

## Culture-Space Workshop 2

### Report

From Monday 7 October through until Tuesday 8 October 2019 the Science Museum Group (SMG) and [European Space Agency](#) (ESA) hosted museum and arts sector professionals as well as academics at the [European Space Research and Technology Centre](#) (ESTEC) located in Noordwijk, Netherlands. For two days the multimedia library in the Erasmus Building at ESTEC was home to a series of lively discussions focused on what diversity means in space, for space, and in space-science museum displays.

This workshop, the second in a series of three, hosted symbolically at the centre of Europe's intergovernmental space agency, took place a day after the popular annual ESA Open Day, where this year approximately 10,000 members of the public visited ESTEC, despite torrential rain, to learn about the facility and its space projects. Arguably, the success of this year's Open Day was a good omen for the SMG as work continues on the forthcoming space gallery.

### Day one

#### Mutual introductions and ESTEC TEST Centre tour

The workshop commenced with a series of mutual introductions. As with the inaugural workshop hosted at the Science Museum, each guest was invited to introduce themselves and identify a specific object they would like to include as an exhibit in a future space gallery. What is unique about this ice breaker is that it often leads to spontaneous conversation between participants, as was especially the case on this occasion. Throughout the workshop there was a genuine camaraderie and excitement about the Culture-Space project as professionals from a variety of disciplines had ample time and space to engage with the key questions centred on space exploration, science and technology, and museum displays and exhibits. Ray Macauley's introduction, focusing on NASA's [the Pioneer plaque](#), led to debate surrounding the morality of sending messages to space, the importance of the sort of message we want to send in the first place, and the purpose of sending a message when we have no evidence there is anyone (or anything) to receive it.

The variety of objects presented during the introductory session touched on the challenge of diversity in space. From an image highlighting the role of women in space, to a DEXA (Dual-energy X-ray absorptiometry) scan revealing the variation between every living being, diversity is an issue that covers a lot of ground. Education, gender, ability, 'race', and interest all fall within the issue of diversity on Earth. Likewise, the Pioneer plaque Macauley presented highlighted how issues of diversity become even more complex once we leave Earth and attempt to communicate with technologically advanced extraterrestrial civilizations in other star systems. As diverse as our planet is, space is more varied. Any missions to detect extraterrestrial life, particularly beyond the Solar System, might encounter life that could function and, perhaps, communicate in a way that is completely at odds with what is considered the norm on Earth.

After introductions and lunch, ESTEC technical staff kindly conducted an extensive tour of facilities at the Test Centre. Reflections of the tour, led by Alison Boyle (Keeper of the Science Collections at the Science Museum), prompted comments and group discussion on the aesthetic of the space labs. Much of the building had seemed empty as we toured, with little sign of human life (although, as one participant pointed out, everything we saw was only possible because of humanity's creativity). The Test Centre was incredibly clean and seemed to be in a state of suspended animation. Participants reflected on the role of engineering in social expectations of what the future will look like, the large, empty, sterile and overwhelmingly white spaces at ESTEC resemble spaces featured in modern science fiction and popular imaginings of planet Earth in the future. The link between subjects became very clear – history, humanities, engineering, and science all contribute to what society understands of itself, its past and its possible future.

After the tour, workshop participants were invited to highlight objects they had noticed that might be suitable as exhibits for the future space gallery in London. The Large Space Simulator (LSS) that had dominated the tour was selected by a few, and many thought it would be ideal to see something like that in action. Three other objects were chosen because of their relationship with the mundane, things that we recognise and relate to from our everyday lives. Clean room outfits, giant balloons (holding the JUICE (JUperiter ICy moons Explorer) spacecraft magnetometer boom), and even an old wheelie office chair placed in

the centre of a clean chamber. These objects were reminders of the people behind the machines, and added an air of nostalgia to an otherwise soulless space.

When considering narratives for framing the Science Museum's future space gallery, ESTEC and ESA could serve as a valuable asset. Displays in buildings at ESTEC celebrate the journey of a spacecraft on Earth before it makes it into the air. With PR campaigns starting at launch, the public are often shown only a fraction of the story or history when it comes to space science and engineering. Taking time to look at how a spacecraft makes it from imagination to exploration would also allow time to reveal the diversity of those who work on the project, in terms of skill sets and life experience.

### Space Mission Project Management

Francois Spoto, Program Manager of the ESA/Roscosmos ExoMars mission, gave a fascinating insight into the work that goes into making a pan-European project work successfully.

