



MTU

Ollscoil Teicneolaíochta na Mumhan
Munster Technological University

A Snapshot of Postgraduate Research at MTU



2021

PGR WRITING COMPETITION



Address from Dean of Graduate Studies

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As our postgraduate research students live and work in an increasingly digital and information-driven age, the ability to write and communicate in a variety of styles appropriate to a range of audiences becomes increasingly important.

The Graduate Studies Office working with the MTU Library Service and others, supports research students to develop their writing skills not just for academic publication but also for communicating to the general public. As part of this initiative, we organized the inaugural MTU Postgraduate Research Writing Competition. Its aim was to provide postgraduate research students from all disciplines across the University with an opportunity to develop their writing skills and communicate their research, in language appropriate to a non-specialist audience, to the wider society.

Students were asked to submit a written article of no more than 500 words. The writing to take on any form, but the piece to be original, solely the work of the author and not published anywhere else in any format. A judging panel assessed the entries on the basis of three judging criteria: content, clarity and creativity.

The Graduate Studies Office would sincerely like to thank the judging panel: Professor John Barrett, NIMBUS Research Centre; Dr Catherine Frehill, Dept of Physical Sciences and Mr Ben Slimm, Marketing and Enterprise Officer for their work.

This compendium comprised of submissions from across all domains of the MTU research landscape including the Creative Arts (Fine Art, Music); Humanities (Social Studies), Sciences (Life Science, Computer Science and Physical Science) together with a number of entries from the various Engineering disciplines. This compendium presents, in the words of our students, a fascinating snapshot of research being undertaken in MTU today.

Dr Stephen Cassidy
Dean of Graduate Studies and Academic Quality Enhancement

In Touch with Data

An Exploration of Data Physicalization

Sarah Hayes, PhD candidate
Department of Computer Science



Data physicalization is the concept of giving physical form to data. It's also a mouthful to say. So instead of defining the term or trying to convince you of its importance, let's take a walk.

Imagine you are making your way through a science museum. You are on your holidays, and you've been exploring the city all day. This museum is the last stop before you head back to the hotel to change for dinner. Your feet are starting to hurt, but you look around, waiting to be engaged by the exhibits. What do you see on the walls? Charts. Bar charts, donut graphs, scatter plots. They are emblazoned on posters and murals, and can be interacted with through large touchscreens. Some play animations when activated, others play sound effects or voiceovers. You stop and play with a few, but if you're honest, they all start to blur together after a while. You wander on.

The next room you enter is different. Gone are the charts. Instead, hundreds of houseplants line the walls. Their flowery scent greets your nose before you see them. Each plant is in a different state of health – some are bright green and flourishing, while others are crispy and brown at the leaves. A sign tells you that each plant represents a country, and that each is given a different amount of water every day depending on the levels of drought currently being experienced in that country. You reach out and touch the dying leaves of Kenya and Brazil, and feel a pang in your heart as they crumble at your touch.

In the next room, you find a library lined with books of different sizes. Another sign tells you that each book is about a different famous scientist or engineer from the country you are in. The number of pages in each person's book represents how popular a search term they are on Google. You are invited to take down any of the books and read a little about their lives. You start to gravitate towards one of the larger books, but stop. Instead, you pick up one of the slim volumes, thinking to yourself that one of the lesser known scientists could use your attention more than the famous ones. You read, with growing curiosity, a few paragraphs about a female physicist who paved the way for modern space travel, but remains largely unknown. The scent of musty pages and leather binding remind you of the library in your hometown – you dip your face to the book and breathe in.

What makes data representations like this library or those plants special? They allow people to explore data, just like the bar charts and line graphs. But unlike these graphics, they are objects that can be held, touched, smelled, turned over. They remind us of past experiences. They hold our attention and please our senses in a way that a graphic or a chart cannot. This is the point, and the power, of data physicalization.

Preserving Privacy in Smart Grids with Accuracy in Results



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Department of Computer Science

Consider yourself sitting in your home watching TV. It's a nice weekend night. Your clothes are in the washing machine. The dirty dishes from the dinner are in the dishwasher. You have no idea how your daily routine is being monitored by just looking at your energy consumption data. Yes, this non-threatening energy data can be used to infer sensitive information about your life style and daily routine so much so that an adversary can tell when you go to sleep or when you wake up, when or how often you do laundry or more threatening information like when you are home or not. This is as a result of frequent reporting of energy consumption data to the power grid. Workflow of a simple smart grid is shown in the Fig.1 below.

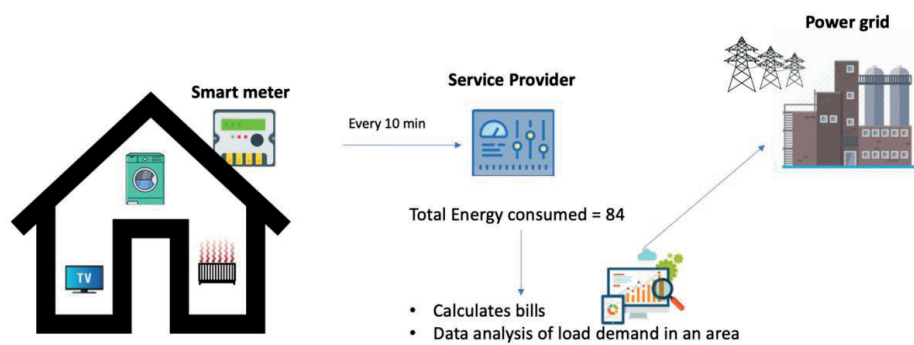


Figure 1: Smart Grid Architecture; Smart meters collect electricity consumption data of a household and sends to service provider for data analysis and billing.

Now the question arise why power grids need this detailed data? With progress in technology, power grids have evolved to be better at meeting highly increasing demand for energy. This new power grid system or Smart grid enables two-way communication between power grids and consumers. This exchange of information helps service providers in devising demand response policies to influence consumers energy demand from peak time to off peak time. Energy consumption data is also used to provide services like accurate billing and load monitoring. Even though reporting energy data has brought a lot of benefits for the consumers and power companies alike, it comes with consumers' privacy implications.

Several machine learning tools are available in the market which can be used to infer sensitive information regarding consumers lifestyle from the energy profile of a consumer. To cater this problem, among many solutions, differential privacy [1] is preferred solution. Differential privacy is a data anonymization technique. It uses a probabilistic model to add controlled amounts of noise in the data such that the results of the query on the data remain close to the original results. As an example shown in the Fig. 2 below, if the total original energy consumption of a household in a month was 100kWh then after the addition of differential private noise the total energy consumption can be between 95 -105 kWh.

