



AUSTRALIAN SCIENCE COMMUNICATORS

Conference Proceedings

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Editors:

Nancy Longnecker, Claire Harris and Kali Madden

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Foreword

With delight, we present the first published Australian Science Communicators conference proceedings. In the proceedings of *Insight, Impact, Innovation*, ASC2014 in Brisbane, you will find the peer reviewed articles, abstracts from keynotes and other presentations and summaries of produced sessions and workshops. We hope that this *Proceedings of the Australian Science Communicators National Conference, 2–5 Feb, 2014, Brisbane* is the first of a long series of published proceedings for ASC conferences.

A big thank you to authors who submitted their work for review, to the Program Committee and to reviewers who supported the peer review process – Emma Bartle, Jenny Donovan, Jean Fletcher, Mzamose Gondwe, Will Grant, Nancy Longnecker, Jennifer Manyweather, Vicky Martin, Jenni Metcalfe, John O'Connor, Lindy Orthia, Will Rifkin and Miriam Sullivan. Using a peer review process in publishing the full papers means that these papers go into the realm of scholarly publications as defined by the Australian Government's audit standards. The full papers can therefore 'count' as a publication category E1 for those who record publications as a performance indicator. The abstracts in this publication satisfy the requirements for publication category E2.

In addition to value to authors on their CVs, I hope readers will find value in the papers and abstracts in the proceedings. As many science communicators transition into the field from other backgrounds, we can find ourselves on a steep learning curve, especially at the early stages of our science communication careers. The papers in this first proceedings provide useful background that can help people up a notch or two on that curve. This speeds the learning process by building on what others have done rather than starting from scratch. The ASC2014 Proceedings adds to a growing collection of resources for science communicators.

Research students invest months of dedicated work into writing research proposals and literature reviews. Most of the full, peer-reviewed papers in this volume fall into this category. It can be difficult to find an appropriate place to publish reviews since they usually do not contain 'new' results. Yet, literature reviews and synopses often synthesise a great deal of current work and can contain insights that are useful to other science communicators. The papers in this volume touch on many current critical issues, including climate change communication, risk communication, science and art collaboration and use of social media to support the community of science communication.

Editing the ASC2014 Proceedings is a swan song for my involvement with ASC after almost two decades. While I maintain my ASC membership, I have a new focus, across the Tasman at the Centre for Science Communication, University of Otago in New Zealand. I look forward to hearing about continued successes of Australian Science Communicators, reading about these successes in future proceedings and working together on some trans-Tasman collaborations.

Nancy Longnecker,

on behalf of the editors: Nancy Longnecker, Claire Harris and Kali Madden

Acknowledgements

The ASC2014 National Conference was an important event for ASC, occurring during the organisation's 20th year of operations. The Program Committee aimed to offer a standout networking platform, a diverse program that helped bridge across disciplines and opportunities for professional development.

The program delivered a variety of quality speakers and sessions, a sci-art exhibition, our first ever poster session and the first ever joint Australian-New Zealand event with the Science Communication Association of New Zealand. And there were opportunities for coffee and popcorn as part of the social events and entertainment.

These proceedings are a significant achievement and represent the culmination of hours of commitment and passion. None of this could have been achieved without the many people who made the conference what it was.

It is important to acknowledge the Organising, Program, Social events, Promotions and Media Committees as well as the peer reviewers and Eventcorp (our conference managers). ASC contributors to committees were: Simon Chester, James Hardy, Claire Harris, John Harrison, Kate Hodge, Heidi Jones, Alex Jurkiewicz, Rod Lamberts, Sarah Lau, Joan Leach, Victoria Leitch, Nancy Longnecker, Kali Madden, Melanie McKenzie, Kate Patterson, Christine Ross, SEQ ASC branch, Jesse Shore, Andrew Stephenson, Kylie Sturgess, Michelle Wheeler, Pete Wheeler, Andrew Wight and others.

Our sponsors were critical to the event as well as the ASC and science communication community more broadly. Thanks to: the Centre for Public Awareness of Science (CPAS) at the Australian National University, CSIRO, the Inspiring Australia Initiative of the Australian Government, COSMOS Media and the Australian Academy of Science.

Our many volunteers who blogged, tweeted and videoed stories and our wider supporters: University of New South Wales Canberra, ComJobs, Hodge Environmental, State Library of Queensland, Queensland Government, BrisScience and The University of Queensland. Thank you.