Having joined the ExoMars project in late 2016, when the project was already underway, Spoto commented that his first challenge had been to integrate within the team. Accepting that team members knew more than him regarding the project's current life cycle and working out how to use this diversity of knowledge in a fruitful way was key to his success. With a goal to launch in 2020, meeting the Manager of ExoMars so close to his deadline provided insights into real pressures he and his team are currently facing.

After a partnership with NASA fell through in 2013, the ExoMars team began working with Roscosmos (the Russian space program). Each space agency concentrated on creating a different part of the technology to be launched, with Russia focused on the surface platform and ESA on the rover itself. These pieces will need to fit together in order to make the mission a success, so effective teamwork is essential. While ExoMars is primarily an ESA project, its work with Russia and America throughout its lifetime, once again, reflects the diversity at the heart of space exploration. Space science and technology is a team effort. When we think back to the future of the Science Museum's space gallery a truly diverse exhibit must reflect the diversity that sustains space work.

In the post-talk discussion, Spoto reflected on how each institution has different ideas of how work should be done, and the challenges that can be faced when two research cultures

are working differently towards the same goal. Spoto's talk celebrated the diversity in knowledge and willingness to facilitate transnational collaboration, essential to successful space exploration.

### Cultural Boundaries: Science, Technology and Art

Miha Turšič's talk on arts and humanities in outer space included an overview of the interaction between his personal career development and the growth of space art in recent years. His first foray into space art was when he sought to design a zero-gravity chair, an impossible concept because a chair itself is a gravity interface. He joined the postgravityart group in Slovenia, who in 1999 staged a theatre performance in zero-gravity flight. According to Turšič, it was the first zero-gravity theatre performance in history.

Working with the Cultural Centre of European Space Technologies in 2012, Turšič considered what it means to be human in non-terrestrial locations and, once again, invited the workshop to explore intersubjectivity in space exploration. Works such as the Trieste Constructivist Cabinet (Slovenia, 1927; reconstructed in 2011), the first levitating sculpture, cross artistic and scientific boundaries, required artists and audiences that understood the importance of both subject areas.

Some of Turšič's work has focussed on scientific instruments presented in an artistic light. He has worked on an exhibition looking at the Konvas film camera used by Cosmonauts and the story behind the instrument, as well as recognising the beauty of the object itself. He describes his most recent work as 'public research', including society and citizens as a research community to conduct research that people are interested in on subjects that they come into contact with—rather than things that may seem remote and inaccessible, such as conventional space science.

Daniela de Paulis, media artist, licensed radio operator and trained radio telescope operator, shared her work *Cogito in Space* with the group. De Paulis recorded electrical brain activity as people observed images of Earth, and then converted the ECG (electrocardiogram) signals into a mono sound file. These sound waves were then transmitted into space, which she reflects is not a new idea with examples such as the Voyager record having also carried sounds into space (in the form of a recording engraved on a gold plated record). In the post-talk discussion attendees considered how de Paulis'

work reflects a current trend in de-materialising art in a way that echoes contemporary communication. While designers of the Voyager message created a physical record for dissemination in space, today she creates digital files that are sent in the form of radio waves that have no discernible physical presence outside the instruments that record and reproduce them as sound waves.

For a series of talks that had considered the relationship between two potentially opposed subjects (art and science), a surprising conclusion reached by some participants in the group discussion was that there are still reasons to keep the two subjects separate. In art, Turšič said, authenticity is important. Artists are invested in trying to overcome the concept of sterility and the quest for cleanliness (Macauley compared this supposed artistic sterility to selectively bred or engineered lab rats that have become unable to survive and reproduce outside of a sterile lab environment and are therefore can be considered obsolete in their natural habitat). Meanwhile, science is sterile; technology cannot be alive. Turšič claimed that both art and science are man-made, but art embodies humans while science could be said to embody what humans try to become.

#### [Throw me the Probe—Adventures in Modern Space Science Outreach \(keynote talk\)](#)

A self-proclaimed child of science fiction, Mark McCaughrean was an astronomer by trade, having worked on ESA's [James Webb Space Telescope](#) (set to launch in March 2021). He now works on outreach projects for ESA; a department he stated has changed considerably since the [Rosetta mission](#). In 2016, the Rosetta mission prompted two Google Doodles, a series of stamps, an award for breakthrough of the year, and an entry in *Nature's* top ten people of the year celebration. Mark's work as a science communicator, rather than a corporate one, has enabled him to take risks within his work.

McCaughrean's outreach team have had a busy few years, creating educational cartoons, launching art residencies, and even producing a science fiction movie, *Ambition*. He claimed "it's perfectly okay to think out of the box" and reflected on the diverse products created to engage audiences who would not normally engage with ESA business.

