CAPjournal

Issue 23 | February 2018

Communicating Astronomy with the Public

Behind-the-scenes of CAPjournal

Stories from the journal's 10-year history

Centennial of the International Astronomical Union in 2019

A sneak preview of the global celebrations planned for the IAU's 100th year

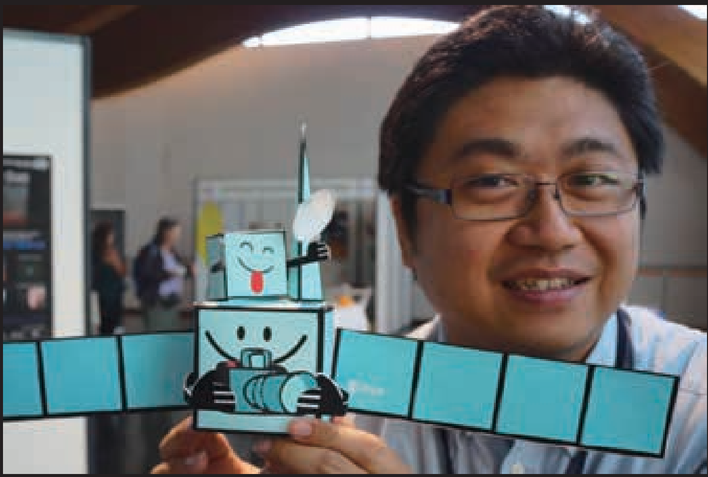
Testing the 'Pale Blue Dot' Hypothesis

How to apply experimental psychology to astronomy

What do you like about CAPjournal? What would you change?
Help shape the future of the journal by filling in a short questionnaire online (details on page 12)

www.capjournal.org

On 19 October 2017, the astronomer Robert Weryk discovered a unique object using the Pan-STARRS telescopes in Hawaii, USA. Subsequent observations revealed the object to be the first interstellar asteroid ever observed. Within 24 hours of receiving a proposal from the Minor Planet Center, the IAU approved a new naming scheme for this new class of object and designated the prototype object as 1I/2007 U1 ('Oumuamua). 'Oumuamua is a dark red highly elongated metallic or rocky object, unlike any other object in our solar system. Credit: ESO/M. Kornmesser



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Cover: This image is an example of citizen-led processed images of Jupiter obtained using JunoCam data. The enhanced colour image shows Jupiter's South Pole, South Temperature Belt and its swirling cloud system comprising the white ovals seen in the image. Credit: NASA/SwRI/MSSS/Gerald Eichstädt/Seán Doran

Editorial

Starting with the current issue, the International Astronomical Union (IAU) Office for Astronomy Outreach (OAO) is taking over the publishing of CAPjournal from the European Southern Observatory (ESO) and moving it to a new home at the National Astronomical Observatory of Japan (NAOJ). This change was originally planned in 2012 but could not be implemented for various reasons until this moment. We hope that this change, in combination with OAO's other activities, will support the astronomy outreach and communication community by providing a platform for sharing best practice. The NAOJ is very proud to be the new home of CAPjournal and promises to provide the best support for the journal's paper publishing services to the growing number of international astronomy communicators.

With regard to the content of this 23rd issue, we are delighted that CAPjournal has just celebrated its 10th anniversary, and I have taken this opportunity to interview two previous editors-in-chief and share some of their views and stories with our readers. In another anniversary celebration, we will look in this issue at the plans for the IAU's 100th anniversary in 2019. In 1919, the IAU was formed, and this organisation has brought about a paradigm shift in how astronomy is conducted. Many actions have been taken by the IAU to support the many exciting discoveries made in the past 100 years. We would like to use the occasion of IAU100 to not only encourage global communities to celebrate the IAU as an organisation, and astronomy more broadly. Also in this issue, our sister office, the IAU Office of Astronomy for Development (OAD), conducted a pilot test to evaluate whether astronomy can change social behaviour, and although definitive results are not available yet, the methodology of applying experimental psychology to astronomy studies is in itself a very interesting concept. You will also learn about language issues faced when conducting an international campaign through the example of the IAU NameExoWorlds competition and about using food to conduct astronomy outreach. We also bring back some of features like opinion pieces — we encourage you to provide your feedback and will publish selected correspondence in the next issue.

I have a few call for actions that need your attention:

1. We want to improve the publication and hear your opinions; please help us by filling in the questionnaire online (details on page 12).
2. We are planning to release a special issue about solar eclipses and would like to call for papers. For anyone interested in this idea, please take a look at the CAPjournal website or contact us.
3. As you know, the subscription CAPjournal is free of charge. However, production costs are high, and we seek sponsors to support the publishing of this journal. If you think your institute may be able to sponsor us, please do get in touch. It will be greatly appreciated!

Lastly, I would like to give a special thanks to the ESO team, in particular, Lars Lindberg Christensen and Georgia Bladon, for their patience, guidance, and assistance in ensuring a smooth handover.

Clear skies,

Sze-leung Cheung
Editor-in-Chief of CAPjournal

Explained in 60 Seconds: *Juno* Surveys Jupiter's Great Red Spot and the Citizen-Led Approach to Imaging

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The *Juno* spacecraft is blazing a new trail in understanding Jupiter's atmosphere and magnetosphere (Daniels, 2016). *Juno* scientists have been keenly anticipating observations of Jupiter's Great Red Spot, a storm the size of two or three Earths that has been raging for over a century. *Juno* passed directly over the centre of Jupiter's Great Red Spot on 11 July 2017, only 9000 kilometres away from the tops of its clouds.

The highest-resolution image of the Great Red Spot has an unprecedented spatial scale of six kilometres per pixel. V-shaped lanes, darker in colour, mark peak velocities in the Great Red Spot's counterclockwise rotation, and smaller anti-clockwise vortices can also be seen. Near the centre of the spot are clusters of clouds 25–30 kilometres in size, reminiscent of terrestrial thunderstorms. Near the northern edge of the Great Red Spot, as the red colour blends into the whiter-coloured, slower-moving clouds, is a long series of linear features spaced about 70 kilometres from each other. This is the first evidence for small-scale atmospheric waves called Mesoscale Gravity Waves within the Great Red Spot. Gravity waves happen when the atmosphere gets disturbed. The force of gravity pulls the atmosphere back into equilibrium, but ripples are left behind. These ripples are gravity waves.

Although most of *Juno's* instruments collect data that need to be downloaded and processed by a science team before they can be made widely available, the results from *Juno's* public-outreach camera, JunoCam, became available to both the science team and the general public within a couple of days of the close approach and captured jaw-dropping moments. Originally intended only as a public-outreach instrument, JunoCam has no dedicated science–analysis team, but the images have proven to be very useful. In fact, astronomers are particularly grateful to talented members of the public who have processed the raw frames and carefully produced images that enhance features without introducing spurious processing effects. For example, the striking figure in this article was created by Gerald Eichstädt, a mathematician in Stuttgart, Germany, with enhancements by Seán Doran, a visual artist in London.

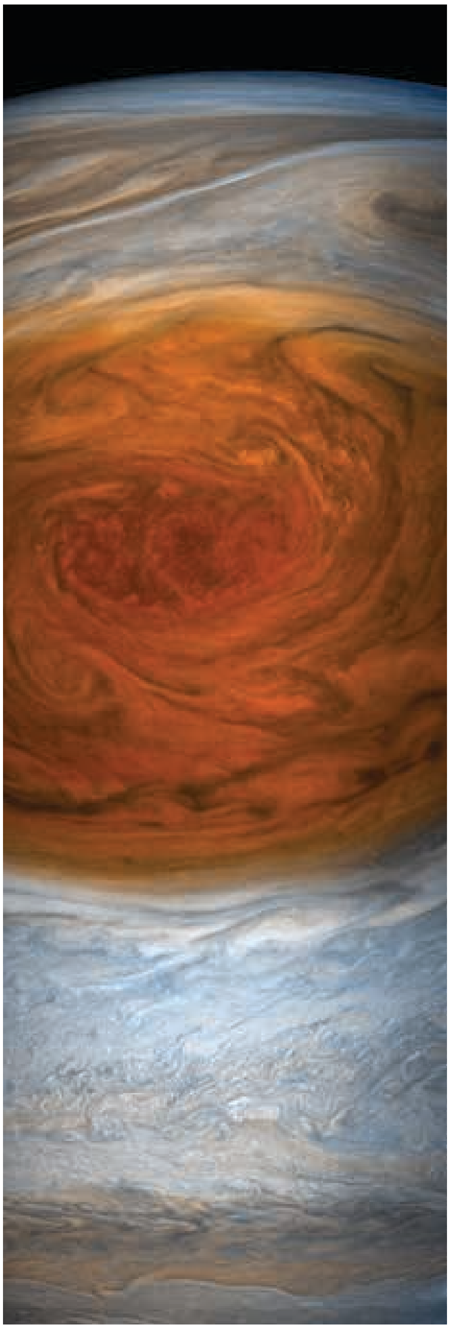

Figure 1. *The highest-resolution colour-composite image of Jupiter's Great Red Spot by the JunoCam instrument. Credit: NASA/Southwest Research Institute/Malin Space Science Systems/Gerald Eichstädt, Seán Doran*

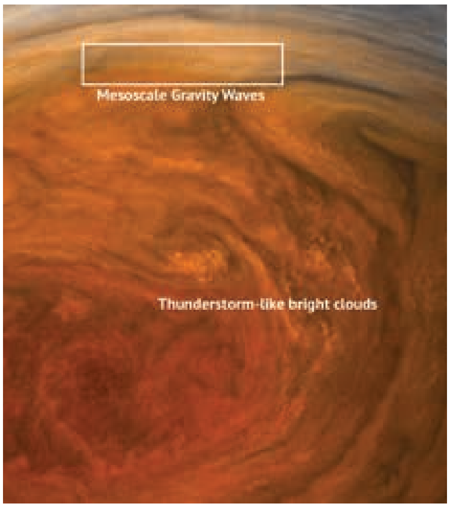

Figure 2. *Close-up of the Great Red Spot showing the mesoscale gravity wave and thunderstorm-like bright clouds. Annotations courtesy of CAPjournal.*

Soon, the information from JunoCam will be assembled along with *Juno's* other observations as well as results from a coordinated campaign of Earth-based supporting observations to extend and support *Juno's* results. Much is owed to the citizen-scientists who helped to track the location of the Great Red Spot and provided detailed processing of Juno's initial results.

This research was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

References

Daniels, Sebastian. CAPjournal 21, December 2016

IAU100: Uniting Our World to Explore the Universe

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On behalf of the IAU100 Task Force.

In 2019, the International Astronomical Union (IAU) will celebrate its 100th anniversary. To commemorate this milestone, the IAU will organise a year-long celebration to increase awareness of a century of astronomical discoveries as well as to support and improve the use of astronomy as a tool for education, development and diplomacy under the central theme *Uniting our World to Explore the Universe*.

The centennial celebrations will stimulate worldwide interest in astronomy and science and will reach out to the global astronomical community, national science organisations and societies, policy-makers, students, families and the general public. The IAU100 activities will be conducted at the local, regional, national and international level. The IAU has set up the IAU100 Secretariat, which is preparing a comprehensive programme of flagship initiatives to reach target audiences worldwide through the IAU National Outreach Contact points[1] and national astronomical societies.

IAU100 Flagship Programmes

The IAU100 celebration will be supported by eight flagship programmes. These are global activity programmes on specific themes which will help achieve IAU100's main goals and reach its target audiences.

1. IAU100 Celebrations
By organising different events, the IAU will bring together high-level representatives, policy-makers and astronomers to discuss the potential of astronomy as a tool for development, education and diplomacy and to raise awareness about the IAU's coordinating role for the global astronomical community over the past century.

2. Astronomy for Society
This programme will focus on highlighting the importance of astronomy in society. As one of the oldest sciences, astronomy is part of every culture's history. Astronomy not only transcends borders, but actively promotes collaborations around the world. Given its technological, scientific and cultural dimensions, astronomy is a unique and cost-effective tool for furthering sustainable global development and for helping achieve the United Nations Sustainable Development Goals[2].

3. IAU100 Exhibitions
Under this flagship programme, the IAU will showcase the major achievements in astronomy over the last century along with selected IAU milestones. The goal of this activity is to produce an exhibition that can be replicated worldwide through the IAU network of National Outreach Contact points and national astronomical societies.

Box 1. IAU100 Goals

1. Increase awareness of progress and exciting developments in astronomy over the past century, in particular:
   - The importance of the collaborative enterprise of astronomy as a whole.
   - The importance of technology development for astronomical progress.
   - The coordinating role of the IAU within the global astronomical community.
2. Promote widespread access to astronomy knowledge and observation experiences.
3. Support and improve the use of astronomy as a tool for education, development and diplomacy.
4. Support and enrich an inclusive, equalitarian and diverse astronomy community.
5. Facilitate the preservation and protection of the world's cultural and natural heritage of dark and quiet skies.
6. Raise awareness and discuss prospective new developments over the next 100 years of astronomy.

Box 2. IAU100 Task Force

Members of the IAU Task Force are as follows:

Piero Benvenuti, IAU General Secretary, Italy
Sze-leung Cheung, IAU International Outreach Coordinator, Hong Kong China/Japan
Lars Lindberg Christensen, Head ESO Education and Public Outreach, Denmark/Germany
Rosaria d'Antonio, IAU Head of Administration, Italy
Ewine van Dishoeck, IAU President-Elect, the Netherlands (Chair)
Jorge Rivero González, IAU100 Coordinator, Spain/the Netherlands
Kevin Govender, IAU OAD Director, South Africa
Maria Teresa Lago, IAU Assistant General Secretary, Portugal
Silvia Torres-Peimbert, IAU President, Mexico
Pedro Russo, Leiden University, Portugal/the Netherlands
Robert Williams, STScI, USA

4. New Worlds: 'Are we Alone?'
The activities within this programme will foster a sense of global citizenship and critical thinking. They will inspire participants to evaluate our place in the Universe through activities related to exoplanets and astrobiology.

5. 100 Years of General Relativity: Eclipse
The year 2019 marks the 100th anniversary of the solar eclipse observations, which served as the first successful test of Einstein's theory of general relativity, fundamentally changing the way we understand gravity and the Universe. This programme will highlight and explain this important milestone by organising commemorative events as well as reaching out to larger audiences to raise awareness about the importance of gravity and Einstein's theory, building on recent discoveries such as the detections of gravitational waves.