Lastly, we want to acknowledge the many Session Producers. These people often worked tirelessly behind the scenes to bring sessions and workshops together and without you, there would have been very little on the program: Maryam Ahmad, Niall Byrne, Signe Cane, Simon Carroll, Tim Dean, Malini Devadas, Tom Dixon, Phil Dooley, Jo Elliott, Jayne Fenton Keane, Simon France, Toss Gascoigne, Hilary Hamnett, Claire Harris, Alex Jurkiewicz, Sarah Keenihan, Adrian King, Sarah Lau, Corinna Lange, Rod Lamberts, Joan Leach, Alison Leigh, Nancy Longnecker, Kali Madden, Ian McDonald, Julia Martin, Eve Merton, Jenni Metcalfe, Robbie Mitchell, Bianca Nogrady, Kate Patterson, Christine Ross, Maia Sauren, Andrew Stephenson, Bronwyn Terrill, Simon Torok, and Peter Wheeler.

It was an honour to work with such committed and professional people for ASC2014.

Claire Harris, Conference Convenor

Kali Madden, Conference Director

SEEING IS BELIEVING: WHY SHOWING THE NITTY-GRITTY DETAILS IS KEY TO PUBLIC ENGAGEMENT AND EXCITEMENT

Drew Berry

Walter and Eliza Hall Institute of Medical Research

Drew Berry is a biologist-animator whose scientifically accurate and aesthetically rich visualisations reveal cellular and molecular processes for a wide range of audiences. Trained as a cell biologist and microscopist Drew brings a rigorous scientific approach to each project, immersing himself in relevant research to ensure current data are represented. Drew received B.Sc. (1993) and M.Sc. (1995) degrees from the University of Melbourne. Since 1995, he has been a biomedical animator at the Walter and Eliza Hall Institute of Medical Research. His animations have exhibited at venues such as the Guggenheim Museum, MoMA, the Royal Institute of Great Britain and the University of Geneva. In 2010 he received a MacArthur Fellowship "Genius Award".

ABSTRACT

Biology reveals the complex choreography of cells and molecules, but much of this science is too small to be directly observed or takes place at dynamic rates beyond our normal perception of time. 3D visualisation of cells and molecules has become an increasingly important component of exploring and communicating biological mechanisms to the public, students and scientific peers. Dynamic visualisations, such as animations, are able to synthesise diverse structural, dynamic and locational data derived from a variety of research sources and data sets, and can thus act as a visual hypothesis for a particular molecular or cellular process. Beyond the bench, 3D visualisations are powerful tools that are being used in classrooms and in the mass media to educate and entertain.

SCIENCE AND THE INFORMATION BIG BANG

Susannah Elliott

Australian Science Media Centre, Adelaide

Susannah has a PhD in cell and developmental biology from Macquarie University, a Graduate Diploma in Journalism from the University of Technology Sydney (UTS) and nearly 20 years of practical experience in science communication with the science-media nexus as her primary focus. She is currently CEO of the Australian Science Media Centre, an independent not for profit organisation that works with the news media to inject more evidence-based science into public discourse. Prior to this she spent more than five years in Stockholm, Sweden, as director of communications for the International Geosphere-Biosphere Programme (IGBP), an international network of scientists studying global environmental change. In the 1990s Susannah managed the Centre for Science Communication at UTS, where she helped establish the successful Horizons of Science series of media roundtables and was involved in numerous other initiatives such as Science in the Pub and Science in the Bush. She sits on various committees and judging panels and lives in Adelaide with her husband and two children.

ABSTRACT

We live in the midst of remarkable times. After years of build-up, the Australian media industry finally hit its tipping point in 2012, resulting in the loss of an estimated 1,500 journalists from outlets around the country and massive changes in the way news is reported. And the haemorrhaging hasn't stopped.

At the same time there has been a tidal wave of new media opportunities arising with "old media" adapting to the new world order and creating seemingly limitless channels of information. According to Rick Smolan, author of the Human Face of Big Data, most of us are now exposed to more information in one day than a person alive in the 1500s received in their entire lifetime. Through our mobile devices we have all become walking data sources and potential news reporters in our own right.

There are clearly amazing opportunities for science and science communication in this big bang of information. But there are also challenges. The sheer size of the information stream bombarding us each day means filtering is a necessity and depth can be one of the victims.

With more and more on offer and a filtering system that relies increasingly on friends, family and professional networks, might it be getting harder to get important scientific messages out to the public? How can we link multiple channels to encourage the kind of deeper social dialogue needed to deal with the plethora of science-based issues that face us? And how can we ensure that the role of investigative journalists in making these linkages and providing depth and context is not lost in the push to get an ever increasing number of snippets out in the shortest possible timeframe?

ON CONFLICT, CHANGE AND CREATIVITY – THE ROLE OF ‘COMMUNICATION CUBED’

Geoff Garrett

Chief Scientist, Queensland

Dr Geoff Garrett was appointed Queensland Chief Scientist from January 2011, following the retirement of Professor Peter Andrews AO. A Cambridge graduate in metallurgy and an academic for 13 years, Geoff led two of the world's major national research institutions - CSIR in South Africa (1995-2000) and CSIRO in Australia (2001-2008). A former South African 'Engineer of the Year' (1999), he is a recipient of the Centenary Medal for service to Australian society through science. In June 2008 he was appointed as an Officer of the Order of Australia (AO) in the Queen's Birthday Honours List.

