

Access all areas: multisensory science exhibitions tailored toward blind, low-vision and diverse-needs communities

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Abstract

Monash Sensory Science is a scientific outreach initiative specifically tailored to members of the community who are blind, have low vision and have diverse needs. The purpose of this initiative is to showcase Australian science and encourage greater participation in science from these often-overlooked communities. This article presents our experience in establishing Monash Sensory Science at Monash University and inspiring other institutions to launch similar outreach events.

INTRODUCTION

There is a significant disparity in the STEM (Science, Technology, Engineering, and Mathematics) field in Australia, in the tertiary education sector and in the employment of individuals with low vision, blindness or disabilities. This issue is reflected in the number of students with disability completing STEM courses,¹ the low enrollment of people with disabilities² and the low rate of full-time employment for people with blindness or low vision.³ The barriers to employment are attributed to negative assumptions held by employers and the broader community.⁴

In biomedicine, these barriers may also include the preponderance of visual display of scientific data and communication, presenting access issues for blind and low-vision students, including those undertaking tertiary-level biomedical science subjects, and blind and low-

vision graduates wishing to pursue careers in biomedicine.

Recognizing the need to make the life sciences more accessible to this underrepresented group, Monash Biomedicine Discovery Institute (BDI) researcher Jamie Rossjohn initiated an outreach exhibition (now known as Monash Sensory Science) in 2018.

MONASH SENSORY SCIENCE

Through collaboration with Dr Erica Tandori, a legally blind artist, who came to work in the laboratory as an artist in residence, a concept took shape. The goal was to develop an exhibition that catered specifically to blind and low-vision communities of all ages and science literacies. This exhibition was informed by Erica's personal experience of blindness. Working with scientists from the Rossjohn laboratory (including Dr Gabby

Watson), and others from the BDI, Erica and researchers created tactile posters using braille, large print, 3D models and other displays centered around the theme of infection and immunity.

The exhibition's launch featured an introductory talk by Jamie about infection and immunity. To cater to attendees who could not view the screens, tactile artworks and models representing various immune cells, bacteria and viruses were arranged on tables to supplement the presentation. Assisted by laboratory volunteers and university disability support personnel, "theme leaders" (scientists and researchers) led breakout sessions, where tactile posters equipped with large print, braille labels and models were used. This free, half-day event at Monash culminated in a lunch hosted by the laboratory. This communal gathering comprising around 100 attendees, and a similar number of scientists, researchers, volunteers and Monash staff, allowed everyone to share in the celebration of the day's success (Figures 1 and 2).

This inaugural exhibition was hosted in May 2018 with the support of Monash and the Australian Research Council (Jamie was an ARC Laureate Fellow when this exhibition was initiated). Further exhibitions were held across Australia, including at the University of New South Wales in December 2018. This successful exhibition was made possible by the enthusiasm of Dr David Jacques, Dr Rom Bouveret, Ms Sue Liu, the late Professor Katharina Gaus and all the staff and students of the European Molecular Biology Laboratory (EMBL) Node in Single Molecule Science at UNSW. Additional exhibitions followed, including The Lion's Eye Institute, Perth (2019) Extrasensory at Parliament House Melbourne (2019) and NextSense at the Australian Hearing Hub, Macquarie University, Sydney (2023).

In 2020, the exhibition was showcased via an online symposium hosted by the United Nations AI for Good conference, and in the same year Erica was a finalist in the Berlin Falling Walls Breakthroughs in Science



Figure 1. Access all areas. The establishment of Monash Sensory Science in 2018 has seen the development of multisensory science exhibitions for blind, low-vision and diverse-needs audiences grow from its inception in 2018 to a flagship exhibition series. Clockwise from left to right: **(a)** four-legged guides at the inaugural Infection and Immunity Exhibition 2018, **(b)** Monash Sensory Science Cancer Research Exhibition 2019, **(c)** tactile explorations of immune cells, **(d)** neutrophil model, **(e)** attendee exploring HIV at UNSW 2018, **(f)** audience members at the Infection and Immunity Exhibition, 2018, **(g)** young attendees, **(h)** tactile poster exploration, **(i)** demonstrating immunity to attendees, **(j)** rotavirus tactile poster, **(k)** bacteria model, **(l)** neutrophil, dendritic cell and pasta-coated macrophage model artworks by Erica Tandori. Photo Credits: Stephen Blake (Stephen Blake Photographic) and Gerard Hynes (Hynesite Photography).



Figure 2. Monash Sensory Science Autoimmunity Exhibition for blind, low-vision and diverse-needs audiences, 2023. Clockwise from left to right: **(a)** an audience member explores tactile models with an exhibition guide, **(b)** a child reads a multisensory science book with headphones and fiducials, **(c, d)** attendees explore tactile posters, **(e)** exploring T cells in the interactive science book, **(f)** exhibition goers explore a vibrating human figure wired to demonstrate multiple sclerosis and other locations of autoimmunity, **(g)** visitors to the autoimmunity exhibition, **(h)** a nest of Monash Sensory Science lanyards, **(i)** a visitor is guided through an exploration of the tactile retina map, **(j)** tactile representation of synapsing neurons **(k)** the Monash Sensory Science team, **(l)** scientists and designers workshoping the development of accessible models. Photo Credits: Gerard Hynes (Hynesite Photography).

for Disability Access to Science during Berlin Science Week.

In 2019, the Monash Sensory Science Exhibition presented *Cancer and Immunity* as its title and theme. Working alongside Erica and Dr Kylie Wagstaff, Monash researchers and volunteers provided an array of tactile models, 3D displays and accessible interactive experiences, including an immersive 3D computer-aided virtual environment (Monash CAVE2) facility tour, staging a significant exhibition on cancer research for blind and low-vision communities.