6. Natural and Cultural Heritage
This programme will focus on showcasing astronomy as a rich and significant aspect of cultural and natural heritage. Activities under this programme will highlight the importance of preserving one's heritage and passing it on to future generations to explore. In addition, activities will promote the preservation of quiet and dark skies by bringing the issues of natural environment and energy preservation to the agenda of decision makers and organising educational and public engagement events.

7. Astronomy for All
An important focus of the IAU100 celebrations will be the implementation of actions to promote diversity and support and encourage women and minority ethnic scientists and engineers at all career levels. This programme will promote inclusive, equitable work environments within astronomy-related careers. In addition, the programme will focus on facilitating access to astronomical resources and careers for people with special educational or physical needs and provide role models and mentors for groups not adequately represented in science.

8. Star-parties
Through the organisation of pavement astronomy events, this programme will enable as many people as possible, especially children, to look at the sky through a telescope and gain a basic understanding of the Universe.

Get Involved!
Whether you are a professional working in astronomy, an amateur astronomer or just someone interested in astronomy, we would love for you to get involved in the celebrations. Please check the IAU website for the latest updates and how to get involved at the regional and national level through the IAU Outreach Network and national astronomical societies.

If you have an interesting activity idea that falls under any of the flagship programmes, do not hesitate to contact the IAU100 Secretariat to share your idea and discuss potential endorsement. In addition, we expect to raise funds for selected grassroots actions at the national and local level soon.

Notes

1 IAU National Outreach Contacts: https://www.iau.org/public/noc/

2 United Nations Sustainable Development Goals: http://www.un.org/sustainabledevelopment/sustainable-development-goals/

Biographies

Jorge Rivero González is the IAU100 coordinator based in Leiden University, the Netherlands.

Ewine van Dishoeck is Professor of Molecular Astrophysics at Leiden University, the Netherlands, the IAU President-Elect and the IAU100 Task Force Chair.

Pedro Russo is the head of the Astronomy and Society research group at Leiden University, the Netherlands.

Sze-leung Cheung is the IAU International Outreach Coordinator based at the National Astronomical Observatory of Japan in Tokyo.

Ten Years of CAPjournal: Perspectives from Past Editors

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Keywords
Interview, 10th anniversary, journal editing

The end of 2017 marked 10 years of CAPjournal and a new era in the journal's life as it moved to the International Astronomical Union's Office for Public Outreach. To celebrate the journal's past, we interviewed two of the longest serving editors from across this 10-year period to get their insights on the highs and lows of the journal and how it has evolved over the past decade.

Interview with Pedro Russo

Pedro Russo was the founding editor-in-chief of the journal from 2007 to 2012. Pedro was, at that time, the coordinator for the International Year of Astronomy 2009, he is now the Head of the Astronomy and Society research group at Leiden University, the Netherlands, and also the President of the Commission C.C2 Communicating Astronomy with the Public of the International Astronomical Union.

Interviewer: It's great to see that CAPjournal has been in print for ten years but it must not have been easy to get everything started. Can you tell us how the original idea for CAPjournal was developed, and what the process has been to get where we are now?

Pedro: Back in 2007, we were ramping up to the International Year of Astronomy 2009; it was clear that there was a need in the community to have a forum for discussion and to present projects, ideas and, most importantly, lessons learned. This was the primary motivation to start a practitioners' journal, like CAPjournal. The main challenge was to convince the community to submit articles: the CAP community is a community of doers, which is great, but it means it is not a community that is used to, or has the time to, write down findings and lessons in the form of articles. This issue still exists, and we are losing a great deal of knowledge that could benefit everyone because of it.

Figure 1. *Pedro Russo. Credit: Pedro Russo*

Interviewer: I know you have very rich experience in science communication and you are also teaching science communication in university now. What are your thoughts on the current situation in the field of astronomy communication, anything you think we can learn from communicators in other science fields?

Pedro: Science communication has been growing a lot in the last decades; there are plenty of masters programmes, formal training and, most importantly, more awareness of the importance of science communication within the research community. Astronomy has been following that trend, and the number of professionals in astronomy communication is now larger than a couple of decades ago. However, research in astronomy communication is still very limited. Very few research articles are published every year, we see this reflected in CAPjournal, where very few articles are submitted under the 'Research & Applications' section. Even at the CAP conference, we rarely have research presentations. So we need to find ways to incorporate more research into the roles, impact and approaches in astronomy communication.

Interviewer: Do you have any further advice for our future authors that might be useful to consider for their research on astronomy communication?

Pedro: Just write it down! We have an extremely creative and active astronomy communication community (in my opinion, the most active and organised community in science communication), and we need to learn from each other to raise the quality and have a more significant impact in what we do. So I would encourage all CAPjournal readers to publish in the journal.

Interview with Georgia Bladon

Georgia was editor of CAPjournal from 2013 to 2017. Georgia currently works at a charitable foundation, the Wellcome Trust, as International Engagement Manager, managing the portfolio of work engaging research communities and the wider public with Wellcome's science research across Africa and Asia. Her work focuses on identifying and implementing strategies for ensuring that the interests of non-scientists shape and improve science; that research is developed with cultural and ethical sensitivity; and that science more broadly is recognised as a core and valued part of society and culture. Georgia also works as a freelance science writer for the European Space Agency and other clients.

Interviewer: You have been the editor-in-chief of the CAPjournal for four years. Can you share with us what the most challenging part of editing the journal is?

Georgia: One of the best qualities of the journal in my view also brings about one of the core challenges as an editor. That quality is the breadth of articles and authors we have in every issue. We have always sought to make the journal as open and accessible as possible and to encourage submissions from communications and

Figure 2. *Georgia Bladon. Credit: Georgia Bladon*

science engagement practitioners worldwide who may not usually think to publish in a peer-reviewed journal. As part of this, we make sure not to penalize a submission based on the quality of the written English. In a perfect world, we would have a facility for translation to improve this accessibility even further, but there have never been the funds. So, instead, we take submissions purely on their content and provide a very in-depth English editing service for those authors whose work may not be done justice by their written English. The challenge is to rework a piece so that the work it describes comes through with absolute clarity, but to maintain through it the voice and the flair of the original author. It is time consuming for both editor and author to get this balance right, but extremely satisfying in the end.

Interviewer: What is the most memorable thing about working on CAPjournal?

Georgia: One of the most memorable things about working on CAPjournal, and one of the things I will miss the most, is the team. I worked remotely, as did our proofreader, so we rarely found ourselves in the same room, but they are a group I have worked with for many years and their commitment and hard work are unrivalled. In addition, the amount I have learnt from working with dozens of authors and peer reviewers over the years will certainly stay with me. There is such a rich landscape of work going on in astronomy communication, and every issue brought new surprises and nuggets of knowledge.

Interviewer: In 2016, the CAPjournal published a special issue on the Rosetta mission; this was a great collection of papers. How did it happen?

Georgia: This was probably the most rewarding, and challenging, issue from my years as editor. It came about as the brainchild of Karen O'Flaherty from ESA who approached me in September 2015 asking whether we might consider a special issue. Karen and the communications team at ESA were keen to capture the vast amounts of work, and learning, from the *Rosetta* mission's communication campaign, and CAPjournal provided an obvious platform. I thought it was a great idea. *Rosetta* captured the world, and I had no doubt our readership of astronomy communication enthusiasts would be keen to hear how. What followed were months of hard work, and a lot of learning of my own. We had a wide range of authors from within and outside of ESA, and because this was an exposé of ESA's inner workings, it had to satisfy the needs not only of those authors but also the relevant senior managers of the organisation. There was a delicate balance to achieve between exposing the times when things had not gone to plan, often the most valuable reflections, while also highlighting the overall success of the campaign. Then there was the controversial 'Shirtgate' and how to handle it in a way that reflected both sides of the heated debate, without letting a single moment dwarf the rest of the campaign. And, lastly, there were two communications teams with two different style guides, resulting in a fair few debates over italics and grammar — a passion for which is common to most of us communication geeks. I'm not going to lie, not everyone saw eye to eye on many of these issues, and there were changes, compromises and tweaks all along the way, but the process of getting there was respectful and rewarding, and the result, something we could all be proud of. I'd do it again in a heartbeat.

Figure 3. *Cover images of CAPjournal since the first issue, with an enlarged image from the Rosetta Special Issue. Credit: CAPjournal*

ASTRONOMY TRANSLATION NETWORK

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ASTRONOMY MATERIALS

SHARE
VALUABLE RESOURCES

The Astronomy Translation Network will develop a global networking framework and web platform which will centralise translation resources and match those in need of translation services with volunteer translators.

Organisers

Office for Astronomy Outreach – IAU

NAOJ
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Partners

IAU OAD
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Astronomers Without Borders
ONE PEOPLE + ONE SKY

SKA
SQUARE KILOMETRE ARRAY

Opinion

Science in the Era of Facebook and Twitter: Get Used to It

Reproduced, with minor editorial changes, from the author's blog

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Keywords
Social media, facebook, twitter, BICEP2, science communication, astronomy, cosmology, ethics

Astrophysicist Heino Falcke reflects on the increased transparency of the scientific process with the rise of social media. He discusses the positives and negatives of having a spotlight shone on scientific results in the embryonic stage and, as a result, the rising number of false findings and claims that find their way into the public eye. What does this new age of communication mean for science? And how do scientists, science journalists and the public need to adapt to ensure a positive change in the way we conduct, communicate and trust science and scientific evidence?

Introduction

"Science is wrong, most of the time"

I am not sure who said that first, but I am sure someone did long before me. This is a banality for those who do cutting-edge science, yet it is a view that is difficult to accept in public discourse. In the days of social media, it is no longer possible to hide the frequency with which science is wrong from the ever-curious public, and it is a discourse that we as scientists and science communicators must not only accept, but actively engage with.

As an astrophysicist, I have had to reflect on this, following a series of small, and large, events that have brought the issue to my attention.

Cosmic Inflation and Other Inflated Stories

It all started with a press conference[1] at Harvard University, where astronomers announced that they had found evidence of cosmic inflation — the period of exponential expansion of space in the early universe. This news quickly spread throughout the world via Twitter and Facebook and was hailed as spectacular evidence for the Big Bang by the regular press[2]. Just a few weeks later, however, the findings were called into question, along with the claims they had led to in social media and press outputs[3]. The immediate uncritical acceptance and praise of the results in social media by many colleagues was very surprising to me. Science seems not to be immune to the hype phenomenon.

Around the same time, the SWIFT telescope announced a new gamma-ray source in the nearby galaxy Andromeda, a finding that was picked up by various news sources and social media channels well before many scientists knew of it. The source, had it existed, would have been very interesting indeed but, alas, it turned out not to be there[4]. Fortunately, the source was discovered not to exist so quickly that neither print media nor TV could report it, but because of the fast pace of social media, the news still had time to spread around the world.

There have been other major false alarms in the past which many (astro) physicists will remember well, such as the announcement of faster-than-light neutrinos[5], life on Mars or cold fusion[6].. However, the changing environment for sharing knowledge right when it is found, and before it can be verified, creates a new challenge, as well as, of course, new opportunities. The question is does it cause science to lose its credibility? This was the question I was asked by our university newspaper[7] in connection with an ongoing debate here which led me to consider the issue in more detail. My answer was that we — scientists, the media and the general public — need to learn how to handle science in the era of social media and adapt to the changing world of communication. Scientists are no longer viewed as the almost omniscient divine beings that, thanks to their unchallenged wisdom, hover well above the ground that absorbs normal mortals. We do not always know better and a more humble self-image should be embraced even if it comes with difficulties.

Embracing Failure in the Public Eye

Failure is part of the scientific enterprise. It is good that some scientists stick their necks out and dare to claim something. However, it is equally good that other scientists try to chop these heads off with counterarguments. That is proper science and cherished academic tradition. Scientific truth is not the outcome of a single eureka moment but of a long sociological process and, hence, it is subject to all human deficiencies. This failure-based process is not new; it is how science has always been done, but traditionally it has been hidden in the ivory towers of academic institutions. Thus, the media and general public have tended not to be aware of it. Social media has changed this, shedding new light on the process of science and revealing the failures on the path to success all too clearly.

In the past, most scientific debates would take place in academic circles and results would only gradually diffuse to the general public. Now the information transfer is instantaneous and often no longer filtered by journalists, who can only follow the wave rather than steer it.

Is that a problem? It may seem so in a society where science seems increasingly optional, where scientific evidence is less and less valued and where science itself becomes part of entertainment and the political circus. The consequence: science is becoming defensive.

In subjects like climate change, vaccination, evolution and ethical issues such as stem cell research, there are vocal minorities, or sometimes even majorities, of the general public that question positions that have a solid scientific evidence base. Moreover, science is big business for large institutions and groups, which raises suspicions about the evidence it produces and puts scientific credibility under even further pressure. Every additional false discovery, immediately amplified by social media, may serve to shatter that credibility further.

Figure 1. *Science in the era of Facebook and Twitter — a whirlwind of hypes and likes. Credit: Heino Falcke, Radboud University*

Sharing Science in the New World

So, what can be done? Shall we dig in and stop sharing our latest findings with each other and the public? Shall we stop making claims and just publish highly polished results?

The latter is, in fact, something that many big science collaborations have adopted as their working model and may become the model of the future. Perhaps too much money is at stake to risk making claims before results are polished, but even so science can still be wrong, so does this approach really give science more credibility?

However, I prefer honesty. Let us simply get used to the fact that science can be wrong — and that scientists can be wrong — without immediately dismissing the entire body of scientific knowledge. Let's raise awareness of what science is, and how it works, among the non-scientists of society, rather than finding new ways to hide it. Scientists should not be afraid of making claims or being wrong. Being wrong is as much a part of our job as is losing part of a football player's job. I am convinced that if scientists are less arrogant and more honest about the inner workings of science, credibility will naturally prevail in the long run.

However, we do need to develop an etiquette on how to communicate science results and how to involve the public in the scientific process in this new world of communication. It needs to be made clear what is discussion and what is an emerging consensus view.

For example, announcements like that of a sudden outburst of a cosmic source need to be made as soon as possible to the community, so others can react before the flare is over. In the case mentioned above, the SWIFT team did nothing wrong. They communicated their result as they usually do: swiftly and properly. The event turned out to be a glitch; that can happen. Any media reporting on such events must make its own choice: either be too late to report or report on something that is premature. To make this call, hire and train good science journalists and do not be afraid of correcting your story if it is wrong.

Very different, however, is the story of the Big Bang result. It was presented in a press conference as 'the first direct evidence of cosmic inflation' accompanied by a rumor-based social media campaign. Nobel prize winners were invited to be present at the data release, and soap opera-style reality TV movies about potential Nobel prize winners went viral. The authors of the paper asked for the media and social media attention, they got what they asked for, and they will have to face the consequences — potentially, along with the rest of the community. The paper in question had not been submitted to a journal and was not vetted by experts; instead, it was released to the entire world together with a very bold claim. Many colleagues hailed this as a major step towards openness and a transition from traditional publishing methods to modern swarm intelligence and social media-based interaction.