TIK AND BUBBLES: THE EVOLUTION OF AN UNDERWATER SUPERHERO

Lloyd Godson

Lloyd Godson is an ultramarathon running aquanaut and adventurer. He loves to live his wild ideas and put them to the test in the real world. He has spent a total of one month living underwater, propelled himself through the Greek islands in a human-powered submarine and holds the Guinness World Records for the most electricity generated by pedalling underwater. In 2007, Lloyd received the coveted Australian Geographic Adventurer of the Year award. Lloyd's underwater projects are a way of tackling environmental issues in a fun, provocative and scientific way. He is determined to create social change and inspire public environmental awareness by using technological innovation in a stimulating way. Most recently, he started developing a new educational initiative called Tik and Bubbles with the intention of designing community-based science projects that are creative, collaborative, challenging and fun.

ABSTRACT

Can a real-life underwater superhero make science, technology and innovation more accessible to the public? Lloyd Godson takes us through his journey from BioSUB Man to Tik and Bubbles. In his latest crowd-funded adventure, Lloyd and his team of young Australian innovators are creating the ultimate underwater superhero headquarters. Blending exploration and art, Lloyd will put their science to the test by living in the crazy creation when it's finished. This superhero might not be able to fly but he pushes the limits of science, technology and human endurance to inspire young people to pursue STEM studies and careers.

THE EVOLVING CHALLENGE OF SCIENCE COMMUNICATION

Ian Lowe

Griffith University

Ian Lowe is emeritus professor of science, technology and society at Griffith University and President of the Australian Conservation Foundation. He directed Australia's Commission for the Future in 1988 and chaired the advisory council that produced the first independent national report on the state of the environment in 1996. He has filled a wide range of advisory roles, including chairing the economic, social and environmental committee of the national energy research council for six years and being a member of the Radiation Health and Safety Advisory Council since 2002. A Fellow of the Academy of Technological Sciences and Engineering, he was made an Officer of the Order of Australia in 2001 for services to science and technology. He is a former president of ASC, wrote a regular column for New Scientist for thirteen years, writes regular columns for Australasian Science and other publications, and won the 2002 Eureka Prize for communication of science.

ABSTRACT

When science was seen as a body of secure knowledge, given credibility by the scientific method and peer review, the task of the communicator was straightforward: understand the science well enough to explain it clearly and simply, then craft the explanation. We now understand science as a process of successive approximations to an understanding that will always have limitations and uncertainties: "islands of understanding in an endless sea of mystery". So communication demands a responsibility to distinguish between what is known with confidence, what is thought probable but uncertain, and what remains unknown.

A greater challenge is the backlash against science from those whose interests or ideology are threatened. Denial of global environmental problems like climate change, of "peak oil" and limits to growth generally, is now a serious issue. Those denying these inconvenient truths flood the blogosphere with personal abuse, unsubstantiated assertions, cherry-picking of data, misquoting of respectable scientists or distorting their views by quoting out of context, and claims that have been systematically refuted. Science communicators have a responsibility to counter this tsunami of misinformation and facilitate community understanding of these important issues.

MAKING SCIENCE ACCESSIBLE: LEARNING SCIENCE OUTSIDE OF SCHOOL

Léonie Rennie

Curtin University

Professor Leonie Rennie is an Emeritus Professor in the Department of Research & Development at Curtin University, Perth. She has a background in science teaching in West Australian schools and was involved in teacher education programs at the University of Western Australia, before taking up her position at Curtin University. She has studied and published widely on science and technology education, visitor interactions at Science Centers and Museums and learning science through activities outside of school.

ABSTRACT

We know that students spent more time outside of school than inside of it, and that most people have left school behind them. Where, outside of school, can people learn about science? One source is science outreach; the science opportunities and activities that institutions or other groups interested in communicating science offer to the public, including families and their school-aged children. Outreach involves many things: travelling exhibits, with or without explainers, science theatre, science festivals, events related to science week, and so on. In this presentation, some outreach activities are described together with the kinds of evaluation activities that have endeavoured to determine what, if anything, participants have learned about science, and if not, what, if anything, we can do about it!

THE INSPIRING AUSTRALIA STRATEGY AND OUTCOMES: NEW IN 2014

Simon France

Inspiring Australia, Department of Industry, Innovation, Science, Research and Tertiary Education

ABSTRACT

The Inspiring Australia strategy was drawn together with input from a wide range of science communicators, educators, journalists and scientists in all states and territories. The strategy and related programs and activities have been valuable platforms for national coordination and leadership for science engagement across Australia. This session will share current Inspiring Australia progress, highlight key achievements, the latest tools and outline ideas for the future.

