# Artificial intelligence providing faster and more personalised mental health treatment

## Drawing on the power of artificial intelligence, Deakin researchers are pioneering a world-first approach to mental health treatment. Known as adaptive experimental design, their concept has the potential to fast-track findings, leading to faster and more personalised health treatments.

Adaptive experimental design is a ground-breaking technique based on a sophisticated algorithm that uses machine learning and 'lean data' to fast-track findings that are equal in accuracy to traditional clinical trials, but obtained in a fraction of the time.

Complex health problems require multi-strategy, multi-target interventions. With the help of super computers, sophisticated mathematical formulae and probability theory, options for treatment are refined to identify the most effective treatment for individuals.

The Deakin researchers have begun a three-year trial using this approach in a project that seeks to optimise treatment for people experiencing psychological distress. Around 1000 Deakin University students are expected to participate – trialling the effectiveness of four different interventions (and in various combinations) and providing on-line feedback that will allow researchers to identify the most effective interventions (or treatments) for individuals.

The interventions have been selected with input from researchers at the Black Dog Institute – Australia's only medical research institute investigating mental health across the lifespan – and include strategies such as mindfulness, sleep, diet or exercise programs. The effectiveness of these interventions on specific groups, determined by gender, demography, age, or other characteristics, will be analysed.

The findings will allow more personalised treatments for individuals experiencing psychological distress in the future.

## How 'adaptive experimental design' can lead to personalised medicine

The concept of 'adaptive experimental design' was developed by ARC Laureate Fellow Alfred Deakin Professor Svetha Venkatesh and her team at Deakin's Applied Artificial Intelligence Institute.

Led by Deakin's world-leading artificial intelligence experts, this research has huge potential to accelerate the time it takes new drugs and treatments to reach the public. Instead of taking years to complete a clinical trial, pharmaceutical companies and other treatment providers could achieve the same results in months with adaptive experimental design. This would result in major cost savings and better treatments reaching the public sooner.

This transformative medical research has the potential to take health care a step closer to personalised medicine. With several successful projects behind it, the current project is a further test case of adaptive experimental design, focussing on treating psychological distress, but in a few years its use of game-changing applied artificial intelligence technologies is likely to improve the ways medical professionals prevent, diagnose and treat a wide range of health conditions, to achieve significant health benefits for Australians and globally.

Apart from mental health care, adaptive experimental design can be used to find better treatments for other significant health challenges where time and cost in identifying which care strategies work best are an issue. For instance, it could improve prescription of medications and primary care health promotion strategies for better management of diabetes, neurological conditions or addiction, amongst many other medical conditions.

## Key Facts

- Deakin researchers are pioneering world-leading artificial intelligence technology that will achieve personalised medicine.
- he process – known as 'adaptive experimental design' – has the potential to fast-track clinical trials across the health spectrum within a decade – bringing better care to individuals sooner.
- This innovative research method can also be applied to fast-track production in many industries, including manufacturing.
- Young people face the brunt of the global burden of mental illnesses. Mental health problems, such as psychological distress, are the largest of all health disorders globally, affecting 792 million people.
- Mental illness is expected to cost the global economy AUD $21.58 trillion by 2030. Mental disorders are on the rise in every country. The economic cost is primarily due to early onset of mental illness and lost productivity, with an estimated 12 billion working days lost due to mental illness every year.

## Effectively tackling mental health

A 2019 Deakin research project – a seven-week trial aimed at increasing discussions around physical activity between general practitioners and their patients – provided the inspiration for the current project with the Black Dog Institute.

One in five Australians will experience symptoms of mental illness in any given year. Mental health problems, such as psychological distress, are the largest of all health disorders globally. Psychological distress, characterised by depression and anxiety, can in some cases indicate the beginning of major depressive disorder, anxiety disorder or other clinical conditions.