I think that is very wrong — or, at least, naive.

The procedure was primarily adopted to beat others (e.g. Planck), to secure dreamed-of Nobel prizes and perhaps to secure tenure and other jobs for collaborators. Does anyone really believe none of these things factored into the story? Science can be a fierce competition, it is not a culture where being honest or humble are necessarily rewarded, and our Harvard colleagues certainly know how to play the game.

So, may I suggest three possible options on how to proceed?

Option One: Enagage the public via social media from the start in a transparent and open way. Make it clear that your results are preliminary and need to be discussed. In fact, make your quest for the result public and let the process take its course. Have a press release summarising the conclusion and any premature media frenzy is the media's problem. Let the public find a way to deal with the process and get used to it.

Option Two: Be quiet and have your work refereed thoroughly and traditionally and then have a press release or even a press conference organised by your institution, following some clear ethical guidelines. In the case of extraordinary claims, the editors of journals should be very careful in selecting a number of very different referees, rather than prioritising speed. Still, be precise and humble in your claims as an author. Let the scientists involved be available on social media to discuss results afterwards.

Option Three: Release your results to the media before submission, but then make it clear that this is just one possible explanation, an interesting hypothesis, a contribution to the discussion. The media needs to learn to understand and report that properly. Certainly refrain from press conferences and emotional YouTube videos in this case.

Which method you choose (I have chosen two and three already and may like to evolve towards one, if allowed to by my peers) also depends on the significance of the result. If you really have Nobel-prize winning results (which I have not had, yet), then method two is perfectly fine — you will get the award irrespective. If you don't, even the biggest press campaign will not get you one. However, for large and long running collaborations funded by the taxpayer it is questionable to me, whether one can or even should expect scientists to refrain from talking about the status of their results via social media. After all, scientists have a right and a duty to the freedom of speech. Maybe option two is no longer the right thing to do?

No matter which method is chosen, let us above all be clear that science is an ongoing discussion. Science can benefit a great deal from social media interaction with scientists and the public but it requires honesty, less agitation, more understanding from the public and a sense of humility among us scientists. In the end, however, it makes us vulnerable — whatever we do. We need to learn to live with that.

Reader's Response

What are your thoughts on the issues raised in this piece? If you would like to share your thoughts with the author, or submit a short response for publication in the next issue of CAPjournal, contact us at editor@capjournal.org.

Notes

1. Press conference proceedings: http://www.cfa.harvard.edu/news/2014-05
2. News of the finding in influential press: http://www.bbc.com/news/science-environment-26605974
3. Press coverage of back pedalling: http://www.washingtonpost.com/national/health-science/big-bang-backlash-bicep2-discovery-of-gravity-waves-questioned-by-cosmologists/2014/05/16/e575b2fc-db07-11e3-bda1-9b46b2066796_story.html
4. Gamma-ray source coverage: http://blogs.nature.com/news/2014/05/rare-cosmic-blast-sends-astronomers-racing-to-telescopes.html
5. Faster-than-light neutrinos coverage: http://en.wikipedia.org/wiki/Faster-than-light_neutrino_anomaly
6. Cold fusion coverage: http://en.wikipedia.org/wiki/Cold_fusion
7. Article from author in University newsletter: http://www.voxweb.nl/wetenschap-moet-wetenschap-uitleggen/

Biography

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The Japanese Experience of the NameExoWorlds Competition: Translating Official Information into Japanese to Enable Domestic Groups to Participate in a Global Event

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Keywords
Global astronomy events, translation, public engagement networking

Translation of information from English is an essential step toward ensuring the involvement of non-English speakers in global events. The NameExoWorlds competition, led by the International Astronomical Union (IAU), was held from 9 July 2014 to 15 December 2015. It was a unique event that invited the public to name celestial bodies. In Japan, language acts as a significant barrier for amateur astronomers and school students to participate in global events hosted in English. To address this concern, we established a domestic working group to set up a Japanese website and provided a translation of the IAU's official site for the NameExoWorlds competition. We also developed additional original information in Japanese when needed and sent announcements to a mailing lists of astronomy societies in Japan. As a result, 28% of the registered groups and 47% of proposals for names were from Japan, making Japan the most active country for these stages of the competition. After the competition had ended, we carried out a survey in the Japanese astronomy community and received 124 responses. We found that most of the Japanese participants referred to our official Japanese website in order to overcome the language barrier and participate in the competition. This article explores our work of translating the competition information into Japanese and our evaluation of the impact of this action on the uptake by Japanese astronomy enthusiasts.

The NameExoWorlds Competition

NameExoWorlds[1] (Montmerle et al., 2016) was a worldwide competition led by the International Astronomical Union (IAU) and organised by the IAU Office for Astronomy Outreach (OAO), which is located at the headquarters of National Astronomical Observatory of Japan (NAOJ) in Tokyo, Japan. The competition gave astronomy clubs and non-profit organisations related to astronomy a chance to name exoplanets and their host stars, referred to as 'exo-worlds'. Ever since the first exoplanet around a main-sequence star — known as 51 Pegasi — was discovered in 1995 (Mayor & Queloz, 1995), more than 3000 exoplanets have been discovered. For these exoplanets, the scientific nomenclature follows the international rules widely adopted by the scientific community, which are drawn from the rules for naming binary stars. For each planet, the name given is that of the host star around which the planets are orbiting, followed by a lower-case letter: b for the first discovered exoplanet, c for the second, and so on. For example, 55 Cancri b, 55 Cancri c and 55 Cancri d are planets that orbit the host star 55 Cancri. These official and scientific names are not very memorable and are more like a code. Therefore, the IAU issued a statement on the Public Naming of Planets and Planetary Satellites, which outlined the first set of rules that allowed the public to become involved in assigning common names to exoplanets[2].

Since the IAU's establishment in 1919, the only way in which a non-professional astronomer can name a minor planet is to discover it[3]. Now, that has changed.

The NameExoWorlds competition is the first opportunity for non-professional astronomy groups to propose names for exo-worlds.

The procedure of the competition was as follows.

Step One: Announcement from the IAU
On 9 July 2014, 260 exo-worlds were listed as eligible for public naming by the IAU. Each exo-world has between one and five exoplanets, all of which were discovered before 31 December 2008.

Step Two: Registration of clubs and organisations
The IAU issued a call to astronomy clubs and non-profit organisations worldwide that could be interested in naming the exo-worlds to register on the IAU Directory for World Astronomy website[4]. Registration originally closed on 31 October 2014 but was later extended to 1 June 2015.

Step Three: Selection of exo-worlds to be named
The registered clubs voted online for which of the 260 exo-worlds they wanted to be

eligible for naming and by 15 February 2015, more than 400 registered clubs and organisations had voted and 20 exo-worlds had been chosen. The exo-world list was released on the IAU official website in April 2015, with 15 stars and 32 exoplanets eligible to be named. Five of the 20 chosen — Ain (epsilon Tauri), Edasich (iota Draconis), Errai (gamma Cephei), Fomalhaut (alpha Piscis Austrini) and Pollux (beta Geminorum) — already had star names, only exoplanets names were eligible for for the next stage of the competition.

Step Four: Submission of proposals for names

The registered clubs and organisations submitted proposals for a name(s) for one of the selected 20 exo-worlds, with a deadline of 15 June 2015. These names had to be based on the naming rules of the IAU[5]. Each group was allowed to propose a name for only one exo-world. A total of 247 proposals from 45 countries were submitted[6] and 237 proposals were approved for voting.

Step Five: Public vote

On 11 August 2015, following a public ceremony at the IAU XXIX General Assembly in Honolulu, USA, the public began voting to rank the proposed names. The public vote was closed on 31 October 2015, by which time 573 242 valid votes had been received.

Step Six: Release of approved names

In early November 2015, the IAU, via its Executive Committee Working Group on the Public Naming of Planets and Planetary Satellites, oversaw the final stages of the competition and validated the winning names from the vote. On 15 December 2015, the winning names of 31 exoplanets and 14 host stars approved by the IAU were released[7].

Japanese Working Group, Website and Content

In the autumn of 2014, the Astronomical Consortium of Japan (ACJ) established a NameExoWorlds working group to encourage Japanese people to participate in this global event. The ACJ consists of several astronomy societies, associations and research institutes such as the Astronomical Society of Japan (ASJ), National Astronomical Observatory of Japan (NAOJ), Japan Aerospace Exploration Agency (JAXA), Japanese Society for Education and Popularization of Astronomy (JSEPA), Japan Planetarium Association (JPA), Japan Public Observatory Society (JAPOS) and Japan Amateur Astronomers Association (JAAA). JSEPA set up its own working group and led the ACJ's working group activities.

The purpose of the ACJ working group was to provide accurate information from the IAU to the Japanese community whenever needed. Many amateur astronomers and school students were interested in naming an exo-world but most of them faced a language barrier and had insufficient English proficiency to participate in the competition. The working group members developed the official website exoplanet.jp[8] and uploaded releases from the IAU in Japanese, including information on how to register an organisation on the IAU Directory for World Astronomy website. The group also provided several examples of the registration form using very simple English words and sentences that Japanese secondary school students could write. According to the questionnaire-based survey responses (summarised in the next section of this article), more than 50% of the groups who referred to the official Japanese website looked at the examples on the website and registered successfully. The group also created newsletters to remind people of deadlines and to provide useful information about the competition. The newsletters were sent to the mailing lists of ACJ-related organisations. Registered groups also received announcements and useful information from Dr. Hitoshi Yamaoka, the IAU National Outreach Contact (NOC) of Japan.

The NameExoWorlds competition also had an educational component, with registered groups needing to know about exo-worlds and the science behind them. The resources created for Japanese audiences reflected this educational compo-

Figure 1. *This illustration shows the procedure of the competition as shown in the official NameExoWorlds poster created by the IAU OAO. Credit: IAU*

研究者からのおすすめ惑星系

ここでは、研究者からのおすすめ惑星系についてご案内します。

←前へ　その他の追加情報

☆ 田村 元秀 氏　（東京大学／国立天文台太陽系外惑星探査プロジェクト探査室長）

系外惑星に興味をお持ちのみなさまへ

国立天文台の太陽系外惑星探査プロジェクト室では、太陽系外惑星（以下、系外惑星）の直接観測をはじめとして、さまざまな系外惑星の観測とそのための装置開発を推進しています。

系外惑星は既に1800個以上発見されていますが、そのほとんどが惑星を間接的に発見する手法です。

惑星を画像に写す「直接観測」では現在日本が世界をリードしています。今回のリストではごく最近に発見された惑星は含まれないため、自分達が発見した惑星ではないのですが、リストに含まれる惑星のうち系外惑星研究で重要と考えられている惑星を少し推薦いたします。

HD 149026 b （主星： HD 149026）

観測が進むにつれ、太陽系の惑星と比べて、系外惑星は実に多様であることがわかってきました。
まさに、「新世界」と呼ぶべき天体たちなのです。
系外惑星探査の国際チームN2Kによって、「すばる望遠鏡」などを用いて発見されたこの惑星は巨大惑星のひとつですが、その平均密度が異常に大きいという特異惑星です。
おそらく、惑星中心に巨大コアがあるためだと考えられていますが、その正体は良くわかっていません。

Figure 2. *This page from the Japanese site recommends planets for voting. Dr. Motohide Tamura recommended HD 149026 b. On this page, he says: 'Dear all who are interested in exoplanets, At the Extrasolar Planet Detection Project Office of NAOJ, we promote observations of various exoplanets and development of observational instruments. More than 1800 exoplanets have been discovered (as of 2015). However, most of them were discovered using indirect methods. Today, Japan is a leading country in direct imaging observations. Though the exoplanet list provided by the IAU does not include my discoveries after 2008, I would like to recommend some which are thought to be important in exoplanet studies: HD 149026 b (host star: HD 149026). With a lot of discoveries, we have learned how diverse exo-worlds compare to our Solar System. This planet was discovered by the international team N2K using the Subaru Telescope and other telescopes. It is a giant planet but an unusual one, with an extremely high density, and is thought to have a giant core. However, more studies are needed to conclude this'.*

nent, with exoplanet researchers in the working group providing basic information on the official Japanese site, such as how to discover an exoplanet and the characteristics of some well-known planets. On the Japanese site the exoplanet list provided by the IAU also showed which planets were discovered by Japanese research groups, to highlight national relevance. This was supplemented by messages from three Japanese researchers of exoplanets, namely, Dr. Motohide Tamura at The University of Tokyo/NAOJ (as of 2015), Dr. Bun'ei Sato at Tokyo Institute of Technology, and Dr. Takahiro Sumi at Osaka University. These astronomers recommended planets based on which important discoveries were made by Japanese researchers (including themselves) using Japanese telescopes. The three planets recommended were HD 149026 b, which has an unusually high density; Epsilon Tauri b, which was the first exoplanet discovered in a star cluster; and OGLE235-MOA53 b, which was the first exoplanet discovered using the gravitational microlensing method. Part of the original content on the Japanese site was a gallery page, where amateur astronomers and astro-photographers could upload images in which the host stars of exoplanets could be seen.

Promotion and Uptake in Japan

Information was distributed across Japan, not only via the website and mailing lists but also via other media, including Twitter. Scientists and astronomy educators wrote articles for amateur astronomy, science fiction, and teachers' magazines and distributed flyers about the competition at their public lectures. Working group members at the NAOJ responded to questions from the media and, as a result, the competition was aired on television and in newspaper articles.

Thus, 28% of the registered groups for the competition were Japanese, making Japan the most active country at the registration stage. As of 28 July 2015, 166 of 600 groups were from Japan, 57 were from the United States, 32 were from Spain, 26 were from Argentina, and 22 were from the United Kingdom. Among the top 20 nameable exo-worlds voted for and selected by the registered groups, seven nameable systems had been discovered by Japanese research groups. For example, HD 104985 b is the first exoplanet discovered by Japanese astronomers using the 188-cm Reflector Telescope of Okayama Astrophysical Observatory in Okayama, Japan, and HD 149026 b was discovered by an international team from Japan, the USA, and Chile using the Subaru Telescope, a 8.2-m optical and infrared Japanese telescope on Maunakea, Hawai'i, USA (Figure 2). Among the 237 proposals for names that were approved to be voted upon and listed on the IAU official website, 111 proposals were submitted by Japan, followed by 15 from the USA, nine from Italy, seven from France, and six from Germany.