DEVELOPING THE EVIDENCE BASE: INSPIRING AUSTRALIA SUPPORTED RESEARCH

Jo Elliott¹, Joan Leach², Nancy Longnecker¹, Fabien Medvecky², Jenni Metcalfe^{2,3}, Léonie Rennie⁴, Suzette Searle⁵ and Sue Stocklmayer⁵

¹ Science Communication, School of Animal Biology, UWA; ² Science Communication, School of Media Studies and Art History, UQ; ³ Econnect; Curtin University; ⁴ Australian National Centre for the Public Awareness of Science, ANU

ABSTRACT

This session updates on four projects that were supported by Inspiring Australia:

- Project A: National Audit of Science Engagement Activity
- Project B: Collation of Science Engagement Data across Australia
- Project C: Understanding the Australian Evidence Base and
- Project D: Determining Impact of Science Engagement.

In Project A, a snapshot national audit of science engagement activities around Australia was conducted in 2012. Data collected in the audit were analysed to compare the qualitative and quantitative data and discover the actual nature of the engagement taking place. Most Australian science engagement is still in either 'first order' (one-way communication from scientist to public) or 'second order' (dialogue between scientists and the public) modes of engagement. Options for increasing third order engagement of the public with science in Australia will be discussed.

Project B identified 140 peer reviewed articles about science engagement in Australia that were published between 1982 and 2011. Topics of climate change, biotechnology and health and medical issues dominate recent publications of science communication. 55 national studies have been identified that were between 1988 and 2013 and determine Australian attitudes towards science and science-related issues.

Project C has encompassed a wide range of activities, including description of case studies to provide vignettes about the impact of public engagement activities, production and implementation of a national survey of Australians' attitudes and behaviour relating to engagement with the sciences, development of an interactive website that provides access to data collected and tools produced and collating national data on the role of media in science engagement.

Project D produced the Inspiring Australia Evaluation Resource Kit. It includes evaluation tools which allow collection of nationally comparable data as well as event-specific data. An overview of results of data collected at various events and selected case studies will be presented. Key measurables that can be used to provide evidence of effective science engagement will be discussed.

Using data collected in all the projects, Project C also involves exploring the gaps between theory and practice, identifying case studies that exemplify best practice and providing access to this information via an interactive website. The website is a work in progress and science communicators are invited to add information.

AN ONLINE COMMUNITY OF PRACTICE AROUND SCIENCE COMMUNICATION: #ONSCI

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ABSTRACT

#onsci is a *Twitter* hashtag and monthly chat session originally created to continue and extend conversations 'on science' stemming from the Inspiring Australia conference of 2011. Each month, participants are invited to join a hosted hour-long *Twitter* conversation on topical matters relating to science communication, education, policy, research, marketing and more. Interested parties also use the #onsci tag to share relevant resources and conduct conversations outside of designated chat times. With approximately 50 participants per session (mostly Australian but also some internationals) in 25 chats, #onsci has been highly successful in providing a forum for those interested in science communication to come together, share ideas and develop their personal and professional networks. #onsci has also contributed to the development of science policy via a submission to the McKeon Review, and teaching of science communication in Australia through informal associations with courses taught at Universities and online. This paper considers the effectiveness of #onsci as an online community of practice around science communication, and consider how future iterations might shape the practice of science communication in Australia.

INTRODUCTION

Twitter is a social media platform that allows users/participants to post short, public messages (a 'tweet') of up to 140 characters. Conversations between users/participants can occur by including individual users' *Twitter* 'handles' (or user names) in tweets. Sometimes conversations grow to include several people; however, as the number of *Twitter* handles increases, the room for conversation within the character limit is reduced. One solution to this problem is to use a hashtag. Hashtags on *Twitter* – marked with the symbol # - are key words or search terms that allow people to find content they are interested in. They can also be used to keep track of conversations if all participants are using the same hashtag. An example of a

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popular Australian hashtag is #agchatoz (see <http://www.agchatoz.org.au/>) which is used to tag information about agriculture in Australia, but is also used to run facilitated discussions on topics related to agriculture each week (Jamieson, 2011). There are currently many hashtag-based *Twitter* groups in Australia and internationally. Their purposes range from informal socialising, to knowledge sharing, to political action (Bruns & Burgess, 2011).

Twitter provides a platform for developing networks around common interests, and allows people who are seen to be either experts in their own field and/or generous sharers of information to quickly gain a large number of 'followers'. The use of hashtags in conversations can expand the capacity of *Twitter* interactions to a higher level, as it no longer relies on the development of personal networks and without the establishment a mutual follower/followee relationship with all or any of the other participants. Even non-registered *Twitter* users can follow a stream of messages containing a given hashtag (Bruns & Burgess, 2011).