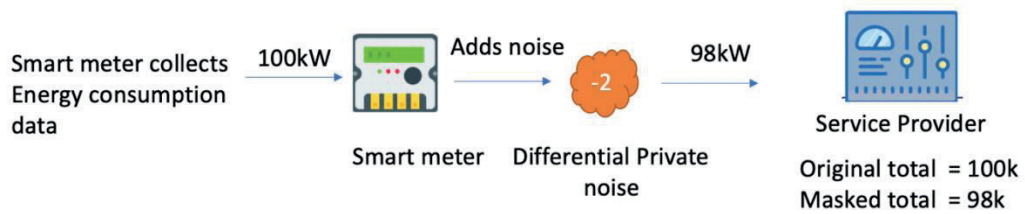


Figure 2. Differential private noise is added to the original data to mask the actual data before sending to service providers.

One of the main limitations of using differential privacy to hide sensitive information of consumers, is inaccuracy in billing and load monitoring due to the added noise in the data. To cater to the side effects of noise in the bills we propose a noise canceling system model which periodically cancels the noise added in the previous sessions [2]. Our model performs significantly better than state of the art existing solutions in terms of preserving privacy of the consumers and maintaining accuracy in billing and load monitoring.

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An Engineering Framework for the Generation of Robust & Verifiable Smart Contracts

(GRV-SC)

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Department of Computer Science



Smart Contracts (SCs) are immutable executable pieces of code that reside on a blockchain network to automate digital workflows by containing self-executing business logic. Many currently deployed SCs manage a large amount of virtual currency worth millions in fiat currency, so the monetary incentives are easily high enough to attract attackers. Therefore, SCs have become subject to external threats and attacks just like any other software programme. A small mistake in defining the logic of SC or exploiting security vulnerabilities in it has resulted in significant economic losses (millions of \$) or penalties.

In recent years, it has become apparent that the reach of SCs is expanding to new application areas such as IoT, enterprise, maritime, cloud, AI, and medical. Since, lack of trust in contracts is unacceptable, therefore, SC vulnerability invocations, auditing standards, vulnerability reporting, security strategy identification, and the need to verify domain-specific properties have become active research areas. SCs are ideally suited for comprehensive formal review because they are compact and time limited. Therefore, from an academic perspective, several tools and approaches have emerged to support the development of secure and robust SCs and to assist in the analysis of already deployed contracts. This type of research includes approaches that use non-formal methods (static and dynamic analysis methods) to detect failures under certain execution conditions, and other methods based on formal techniques, with the goal of automatic formal verification (FV) of SC. While non-formal methods can only test a specific query under specific scenarios, they cannot prove the correctness of SCs in general, which makes it difficult to detect complex patterns. Similarly, numerous machine learning (ML) based technologies have emerged to detect vulnerabilities in SCs for which they have been trained. Moreover, some approaches rely heavily on a set of expert-defined rules/patterns that can be error-prone and lead to significant false positives or false negatives. For this reason, academia and industry have moved to formal verification, which has proven effective in achieving such correctness goals, although it is very costly and more difficult to automate. Moreover, there is no comprehensive lifecycle management framework for SC on the market to date that integrates automated modelling and formal verification techniques in one place to address all root causes and potential vulnerabilities associated with SCs. Apart from this, most solutions are platform and language specific. To overcome these risks and challenges, tools and services are needed that are based on modelling and formal techniques and include a robust methodology for SC verification and lifecycle management.

Therefore, this study proposes an engineering framework for generating robust & verifiable smart contracts (GRV-SC framework) that uses SC modelling and automated formal verification methods to verify the security, resilience, extensibility, optimization, and risk management of SC development in the pre-development phase. In the subsequent network implementation phase, a set of automatically generated test scenarios is provided to verify the privacy and scalability of the contract in real-world ledger networks.

Robust Control Strategies For Optimal Operation Of Distributed Generation In Smart Microgrids



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Global warming from burning fossil fuels has been a problem that everyone can feel with more and more extreme weather and natural disasters. The alternatives to fossil fuels are renewable energies such as solar, wind, ocean and biomass. Among the green energies, solar energy with solar panels can be applicable for resident houses. However, with the high increase in solar energy, there are problems with the distribution network needed to be solved.

High solar energy can cause the network voltage to be higher than regulation. To reduce the voltage, solar power can be reduced. However, reducing the solar power for voltage can lead to the lower energy production of the customers. Therefore, this research is about developing an optimization method that can control a group of solar systems to operate cooperatively for maximizing energy production while maintaining the voltage under the limit. In a network, the high voltage of one house can cause the voltage levels of other houses to be increased so that the optimization control can ask a few solar systems to reduce their power and the others to produce high solar energy.

The optimization can be possible with the help of communication links between the controller and the solar systems. However, in the case of broken communication, the commands from the controller may not be optimal anymore. In this research, the optimization controller is able to cope with the communication loss to a few solar systems in the network. The optimization control can also be applied for different controllable groups in a network.

The controller needs a certain amount of time to perform the optimal calculation. By the time the optimal calculation is completed, the state of the network is changed. Therefore, the controller has to calculate the optimal results for the network in the next period. To do that, a prediction method is applied to estimate the state of the network in the future. It is known that the longer the time section to be predicted, the less accurate the prediction or the more complicated the prediction method. In addition, there are unexpected changes in solar irradiation and the energy usage of households. Thus, the prediction in this research is used to forecast a very short time ahead leading to more accurate results.

The application of the optimization control in the simulation has shown that the effectiveness of improving the total energy production of solar systems in the controllable groups. In the simulation, the network was always stable even in the case of communication loss and large prediction mismatches. The optimization method in this research may contribute to the field of smart grids in the future with high penetration of renewable energies.

Enhancement of Socio-Economic and Environmental Sustainability



Through Optimal Integration of Renewable Energy Sources and Electric Vehicles into Power Distribution Network

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Department of Electrical and Electronic Engineering

The modern power system is expected to follow the three pillars of sustainability: environmental, economic, and social. Renewable energy sources (RESs) and EVs are seen to be the building blocks of these pillars and such vision can be achieved through green energy generation, improved energy market practices, and enhancement of power supply reliability. The intermittent nature of renewable energy sources (RESs) and EVs load presents several challenges such as voltage fluctuations, power quality degradations, and peak load augmentation, which result in affecting the stability of the power system and introducing higher energy costs. Furthermore, the increasing penetration of RESs and EVs requires an interconnection between retail and wholesale energy market to encourage the prosumers in energy market participation with incentive-based demand response programs and energy trading. In the literature, the integration of RESs and EVs have been either studied from the power grid (voltage stability etc.) or economic (energy cost etc.) perspectives. However, an arbitrage consideration of technical, social, and economic requirements from several entities such as power grid, prosumers, and public parking lots etc., along with their requirements are yet to be studied extensively.