When the public vote started, a page on how to vote was set up on the official Japanese website and a brief Japanese translation of the proposed names was provided. Messages and explanations from Japanese individuals who had proposed names were also uploaded to the website. Some working group members wrote articles about the public vote for amateur astronomy magazines, and members at NAOJ responded to media enquiries. However, we did not have a strong strategy to reach beyond the astronomy community. In the public vote, the IAU received 573 242 valid votes, which equalled 0.94% of the public votes worldwide and ranked Japan 18th in the number of voters; in contrast, 36.27% of the votes were from India, 19.48% from the USA, and 7.93% from Spain[9].

Compared to the population of each country, 0.016% of the people in India voted (34th place in comparison with the population), 0.035% in the USA (11th place), 0.099% in Spain (1st place), and only 0.004% in Japan (76th place).

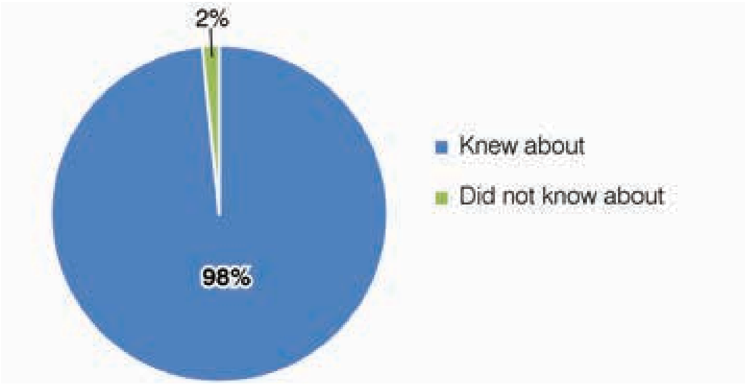

Figure 3. This graphic shows percentages of the 124 respondents who knew and did not know about the NameExoWorlds competition.

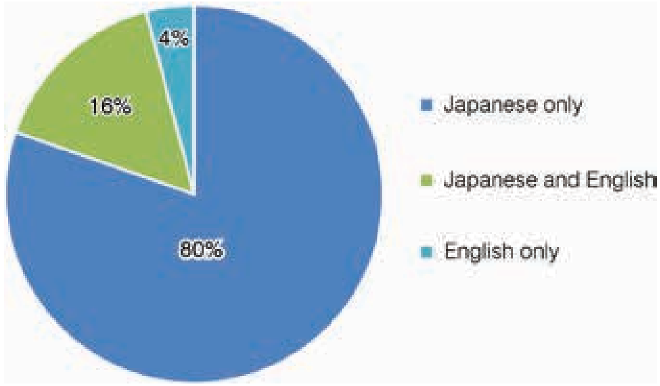

Figure 4. This graphic shows the languages in which the 122 respondents from the Japanese astronomy community found out about the NameExoWorlds competition.

Despite the small portion of votes from the Japanese public, names of four exoworlds proposed by Japanese groups won and were approved by the IAU: Tokushima Prefectural Jonan High School Science Club named 18 Delphini 'Musica' and its planet 'Arion'; Kamagari Astronomical Observatory named the planet Ain b 'Amateru'; Okayama Astro Club named HD 81688 'Intercrus' and its planet 'Arkas'; and the student club at Hosei University Libertyer named xi Aquilae 'Libertas' and its planet 'Fortitudo'. All four of these planets were discovered using the 188-cm Reflector Telescope at Okayama Astrophysical Observatory.

Results from a survey among the Japanese astronomy community

Respondent

The Japanese language support provided by the working group was successful in ensuring a high registration rate and generating a large number of final entries of Japanese origin. To identify the success of key components of our activities, a questionnaire survey was carried out within the Japanese astronomy community. The announcement of the survey was sent to members of ACJ-related societies and registered groups via email. Using a Google Form, 124 answers were collected between 15 January and 15 February 2016, and 122 of the respondents (98%) knew about the NameExoWorlds competition (Figure 3).

Knowledge of the Competition

Of the 122 respondents who knew about the competition, 98 (80%) had found information about the competition in Japanese language only, 19 (16%) found it in both Japanese and English, and five (4%) found it only in English (Figure 4). In total, 96% of our respondents had received Japanese information.

The announcement of the competition was made through the network of the societies and personal contacts. Our survey respondents belonged to ACJ-related societies, and as expected, almost half (48%) the respondents who learned about the competition in Japanese received an announcement via the societies' mailing lists (Figure 5). Information was also conveyed from person to person; the respondents learned about the competition via personal communications (17%), at conferences (16%), and at the NAOJ's open house events (8%). About 35% of the respondents learned about the competition on websites such as exoplanet.jp and the website of the Japan Amateur Astronomers Association (JAAA). However, about 60% of those who visited the websites also received information via the mailing list. It is natural to see a majority of the respondents received the information through the mailing list since we used the same channel for conducting the survey. On the other hand, only 5% of the total respondents received information via newspapers and magazines.

Level of Participation

Of the 122 respondents who knew about the competition, 72 (59%) registered their groups, 29 (24%) participated in the pub-

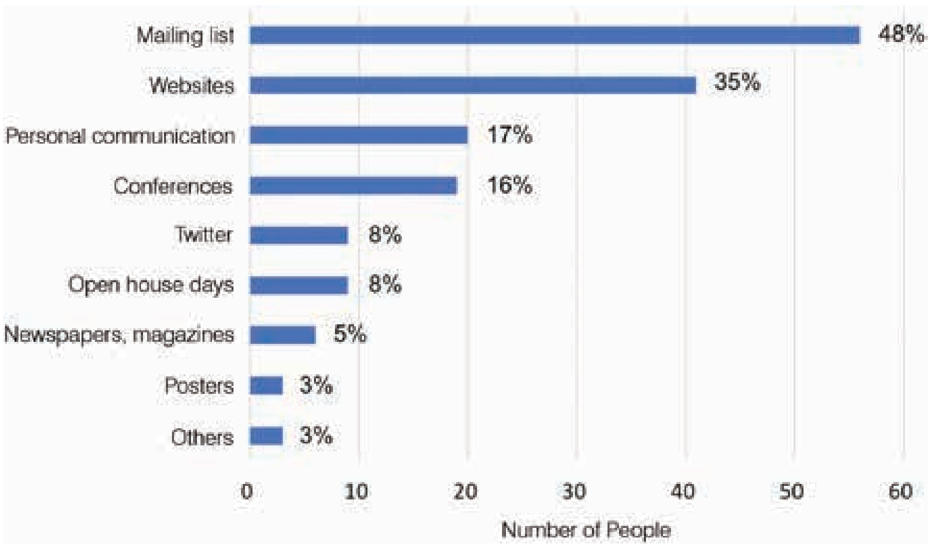

Figure 5. This graphic shows which resources the Japanese respondents used to learn about the NameExoWorlds competition. Percentages are fractions divided by the total number of respondents who read Japanese resources (117). The survey allowed for more than one option to be selected.

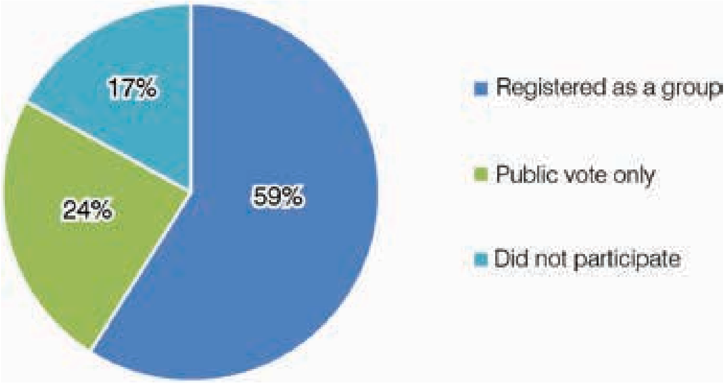

Figure 6. This graphic shows the distribution of how the 122 respondents participated in the NameExoWorlds competition.

lic vote only, and 21 (17%) did not participate in the competition (Figure 6). Over 80% of the registered respondents also proposed names (64 out of 72) and participated in the public vote (60 out of 72). Among the 72 registered, 69 (96%) referred to the official Japanese site. The reasons that people did not refer to the official site were that they did not need Japanese language support (one) or were not aware of the site (two). This means that almost all of the respondents referred to the official Japanese site once registered.

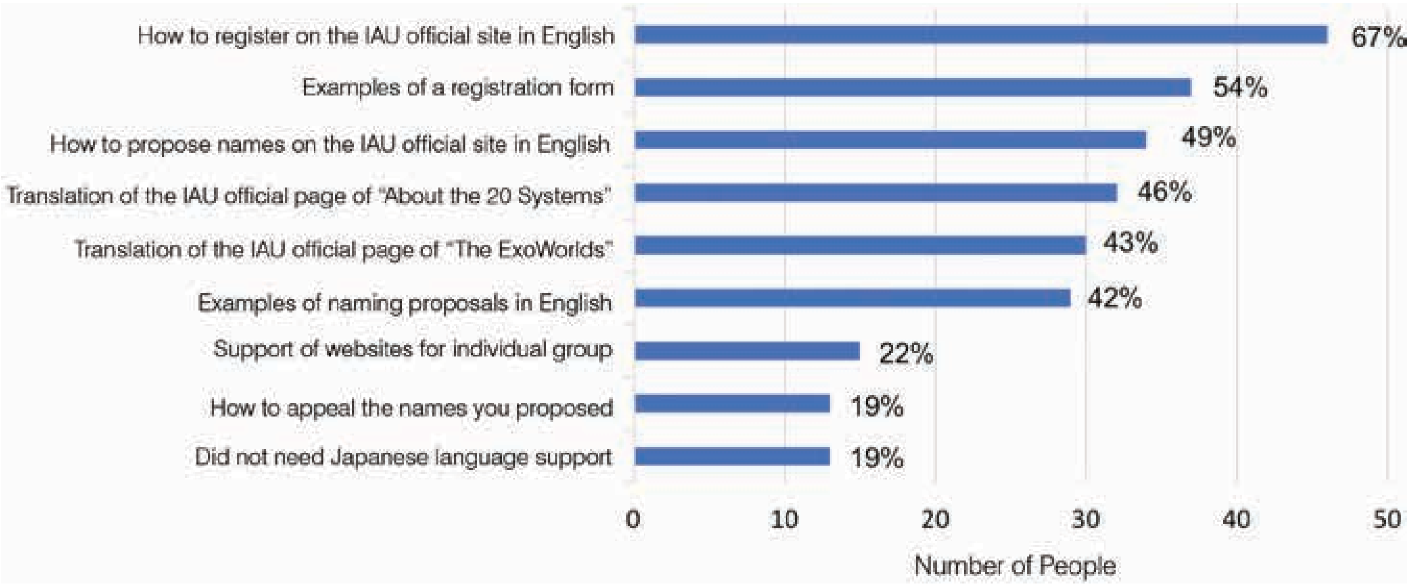

Figure 7. This graphic shows the reported 'essential pages' on the official Japanese website used by the 69 respondents who referred to the site at registration. Number one (how to register), number four (about the 20 systems) and number five (the exo-worlds) were the translation of the IAU official site, and others (except number nine) were original information developed by the Japanese working group.

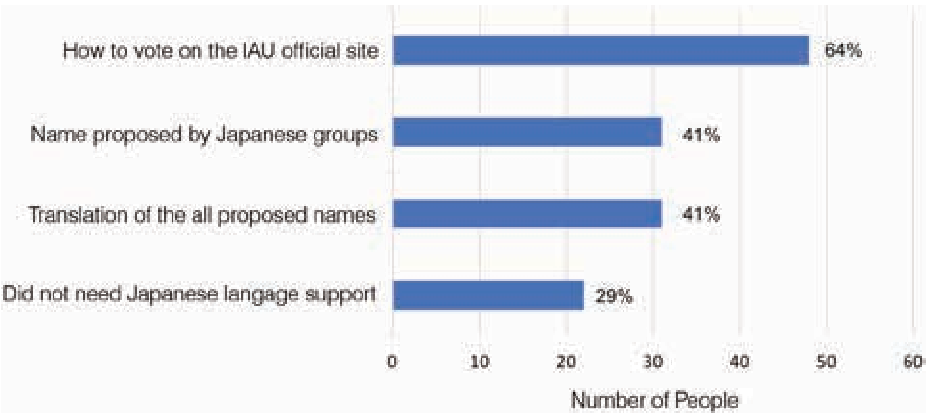

Figure 8. This graphic shows the reported 'essential pages' on the official Japanese website for the 75 respondents who referred to the site at the public vote. Number three (the all proposed names) is the translation of the IAU official site, and number one (how to vote) and number two (name proposed by Japanese groups) are original information developed by the Japanese working group.

The Registration and Submission of Proposals

According to the answers to the question, 'Which page in Japanese was essential for you to register your group and to propose a name for an exo-world?' among the 69 respondents who referred to the official Japanese site (multiple answers allowed), the most important information was 'How to register on the IAU official website' (translation of the IAU official site), followed by examples of a registration form (Figure 7).

More than 40% of respondents considered that all the three translated pages of the IAU official sites ('How to register', 'About the 20 systems' and 'The exo-worlds') were necessary. Also, about half of the respondents needed simple examples for registration and submission of proposals in English. Multiple respondents sent their appreciation for the Japanese working group, saying things like 'Without the official Japanese site, I could not have registered'.

The Public Vote

A total of 89 respondents participated in the public vote: 60 registered and voted, while 29 did not register but only voted. Of the 89 respondents, 75 (84%) referred to the official Japanese site. The reasons that 14 people did not refer to the Japanese site were that they did not need Japanese support (14) or were not aware of the site (three). The lower rate than the number of registered people referring to the Japanese site (96%) implies that voting using multiple choice in English was easier for Japanese users than registration, which required English writing. Among 75 respondents who referred to the Japanese site to vote, 29% responded that they could have voted without Japanese support (Figure 8), while 64% stated that they needed the primary information about 'how to vote' in Japanese in order to vote.

Among the respondents, 21 did not participate in the competition although they knew about it. The main reasons were that they did not know how to participate (six), they were not interested in the competition (five) and they did not have enough time (three). We also received other feedback about the competition from the participants, which included calls for a better schedule and one that did not change, as this had reportedly created difficulties for the participants. There was also a suggestion that the winning names should stick to the rules and that modified versions should not be permitted. Easier ways to register and vote and consistent and clear rules were also cited as barriers to participation in the competition.