TWITTER FOR ORGANISED COMMUNICATION 'ON SCIENCE': #onsci

'#onsci' is a *Twitter*-based science communication 'group' that began in April, 2011. It is run on a voluntary basis by a core group of four people (the authors) who share a common interest in innovative science communication, and who are active on social media, including the use of *Twitter*. The concept began following a summit held by Inspiring Australia, the national strategy for engagement with the sciences (<http://www.innovation.gov.au/science/inspiringaustralia/Pages/default.aspx>). With participants eager to continue conversations initiated at the summit (both face to face and *Twitter* discussions), an opportunity emerged to organise and collect these thoughts under a *Twitter* hashtag. The authors established the #onsci hashtag to identify tweets relevant to these conversations, and to launch a plan to have regular monthly *Twitter* discussions 'on science' (Alford & Hutson, 2011). Although other more generic science communication hashtags do exist, such as #scicomm, #onsci is unique in that it reflects a desire to welcome diverse participation by people sitting both inside and outside of strictly science communication roles. Since April 2011, facilitated discussions, or 'chats' have occurred on a monthly basis, most of which have been archived at <http://bridge8.wordpress.com/2012/01/30/onsci/>.

#onsci (and *Twitter* in general) allows information that is available online to be shared through the posting of links within the tweet. One of the limitations with *Twitter*, however, is that it is transient and tweets disappear over time. Users can 'favourite' a tweet, making it accessible for longer, but this would be difficult to do over a whole conversation. There have been a number of online tools developed to archive social media content and the one that seems to have had the widest adoption is *Storify* (<http://storify.com/>). *Storify* allows the tweets within a conversation to be collected and archived. It also provides the opportunity for curation and the development of narrative and connection to other relevant material. If performed with careful attention to detail, visually-appealing and sequenced records of online interactions such as facilitated *Twitter* discussions can be created using *Storify*. However, one downside of *Storify* for collecting lengthy and multi-participant discussions is that it can take some time to curate and reassemble the conversations. Popular #onsci topics have had over 50 tweeters and although the chats have set questions and a moderator, side conversations inevitably develop, often containing interesting information. As a

result, more recently the #onsci team has focused on quickly archiving the tweets (and links) as they occur in near-real time to rapidly provide a complete record. The collations are placed on the Bridge8 website and available for anyone to access (<http://bridge8.wordpress.com/2012/01/30/onsci/>). This means that people who miss the conversation are still able to participate (by reading and later posting on *Twitter* using the hashtag) if they wish.

Coordinating #onsci chats involves a number of tasks, which are rotated between the organising group. Each month a new topic is selected and then a pre-chat blog post is written and posted, providing an indication of what issues and questions in particular will be addressed. The chosen host uses the @onsci account (<http://twitter.com/onsci>), offering links and background reading and then a guided series of questions in the lead-up to and over the hour-long duration of the chat. So far, almost all of the topics have been determined by the core founders of #onsci, based on knowledge of issues in science communication and stimulated by topical issues arising in the general science and communication environment. On occasion, other participants have been involved in organising specific chats by either suggesting topics, taking on hosting duties for the chats (providing a novel and arguably rare opportunity to develop skills in this area), or by recording. At the time of writing this article, the @onsci account has more than 1000 followers, although each chat session usually consists of 20-60 active participants, with many others observing the conversation rather than contributing, or using the hashtag outside of chat times to ask questions or post links to the broader #onsci community.

CAREER ISOLATION IN SCIENCE COMMUNICATION

Science communicators, especially those within organisations, are “boundary spanning individuals” (Tushman & Scanlan, 1981) who communicate broadly both within the organisation and outside of it. Often, they may be the only person in a science communication role within their organisation or work unit, and hence have limited interactions with like-minded colleagues or indeed those who are informed of current research or best practice in science communication. For many science communicators, access to knowledge about science communication may be difficult, especially those working outside of academic or research institutions. There are very few opportunities for professional development. A feeling of unity amongst science communicators can also be muddled by the diversity of their roles: for example, ‘science communication’ as an umbrella term includes freelance science writers working for themselves, science journalists working within a media organisation, outreach officers working within a research organisation, research scientists with an interest in blogging and radio work and teachers of science in school and tertiary institutions. An additional layer of isolation may be experienced by scientists who are interested in communicating their science more broadly and engaging with the public due to lack of institutional support. Scientists wanting to communicate more broadly may indeed be actively discouraged by their organisation, especially those using social media (Stemwedel & Andrews-Polymenis, 2011; Bik & Goldstein, 2013).

Science communication in Australia can be a particularly lonely profession. Inspiring Australia’s 2010 investigation into the practice of science communication in Australia highlighted the extent to which many working in the field may feel isolated. The document summarising the consultations (available at <http://www.innovation.gov.au/>

science/InspiringAustralia/Documents/InspiringAustraliaReport.pdf) reported that:

One of the significant aspects of the consultations was that they brought together science communicators from across each state and territory; surprisingly many had little previous interaction with each other (Inspiring Australia Report, 2010, p18).