Therefore, the above-mentioned knowledge gaps can be covered by the development of a smart charging energy management system (SCEMS) to optimally enhance the penetration level of RESs and EVs into the power grid by formulating multi-objective functions in the presence of techno-economic and social constraints. SCEMS can exploit AI approaches to capture the stochastic nature of RESs and EVs users to obtain an optimized solution.

The architecture of SCEMS with functional components is illustrated in Figure. 1.

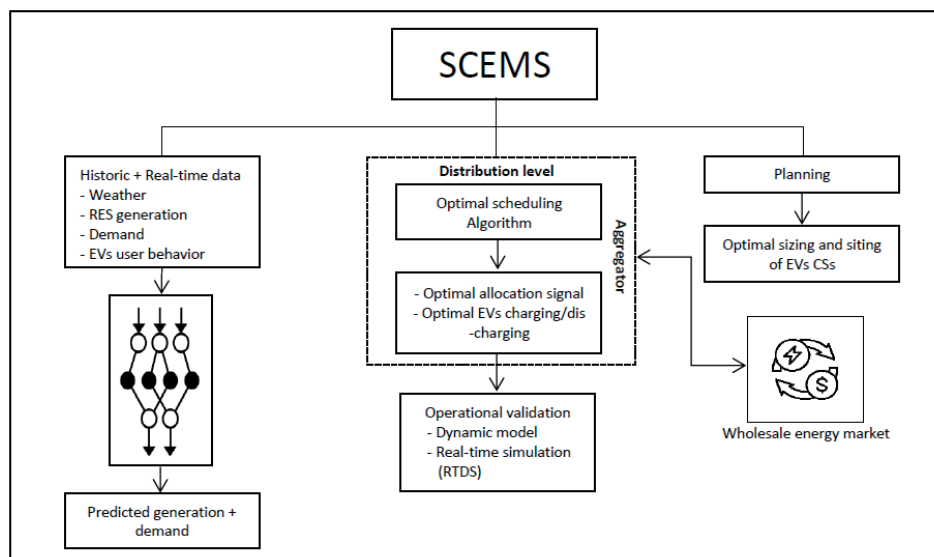


Figure. 1. SCEMS architecture.

Sending Microbes to Mars

My Out-Of-This-World Research

Daniel Keaney, PhD candidate
Department of Biological Sciences



The aim of my research is to design bacteria for bioremediation on Mars.

What does this mean?

Bacteria are everywhere and they can be both helpful and harmful to mankind. Each species of bacteria has its own set of 'superpowers' such as being radiation resistant, or able to live in incredibly hot or cold environments where life could not survive. Some bacteria possess the power to save the environment through bioremediation. Bioremediation is defined as, "the use of either naturally occurring or deliberately introduced microorganisms to consume and break down environmental pollutants, in order to clean a polluted site". These bioremedial bacteria can do this using special enzymes encoded for within their unique genomes. Enzymes are biological machines contained within the bacterium and they are capable of doing many task-specific functions. During the process of bioremediation (as shown in the diagram), toxic environmental pollutants, such as oil spills within rivers, oceans or soils, come in contact with these bioremedial bacteria. These bacteria recognise the pollutant and activate their enzymes, which begin to feed on the different chemical components of the pollutant. The enzymes convert the toxic material into cleaner, less harmful ingredients, which in turn feed the bacterium and helps to clean the surrounding environment.

How does this translate from Earth to Mars?

Sodium perchlorate is a salt-based toxic environmental pollutant that can be created as a by-product of farming, the burning of rocket fuels and munitions manufacturing. This salt pollutant often ends up in our soils, rivers and our oceans where it causes damage to aquatic life. It's also a major concern within domestic water supplies in the USA. Perchlorate also happens to be found on the surface of Mars in toxic amounts. If humans were to colonise Mars, the crops grown within Martian soils would absorb the toxic perchlorate from the soil (this is known as bioaccumulation; the passing/accumulation of toxins through the food chain), and upon consuming these tainted crops, colonisers would be poisoned. Fortunately, a bacteria known as *Dechloromonas aromatica* has the bioremedial ability to break down perchlorate into harmless chloride ions and even oxygen which colonisers can use to breathe, all thanks to its specialised enzyme; perchlorate reductase.

Where does the design bit come in?

The aim of my project is to determine what's the best way to ensure bacteria can bioremediate the most perchlorate on Mars. *Dechloromonas* alone isn't the best candidate to send to the Martian surface. Therefore, I aim to take those special 'superpower' genes encoding for the enzyme perchlorate reductase and "express" them (make it work) in another species of bacteria that's more suited to the Martian surface (such as *E. coli*). I also want to assess if a community of different bioremedial bacteria could yield an enhanced degree of bioremediation in comparison to a genetically modified bacteria too. Other fun aspects of the research includes quantifying enzymatic perchlorate metabolism and observing how these candidate space bacteria react to a simulated Martian environment; such as daily temperature fluctuations and UVC exposure.

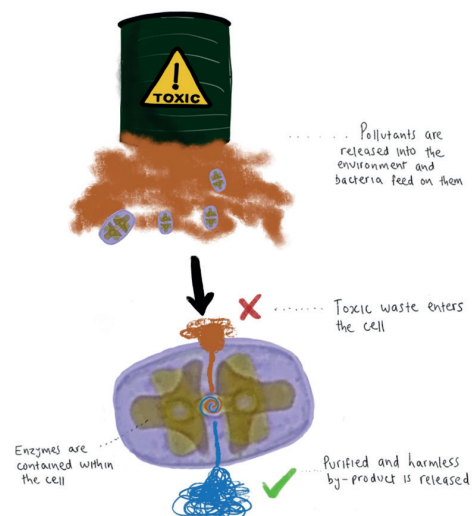


Fig. 1: The process of bioremediation (designed and created by Daniel Keaney)

Farming The Sea

Cleaning Up Our Act

Amy H Fitzpatrick, PhD candidate
Department of Biological Sciences



Seagrass, periwinkles, oysters - while nowadays such delicacies feature on Michelin-starred menus, they were the scrapings which sustained starving Irish peasantry during the Great Famine of 1840-1847. Ireland and its people have a complicated relationship with seafood, owing in part to its reputation as a poor man's food ('bia bocht') and the dangers that came from eating filter feeders. Oysters filter up to 150 litres of water per day, making them an excellent source of nutrition but also disease-causing pathogens. The fishmonger Molly Malone likely died from typhoid fever after eating shellfish, a common fate in the 17th century before advances in sanitation.