Discussion

The results of the survey revealed the fact that a language barrier exists among non-professional astronomers, including amateur astronomers and school students, and that the working group's development of an official Japanese website was essential for these individuals and groups to participate in the worldwide NameExoWorlds competition.

The working group's constitution of professional astronomers, amateur astronomers and members of several ACJ-related societies was key to its success as it enabled these individuals to provide an accurate translation of the IAU official site and development of original web content with reliable information. Within the working group, professional and amateur astronomers worked together to develop the web content and distribute information. Thanks to the location of the IAU OAO at the NAOJ headquarters, the working group members could be in direct contact with OAO and send cross-checked information from the IAU to the Japanese community with minimal time lag. In addition, the working group was authorised by the ACJ, and

Box 1: Summary of Survey Findings

- 98% of the survey respondents knew about the NameExoWorlds competition.
- At least 80% of the respondents first heard about the competition from Japanese sources and purely relied on the Japanese information rather than the IAU's official site written in English.
- 83% of the respondents who knew about the competition joined in some capacity.
- 59% of the respondents who knew about the competition registered as a group.
- 7% of the respondents who knew about the competition dropped out (they registered in the first stage but did not propose a name in the next stage).
- 24% of the respondents who knew about the competition did not register but only voted.
- The Japanese translation of the registration guidelines proved to be the most useful of the resources created.
- For Japanese speakers, voting using multiple choice was easier than registration, which required English writing.

Competition Stage	Worldwide	Japan
Registration from clubs and organisations	600 groups (as of 28 July 2015)	166 groups (28%, 1st place)
Selection of exo-worlds	20 exo-worlds	Seven exo-worlds discovered by Japanese researchers
Submission of proposals	237 proposals*	111 proposals (47%, 1st place)
Public vote	573 242 votes	5411 votes (0.94%, 18th place)
Approved names	19 exo-worlds**	Four exo-worlds (21%, 1st place)

** The number of proposals approved for voting.*
*** The winning name for tau Boötis was not approved by the IAU.*

Table 1. *Statistics comparing competition uptake in Japan with other participating countries at each step of the competition.*

its website and newsletters were shared widely throughout the nation through its channels.

Reaching beyond the astronomy community was challenging. Strategic publicity planning and media contacts should have been considered in the public vote. In the future, we would like to investigate successful examples in other countries.

To increase the number of participants in the global event, a simpler procedure seems to be necessary. The main reasons that respondents who did not participate gave for their lack of participation were that they did not know how to participate and that they did not have enough time. These reasons imply that the competition procedure was too complex and the timeline was too short.

Some of our respondents submitted written requests to the IAU to develop a voting page that was less text heavy and had translations in other languages. Creation of a translation network and provision of less official pages but in multiple languages would be desirable if the competition is to be held again.

There were also other cultural barriers to participation in the competition. For the public vote, participants were required to answer questions to prevent voting by a robot. The validation system used was produced by Google, and most photos in the quizzes were based on American culture. Thus, some Japanese participants had difficulty recognising the difference between a street sign and a traffic sign, a pancake and a cake, etc. Consideration of diverse cultures in addition to various languages is thus important for a global event.

Conclusion

Establishing a domestic working group in Japan and developing an official Japanese website helped with the language barrier for the Japanese astronomy community. Among our survey respondents, 96% referred to the Japanese website when they registered, and 84% did so when they voted. The most important information provided was simple content such as 'How to register' and 'How to vote' on the IAU official website. Being able to access primary information in their mother tongue was thought to lower the language and psychological barriers faced by many Japanese astronomy community members. Simple examples of English writing for registration and submission of proposals also seemed to be helpful.

Existing mailing lists of the ACJ-related societies were useful to distribute information. On the other hand, a strategic publicity plan should have been considered to reach more people outside of the astronomy community.

Web design with less text on the IAU official site would have been helpful and having the public voting page in various languages would have attracted more participants. Consideration of diverse cultures, in addition to various languages, is thought to be important for a global event.

Acknowledgements

The authors would like to thank Dr. Akihiko Tomita from Wakayama University and Dr. Hidehiko Agata from National Astronomical Observatory of Japan for their valuable comments.

Notes

1. NameExoWorlds website: http://nameexoworlds.iau.org
2. NameExoWorlds press release: http://www.iau.org/news/pressreleases/detail/iau1404/
3. IAU naming: https://www.iau.org/public/themes/naming/
4. IAU directory: https://directory.iau.org
5. The IAU naming rules are: 16 characters or less in length; preferably one word; Pronounceable (in some language); Non-offensive; Not too similar to an existing name of an astronomical object. More details are explained at: https://www.iau.org/public/themes/naming_exoplanets/
6. IAU press release: https://www.iau.org/news/pressreleases/detail/iau1511/
7. Winning names announcement: https://www.iau.org/news/pressreleases/detail/iau1514/
8. Official website exoplanet.jp has been moved to: http://tenkyo.net/exoplanets/wg/index.html
9. Statistics from the competition: http://nameexoworlds.iau.org/statistics

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Biographies

Kumiko Usuda-Sato is an astronomer who currently works at the National Astronomical Observatory of Japan (NAOJ) Public Relations Center in Tokyo. During her 15-year stay in Hawai'i, she conducted extensive outreach activities for the local community.

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Hitoshi Yamaoka is an astronomer in the area of supernovae research and works at the NAOJ Public Relations Center. He also serves as the National Outreach Contact (NOC) of Japan at the IAU OAO.

Toshihiro Handa is an astronomer working on the Milky Way Galaxy and received a Prize for Science and Technology in the Public Understanding Promotion Category from the Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan, in 2012.

The Hands-On Universe: Making Sense of the Universe with All Your Senses

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Keywords
Astronomy, public engagement, education, visual impairment, gastronomy, art and science, creative writing

For the past four years, the Hands-On Universe public engagement programme has explored unconventional, interactive and multi-sensorial ways of communicating complex ideas in cosmology and astrophysics to a wide variety of audiences. The programme lead, Roberto Trotta, has reached thousands of people through food-based workshops, art and science collaborations and a book written using only the 1000 most common words in the English language. In this article, Roberto reflects in first person on what has worked well in the programme, and what has not.

Introduction

On a balmy evening in June 2015, I took my seat as a member of the general public at Cheltenham Science Festival, UK. It was a sold out event in the festival's programme, and Professor Charles Spence, of Oxford University's CrossModal Research Laboratory, and experimental chef Jozef Youssef of Kitchen Theory[1], charmed the audience with a talk about their ongoing collaboration. The chef and the scientist (as they like to present themselves) described their exploration of how multi-modal sensorial experiences influence the way we perceive (and enjoy) food. The scientist sought novel insights on how the brain operates: did stroking a velvet surface as opposed to a rough one increase the sense of sweetness in food? Answer: yes, as was exemplified in a classic experiment going back to Italian futurist Filippo Marinetti, who presented it in a futurist cookbook in 1932 (Marinetti, 1932, 2014). On the other hand, the chef wanted to use the latest insights of experimental psychology to create surprising, multi-sensorial dining experiences for his guests [Bosker, 2015].

Figure 1. *The Hands-On Universe project logo. Credit: Hands-On Universe*

At the end of the talk, after everybody else had left, I approached Jozef: 'Have you ever thought about what dark matter might taste like?', I asked him. 'I haven't, but we can!' was his reply. This was the start of a journey together that would lead to the g-ASTRONOMY project, part of a series of public engagement activities I created and presented in the UK and abroad, and to some of the most memorable and moving moments in my public engagement work to date.

The series of activities — called the Hands-On Universe Project[2] — aimed at lowering access barriers for the public to topics in astronomy, cosmology and astrophysics. The common thread of the various activities was to generate curiosity and engagement by moving away from purely intellectual explanations, in favour of more interactive, multi-sensorial and dialogic means of engagement. Funded by the Science and Technology Facilities Council (STFC) (one of the seven research councils in the UK), the project ran for four years until September 2017, during which time I had the privilege of being an STFC Public Engagement Fellow. Being a fellow meant that part of my salary was covered by an STFC grant, which freed up some of my time as an academic member of staff at Imperial College London to work on the Hands-On Universe project. After more than a decade of doing science communication in my 'free' (and often, family) time, the grant gave me the opportunity to pursue it as an official part of my job. This made a huge difference: I now had the time to design and implement a coherent engagement plan and the resources to run it.

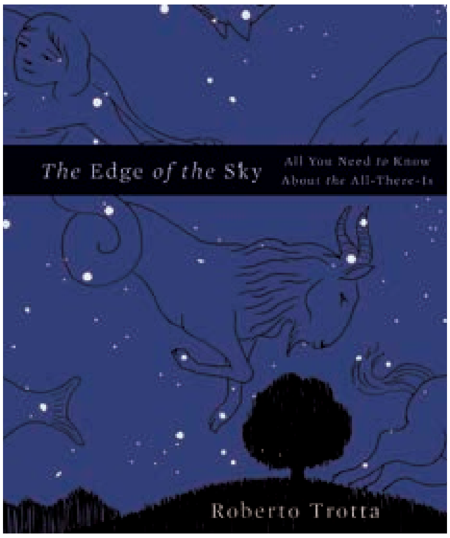

Figure 2. *The cover of Roberto's book, 'The Edge of the Sky', written using only the 1000 most common words in the English language. Credit: Antoine Déprez*

My research as an astrophysicist at Imperial College London, UK, deals with some complex and faraway concepts such as dark matter, dark energy and the Big Bang. But as a science communicator and educator, I had been asking myself for years how we can make some of the most difficult concepts in modern physics fun, engaging and accessible to all. The Hands-On Universe project grew out of my quest for novel ways of engaging the public with my subject, often perceived (for right or for wrong) as inaccessible. After giving hundreds of public talks and lectures over the years, I had grown a little disillusioned with traditional public engagement for-

Figure 3. *Roberto presenting the Great Cosmic Cookery Show at Imperial Festival 2014. Credit: Imperial College London*

mats. I was particularly wary of the top-down model of engagement generated by the lecture format — the scientist speaking, the public taking it all in, and perhaps asking questions at the end. I felt it would be much more enriching for both parties if a format were used that enabled a more dialogic encounter between the scientist and the public.

This was the starting point for the project, which had three main, intertwined strands. The first aimed at using multi-sensorial experiences based on food to create original and engaging metaphors for concepts in astrophysics ('g-ASTRONOMY'). The second strand was to foster art and science collaborations to widen participation to sectors of society not traditionally interested in astronomy. And the third strand used my book, The Edge of the Sky: All you need to know about the All-There-Is (which talks about modern cosmology using only the 1000 most common words in the English language [Trotta, 2014]) as a way of reaching both very young children and adults interested in creative writing.

g-ASTRONOMY: Beyond Visual Representation of Astronomy

The g-ASTRONOMY strand of the Hands-On Universe programme set out to test the idea of using food as an engaging yet scientifically accurate metaphor for astrophysical phenomena. After all, food concerns us all, and we all have a relationship with it.

I have been working with food in my engagement work for some time. I have used focaccia bread to explain the expansion of the Universe, worked with school children to build a to-scale Solar System

Figure 4. *An edible Solar System developed with experimental chefs using a technique called 'spherification' to produce the planets, presented at an event at the London Science Museum in December 2015. The asteroid belt is made of chocolate crumble, and other minor bodies (including comets) are made of edible silver flakes. Credit: Imperial College London*

Figure 5. Children exploring the makeup of the moon with muffins at a Hands-On Universe workshop for families. Credit: Roberto Trotta

from fruits and vegetables (with peppercorns for the asteroid belt!), and developed a travelling cookery show based on early Universe cosmology. In fact, when I first met Jozef Youssef at the Cheltenham Science Festival, I was there to present 'The Great Cosmic Cookery Show', an event for families which aimed to use cookery as a fun and interactive way to talk about space. Children and their parents thus explored black holes with 'Spacetime Tortillas', built a replica Solar System with fruits and vegetables on skewers, baked 'Moonberry Muffins' to explore gravity and the formation of moon craters, and created a 'Nuclear Sunrise' cocktail representing the chemical makeup of the Sun. The whole thing was messy, memorable and surprisingly scientifically accurate.

The ongoing collaboration with Jozef Youssef and his development chefs, took my own early experiments using food for science engagement to a new level of sophistication. Youssef and his team of trailblazing chefs devoted to multi-sensorial dining experiences, have brought the expertise of professionals to bear onto the question of how to communicate cosmology and astrophysics with food. g-ASTRONOMY aims to break the assumption that astronomy and astrophysics can only be understood in terms of visual representation. Instead, we wish to create simple, elegant (and edible) metaphors for some of the Universe's most complex ideas, so as to enable people to engage with some of the most important theories in astrophysics in a new, accessible and delicious way.

Our collaboration produced an edible orrery of the Solar System, with visitors of London's Science Museum invited to create their own edible planets with a technique called 'spherification' — producing liquid spheres encapsulated in a thin membrane that burst in your mouth in an explosion of taste.

For the Cheltenham Science Festival 2016[5], we created a cocktail named 13.796, after the age of the Universe in billions of years, which was inspired by the cosmic timeline from the Big Bang to the present day. Served in a martini glass, which signifies the expansion of the Universe, time in the cocktail flows from the bottom up. The cocktail is composed of three layers of decreasing density that do not mix with

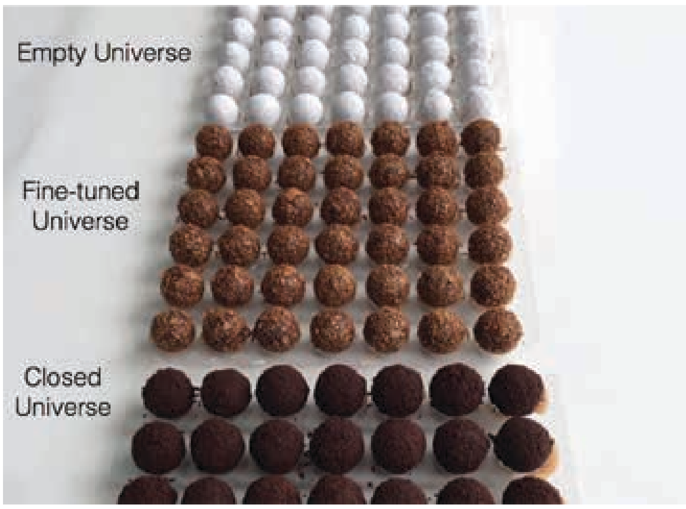

Figure 6. Chocolate pralines designed to express various corners of the multiverse in a multi-sensorial fashion. The weight, texture and filling metaphorically match the properties of the pocket universes they represent. Credit: Stefano de Constanzo

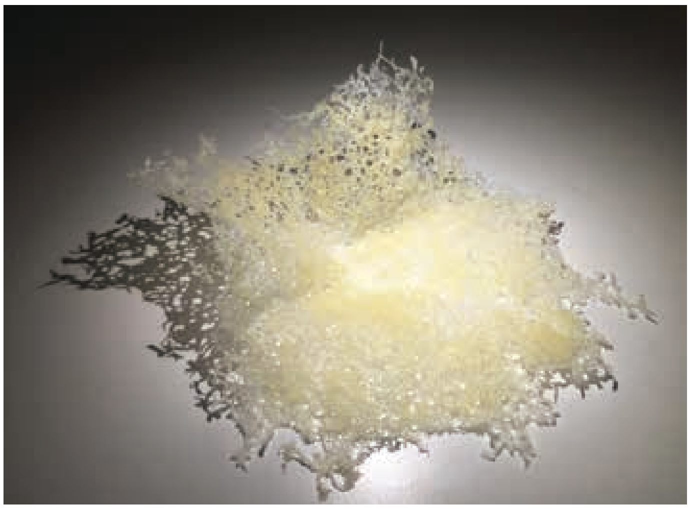

Figure 7. A delicate parmesan tuille is used to grasp the properties of Einstein's space-time and the existence of dark matter in the Universe. Credit: Stefano de Constanzo

each other. Each layer relates to a cosmic epoch: the early Universe plasma at the bottom (mango smoked with wooden chips from whisky barrels), the dark ages when the Universe became transparent (jellified coconut Malibu) and the formation of the first galaxies (coconut water with a suspension of vanilla pods). A scientifically accurate, utterly delicious and slightly inebriating representation!