The report also emphasised the urban focus of many science communication activities, suggesting that perhaps those working outside of the major capital cities could feel even further isolated:

A great deal of the science engagement activity is 'metro-centric', catering primarily to capital city residents clustered along the coast (Inspiring Australia Report, 2010, p20)

A desire for science communicators to come together in a professional capacity was also reported:

[Consulted science communicators] consistently expressed a willingness to share best practice, set industry standards for communicating science and look for ways to complement each other's activities (Inspiring Australia Report, 2010, p11)

#onsci AS A 'COMMUNITY OF PRACTICE'

The creation of #onsci was in part inspired by the idea of 'communities of practice': groups of people informally bound together by a shared expertise and a passion for shared enterprise, who interact regularly to learn how to do it better (Wenger & Snyder 2000; Wenger 2004). Communities of practice have been a topic of interest to scholars in knowledge management, particularly in the last 20 or so years. As 'knowledge work' has increased, the interest in knowledge management has grown amongst organisational theorists, along with interest in how people within organisations, and organisations themselves, learn. This is particularly important in rapidly changing fields where it may be difficult to stay 'up-to-date'. Knowledge creation is described as a dynamic process (Nonaka 1994) which results from four modes of knowledge conversion: socialisation (sharing experiences), externalisation (turning knowledge into an explicit form), combination (assembling new combinations of explicit knowledge) and internalisation (incorporating explicit knowledge into personal, tacit knowledge) (Jasmuddin, 2012). At least three of these processes involve social interactions; knowing involves exchanging and contributing to the knowledge of a community (Wenger, 2004).

Social learning is a key aspect of a community of practice which builds a body of knowledge and a sense of identity. Communities of practice incorporate three fundamental elements: domain of knowledge - the area of knowledge that brings the community together; community – the group of people for whom the domain is relevant; and practice – the body of knowledge, methods, tools, stories which members share and develop together (Wenger, McDermott & Synder, 2002; Wenger, 2004). One of the challenges in a community of practice is finding out what is known by whom, i.e. locating and identifying expertise and understanding the patterns of knowledge distribution. Personal, social, or organizational networks facilitate awareness about knowing entities and their possession of knowledge. Similarly, information technologies can facilitate the efficient and effective nurturing of communities of practice through which distributed knowledge can be coordinated (Sambamurthy & Subramani, 2005).

Although a large proportion of the research literature is focused on communities of practice within large organisations as a way to facilitate organisational learning and performance (for example, Lesser & Storck, 2001), there is an emerging area of research examining communities of practice across organisations to improve performance in a particular area, for example the health sector (reviewed by Ranmuthugala et al., 2010). The role of information technology in assisting the development of communities of practice (through use of email, bulletin boards etc) has been an area of research for some time; research on the use of *Twitter* and other social media for developing communities of practice is still emerging (Panahi, Watson & Patridge, 2012; Wesely, 2013) There have been no studies (to our knowledge) of the use of *Twitter* to develop a community of practice in science communication.

AIM

In this paper we make a preliminary exploration of #onsci as a *Twitter*-based community of practice for science communicators. Our particular interest is in the knowledge sharing and community building aspects of #onsci, as these aspects have been identified in the recent Inspiring Australia report as activities that Australian science communicators desired and found rewarding. In addition, these are aspects that motivated us, the authors, to initiate #onsci. We also participate in the science communication space and want to increase our own opportunities to learn and feel part of a community.

Our specific research questions are:

1. Is #onsci working to build a community for science communicators?
2. What kinds of knowledge acquisition, sharing, retention occur within #onsci?

This preliminary investigation of #onsci is important because it will also contribute to the gaps in current knowledge about online, in particular *Twitter*-based, communities of practice that can be applied to other disciplines. In addition, the findings will be used to understand the role of #onsci as a community of practice, develop future plans for #onsci and to speculate on the capacity of #onsci to contribute further to science communication in Australia.

RESEARCH METHODS

APPROACH

As mentioned, there is limited research on learning and knowledge exchange in *Twitter*-based communities of practice. Previous approaches to understanding learning in online communities have used qualitative surveys, for example the study of social media and physicians by Panahi and colleagues (2012). Given that #onsci is entirely voluntary, limited resources led us to use the information about #onsci that was already collected, namely the tweets archived through the chats themselves. In addition, the theme of the chat on the 17th of October 2013 was “looking at #onsci” to assist with the collection of feedback for the preparation of this paper.