Today, systems are in place to limit the pollution of waterways and monitor how safe our food is. However, Ireland's water network is largely unmapped. How many of us grew up in houses connected to a septic tank rather than the mains? This makes it difficult to identify where raw sewage is entering our waterways. As our cities and towns have expanded, the wastewater treatment plants are not large enough for the ever-increasing population - the frequent 'Boil Water' notices issued after periods of heavy rainfall are a testament to this.

One virus which accumulates inside shellfish is norovirus, also known as the winter vomiting bug. This virus can survive for long periods in cool water with low salt content such as the Atlantic Ocean during the winter. As sewage contains waste from many people, multiple genotypes of norovirus can end up inside oysters. Symptoms of norovirus include explosive diarrhoea and vomiting and it spreads like wildfire.

At the Teagasc Sequencing Facility, Co.Cork in collaboration with MTU and the Marine Institute, Galway, we are 'fingerprinting' all the genotypes of norovirus found inside oysters. Sequencing or 'fingerprinting' involves reading a series of bases, or letters. We all have a unique series of letters and that makes up our genome. Usually we don't need to read the entire series of letters that makes up human or viral genomes and instead we target a small region that provides enough information to identify an individual or group. Oysters contain RNA from genes being expressed by the oyster and bacteria and viruses living in the oyster gut alongside the inactive norovirus. Less than 0.1% of the RNA inside an oyster is viral RNA and only some of that viral RNA is from norovirus.

We are improving sequencing of norovirus by removing some of the oyster RNA or targeting the norovirus RNA. This is akin to looking for a needle in a haystack by making the haystack a lot smaller or by making the needle easier to find. We monitor norovirus genotypes circulating in Ireland or in an outbreak situation. By collecting and sharing this information we help target vaccine development and antiviral research and it allows us to watch for new viruses that could cause illnesses.

Shellfish farming is sustainable and has a positive environmental impact but we need to clean up our act to make it safe to eat all year round.

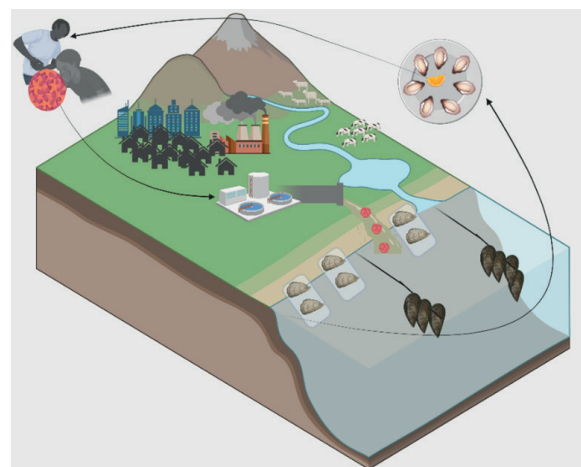


Fig. 1. The circular pathway of norovirus in the community

Kissing disease

Infectious Mononucleosis

Patrick Naughton, PhD candidate
Department of Biological Sciences



With the easing of Covid19 restrictions, the re-introduction of third level students to university campuses and increased social activity there is a disease that college students need to know more about. That disease is Infectious Mononucleosis (IM) or Glandular Fever – colloquially known as the ‘kissing disease’.

Why is it called the ‘kissing disease’?

The main means of spreading this disease is by transfer of infected saliva from one individual to another.

What causes the disease?

The causative agent of IM is the Epstein-Barr virus, a herpes virus, eponymously named after the British scientists, Anthony Epstein and Yvonne Barr who first observed this virus in human B-lymphoma cells in 1964. The virus particles were discovered in tissue samples taken from children suffering from Burkitt’s lymphoma, an aggressive type of lymphoma, endemic in tropical Africa.

Will you be affected?

Although > 90% of the world’s population eventually gets infected with the virus the vast majority of people show no sign of the disease. Asymptomatic infection with the virus generally occurs early in life; of those infected later in life a small cohort can present with IM – an acute debilitating response to the virus.

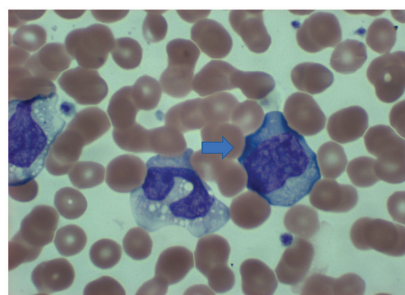
What are the symptoms of IM?

IM is a self limiting disease and the symptoms vary but are transient; they include fever, fatigue, malaise, sore throat, swollen lymph glands (particularly of the neck), swollen liver and spleen. In cases of swollen spleen medical advice is to restrain from strenuous physical activity and contact sports for a period until the patient has recovered sufficiently and swelling has subsided, a ruptured spleen would be considered a medical emergency.

My research

Being a medical scientist my work involves the investigation of disease at a cellular and macromolecular level. The diagnosis of IM is complex; not all cases present the same clinically and laboratory results can vary particularly between different age groups.

The slide above shows a typical reactive lymphocyte observed in cases of acute IM; the atypical lymphocytes seen early on in infection are one of the earliest biomarkers for the presence of the disease. Patients’ specific antibody responses often mirror the typical blood picture seen in acute cases of IM.



My research involves a multivariate analysis of the laboratory data collected in the Mercy University Hospital on a large population of patients suspected with IM. I will use bioinformatics to establish an algorithm for the proper diagnosis of the disease. Following presentation of the data analysis I hope to substantiate my findings with hospital case studies highlighting the importance of applying the algorithm to enable clear, unambiguous diagnosis of the disease, particularly in atypical cases.

By improving the diagnostic paradigm requesting clinicians will be better informed, this, it is hoped, will result in more precise, conclusive and accurate diagnosis of IM, mitigating the requesting of unnecessary tests, saving time and money, and ultimately leading to better patient management and outcome.