Other outputs created as part of the project included a parmesan tuille which encapsulated the distribution of galaxies in the sky and Einstein's notion of a malleable space-time continuum — a tool used to explore the meaning of 'cold' vs. 'hot' dark matter.

We also presented the speculative notion of a Multiverse with different pocket universes, each with its own laws of physics and different constants of nature, using three chocolate pralines. Their contents, texture, and density where carefully chosen to embody an empty universe, an over-dense universe, and our own, finely balanced Universe, with its 25% dark matter (chocolate crumble), 70% dark energy (coffee-milk chocolate ganache) and 5% all-important normal matter (passion fruit gelatine).

Building on the learning from the project so far, we have now embarked on an even more challenging project: in collaboration with the Royal National Institute of Blind People, we designed an event exclusively for people with sight loss, which we ran for the first time in London, UK, in March 2017[4].

The workshop has been specially designed to provide an immersive and interactive experience without the need for visual cues. Visitors are able to simultaneously feel and taste the evolution of our Universe from the Big Bang to the formation of galaxies and experience the multiverse theory through how different universes might taste, rather than how they look. The cocktail was also modified to use in the workshop. It was broken down into three different sections, with the first one served in specially designed 3D-printed cup holders that reproduce in a tactile form the 'bumps' in energy found in the baby Universe. These energy bumps are based on data from the cosmic relic radiation collected by the microwave satellite Planck. The 3D printed cup-holders have been created by Imperial College London's Advanced Hackspace, and build on previous work by Dr David Clements, also at Imperial.

The feedback from participants with visual impairment has been very humbling and encouraging: *'I have never experienced anything like it before'; 'I cannot stop thinking about it!'; 'Life changing'*. The g-ASTRONOMY project is about using all of our senses to better communicate complex ideas in astronomy and astrophysics, and it has been a privilege to work with people with sight loss to better understand how to take the concept forward. The insights and feedback of this group will shape the next phase of g-ASTRONOMY: moving away from edible tableaux of astronomical ideas and exploring deeper analogies in terms of the physics at work both in the Universe and in the kitchen.

Art and Science Collaborations

With the Hands-On Universe programme, I explored the arts as another route to reach a different kind of public than people already interested in astronomy. I have long been interested in art and science collaborations as a way of exploring a genuinely new territory between the two. Sometimes, such collaborations end up providing a mere 'artist's impression' of a scientific concept, which is often unsatisfying for public engagement purposes. At the opposite end, they might provide not much more than a veneer of scientific respectability on a pre-existing artistic concept. In order to be truly cross-disciplinary, an art and science collaboration has to leave the safety of both the artist's and the scientist's territory; become unmoored and explore an approach that is genuinely in-between.

Figure 8. *3D printed cup holder showing in a tactile fashion the distribution of temperature in the very early Universe, as measured by the Planck satellite. The size of the holder matches the size of the visible Universe at 10^{-34} seconds after the Big Bang. The smoked mango drink is a representation of the primordial plasma that filled the Universe at that time. Credit: Tom Walker*

Figure 9. *One of the participants at the g-ASTRONOMY event for visually impaired people enjoys a taste of the Multiverse. Credit: Tom Walker*

The very real danger in creating a project outside of either discipline is that the outcome may not be satisfactory from either point of view. This risk, however, is usually worth taking and when the chemistry is just right both the artist and scientist can come away feeling that together they have achieved something that neither of them could have done alone. A collaboration that left this positive impression on me was with the artists Ole Hagen and David Cheeseman. Ole, David and myself had been discussing ideas at the boundaries of our respective work for several years — in 2013, one of our proposals even made it into the 100 best proposals for the UK art competition Artangel. Out of these long-standing discussions and exchange of ideas grew the show 'All There Was', presented at the Institute for Contemporary Art Studio in London as part of a year-long series of 50 shows in 50 weeks [Ustek, 2018]. The title of the exhibition came from the three most frequently used words in my book, 'The Edge of the Sky'.

The opening night of the show saw a performance piece, in the form of a conversation ('Does Darkness Matter?') between Ole and myself, revolving around our respective approaches to knowledge in the Universe. As the dialogue moved on, we sketched our ideas on opposite ends of a specially designed concertina-shaped blackboard, which upon unfolding revealed the unsuspected meeting of the two perspectives in the middle. The show consisted of seven sculptural pieces created by Hagen and Cheeseman as a reflection on the 'Big Seven' features of today's post-Newtonian Universe which were identified by our conversations: dark matter, dark energy, inflation, the Higgs particle, exoplanets, black holes and supersymmetry.

What we were interested in exploring with the show were the boundaries between science and visual art, including concept, hypothesis, meaning, representation and communication. It was very stimulating for me to snap out of the usual scientific perspective of the concepts we had identified. Together, we looked at these ideas from the point of view of Cheeseman's interest in illusion, in the haptic and experiential encounters with objects and in experiments using mirrors and magnets. Hagen's multidisciplinary approach brought to our relationship an investigation of theatricality, myth-making and cosmology. Ultimately, our efforts converged in a show that was trying to depict and grasp the invisible, both in art and astrophysics.

Figure 10. Non-Euclidean Blackboard Three: The concertina used in the opening performance of the 'All There Was' show at the Institute of Contemporary Art in London. Credit: Sylvain Deleu

Lessons Learnt

Inevitably, looking back at the Hands-on Universe project now that it is over, there are a few aspects of it that I would do differently. It is important to step away from the culture of positive reporting and talk about the shadows, as well as the highlights, as this allows us to reflect critically and to improve in the future.

Perhaps my biggest regret is that I have allowed myself to be overly driven by my enthusiasm for the project. This meant that it was difficult for me to ever say no to the enticing requests I received. As a result, I ended up giving talks and leading workshops aimed at audiences that perhaps did not really need to be stimulated, as they were already very much on board with the broad aims of my work. In other words, I wish I had dedicated a larger fraction of my time and efforts to the more difficult-to-reach audiences, rather than giving in to hugely satisfying (but arguably less important) opportunities to talk to science-minded and science-savvy audiences.

Another aspect I now realise I did not pay sufficient attention to is evaluation. While evaluation often has a reputation for being a boring and bureaucratic way of measuring things that are difficult to quantify (audience engagement, change of perspectives, lasting value), I wish now that I had made a more consistent and sustained effort. It would be useful to have more precise statistics on the public I reached — gender, background, education level, age, etc. — to enable me to better answer the fundamental question at the heart of most science communication: 'Did it make a difference?'. Ultimately, this is a very difficult concept to measure accurately (or at all), but it constitutes perhaps the central question of any public engagement work.

After four intense and fun-filled years designing and delivering the 'Hands-On Universe', I will now concentrate my efforts on further developing the g-ASTRONOMY programme. While my work with Kitchen Theory is only in its infancy, I sense a great potential for this collaboration. Everybody I spoke to about it has been supportive, perhaps stimulated by the surprise factor and the many possibilities that this concept opens up for reaching new audiences and exposing them to cosmological ideas in an original way. Our quest to put the biggest questions in physics on the tip of your tongue has only just begun.

Acknowledgements

Parts of this article have been previously published on the Scientific American blog[6].

Figure 11. *Non-Euclidean Blackboard one to four: Two pieces from the 'All There Was' show, created by David Cheeseman. Credit: Sylvain Deleu*

Box 1: The Hands-on Universe Project in Numbers

9000+ people reached in person

20+ talks in schools

100+ talks and workshops

20+ radio and TV appearances

20+ podcasts appearances

11 articles for the general public

11 literary and scientific festival appearances

4 awards

The Hands-On Universe project has been supported by the Science and Technology Facilities Council. g-ASTRONOMY is supported by the Institute of Physics, the Royal Astronomical Society and the Science and Technology Facilities Council.

The Hands-On Universe would not have been possible without the help, contribution and support of many people. I would like to thank Sally and Kate at The Purple Kitchen; Jozef Youssef and Stefano de Costanzo of Kitchen Theory; the students at Imperial College's Science Communication Masters' programme; Dr David Clements; Dr Ole Hagen and David Cheeseman; the book "fig-2" curator Fatos Ustek; Alice Glanfield and Stacy Rowe at the Royal National Institute of Blind People; and Jing Shen Pang, Sam McKenney and Ingrid Logan at Imperial's Advanced Hackspace. Last but not least, I thank my wife Elisa and my children Emma and Benjamin for supporting my efforts even when that meant me being away from my family.

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Biography

Roberto Trotta is a theoretical cosmologist at Imperial College London, UK, where he studies dark matter, dark energy and the Big Bang. He is also the Director of Imperial's Centre for Languages, Culture and Communication Roberto is a passionate science communicator and the recipient of numerous awards for his research, outreach and art and science collaborations, including the Lord Kelvin Award of the British Association for the Advancement of Science and the Michelson Prize of Case Western Reserve University. His award-winning first book for the public, 'The Edge of the Sky: All you need to know about the All-There-Is', endeavours to explain the Universe using only the 1000 most common words in the English language. Roberto was named as one of the 100 Global Thinkers 2014 by Foreign Policy, for 'junking astronomy jargon'.

First Step to Understand Intergroup Bias and Cohesion from the One World Experiment: A Pilot Project to Evaluate the Effect of the 'Pale Blue Dot' Hypothesis

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Keywords
Evaluation, science education, intergroup bias, prejudice, altruism, randomized controlled trial, Pale Blue Dot, astronomy, science communication

The One World Experiment was carried out as a pilot effort in Cape Town, South Africa, to test whether exposure to an astronomy intervention affects empathy and altruism in children. The intervention focused on introducing children to knowledge around the Earth's position in the Universe and collecting data to assess the effect. This paper presents the project background as well as the methodology and results from the project's first phase, designed to understand the possible difference in empathetic response between a child and other 'ingroup' and 'outgroup' children; for any child, an 'ingroup' child is one belonging to their own social group (in this case, nationality), and an 'outgroup' child is one belonging to a social group other than their own. It is found that the students across the study have a strong cohesion to those of the same nationality but that there is no nationality bias in their feelings towards how other children share their joy with them. Full analysis of the data, which will compare the control group and experimental group results and focuses on the impact of astronomy intervention, is underway for future publication.

Introduction

The Pale Blue Dot is a famous image of Earth taken by the *Voyager 1* spacecraft on 14 February 1990, when it was around 6 billion kilometres from us. In this picture, taken at the suggestion of the astronomer and science communicator Carl Sagan, Earth appears as a pale blue dot, a tiny point of light, less than a pixel in size. Over the years, this image has come to symbolise our place in the Universe, the connection we have to one another as well as to the planet. As Sagan later wrote in his book, the image 'underscores our responsibility to deal more kindly and compassionately with one another and to preserve and cherish that pale blue dot, the only home we've ever known'.[1]

The image and the philosophy behind the Pale Blue Dot have inspired awe and excitement in many people around the world. It is assumed that knowing one's place in the Universe alters perception and induces more empathy towards fellow humans. Indeed, astronomy has been employed as a tool for diplomacy and international cooperation[2, 3]. In our era of unprecedented migration, and anti-immigration sentiments, astronomy could be viewed as a panacea that can bring people together. Astronomy outreach projects provide anecdotal evidence that looking through a telescope provides a unique perspective that can induce empathy and lead people to overcome hostility.

From October to November 2015, the astronomy outreach project 'One World Experiment' was carried out among 938 secondary school students in Cape Town, South Africa and studied using a randomised controlled trial (RCT). RCTs are often considered the ideal study design to measure and evaluate the effectiveness of interventions. The IAU Office of Astronomy for Development (OAD) and Hosei University together with the South African Astronomical Observatory conducted the trial and the Consolidated Standards of Reporting Trials statement (Begg et al., 1996) guidelines were used for designing and reporting on the trial.

This experiment aimed to test whether exposure to an astronomy intervention would affect intergroup biases and other-regarding preferences (empathy and resource allocation) in children. Intergroup bias, also known as ingroup-outgroup bias, is the tendency to favour members of one's own group over others (Sumner, 1906). People with intergroup bias may perceive their own group members positively simply because of the ingroup and may view the outgroup negatively simply because it belongs to another grouping (Bigler et al., 1997). Empathy, altruism and prosociality are critical foundations for a stable human society. Research shows a tendency for individuals to feel more empathy and engage in more prosocial behaviour towards individuals categorised as belonging to their own social group relative to other groups. Failure to empathise is more likely if 'the sufferer is socially distant' (Cikara et al., 2011).

Although empathy is a key prosocial response, (intergroup) biases develop at a very young age. This intervention introduced children aged 9 to 11 years to astronomical perspectives of Earth's position in the greater cosmos (e.g., a view of Earth from space appearing as a pale blue dot). The intervention emphasised humanity as a social group to reduce intergroup biases in empathy and increase prosocial behaviours towards those outside of nationally

Figure 1. *The Pale Blue Dot is an image of the Earth taken by the Voyager 1 spacecraft from a distance of more than four billion miles away. From this distance, Earth is a mere point of light, less than the size of a picture element even from a narrow-angle camera. Credit: NASA/JPL*

defined 'ingroup' categories. From the viewpoint of space, viewing the Earth without national boundaries often made astronauts change their views of the world by invoking a sense of universal brotherhood. This experience is known as the 'overview effect' (Yaden et al., 2016). The intervention was designed like a simulated experience of the overview effect.