ESA have not been afraid to go out of their way to reach audiences that might doubt science is for them. For three years in a row they have hosted a panel at a key science fiction convention in London, with the room being completely filled each time. They've also worked

with musicians to create and inspire art on the theme of the Rosetta space mission, and even launched ESA's Space Rocks, an annual celebration of space exploration that brings space-scientists and music artists together for a series of public talks and a large-scale concert in London.

McCaughrean and his team are able to put multiple ideas into action. They can look to do things differently and take risks with their new outreach strategies. During the Q&A session following McCaughrean's presentation, it was agreed that there is some way to go in creating a truly diverse team at ESA, but McCaughrean maintained that a creative, risk-taking outreach team with the freedom to focus on the science before the Agency is a step in the right direction to inspire future generations.

### Day two

Before Recapitulation led by Ray Macauley, Doug Millard (Deputy Keeper at the Science Museum and leader on the Culture-Space workshop series) gave attendees an insight into what it takes to create a new space gallery at the Science Museum. With typically five years from conception to delivery, a gallery at the Museum is typically larger and must have a longer lifespan than a temporary exhibition. There is a wide array of teams involved in creating a new gallery, from Development to Learning and from Audiovisual to (wood, metal and plastic) Workshops. The audience for a gallery tends not to be as distinct as that for an exhibition, who will often have booked a specific time and day to go out of their way and visit the new Museum exhibition. Curators need to be aware of grazing visitors, and note that visitors to a future space gallery in the Science Museum will range from specialists to complete newcomers to the world of space-science.

The future space gallery will need to last for around 25 years, staying relevant and interesting to approximately 3 million people that attend the Science Museum every year. With word counts impacting how much the curators are able to say, and a family visit often being dictated by the youngest visitor, it is clear the challenge of creating a new gallery goes far beyond the academic debates the three Culture-Space workshops centre on.

### Diversity at ESA

Ersilia Vaudo, Chief Diversity Officer at ESA, spoke about the issue of diversity in action at the Agency. As an institution comprising of 22 member states, with 14 different languages,

ESA unites scientists to achieve things that could not be done in isolation. At the same time, keeping such a diverse workforce running smoothly is not something that happens without effort.

Vaudo shed light on diversity challenges the Agency faces moving forward. She noted that most new employees at ESA are over 40, as their demand for experienced scientists makes it difficult to justify hiring younger staff members. This is not helped by a current global decline in young people choosing to study STEM (Science, Technology, Engineering and Mathematics) subjects. She suggested that children love space, but not enough to pursue a career in it. She wondered if it was time to change the narrative of space travel, making it clearer to the public that missions to Mars and beyond are beneficial to society, for instance in the fight against climate change, and not just for the sake of “conquering” another planet.

She also raised the question - what can be done to welcome differently abled members of society into ESA? According to Vaudo “In space we are all disabled”, so there is room for ESA’s workforce to become even more diverse in the future.

In the post-talk discussion we explored how work in space can benefit society, and the economy as a whole. Adventures into the galaxy need not inspire children to try and follow suit as there are plenty of more recognisable Earth-bound occupations that require similar skills. Perhaps space science could be used as a flagship subject to attract more people into STEM in general.

### Conformity of display

Making the argument that it is possible to change conventional gallery narratives and the public’s experience of this narrative through curation, Ellie Armstrong’s talk began with a discussion of the Whitney Plantation Museum in Louisiana, USA. At this plantation, the story focuses on the lives of enslaved people, leading visitors through the lived experience of enslaved children in the plantation before taking them to the main house where the planter slave owners lived as a last stop. Focusing on the story from the perspective of the people enslaved, the Whitney Plantation Museum gives what is arguably a more honest and total impression of historical events, places and people.

Armstrong, a PhD Candidate at University College London, invited workshop participants to consider what diversity means, what the purpose of diversity means in relation to the

Science Museum's future space gallery, and who contributes to discussions on diversity. She reminded participants that people enjoy visiting the Science Museum—the 4000 children that visited last year included—and so the Museum is in a comfortable position to impact (and possibly change) the historical narrative.

For her doctoral research, Armstrong has been looking at three science galleries in London. Her study of the Science Museum has enabled her to highlight the lack of diversity in the current space gallery. Of the people pictured in the gallery, 11% are Apollo astronauts—with only one Russian cosmonaut (Yuri Gagarin) featured. Only five women are named in the gallery, and Armstrong drew attention to image captions that name astronauts but not the other members of the space mission surrounding them, such as the technicians and engineers.