The Next “Phage” of Treating Johne’s Disease



Controlling the spread of transmission of *Mycobacterium avium* subspecies *paratuberculosis* with Bacteriophages

Max Kevane-Campbell, PhD candidate
Department of Biological Sciences

What exactly is Johne’s?

Johne’s disease is a scourge to farmers worldwide. It is a type of disease that causes chronic and infectious inflammation and lesions along the inside of the intestine of, primarily, cattle as well as other types of ruminant based animals, i.e., goats and deer [2,5,6,11].

The disease is caused by the bacteria known as *Mycobacterium avium* subspecies *paratuberculosis*, referred to as “MAP” for short, and belongs to the family *Mycobacteriaceae*, the genus *Mycobacterium* and is a well-defined subspecies of the *Mycobacterium avium* complex, also known as “MAC” [6,9,11].

The clinical syndrome of Johne’s was first recognized in the early 1800s, but it was not until 1895 when Dr. Heinrich A. Johne and Dr. Langdon Frothingham discovered the bacteria within the intestinal tract of affected cattle in Germany after receiving tissue and intestinal samples from a sick Guernsey cow provided by Dr. F. Harmes [3].

Why Johne’s is such a big problem

The disease is a blight on cattle-based industries, with costs estimating from a range between €13.80 – €200 per cow per year within the worst case of infection.

Costs are mainly associated with the reduction of milk production and the increase in costs for animal health [13].

Because MAP is a member of the MAC group, it is extremely difficult to treat with standard antibiotics [7]. Their strong resilience is thanks to the high amounts of lipids they contain, over 60%, within their cell wall.

The cell wall acts like a layer of armor for the bacteria and gives it both protection and support. Since the cell wall has such a high concentration of lipids, it gives the bacteria unique properties such as hydrophobicity (the property of a substance to repel water), acidfastness (the ability to resist decolorization by acidified alcohol), increased resistance towards chemicals (e.g., chlorine) and physical processes (e.g., pasteurization) [10].

Other factors such as having an extremely slow growth rate and an inactive dormant stage outside of the host makes MAP difficult to treat with antimicrobials [5].

So far, the most effective method of preventing Johne’s disease is careful on-site farm management practices and culling infected animals as there is no fully effective vaccine or antibiotic strategy that is licensed in Ireland for the disease [4].

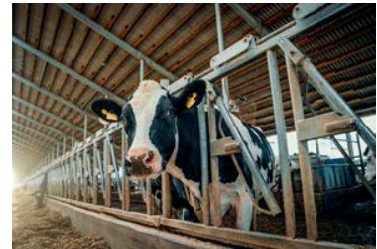


Figure 1.1. Image of the primary target of Johne’s Disease, a Holstein Friesian Cow [8].

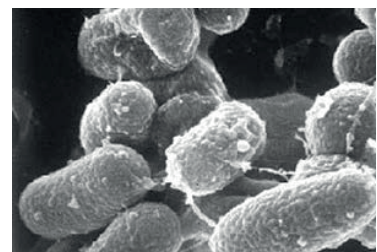


Figure 1.2. Scanning electron micrograph image of rough MAP grown in culture media without Tween [1].

What's being done to treat Johne's

As MAP has such strong antibiotic-resistant properties, alternative ways to treat the bacteria have been investigated. The alternative that has the most potential is phage therapy.

Phage therapy, is the practice of using phages, a unique type of virus that only infect and destroy bacteria, to treat bacterial-based infections.

Phages range from 100-500 nanometers (nm) in length and are the most abundant biological entities on the planet, with an estimated number of 10 phage particles in the biosphere, a phenomenally large number that translates into approximately a trillion phages per grain of sand in the world.

Phages have been identified and isolated from nearly every environment where bacteria exist. It is heavily hypothesized that there is at least one type of phage, and most likely more than one, that infects every strain of bacteria.

Conclusion

The aim of the research is to investigate the feasibility of using phages as an alternative means of controlling Johne's disease by targeting MAP and preventing the spread of transmission.

New and existing phages, as well as phages acquired from environmental sampling, will be propagated and engineered to maximize their efficacy against the MAP pathogen and delivery strategies will be investigated using modern technologies on how to best implement this strategy.

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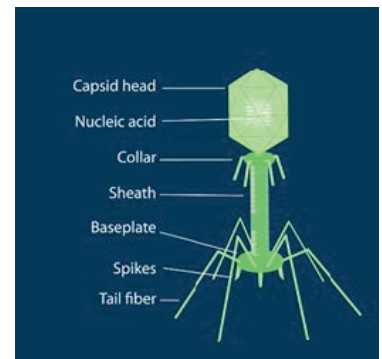


Figure 1.3. Image of the basic structure of a bacteriophage [12].

An Investigation Into The Provision Of Trauma Training In The Irish Early Childhood Education & Care Sector



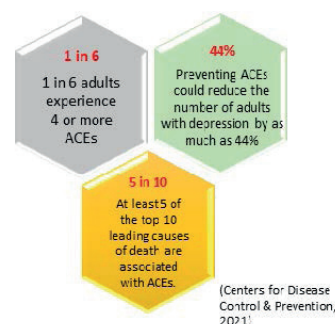
Meeting The Grade Or An Abject Failure?

Catherine Corcoran, PhD candidate
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The more healthy relationships a child has, the more likely he will be to recover from trauma and thrive. Relationships are the agents of change and the most powerful therapy is human love (Perry, 2006).

Overview & Rationale

Childhood adversity is an emerging public health matter, which has generated concern in the Early Childhood Education & Care (ECEC) field in Ireland (Prevention & Early Intervention Network, 2019). The term Adverse Childhood Experiences (ACEs) originated from a groundbreaking study in 1995 and refers to three specific areas of adversity including; physical and emotional abuse, neglect and household dysfunction (Felitti et al. 1998). The original study documented a checklist of 10 potential adverse experiences.



ACEs - what's the fuss?

Trauma and ACE exposure is common, and a host of negative consequences can span the life-course including; alcoholism, depression, early initiation of sexual activity, sexually transmitted infections, adolescent pregnancy, and pre-mature death. The experience of 4 or more ACEs is a threshold for increased risk of heart and liver disease, unemployment, poor mental health, and social isolation. These experiences can profoundly alter brain-body functioning and require specialised intervention; Trauma-Informed Practice (TIP), a principle-orientated intervention to encourage healing and recovery.

Why is this research important?