Effectively tackling psychological distress and mental health disorders requires the selection of the right treatments with the most efficacy. Applying artificial intelligence techniques can help determine the most effective treatments without trial and error personalising treatments to individual characteristics from the very first consultation. This research will uncover the best therapeutic interventions for distress, anxiety and depression for individuals and shorten the time people are provided with mental health treatments that don't help them, because feedback is provided so quickly.

## Applications beyond health

*Adaptive experimental design can also increase production times in many industries, including manufacturing.*

Beyond the medical field, adaptive experimental design has potential in manufacturing or, indeed, any sector where the efficacy of new products or systems must be demonstrated.

The method has already proven to be successful in several domains, from manufacturing to analysing social media. A breakthrough — with results published in the prestigious journal Scientific Reports — was achieved in 2017 through a collaboration with the company HeiQ Australia, based on the Waurn Ponds campus. The faster, cheaper and more effective approach of using adaptive experimental design to optimise products and manufacturing processes was demonstrated in the development of HeiQ Australia's first product HeiQ Real Silk, which is now being used in the global textile market for apparel and home textiles, such as bedding.

'With new materials and new processes – unlike an established material like steel, for instance – the legacy knowledge base is often limited. The computational models don't exist and the cost of building new ones is very high,' explained Professor Venkatesh, Co-Director of Deakin's Applied Artificial Intelligence Institute.

'We don't have a complete data set for new materials, so we have to generate knowledge through experimentation. Machine learning allows us to be nimble, so we can optimise new materials using a handful of experimental data points – or lean data. The software acts as an experimental assistant to help navigate experimental complexity.

## Grants and Funding

This research project is being funded through a $4,995,434 grant from the Australian Government's $20 billion Medical Research Future Fund (MRFF), through its Applied Artificial Intelligence Research in Health Investment program.

ARC Laureate Fellow and Co-Director of Deakin's Applied Artificial Intelligence Institute (A2I2), Alfred Deakin Professor Svetha Venkatesh is co-leading this project with Scientia Professor Helen Christensen AO, Director of the Black Dog Institute.

Professor Venkatesh is one of the top 15 women working in artificial intelligence in the world. Her A2I2 team on this project are Associate Professor Sunil Gupta, Associate Professor Santu Rana, Associate Professor Truyen Tran, Dr Thomas Quinn, Professor Kon Mouzakis (A2I2 Co-Director) and Professor Rajesh Vasa.

## Collaboration

Deakin's research is jointly led with the Black Dog Institute and the University of NSW; in collaboration with Macquarie University's Centre for the Health Economy, Australian Psychological Society, The Garvan Institute and the Australian Medical Association.

## Commercialisation

Adaptive experimental design has been used within industry. The textiles company Hei Q Australia (based on the Waurn Ponds campus) worked with Deakin researchers using adaptive experimental design to develop its first product Hei Q Real Silk, which is now being used in the global textile market.

'Adaptive experimental optimisation allows us to be a hundred to a thousand times faster than conventional "design of experiment" methods,' said Dr Alessandra Sutti, from Deakin's Institute for Frontier Materials, who worked with Hei Q Australia on the project.

'The collaboration was inspired by the challenges of industrial innovation,' said Dr Murray Height, CEO, HeiQ Australia.

'We needed to efficiently generate knowledge about a novel technology with very tight timeframes, to bring a product to market. Adaptive Experimental Design has given us a fast and powerful way to accelerate product development and implement advanced manufacturing processes. This methodology has clear potential to benefit material and process-oriented industries seeking efficient and nimble innovation.'

https://www.deakin.edu.au/research/research-news/articles/new-scientific-method-to-supercharge-innovation

## More Information

Applied Artificial Intelligence Institute ($A^2I^2$)

Professor Svetha Venkatesh, Co-Director, $A^2I^2$

Black Dog Institute

Media release

*'The AI developed for this project can be used in significant health challenges where time and cost in identifying which care strategies work best are an issue… Other health challenges that stand to benefit include the management of diabetes, neurological conditions, addiction, medications, sleep treatment and primary care health promotion.'*

**Alfred Deakin Professor Svetha Venkatesh, Co-Director $A^2I^2$**