Through work with children, Armstrong has obtained evidence that children understand the idea of collaborative help when they are asked directly how to tackle problems. As such, she argues they would understand the space story with the diversity of skills, job titles, and workers celebrated.

After Armstrong's talk the Science Museum curating team reflected that there will be some short term fixes to the Museum's current space gallery to address the issues raised in her talk. It was agreed that the main lesson for those working on the future space gallery should be that it tells a number of small stories in an equal way, rather than selling one grand narrative.

### [The Human Condition: Mind and Body](#)

Elisa Raffaella Ferré, Cognitive Neuroscientist and Senior Lecturer of Biological Psychology at Royal Holloway University of London, began the final section of the workshop with a talk about the brain and its behaviour in non-terrestrial gravity. Although the human brain constantly adapts and changes to new environments, space exploration is the ultimate challenge as the brain is exposed to adverse radiation, acceleration, noise, altered gravity, isolation and stress. Ferré's research focuses on how the brain responds to micro-gravity outside of the Earth's atmosphere.

While the brain has no sensor for gravity, it uses vestibular, visual, and proprioceptive cues to situate itself in space. As each brain works differently, and an incredibly minute

proportion of the world's population have actually made it into space, scientists struggle to cite specific neurological reactions to altered gravity states. As we move towards a world where commercial space flight may be possible, it is important to know how an untrained individual might survive in outer space.

Ferré is currently working on an ESA funded project to understand how people perceive weight in altered gravity, having previously shown that motor abilities, goal-directed movements, and cognition are all impaired by altered gravity. The fact that people perform worse in altered gravity is something to keep in mind as scientists look to the future of space flight.

The final talk of the two-day workshop was given by Kate Robson Brown, whose work focuses on bone density, demonstrating how space science can help improve life on Earth. If human beings did not exercise on the International Space Station, Robson Brown reported, 12% of an astronaut's bone density would be lost. The radiation exposure outside of Earth's atmosphere is a serious risk to health. The only way to test how to look after an astronaut's bone marrow while in space is to use 'phantoms', which represent human tissue. A phantom is an object made to represent a human body or body part, it is made of materials that react to external factors in the same way a human body would and so can give researchers an idea of how someone would respond to high levels of radiation exposure without having to subject a living being to testing. These are typically used to work out what radiation exposure is safe for medicinal use, and are modelled on an average US soldier from the Second World War—as such not representative of the diversities in age, gender, nationality, and other categories that exist world-wide.

Robson Brown has worked to create new phantoms for a wider range of people, with information available for public access online (through Caldose) serving as virtual phantoms. Just as each individual has their unique genetic makeup; it has become apparent that each individual that journeys into space may need a bespoke solution to best look after their bone density. Shorter trips seem to be better for bone density, and exercise is essential—but the type and amount required for each astronaut varies. Robson Brown made the point that female bodies are, on average, better at releasing and reabsorbing calcium, which is potentially best for maintaining a stable bone density while in space. Diversity in this case may be the best possible future for space travel. Conversely, as scientists reach a point

where they could find the ‘perfect’ human specimen for space travel, might we face a future where the diversity in space science is actually under threat rather than opening up to new possibilities.

## Conclusions

Diversity in space science is a complex issue that could never be truly served justice in a two-day workshop. The professionals that gathered at ESTEC raised more questions than they did answers but with the Science Museum’s space gallery years from completion, now is certainly the time to start thinking about the challenge ahead.

Throughout the workshop it became clear that there was no ‘one suit fits all’ definition of diversity, the word encompasses national, ethnic, gender, intellectual, subject, physical, and age barriers alike. The challenge of diversity starts at the conception of a new space technology and continues through to the display of this technology in a gallery years later. While museums, the Science Museum included, have traditionally focused on singular, easy to consume narratives that focus on simplistic stories—such as the triumph of American astronauts Neil Armstrong and Buzz Aldrin landing on the moon—now could be the time to create multiple narratives and lace more human stories and experiences into the history.

Space travel is not just about the astronauts. For every space rocket launch there are thousands of engineers, technicians, scientists, marketing staff, creative designers, and so on behind the scenes. As discussed in the previous workshop, science fiction writers and filmmakers play a huge role in societies understanding of the past and future of space travel so, surely, they are as much a part of the story as those who wear spacesuits are.

Space travel is not just for muscular white men with natural mathematic ability, nor has it ever been. A major space gallery at the Science Museum that celebrates and demonstrates this fact promises to have a positive impact on what happens next for institutions such as ESA and society at large.

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