To date, Ireland has not developed a dedicated trauma training model for the ECEC profession, a cohort who directly work with an endeavor to educate and care for children. As an emerging initiative, this research serves to establish a pioneering and novel trauma training programme which would be specifically developed for, and offered to, ECEC practitioners in Ireland to assist in their delivery of TIP.

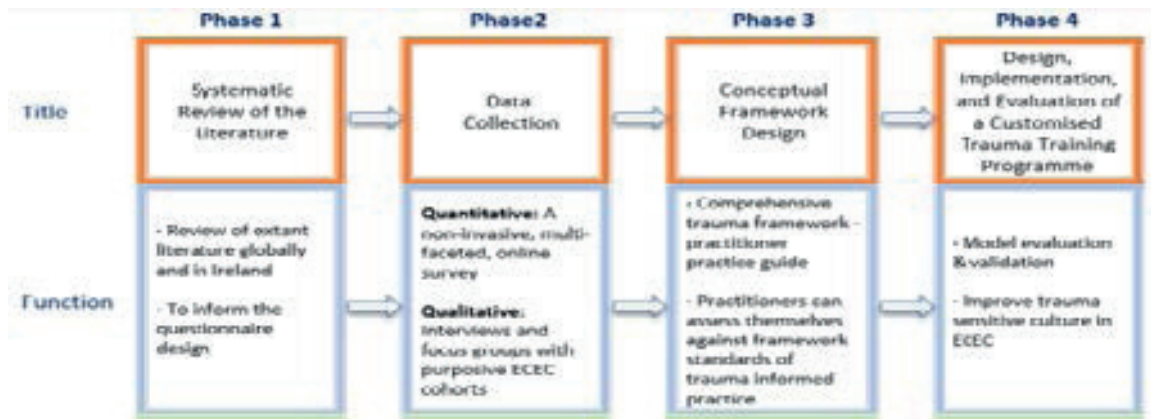
Research questions?

In order to assess the depth and scope of the trauma informed trajectories offered to, and obtained by, ECEC practitioners, the following four research questions are posed:

1. What current trauma training is offered to ECEC practitioners in Ireland during Initial Practitioner Education (IPE) and Continuous Professional Development?
2. What training do ECEC practitioners require to become trauma sensitive/ aware/ informed/ responsive, and how can ECEC practitioners be assisted in understanding and delivering a trauma informed approach to educating and caring for children aged from birth to 6 years?
3. What are the key components of effective approaches used by ECEC practitioners to provide trauma informed practice, including methods of evaluation of effectiveness?
4. What policies, procedures and practices, including targeted preventions, should ECEC services employ in order to implement a trauma informed approach to ECCE in Ireland?

Methodology

A mixed methods approach will be utilized, and a strategic four-phase methodology process will be employed.



Conclusion

This research maintains that the integration of trauma-informed education should be actively rolled out in Irish ECEC services in order to build resilience, improve outcomes and resist re-traumatisation; and the proposed research is an attempt to achieve this.

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Multi Criteria Optimization of Demand-Controlled Ventilation

for safe and energy efficient indoor environments in industrial buildings



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Abstract

Heating, ventilation, and air conditioning (HVAC) energy consumption in buildings involving manufacturing practices (for example, warehouses, factories, data centers, cleanrooms), can account for almost 80% of total production facility energy use [1] and this is largely due to strict hard and fast rules set for the operation of these systems. In other words, they operate at their full operational capacity irrespective of the occupancy within these building spaces. In the light of recent COVID-19 pandemic, majority of industrial buildings are forced to always run their HVAC systems throughout all times of the day to prevent accumulation of the virus and air droplets containing it, that can lead to higher energy consumption than typical office or residential facilities. Demand Controlled Ventilation (DCV) using carbon dioxide (CO₂) sensor-based occupancy detection control strategies has been suggested by American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) to overcome this issue. This technique of ventilation turns the HVAC off during times when there are no people in the building. However, for industrial spaces, there is always a high risk of particle accumulation or deposition on the manufacturing process, which can lead to poor quality products. Therefore, an investigation on the application of DCV in industrial indoor environments is required due to limited validated studies on this subject.

Research Objectives

The research objectives are as follows:

1. Determine what are the optimum operating conditions and cost-benefit trade-offs between high levels of HVAC operational energy efficiency in both production and non-production environments, particulate cleanliness levels in production spaces and sufficient reductions in risk of airborne infectious spread of pathogens by adopting strategies such as DCV.
2. Develop solutions to support industry in addressing the new multi-criteria operating environment for HVAC systems.
3. Through a combination of field studies and modelling of the adjustments mentioned, it is intended that the research will produce guidelines, recommendations, and robust strategies for adopting DCV.

Research Methodology

Two of the possible approaches to the project are given as under.

• Controlled Laboratory Experiments

The Ventilation Test Chamber at MTU Energy Lab will be employed to investigate whether optimised ventilation regimes developed within the modelling stage translate appropriately to real physical applications. This chamber can also be used to apply numerical models pertaining to air flows inside an industrial space, for example, a cleanroom, when there are access related problems in altering mechanical energy system operation in industrial buildings. The Ventilation Test Chamber has been employed for ventilation studies in the past and similar approaches have been adopted by researchers for this type of scientific inquiry [2] [3][4].

• Field Investigations

A key aspect of the project will be to survey and map industrial ventilation systems that use demand-controlled strategies in biotech manufacturing and develop representative systems from this mapping exercise. An industrial partner facility will also be identified where improved DCV strategies can be practiced online to verify expected efficiency improvements.

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The HydroSED Project

Forestry Impacts on the Irish River Environment

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In the face of climate change, protecting biodiversity, reducing atmospheric CO₂ and transitioning to a more biobased economy is essential. In this context, forests represent a valuable resource (Department of Agriculture, Food and the Marine (DAFM), 2014). Ireland currently has among the highest rates of planting new forest ('afforestation') in Europe (Forest Europe, 2020), and afforestation is expected to continue over the coming decades. With over 11% forest cover in Ireland today, it is expected that 18% of the national land area will be under forest cover by 2050 (DAFM, 2014). It is clear that we can expect more tree planting and harvesting activity in Ireland.