Another approach, used to investigate the community of practice of world language teachers on *Twitter*, is a *netnography*, ‘a type of virtual ethnography that uses participant-observational research based exclusively on online fieldwork’ (Wesely,

2013). In this current study of #onsci, all of the authors are also participants within the community, contributing to the discussions as well as contributing to the running of #onsci (often at the same time). The authors have a detailed knowledge of the linkages #onsci has developed since its inception, such as blog posts and conference panel sessions. The archived tweets from the #onsci chats provide an excellent opportunity to analyse the knowledge exchange within the community and have several advantages over a qualitative survey or interviews, both of which are typical methods in research. Firstly, all of the collected tweets are considered within the public domain, so that ethical considerations about anonymity are not required. Secondly, these tweets have been made voluntarily and unprompted (with the exception of those during the most recent chat) as part of the #onsci community. Thirdly, the risk of low and biased responses to surveys can be avoided. Finally, within the chats themselves, there are specific examples of knowledge sharing that may not be identified via a questionnaire or interview.

ANALYSIS

At the time of writing there were 27 archived collections of #onsci chats containing between 100 and 400 individual tweets. Each collection was scanned to identify tweets that broadly related to the research questions because most of the content of the chats related to the specific topic and questions for that chat. These tweets (150 in all) were placed in a separate collection for thematic analysis (Denzin & Lincoln, 1994). Codes included 'community', 'information sharing', 'self-reflection' and 'belonging', and these were used to elucidate the main themes within the #onsci tweets. The themes are presented in the next section with example tweets provided for the purpose of illustration.

RESULTS

THE #onsci COMMUNITY

One of the clear benefits of #onsci has been its creation of a sense of community between those interested in communicating science across urban and regional Australia, and internationally. Each chat session started with a welcome from the @onsci host, and then asked participants to introduce themselves and offer a brief description of their professional and other interests. Participants usually offered a brief explanation of why they were present for each particular chat topic:

@onsci: But first introductions. It's @heatherbray6 hosting tonight. Who else is out there? What do you do? #onsci (Sep 19 2013)

@sumenrai79: Hi #onsci! 1st time here, so will lurk and contribute if I can :) Ex primary teacher & science communicator, still an enthusiast :) (Feb 16 2012)

@ki_sekiya: Ken, Public Relations graduate - one-day-will-return-to-environmental-science-student #Onsci (Feb 16 2012)

Although many regular participants were located in the main cities of Australia (Sydney, Melbourne, Canberra, Adelaide, Perth, Brisbane), others came from smaller centres such as Townsville, Armidale and regional Western Australia. Tweepsters also dropped in from the USA, the UK and Canada:

@Nanobozho: #onsci Made it! 5:00 am in Canada; fire in the wood stove, heavy frost & light snow on the ground in this part of Santa's country. (Dec 13 2012)

Participants attended regularly and willingly, often expressing dismay and apologies to the #onsci community if they had another event, or work and family commitments that prevented them attending. A sense of community and happiness in being involved was often expressed by participants:

*@andanin: I think the best thing about #onsci is finding awesome new people to follow *waves to everyone* (Feb 16 2012)*

*@willozap: #onsci ... finding someone who is *really* interested in the same things as I am." (Feb 16 2012)*

@dabeattie99: Good chat tonight - made me feel better about the grant I'm writing - merry Xmas all you #onsci 'ers (Dec 13 2012)

Participants valued the opportunities to interact with people that they otherwise rarely 'met ' outside of conferences:

@treemie: #onsci I talk to many many more scientists and communicators because of Twitter - rather than just talking to colleagues or ppl at confs. (Apr 12 2012)

@nessyhill: I like #onsci for continuing discussions with people you would only normally see at ASC confs. Great to connect with new people, too. (Oct 17 2013)

Participants also valued the opportunities to exchange ideas and have conversations:

@turtlesatJCU: yes, #onsci is connections, encouragement, community, ideas, diversity, awareness to help me/us communicate research (Oct 17 2013)

@JessicaMcdnld: Thanks @onsci! Really exciting to exchange ideas with people on the other side of the world! #onsci (Jun 20 2013)

@angelalush: #onsci topics+discuss give me a wider perspective as well. On personal note it's encouraging and reassuring that these convos take place! (17 Oct 2013)

@cupslinga: Thankyou all in #onsci, i'm glad other people are annoyed/realize the same trend! (Feb 7 2013)

Some participants noted that they used the #onsci chats to expand their networks:

@dabeattie99: #onsci the networking connections are beginning to yield possible outcomes - but still early days for professional impact (Oct 17 2013)

@mwikramanayake: @onsci: Not sure I can quantify impact for you but I'm sure it has It give sci journos another way of connecting w/ scientists #onsci

#onsci also facilitated identifying 'new' people within the community:

@Alan_Junior: I'm definitely capable of answering Q5. A5 #onsci well you've attracted me: New Media Arts Graduate from @jcu #Townsville (Apr 12 2012)

@dabeattie99: #onsci I mainly use the interactions from each discussion to find new people to follow - I have not used Storify (yet) (Oct 17 2013)

#onsci was also an effective platform to expose new populations of science communicators to social media in practise, such as students in The University of Adelaide's Communicating Science Winter School short course (#cs7020), Australian National University's Masters in Science Communication (#scom8012) and Queensland University's Introduction to the Role of Science and Technology in Education (#educ1706).