MULTISENSORY APPROACH

The Sensory Science initiative has continued to evolve through annual exhibitions. The incorporation of multisensory approaches including the use of computer-driven interactive displays, sound, music, sonification, data projection and novel display has been made possible with

the work of Dr Stu Favilla, Interaction Designer at Swinburne University of Technology. This has provided accessible and integrative approaches to compliment displays and artworks created by Erica including music, data and image sonifications. During the pandemic, they developed interactive multisensory science book prototypes, with the intention to enable “mini exhibitions in a book” that could be sent on roving tours to communities during a lockdown or to more remote locations. The books were also featured in the 2023 *Monash Sensory Science Autoimmunity Exhibition*, the first event to be held since the pandemic.

The books entitled *My Goodness, a Multisensory Exploration of Nutrition and Immunity* and *The Heroes Within You, a Multisensory Exploration of Infection and Immunity* were funded with the assistance of the ARC Centre of Excellence in Advanced Molecular Imaging (Imaging CoE) and the Department of Industry, Science, Energy and Resources National Science Week grants in 2021

and 2023. The books contain small chapters written by scientists and researchers in the field of infection, immunity and gut health. Each page is illustrated with tactile artworks of protein molecules, cells, viruses and biomedical concepts created by Erica with accompanying music and sonifications created by Stu Favilla. Pages are narrated to the reader over headphones. Page turning is detected by cameras scanning optical fiducials driven by computer software (developed by Stu). Computers were embedded in custom-built book stands created by Swinburne University Industrial Designer Dr James Marshall.

Many researchers contributed to the book content, based on their expertise in the gut microbiota, immune responses toward pathogens, autoimmunity and cancer. These books promise to have far-reaching impacts as the goal is toward publication and distribution of this informative resource to low-vision, blind and diverse-needs communities into the future.

CO-CREATION AND STAKEHOLDER ENGAGEMENT

In preparing the *2023 Sensory Science Autoimmunity Exhibition*, researchers Drs Laura and Lisa Ciacchi from the Rossjohn laboratory were appointed as project coordinators. In addition to the recruitment of volunteers, stakeholder engagement and collaborating with researchers, Laura and Lisa led co-creation workshops alongside Erica and Stu to help researchers create tactile models and interactions around the theme of autoimmunity. The newly formed Monash Assistive Technologies and Society (MATS) research group also exhibited their assistive technologies and concluded the exhibition with closing remarks on the role of assistive technologies and social inclusion. At the exhibition, Stu, whose research includes STEM education through spatial sound and immersive audio, incorporated music into the event. This approach enables researchers and individuals to use their sense of hearing to analyze and interpret scientific data and has many implications in inspiring out-of-the-box thinking and a universally accessible understanding of complex scientific concepts.

Alongside the interactive books, QR codes accompanied many of the tactile posters, enabling access to additional scientific information about the displays through participants' smartphone devices and supporting engagement with both the experts presenting topics and the interactive artworks and posters. The event provided a glimpse into the research being conducted at Monash and collaborating laboratories across Australia. By explaining concepts of autoimmunity in concise and easily accessible ways, scientists are challenged

and enriched by the task of using multisensory strategies to explain their research findings.

For scientists participating in the creation of sensory science exhibitions, such initiatives may provide the opportunity to reflect on personal experiences and a re-engagement and passion for science. Aside from educating and engaging with the community, these Monash Sensory Science events call us to appreciate the hard work and effort that we dedicate our lives to in pursuit of benefiting society and making a difference in others' lives outside of our own. This experience is humbling and creates a sense of comradery with other researchers and encourages collaboration and connection. It was inspiring to see researchers and students passionate about the research. It gives the public confidence that researchers are making great strides to assist disease sufferers and develop therapeutics and diagnostic methods.

2023 was also the first year with the inclusion of a patron for the event, vision-impaired Australian Paralympian Jaryd Clifford. Jaryd provided insights into his condition and an uplifting message for those who are seeking to push boundaries and pursue their goals despite their disabilities. This was a truly inspiring addition to the exhibition and a reminder too that diversity and inclusion of a myriad of perspectives enrich science and the wider community. Making science accessible to all, the Monash Sensory Science Exhibition initiative has raised awareness of the importance of inclusion in science discourse and highlighted the value and contribution of different ideas and perspectives in science. The 2023 exhibition was a success, with more than 140 participants excited to learn more about autoimmune diseases and enthusiastically engaged with tactile artworks, models and interactive displays.

LOOKING AHEAD

Monash Sensory Science has gained momentum over the years, acknowledging the significant support of Monash Disability Support Services; Monash events and marketing teams; researchers; faculties across the University; industry partners and organizations such as Vision Australia, Guide Dogs Victoria, Retina Australia, Blind Citizens Australia, Able Australia and the Macula Foundation. Monash Sensory Science is continuing to aim to change the paradigm of possibilities in science by broadening the conversation to include the low-vision, blind, deaf and diverse-needs communities, thus encouraging a future of diversity in science and technology.

It is our vision that the Monash Sensory Science initiative continues to grow, increasing global awareness

of the value of inclusion and the need for the representation of people living with blindness, low vision and diverse needs in STEM.

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AUTHOR CONTRIBUTIONS

Erica Tandori: Writing – original draft. **Laura Ciacchi:** Writing – original draft. **Lisa Ciacchi:** Writing – original draft.

Jennifer D Ly-Huynh: Writing – review and editing. **Stuart Favilla:** Writing – original draft. **Jamie Rossjohn:** Writing – review and editing.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest associated with this research.

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