It must be mentioned that this intervention was performed at a small scale and low cost, as a proof of concept. We hope this pilot initiative will guide others interested in repeating this experiment.

Background

Astronomy communication with the public takes many different forms. Traditional astronomy education activities, marked by awareness-raising actions such as sky observations and public lectures fall under the broad category of outreach. These activities aim to motivate the audience by providing a window into the most fascinating aspects of astronomy. They are meant to be fun experiences that introduce exciting themes of science and astronomy to wide swathes of people.

Such activities routinely inspire thousands, if not millions, around the world. Many scientists are able to pinpoint their interest in science to a particular outreach event, but this impact is broadly recorded anecdotally. These events have a hit-or-miss approach about their impact and typically attract people with an established interest in science. Without methodical evaluations, it is hard to measure the impact of such edutainment.

Evaluations are essential to measure the impact of interventions. Evaluation is defined as the 'systematic, objective assessment of an ongoing or completed intervention, project, policy, programme, or partnership. Evaluation is best used to answer questions about what actions work best to achieve outcomes, how and why they are or are not achieved, what the unintended consequences have been, and what needs to be adjusted to improve execution'[4].

Different types of evaluation are used to address different dimensions of project impact and effectiveness and are of interest to different stakeholders. For example, process evaluations focus on implementation and how, for whom and under what conditions a project worked; impact or outcome evaluations measure significant changes attributable to the project and whether and to what extent target outcomes were achieved; and economic evaluations measure cost-effectiveness. It is important to note that not all projects can be evaluated, such as those without clearly defined goals and projects that do not aim to change observable outcomes.

An RCT is one type of impact evaluation in which participants are randomly assigned to groups that receive an intervention or serve as the control group which does not receive the intervention. RCTs are considered the gold standard in impact evaluation. By randomly assigning participants to the experimental and control groups and comparing the outcomes between the groups, the effectiveness of a project can be measured. Since participants in an RCT are randomly assigned, any differences in outcomes can be attributed to the programme or intervention rather than other factors[5].

Figure 2. *The astronomy outreach project, 'One World Experiment', was carried out among 938 secondary school students in Cape Town, South Africa. Credit: IAU Office of Astronomy for Development*

Experiment

The intervention aimed to foster the development of a social identity based on a 'common humanity'. By placing all of humanity as the ingroup and any other life (outside of Earth) as the outgroup, the intervention aimed to reduce the salience of national and ethnic identities and increase empathy and prosociality toward individuals in different national groups.

The primary outcome of interest is whether there is any immediate effect of the intervention on children's helping behaviour toward anonymous ingroup versus outgroup members.

The null hypothesis is that there will be no difference in primary and secondary measures between students in the experimental and control groups. The experimental hypotheses are that students in the experimental group will report higher cohesion and higher levels of empathy with the outgroup than students in the control group.

Experimental Design

The experiment was designed as a cluster RCT (in which the unit of randomisation is a group or cluster rather than an individual) with an experimental and control arm. The cluster unit of intervention is a class group. The sample size is the average number of students per class group multiplied by the number of class groups that participated in the trial. These class groups were part of schools that were contacted in the target area and agreed to participate in the study. All of the schools are located in the same area and share a similar setup and level of infrastructure.

For students in these selected schools, their own national group was South Africa (the ingroup). The outgroup was chosen such that it differed from the ingroup along only one dimension. Kenya was chosen as the outgroup because it is an outgroup with which the children are somewhat familiar, and it is not associated with overtly negative stereotypes and does not differ along the race dimension.

Astronomy Activity

The intervention is designed to introduce children to the inter-connectedness of the human species and the bond that we share with the planet. This can be achieved by using astronomy as a tool, i.e. by exposing them to the concept of the Pale Blue Dot[1].

We created a video using a combination of Google maps, Mitaka software, Google Street view and NASA's 'Eyes on the Sky' application. The instructor takes the children on a tour of chosen locations in different countries on Earth and then through the Solar System, stopping over for a brief exploration of the surface of Mars.

Measurement

The astronomy activity was preceded or followed by the measurement for the control and experimental groups, respectively.

Control — The control group receives the measurement first, followed by the astronomy intervention.

Experiment — The experiment group is administered the astronomy intervention, followed by the measurement.

Data Collection

The data were gathered from 938 students (472 boys and 466 girls). After incomplete data were removed, the data from 683 students (319 boys and 364 girls) were used in this research.

The measurement process involved two parts:

Voting — This was intended to test the helping behaviour of the children toward children from other groups (in this case, nationalities). Each student had a card with envelopes affixed under a gender-neutral picture of a child from their country (ingroup) and a child from a chosen foreign country (outgroup). Students were given three tokens each and told that each token represents one unit of currency. They were told that whichever envelope they put the token in, a real donation of that amount would be made to the child whose envelope they chose.

Questionnaire — Students were asked to mark responses to the following questions on a separate card. There were two sets of five questions, one for the home country and the other for the chosen foreign country. The intervention provider explained each question.

Question 1. How similar do you think this child is to you?
A. Very different
B. A little different
C. Neither different nor similar
D. More similar than different
E. Very similar

Question 2. How would you feel if something good happened to this child?
A. I don't care at all
B. I feel neutral, okay with it
C. I feel happy
D. I feel very happy
E. I feel very, very happy

Question 3. If something good happened to you, how do you think this child would feel?
A. The child doesn't care at all
B. The child feels neutral, okay with it
C. The child feels happy
D. The child feels very happy
E. The child feels very, very happy

Question 4. How much would you like to play with this child?
A. Not at all
B. A little bit
C. Medium
D. I would like to
E. I would really like to

Question 5. How would you feel if this child got hurt at school?
A. Very sad
B. Sad
C. Medium (not happy)
D. I would not care

In schools, the astronomy intervention and measurement were carried out in Xhosa (isiXhosa), which is one of the official languages of South Africa, and English.

Brief Summary of the Auxiliary Analysis

Full analysis of the data, which focuses on the impact of astronomy intervention, is under way within the collaboration. This paper describes the auxiliary analysis of possible differences in response among ingroup and outgroup children to the parts of assessment measures with no reference to the astronomy intervention by collectively dealing with experimental and control groups. Correlation analysis was performed to examine the strength and direction of the linear relationship among the answers to the questions.

Students in the same class are more likely to respond in a similar way. The intercluster correlation coefficient (ICC) was calculated to confirm whether there was high similarity between values from the same class or not. The ICC ranges from 0 to 1. A low ICC close to 0 indicates that values from the same class are not similar. On the other hand, an ICC close to 1 indicates high similarity between values from the same class. According to Hox (2002), rules of thumb for interpreting the ICC were as follows:

small: ICC = .05, medium: ICC = .10, large: ICC = .15

ICCs in all questions except q1SA were smaller than .05. The ICC of q1SA was also lower than .10. Since the ICC result show the students in the same class are not highly similar, we performed analysis using individual students' data.

Data Analysis Procedure

In this paper, four questions (q2SA, q2K, q3SA and q3K) are focused on, and associations among the responses to these are examined. For data analyses, the answer options (A, B, C, D and E) were converted into ordinal variables (1, 2, 3, 4 and 5) and SA is used to denote the set of questions relating to the fictional South African child and K to denote the set of questions about the fictional Kenyan child. From the four questions, two questions were chosen as question combinations. [q2SA–q2K] is the abbreviation used to represent the association of the answer between q2SA and q2K.

a) Calculating the Spearman rank correlation coefficient

In correlation analysis, a sample correlation coefficient is calculated. The correlation coefficient ranges between –1 and +1. The more the value of the correlation coefficient is closer to +1 or –1, the stronger is the positive or negative correlation between variables. According to Cohen

Box 1: Abbreviations

Abbreviations as shown below were used in our research:

q[n]SA, q[n]K (n: question number)
e.g. q2SA means question number 2 and that the child in the question is a South African child (the ingroup).
e.g. q3K means question number 3 and that the child in the question is a Kenyan child (the outgroup).

[All]: All students (683)

[Boy]: Boy students (319)

[Girl]: Girl students (364)

[vote_SA]: Students who gave more tokens to the South African child than the Kenyan child (541)

[vote_K]: Students who gave more tokens to the Kenyan child than the South African child (144)

(1992), the rules of thumb for interpreting the correlation coefficient are as follows:

small: $|r|=.10$, medium: $|r|=.30$, large: $|r|=.50$

For example, the linear correlation between the height and weight of children can be interpreted by calculating the correlation coefficient. If this correlation coefficient is closer to +1, the height and weight are strongly positively related.

Depending on the number and type of variables, there are different types of correlation coefficients. In this paper, the direction and strength of the association between two variables are quantified by calculating the Spearman rank correlation coefficient, which is used for ordinal variables, including Likert scales.

b) Calculating the partial correlation coefficient using the Spearman rank correlation coefficient

When the correlation analysis is performed by calculating the correlation coefficient, the two variables q2SA and q2K are influenced by other variables. The partial correlation coefficient can eliminate this influence.

Results

Partial correlation coefficients are calculated from correlation coefficients. Among partial correlation coefficients related to question combinations between q2SA, q2K, q3SA, and q3K, five partial correlation coefficients (q3SA-q3K for [vote_K], q2K-q3K for [All], [Boy], [Girl], and [vote_SA]) were higher than the medium effect size of Cohen's index, i.e. 0.30 (Cohen, 1992). For these partial correlation coefficients, confidence interval (CI) was calculated. Further, the p-value of the test for association and the statistical power of the post-hoc analysis for each partial correlation coefficient were summarised, as shown below:

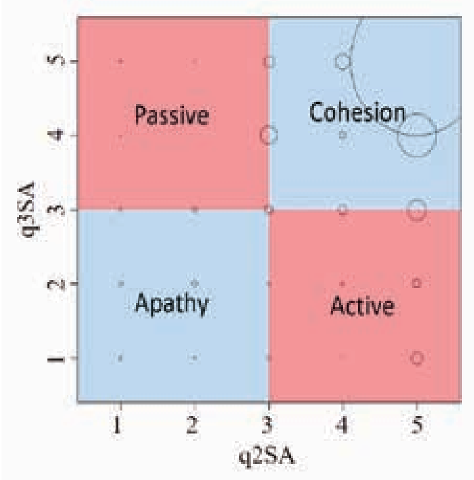

Figure 3. *Bubble chart for q2SA and q3SA [All]. The size of the circle represent the frequency of the answer set to questions. The X-axis and Y-axis show the answer options (from 1 to 5) of q2SA and q3SA, respectively.*

「q2K-q3K」

[All] $r = .33, p < .05, 1\text{-}\beta > .99$, 95% CI [.26, .40]

[Boy] $r = .35, p < .05, 1\text{-}\beta > .99$, 95% CI [.25, .44]

[Girl] $r = .31, p < .05, 1\text{-}\beta > .99$, 95% CI [.21, .40]

[vote_SA] $r = .33, p < .05, 1\text{-}\beta > .99$, 95% CI [.25, .40]

where β is the error probability.

「q3SA-q3K」

[vote_K] $r = .40, p < .05, 1\text{-}\beta > .99$, 95% CI [.25, .53]

With regard to the question combination [q2SA-q3SA], the majority of the students answered 5 for both q2SA and q3SA. The percentage of the answer result (q2SA = 5, q3SA = 5) for each classification is about 40%. Figure 3 shows a bubble chart of the question combination between q2SA and q3SA for [All] divided into four sections.

We found that the correlation of the cohesion among the ingroup and outgroup students can be determined by focusing on the question combination [q3SA-q3K].

[vote_K] and [All] were used to compare differences in answer results between these classifications.

Figure 4 shows a bubble chart of [vote_K], while Figure 5 shows one of [All].

The question combination [q2K-q3K] enabled us to examine the impression of the outgroup in detail. For comparison, [vote_SA] from these classifications and [vote_K] were considered. Figure 6 shows a bubble chart of [vote_SA], while Figure 7 shows one of [vote_K].

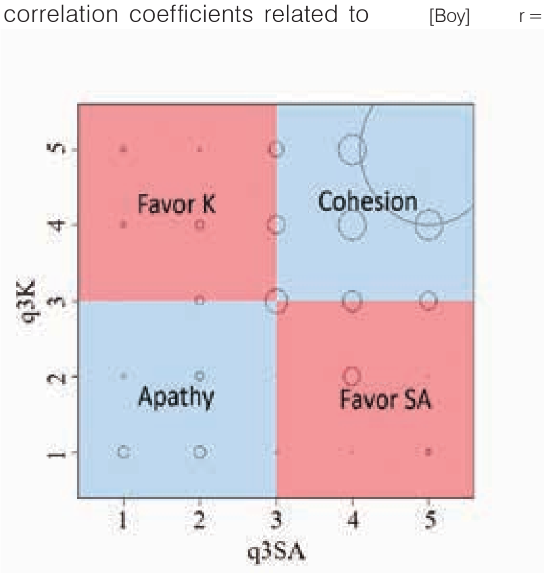

Figure 4. *Bubble chart for q3SA and q3K [vote_K]. The size of the represents the frequency of the answer set to questions. The X-axis and Y-axis show the answer options (from 1 to 5) of q3SA and q3K, respectively.*

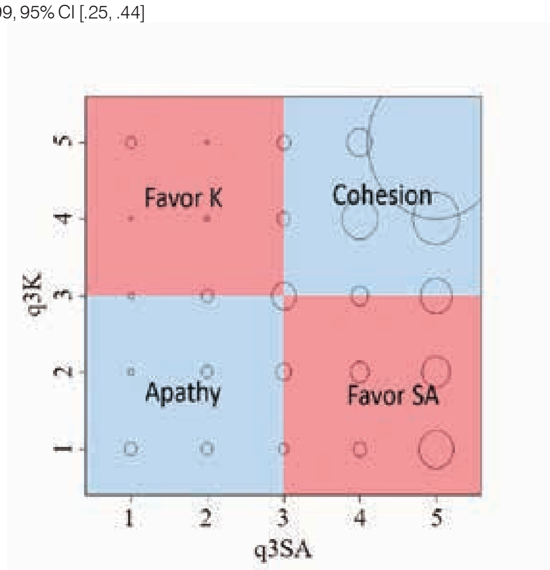

Figure 5. *Bubble chart for q3SA and q3K [All]. The size of the circle represents the frequency of the answer set to questions. The X-axis and Y-axis show the answer options (from 1 to 5) of q3SA and q3K, respectively.*