Much of Ireland's forestry is located in upland areas (Upton et al., 2014), often found close to the source of rivers. Forests can play an important role in improving water quality and aquatic habitats (Forest Service, 2018). However, forestry operations can have negative impacts on water quality relating to river flow and levels of fine sediment in rivers (Safaeq et al., 2020). Fine sediment refers to small particles less than 2mm in diameter (Woods and Armitage, 1997), much of which is very fine and carried along in streams. Fine sediment can have negative impacts on aquatic species and habitats (Bilotta and Brazier, 2008), and can also absorb and carry pollutants in the environment (Walling and Collins, 2016). Forestry has been identified among the major pressures on water quality in Ireland today, particularly in relation to fine sediment release and impacts on river flow (Environmental Protection Agency, 2019). With a national obligation to protect our rivers in compliance with the European Water Framework Directive (WFD) (2000/60/EC), it is essential that we better understand forestry impacts on the Irish river environment.

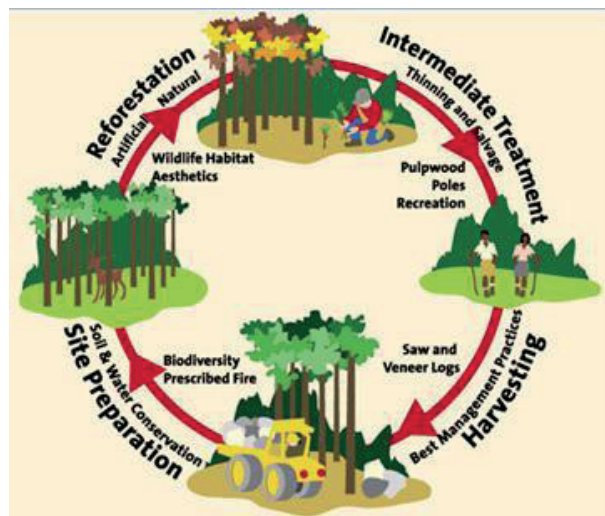


Figure 1. Lifecycle of forestry operations at a forestry site. Source: https://www.oregonloggers.org/Forest_About_FullCycle.aspx

'HydroSED' is a research project funded by DAFM which is investigating the impacts of forestry operations on fine sediment and river flow in Ireland. The project is being run by a multidisciplinary team of researchers from University College Dublin and Munster Technological University, in partnership with both public and private stakeholders in the forestry sector. A number of forestry sites located close to small, upland streams in varied catchment settings have been selected, with different forestry operations planned to take place across the sites. Planned forestry operations include **1) tree harvesting; 2) afforestation; and 3) reforestation** (replanting a forest at a harvested site)/**windrowing** (clearing leftover material at a harvested site to make space for planting a new forest).

Equipment is being installed at field sites to measure fine sediment and flow in the streams before, during and after forestry operations take place. From this field campaign, the project aims to understand how these forestry operations affect fine sediment and flow in streams, and how site characteristics such as soil type can influence these effects. A range of other field, laboratory and desk-based activities will also be carried out to evaluate the impacts of forestry operations on the study sites. The knowledge and understanding gained over the duration of the project will contribute to the development of policy and on-site forestry best management practices in Ireland. This will help to ensure a sustainable forestry

sector in Ireland; one that will benefit and safeguard our rivers for the future while contributing to our national strategy to both tackle and adapt to climate change.



Figure 2. Image of a harvested forestry site in Co. Wicklow. Photo by Rodhraí Crowley

For further reading/information on:

- 1) HydroSED Project –
 - a) <https://www.cit.ie/sirig/hydrosed>
 - b) <https://www.ucd.ie/hydrosed/>
 - c) For Twitter updates follow us @hydroSED_

- 2) Forestry and water quality in Ireland – (EPA Catchments Unit, 2019)
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Investigation of 'chlorine free' cleaning products as a source of alternative residues



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Ireland is an agricultural country and dairy production is also an important part of this economic production [1]. Every single day people in this country and also around Europe drink or eat milk or its derivate products which come from the Irish dairy industry [2]. The Irish Agricultural and Food Development (Teagasc) shows the milk production at 7.5 billion litres in 2018 [3].

One of the most prominent fears in Europe around food safety is the presence of hazardous by-products in food. This situation ended in the creation of the Rapid Alert protocol with the mission of informing all European countries about the risk in food [4][5].

The high level of dangerous substances come from the use of disinfection products like chlorine-based ones, particularly the Sodium Hypochlorite, which is more commonly known as the active component in cleaning products like bleach or other thousands of disinfectant products used in the home and also in industry [6].

The main problem with chlorine based disinfectant products is the high synergy with organic molecules [7], such as the case of dairy products which could include water coming from a river which contains organic material like leaves and tree logs or branches. This reaction can create certain by-products, the main and the most important example is the Trihalomethanes (THM) [8].

The presence of THM in food or drinks are immediately related to cancer and other types of illnesses like vascular problems and premature births, so it is important to change the presence of this by-product [7].

That is the reason why changing the disinfection process in the dairy industry is so important [8]. The chlorine-free detergents are becoming a great opportunity with good performance in the disinfection activity and can also be used effectively in lower temperatures. This means less cost in the disinfection process and also erasing the presence of THM in food [9].

But how can we be so sure about the safety of these new chlorine free products? And how can we measure the presence of these dangerous by-products? Those questions are the core of this research. Raman Spectroscopy is a technique which uses a laser with the mission of exciting the molecules in the sample and where the Raman can detect that change in the excitation around the molecules. Every single molecule has its own signal so that is useful [10]. This technique has also been used in milk components characterisation like fats and proteins in recent years [11] and has also been useful in the detection of chlorine and THM for a long time [12].

But Raman Spectroscopy needs additional assistance because the system itself is not that powerful, so the enhancement appears as a solution to this problem [10]. The Surface-Enhanced Raman Spectroscopy or SERS is a technique that helps in the vibrational signal (like a magnifier with the sunlight) amplification of the molecules inside the sample [13]. This is useful when the concentrations are tiny like in the case of TBH or chlorine in milk samples.

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A qualitative exploration of expressive arts activities for adults with intellectual disabilities from the social care work perspective



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This research targets, 'A qualitative exploration of expressive arts activities for adults with intellectual disabilities from the social care work perspective.' The intentions are not to follow in the steps of others within the realm of social care but to lead the way in understanding how social care workers use the tools of expressive arts activities to help and guide their supported persons. Correlating this data has been a joyous experience to say the least, as new opportunities and potential framework structures arise on a regular basis.

This venture will also be a progression towards opportunity, to inspire the improvement of a supported persons quality of life in our social care systems and to push more on the thought of doing and wanting to do more for our supported persons wellbeing, to increase the knowledge, and the professional practice of social care, which can be sourced through CORU.

Studies such as this one, have an obligation to educate not only the reader but social care organisational structures that have the power and the ability to implement them in our working world to support vulnerable adults with intellectual disabilities.

