referendums and evidence from the website of the California Secretary of State says:

"Between 1912 and February 2014:
A Total of 79 referenda were titled and summarized for circulation.
A Total of 30 referenda (37.97%) failed to qualify for the ballot.
A Total of 49 referenda (62.03%) qualified for the ballot.
Of the 48 which qualified and have been voted on, 20 referenda (41.67%) were approved by the voters.
Total of 28 referenda (58.33%) were rejected by the voters." (sos.gov.ca, 2015)

This provides evidence that the people and the politicians work together on important issues concerning everyone. This in theory benefits California as whether they accept or reject new laws to be passed the fundamental concept that still remains throughout is that they are participating. The people do get a say. If Britain were to experiment with referendums the people would be more a part of democracy than Britain has ever been before. Together Britain can flourish and can learn from the past so that we can thrive in the future.

In addition to this an improvement to British democracy could be to tighten the control over politicians once they are elected. One politician- Lord Hailsham once described Britain as an 'elective dictatorship' and not a democracy, because of the lack of power that citizens had to influence politicians in between elections. This also reinforces the point I made earlier – that democracy is not just about having the right to vote in elections. But rather always co-operating in between them also, to sustain democratic control. A suggestion to sustain democratic control 'by the people for the people' could be as a law; in-between elections the worries that are made by the public collectively from evidence gathered have to be addressed and methods of solving these issues have to be put forward otherwise parties risk facing immediately being degraded in the next general election as a consequence of breaking that law. This suggestion will most definitely ensure the public's worries are being considered and evaluated carefully as politicians will worry about that consequence and also losing votes in the process. An example of this in British society is the problem of the NHS having the 'worst A&E waiting times in a decade'. A poll taken by BBC news showed ' Of 4,209 adults asked, 74% ranked it "very important" while 93% found it either "very" or "fairly important" (BBC News, 2015).' Evidently this is an issue that British citizens feel extremely strongly about and to truly improve British democracy why not do the obvious, and listen to British citizens.

Furthermore the rules about who is eligible to vote can be perceived as unfair. A variety of countries have started to experiment with lowering the voting age, including Scotland. It could be argued that the rules on who is able to vote should be altered so that in the process this can improve Britain's democracy. One way to do this would be by lowering the voting age and including the youth in democratic decisions, allowing them to participate and fully grasp the rights of which a democracy states. Including them, as opposed to excluding them, from a process that will be moulding and shaping their lives but instead allowing them to choose if that will be in a positive or negative way. A way of deciding at which age you can vote could be by the age of the working population of Britain (15 and over). You are eligible to vote at this age because you are contributing towards the economy and so the elected government's decisions can affect you. However this rule should be applied more lightly as people who presently do not contribute to the economy such as people who are retired would not be excluded from this if they have previously contributed to the economy.

Also it is important to have the option of 'no vote' on the voting ballot because this allows British citizens to gain their democracy and to have a real sense of choice. They can choose who they want to vote for or they can choose not to vote for anyone at all. It will improve Britain's democracy by allowing parties to change their arguments or to improve their arguments by giving the public something to vote for and therefore ensuring that the 'no vote' option is never used. This new incentive will contribute to the improvement of Britain's democracy because the people can feel like they are the ones obtaining the power and not the politicians. Of course there are risks that need to be taken into account such as if 'no vote' or 'none of the above' wins what are we to do next? In response to this if it ever occurred the necessary measures would have to be taken. In this case if 'no vote' won the public would have to state their reasons as to why by taking polls but also having the option of saying specifics if their reasons are not one of the options on the poll but these would only be one word responses. Once the public have decided the top two will be addressed by parties and another election will take place.

Finally, the stigma of politicians all being the same is one of the many factors that represses the evolution of British democracy and is something that should be eliminated in order for progression to occur. In 2015 ITV held a leaders debate where Nigel Farage- UKIP leader stated 'I told you they were all the same' (ITV, 2015). A Politician stating that can be considered contradictory as all implies all politicians... which he is!

Data extracted from IPSOS-MORI shows just 16% of Britons trust politicians to tell the truth compared with 22% trusting journalists and estate agents and 31% who trust bankers. These figures exemplifies the point to which I am making. That the public do not trust the people who are believed to hold the fate of Britain in their hands. This is very concerning. This is an element to British democracy that truly represses its evolution. To improve this it is advised that the public talk to politicians to solve the underlying problems that holds back the relationship between Politicians and the public.

In conclusion, Britain's democracy can certainly be improved and must be done so by consulting with British citizens, demolishing the line that divides our worlds from theirs.

Bibliography

BBC News, (2015), "NHS 'most important issue', says BBC/Populus poll", www.bbc.co.uk/news, 26th January 2015

IPSOS-MORI, (2015), "Politicians trusted less than estate agents, bankers and journalists", https://www.ipsos-mori.com/researchpublications/researcharchive/3504/Politicians-trusted-less-than-estate-agents-bankers-and-journalists.aspx, 5th January 2015

ITV, (2015), "The Leaders Debate", www.itv.com/itvplayer, 2nd April 2015

Parliament Official Page , (2015), www.parliament.uk

PoliticsResources.Net (2012), "Turnout in General Elections", http://www.politicsresources.net/area/uk/turnout.htm, 22nd October 2012

Robertson, D, (1986), The Penguin Dictionary of Politics, London: Penguin

University of Nottingham, (2011), "Politics in 60 Seconds: Voter Apathy", www.youtube.com, 24th January 2011

Wikipedia, (2015), "Participatory Democracy",en.wikipedia.org/wiki/Participatory_democracy

Whiteley, P, (2014), "Does Citizenship Education Work? Evidence from a Decade of Citizenship Education in Secondary Schools in England", Parliamentary Affairs, 67: 3, 513-535

About the authors

S. is a Year 10 pupil at Hillcrest School, Birmingham. Mark Goodwin is a Fellow in Public Policy at the University of Cambridge where he researches the committee system of the UK Parliament.

PhD Tutor's note

The essay shows an excellent understanding of the key criticisms of democratic politics, and British democracy in particular. The paper tackles a wide range of issues including voter apathy, lack of participation and low trust. S. demonstrates the ability to construct logical arguments and to identify connections between key ideas covered on the course. The use of evidence is exceptionally good. The essay presents data graphically to communicate the key points. It makes use of sources discussed in class, sources provided during the placement and sources discovered independently including academic articles in scholarly journals. It is also clear that thought has been given to the quality and reliability of sources.

The Scholar