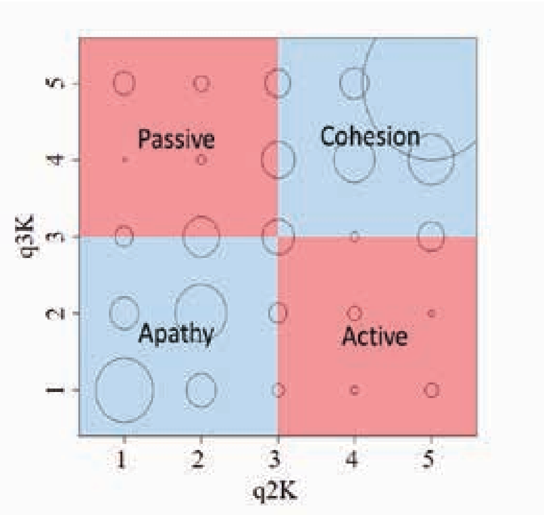

Figure 6. *Bubble chart for q2K and q3K [vote_SA]. The size of the circle represents the frequency of the answer set to questions. The X-axis and Y-axis show the answer options (from 1 to 5) of q2K and q3K, respectively.*

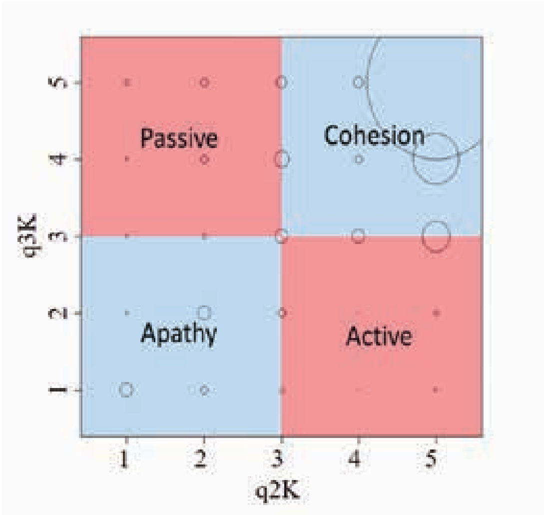

Figure 7. *Bubble chart for q2K and q3K [vote_K]. The size of the circle represents the frequency of the answer set to questions. The X-axis and Y-axis show the answer options (from 1 to 5) of q2K and q3K, respectively.*

Discussion and Conclusions

The present RCT was implemented as a pilot project to test the feasibility of adding and running a low-cost evaluation component to a typical educational intervention at the school level. The trial and results are important not only in the context of this particular intervention but also for astronomy and science popularisation and outreach activities. Our findings demonstrate that it is possible to run evaluations to better understand the impact of such interventions.

(1) Strong cohesion among South African children

The interpretation of each section in Figure 3 is as shown below:

The top right section [Cohesion]:
The answers to both q2SA and q3SA are high. In this section, students think they can share their joy with others in the ingroup.

The top left section [Passive]:
The answer to q2SA is low, while the answer to q3SA is high. In this section, students think they are not interested in sharing joy with the ingroup, although the ingroup shares joy with them.

The bottom right section [Active]:
The answer to q2SA is high, while the answer to q3SA is low. In this section, students think they can share joy with the ingroup, but the ingroup is not interested in sharing joy with them.

The bottom left section [Apathy]:
The answers to both q2SA and q3SA are low. In this section, students do not think they can share joy with others in the ingroup.

As can be seen from the figure, the circle located in the upper right corner (q2SA = 5, q3SA = 5; question combination [q2SA-q3SA]) is particularly large. This indicates that students show strong cohesion with the ingroup in any classification.

(2) No nationality bias among [vote_K]

The interpretation of each section in Figures 4 and 5 is as shown below:

The top right section [Cohesion]:
The answers to both q3SA and q3K are high. In this section, students think both the ingroup and outgroup share joy with them.

The top left section [Favor K]:
The answer to q3SA is low, while the answer to q3K is high. In this section, students think the outgroup shares joy with them.

The bottom right section [Favor SA]:
The answer to q3SA is high, while the answer to q3K is low. In this section, students think the ingroup shares joy with them.

The bottom left section [Apathy]:
The answers to both q3SA and q3K are low. In this section, students do not think the ingroup or outgroup shares joy with them.

At the right end of Figure 5, we see a vertical distribution of answers along q3SA = 5. This indicates that the answer results of q3SA concentrate on 5, while those of q3K scatter from 1 to 5 for [All]. Moreover, it also confirms that these features appear for the classification of [Boy], [Girl], and [vote_SA]. In the case of [vote_K], the majority of answer results particularly concentrate on the upper right corner (q2SA = 5, q3SA = 5) of Figure 4. Additionally, it has been observed that the partial correlation coefficient between q3SA and q3K for [vote_K] is 0.40. This value is higher than the medium effect size of Cohen's index, that is, 0.30 (Cohen, 1992), indicating a remarkable positive correlation in this question combination. These results lead to the conclusion that [vote_K] have no bias about their impression of how others share joy with them regardless of whether the other is an ingroup member or outgroup member.

Partial correlation coefficients of [q2K-q3K] for each classification are 0.33 [All], 0.35 [Boy], 0.31 [Girl], 0.33 [vote_SA], and 0.28 [vote_K] respectively. In this question combination, partial correlation coefficients for [All], [Boy], [Girl], and [vote_SA] are larger than a medium effect size of Cohen's index, 0.30 (Cohen, 1992).

The interpretation of each section in Figure 6 and Figure 7 is as shown below:

The top right section [Cohesion]:
The answers to both q2K and q3K are high. Students in this section are willing to share joy with the outgroup.

The top left section [Passive]:
The answer to q2K is low, while the answer to q3K is high. Students in this section are not interested in sharing joy with the outgroup, while the outgroup shares joy with them.

The bottom right section [Active]:
The answer to q2K is high, while the answer to q3K is low. Students in this section are willing to share joy with the outgroup, while the outgroup is not interested in sharing joy with them.

The bottom left section [Apathy]:
The answers to both q2K and q3K are low. Students in this section are not willing to share joy with the outgroup.

As shown in Figure 6, distribution is presented on the diagonal from the bottom left to the top right. It means that a positive correlation is indicated by the partial correlation coefficient that exists between q2K and q3K for [vote_SA]. Furthermore, it also confirms that these features appear for the classification of [All], [Boy], and [Girl]. Due to the above results, it can be seen that students mainly show their cohesion with not only the ingroup but also the outgroup for these four classifications. However, there are positive correlations interpreted from their partial correlation coefficients above 0.30, indicating that the degree of sharing joy with the outgroup is correlated with the impression of how the outgroup shares joy with the students. Further, students can roughly be divided into two groups on the basis of the distribution features. The first group consists of students who are willing to share joy with the outgroup. The other group is indifferent to sharing joy with the outgroup. Compared to other classifications, the majority of answer results for [vote_K] are particularly concentrated in the upper right corner (q2SA = 5, q3SA = 5) of Figure 7. As is evident from this result, students in the classification of [vote_K] strongly believe that they would be willing to share joy with the outgroup. These results indicate that the strength of cohesion almost all of the students show with the outgroup varies widely, whereas [vote_K] show high cohesion with the ingroup as well as the outgroup.

The full analysis will consider the impact of astronomy intervention on ingroup-outgroup bias. The first step result presented here will form the basis to compare the difference among the complete dataset versus the control group and experimental group about the nationality cohesion and nationality bias following exposure to the "pale blue dot" message.

All the publications based on this study only present summary statistics and ensure that neither any school nor any of the children are identifiable. Participation in this study was entirely voluntary.

Acknowledgements

First, we would like to express our deepest gratitude to Dr. Eli Grant, who was the research and development manager of the International Astronomical Union Office of Astronomy for Development (IAU-OAD)[6], for his many helpful suggestions during this research. We are pleased to acknowledge the assistance and efforts of Mr. Kevin Govender, who is the director of IAU-OAD and Prof. Sadanori Okamura at the Department of Advanced Sciences at Hosei University. We were fortunate to have had several helpful discussions about designing the intervention of this study with Prof. Mina Cikara and Ms. Linda Chang of the Harvard Intergroup Neuroscience Lab[7] at the Department of Psychology at Harvard University, our research partner. In collaboration with them, full analysis of the data to focus on the impact of astronomy intervention is also currently in progress. We are also deeply indebted to Ms. Buzani Khumalo and Mr. Sivuyile Manxoyi, who are members of the South African Astronomical Observatory's (SAAO) SALT Collateral Benefits Division[8] for their support. This research is sponsored by a grant from the Japan Ministry of Education, Culture, Sports, Science and Technology (MEXT) Public-Private Partnership TOBITATE! Young Ambassador Program[9]. Our study is supported by funding from the International Astronomical Union[10], South African Department of Science and Technology[11] and South African National Research Foundation[12]. We would like to thank our family and friends for their support. We are also extremely grateful to the students, who willingly participated in the study and provided invaluable data.

Notes

1 The Pale Blue Dot available at http://www.planetary.org/explore/space-topics/earth/pale-blue-dot.html

2 Columba-Hypatia: Astronomy for Peace available at http://www.astro4dev.org/blog/category/tf2 columba-hypatia-astronomy-for-peace/

3 Madsen, Astronomy and international science diplomacy, IAU General Assembly, Meeting #29 available at http://adsabs.harvard.edu/abs/2015IAUGA..2244281M

4 Monitoring and Evaluation, IAU Office of Astronomy for Development available at http://www.astro4dev.org/monitoring-evaluation/

5 Introduction to Evaluations by Abdul Latif Jameel Poverty Action Lab available at https://www.povertyactionlab.org/research-resources/introduction-evaluations

6 International Astronomical Union Office of Astronomy for Development (IAU-OAD): http://www.astro4dev.org/

7 Harvard Intergroup Neuroscience Lab: http://www.intergroupneurosciencelaboratory.com/

8 South African Astronomical Observatory's (SAAO) SALT Collateral Benefits Division: http://www.saao.ac.za/outreach/scbp/

9 Japan Ministry of Education, Culture, Sports, Science and Technology (MEXT) Public-Private Partnership TOBITATE! Young Ambassador Program: http://www.tobitate.mext.go.jp/about/english.html

10 International Astronomical Union: https://www.iau.org/

11 South African Department of Science and Technology: http://www.dst.gov.za/

12 South African National Research Foundation: http://www.nrf.ac.za/

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Column

The World at a Glance: Highlights from IAU National Outreach Contacts

Editor's note: From this issue forward, we will have a regular column in CAPjournal featuring brief highlights from the IAU National Outreach Contacts (NOCs) network. The NOCs network was created by the IAU Office for Astronomy Outreach (OAO) by volunteers with extensive experience in public outreach to facilitate communication and actions between the IAU and its national communities. These updates are brief, but you can visit the respective NOC page[1] for more details.

Algeria

Jamal Mimouni: 'The Vibrating Universe', the 16th National Festival on Popular Astronomy, will take place from 22-24th March 2018.

Hungary

Zoltan Kollath: The third International Dark Sky Park (Bükk) was announced.

Romania

Dumitru Pricopi: A national network for meteor observation was set up.

Ethiopia

Alemiye Mamo Yacob: 'AstroBus–Ethiopia' was organised from the 20th to 30th of October 2017.

Madagascar

Zara Randriamanakoto: Malagasy Astronomy & Space Science was officially registered as an association.

Namibia

Eli Kasai: A World Space Week commemoration was held in early October 2017.

South Africa

Sivuyile Manxoyi: A teacher training programme was conducted on the theme 'Earth and Beyond' in two provinces.

Guatemala

José Rodrigo Sacahui Reyes: The project 'De Guate al Cosmos' was launched.

Zambia

Prospery C. Simpemba: Zambia is set to launch an astronomy outreach programme in schools in January 2018[2].

Uruguay

Andrea Laura Sosa Oyarzabal: The public University of Uruguay opened a new observatory[3].

Syria

Mohamad AlAssiry: Despite the political situation, the Syrian Astronomical Association was building an observatory and opened in August 2017.

Bangladesh

Farseem M. Mohammedy: A beginner's workshop and an event to discuss the Cassini Mission were organised.

India

Samir Dhurde: AstroProject film[4] 'From Dust to Stars' featuring Indian observatories was launched.

Japan

Hitoshi Yamaoka: A set of inspired events will be held around CAP2018[5] in Fukuoka.

Russia

Dmitri Wiebe: The first sidewalk astronomy event was organised in Norilsk.

Indonesia

Avivah Yamani: The Timau National Observatory will have its first light around 2019/2020.

Hong Kong China

Kam Cheung Leung: A seminar on lunar and planetary imaging and observation was organised.

Nepal

Jayanta Acharya: The Takshashila Astronomy Club (TAC) organized a talk on 27 November 2017 at the Takshashila Academy hall.

Sri Lanka

Thilina Heenatigala: Students of Royal College received the Guinness World Record for launching the highest number of water rockets (1950) simultaneously.

Thailand

Wichan Insiri: UNESCO Director General, Irina Bokova, officially declared the International Training Centre in Astronomy (ITCA) open on 28 August 2017.

• ***The IAU NOCs Network***

Armenia

Sona Farmanyan: 'Astronomical Heritage of the Middle East' has been approved under the UNESCO Participation Program.

New Zealand

Karen Pollard: The Aoraki Mackenzie International Dark Sky Reserve held its third Starlight Festival in October 2017.

Notes

1. NOC pages: www.iau.org/public/noc/
2. http://southernafrica.astro4dev.org/
3. http://www.cure.edu.uy/?q=node/677
4. http://www.astroproject.in/films/
5. https://www.communicatingastronomy.org/cap2018/

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Technical and esoteric language should be either avoided or used with a footnoted explanation if absolutely required. All contributions will be made to conform to British spelling and punctuation practice. Figures and tables should be referred to as "Figure n" and "Table n" respectively. Acronyms should be spelt in full once and then parenthesised; thereafter they can then be used as lettered acronyms. Numerals should be used for numbers greater than two words and always for numbers greater than ten.

Manuscripts should be delivered in MS Word or text (.txt) format, with no formatting apart from bold, italics, super and subscripts. Hard carriage returns after each line should be avoided, as should double spacing between sentences. If the contribution contains figures, these may — just for the sake of overview — be pasted inline in the Word manuscript along with the caption (Word files below 4 MB are encouraged). However, images must also be delivered individually as Tiff, PDFs, vector-files (e.g.,.ai,.eps) in as high a resolution as possible (minimum 1000 pixels along the longest edge).

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