As I read, explore, write, at a desk or on my floor, my research decisions impact me more and more. I have to decide, I have to believe that I am the tide, with limited time. I have learnt an academic must; a must I intend to confront. I have learnt that all we have to decide, is what to do with the time that is given to us.

I realise that this is my chance, my responsibility, to find a light in social care working practices. Enabling positive routines, for the workers that spend their days and their nights caring for vulnerable adults with intellectual disabilities.

The questioning of direction is ongoing, at times I feel strong enough to tackle the exploration process day after day, and most days I do. Yet other days I feel thin, or even stretched, like butter scraped over too much bread. This is where it is vital to have support systems in place to help us find our way back on our academic journeys again.

As we journey through this academic venture, I realise that not all those who wander are lost. Each step, brings hope, inspiration, and a thirst for knowledge that transcends to our families, friends, and peers. On these winding roads, we must mind our feet otherwise there is no knowing where we might be swept off to. Although I am not an experienced researcher, it is important to remember that even the smallest person can shape and change the course of our future.

Solastalgia

Exploring a Sense of Place

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This research project responds to our current moment of climate crisis and environmental degradation by presenting an intensive engagement with Ballyhighland woods, a small and semi-natural woodland close to my home in Wexford. It takes a position of local advocacy of creative practice to communicate the story of climate change.

Using Ballyhighland woods as a concept case study, the research will be examined and tested through a visual art practice, supported by contextual materials, theoretical underpinning and written thesis. The project will draw on the expansive body of literature involving environmental writing such as eco literacy for art practitioners, eco psychology, eco philosophy, symbiotic science, and tree ecosystems.

My concept developed from an ongoing devotional relationship with Ballyhighland woodland from 2008 to the present. In 2020 I completed the Art Textile Special Purpose Award in CCAD, for work that engaged a multi-media exploration of the natural forms of branch structures, the intricacy and interconnection of tree details. Therefore this research project and creative practice is both a natural continuation of my practice and a timely contribution to the growing body of research around tree ecosystems, eco psychology and ecophilosophy.

I see this specific location and its aesthetics as a complex interconnected systems of organisms in constant communication. Henceforth this specific location merits close examination and a personal interpretation.

Climate change is impacting the ways in which we experience nature, which in turn has an effect on human cognitive function and mental health, particularly with the recent catastrophic events that have taken place in Europe, USA, AU and India. Apart from being traumatised by these climatic events how does one emotionally find words to describe their new surroundings?

To explore this answer, Glen Albrecht's new language of emotions in particular Solastalgia & Soliphilia from his book Earth Emotions can more adequately describe the complex emotional responses to climate catastrophe and environmental degradation. These new words are most relevant to my research in which they describe an attachment to a place and articulates the distress and experiences of destructive forces that alter a physical place, in particular relating it more to our own locale.

In order to relate to the emotional and experiential connection to climate change, Ballyhighland woods will act as a canvas to explore a specific local area, its ecosystem and contribute to the need of local connections of care and respect towards a place that ultimately support us and promote active personal engagement with environmental change.

Through a visual studio practice using printmaking, photography, textiles, video and audio, I will closely examine the living communities in Ballyhighland woods, exploring the emotional range and agency that a deep connection to place will deepen understanding of what is required for enduring personal, collective and planetary wellbeing.

Accessibility vs Exclusivity

Caitlin Kelly, MA candidate
MTU Cork School of Music



Accessibility vs Exclusivity

THIS DOCUMENT USES THIS FONT TO MAKE IT MORE ACCESSIBLE FOR DYSLEXIC PEOPLE, AS WELL AS A COLOUR SCHEME TO MAKE IT MORE READABLE FOR COLOUR BLIND PEOPLE. THE DOCUMENT HAS ALSO BEEN CHECKED FOR SUITABILITY WITH A SCREEN READER.

ACCESSIBILITY VS EXCLUSIVITY: A CULTURAL BATTLEGROUND?

Accessibility is something that I hold very dear. As a disabled academic, the most important thing for my research to accomplish is better and more equitable access in culture and leisure activities for people with disabilities. In fact, equal access to cultural activities is actually a right!

ACCESSIBILITY ISN'T JUST ABOUT LETTING PEOPLE INTO SPACES, VIRTUAL OR OTHERWISE, IT'S ALSO ABOUT FACILITATING CONNECTIONS WITH THE COMMUNITY.

When I started out on my research journey, the primary focus was on making Virtual Reality (VR) gaming more accessible for people who are visually impaired. I felt the lack of access to something that is progressively becoming

such a large part of our culture is unjust. Now however, I've begun to see how much work needs to be done in all aspects of extended reality*, as well as our culture, and our cultural heritage. Accessibility isn't just about letting people into spaces, virtual or otherwise, it's also about facilitating connections with the community.

*Extended reality refers to Augmented, Virtual and Mixed reality tech, all of which are virtual simulations or additions to the real world

Something that I've encountered frequently in my journey into accessibility is the attitudes of the general abled public. Many people wish to help, and believe that accessibility is the way forward, but there are just as many people who would argue against accessibility measures that could be taken.

A clear example of this can be seen within the gaming community. Huge strides have been made in the industry (e.g. like the Xbox and its accessible controller, or even EA's recent accessibility pledge), but sometimes it can get rather grim. In the last few months, game developers and game fans have taken umbrage with developers choosing to implement new accessibility tools.

Recently a game called *Psychonauts 2* was released, and it announced that it would feature a game mode where the player could not die.



Psychonauts 2

This game mode was optional, of course, and different difficulty levels still existed. However, the issue came about when it was discovered that people could still acquire achievements with this mode enabled. People were outraged, throwing insults at the developer and at people who would use this mode. I'm sure that at least one person reading this probably agrees with the discourse. However, let me

pose this question, have you considered that what you see as easy may be completely impossible for someone else?

When discussing this with someone, they said that they felt that they had earned exclusivity - that people should just get better at playing. But this person was abled. They wouldn't know how frustrating it could be to use an eye tracker to play, or how much content and lore they'd miss if they couldn't see the screen or read the subtitles. In the end this person admitted that they would rather exclusivity over inclusivity.

This attitude is incredibly common. The saddest part of this perspective is that it's self-sustaining, even though studies have shown that inclusion in cultural activities and cultural heritage (and make no mistake, games are becoming part of our heritage), leads to better community cohesion and understanding. My message to you; Are we doing enough to be inclusive, or are we part of the problem?



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