@rakshet: hello #onsci, masters student currently doing a course in communicating science #cs7020 (Jul 18 2013)

@Miss Pezaro: #onsci wonderful to see so many ppl from science community interested in science in primary schools :D #educ1706 (Sep 15 2011)

@onsci: And we're out of time! Thanks for your contributions, and to the ANU #scom8012 students joining in for their first #onsci. (Apr 12 2012)

#onsci chats also brought together communities such as those participating in National Science Week, the #protectresearch social media movement, those in the science education field (and using the hashtag #ozscied) and the Australian Science Communicators.

@lvalaine: @scienceupulie @dr_krystal #onsci #protectresearch is what brought me to Twitter to interact with all of you. No regrets (Feb 16 2012)

@ASTA_online: Thanks everyone for a fascinating #onsci discussion. Hashtag for ongoing discussion of science education in Australia is #ozscied (Sep 15 2011)

Participants also expressed the possibility that #onsci could be developed further to bring more people in to the community:

@turtlesatJCU: The big sci com gap from my perspective is communicating sci to people in remote Oz. Perhaps #onsci can help @onsci (Oct 17 2013)

@dabeattie99: I feel more that we should use #onsci to bring people into Twitter for scicomm - these conversations are why I stay on Twitter (Oct 17 2013)

There are few tweets that suggest any dissatisfaction with the chats or the broader community:

@alankerlin: #onsci well that felt like talking to a wall while a handful of regulars just talked with each other...(Nov 8 2012)

The lack of dissatisfied tweets could be due to people not wanting to appear negative in a community of professional peers, or people choosing to withdraw from a chat rather than post an opposing view. This is a limitation with research of this nature: people may interact differently within a public forum than they would interact in private. Participants may also prefer to express displeasure or suggest improvements outside of *Twitter*. It is not possible to monitor the number of people looking at tweets containing a particular hashtag, and participation can only be estimated from those who are actively tweeting, therefore it is also not possible to identify participants who withdraw. Technical difficulties with *Twitter* can also cause someone to find interaction difficult or to withdraw:

@realscientists: Had planned to tweet to #onsci as I hosted as well, but the system is so slow tonight having trouble reading what it there :/(Mar 7 2013)

KNOWLEDGE ACQUISITION AND SHARING IN #onsci

#onsci is by nature a knowledge sharing community. Sharing of knowledge is a big part of the participants' day job, whether they are a scientist, science writer, science communicator or teacher. One of the most important aspects of #onsci for the community is the learning opportunities that participation provides, even if it's just 'watching the chat':

@Dr_HelenMC: Not participating, but learning lots from #onsci chat, thanks guys! (Feb 07 2013)

#onsci relies heavily on the knowledge of its participants. Information is frequently shared between participants:

@ehurt01: @heatherbray6 Where can I get more info? #onsci (Jun 14 2012)

@heatherbray6: @ehurt01 Have a look at this <http://ow.ly/1NI6Ao> [link to Inspiring Australia website] #onsci :) (Jun 14 2012)

@ScientistMags: @onsci what is civic science? #onsci (Nov 08 2012)

@sciencesarah: I don't know what civic science actually means...#onsci (Nov 08 2012)

@kristinalford: @sciencesarah Shorthand for dialogue, participatory democracy - public having a role to be informed and inform direction of research #onsci (Nov 08 2012)

@kristinalford: @cpezaro can you explain what C2C is for our non-teaching participants? Like me? #onsci (Aug 9 2012)

@cpezaro: @kristinalford #onsci C2C is "Curriculum to Classroom", a set of teaching documents (lesson plans, resources) that teachers are strongly...(Aug 9 2012)

@cpezaro: @kristinalford #onsci ...encouraged to use [redacted] (Aug 9 2012)

@dr_krystal: @brittgow @leahtaylors The UK has Science Learning Centres for teacher PD.. is there an Australian equivalent? <https://www.sciencelearningcentres.org.uk/> #onsci (Aug 9 2012)

@ScientistMags: @dr_krystal Currently PD is mostly state based due to different curricula. #onsci @brittgow @leahtaylors (Aug 9 2012)
@ScienceMum: @dr_krystal Yes - Science as a Human Endeavour is a strand, 'equal' with Science Understandings (trad. sciences are 4 strands) #onsci (Aug 9 2012)
@dr_krystal: @ScienceMum Thanks... I didn't know that #onsci (Aug 9 2012)

Learning appears to be one of the main motivations for participating in #onsci:
@CentenaryInst: Thanks @onsci @nessyhill Really learned a lot from tonight's discussion. (Apr 12 2012)

@CSHeart Research: #onsci Thanks heaps, learning lots about socmed, Twitter etc from all you clever people! (16 Feb 2012)

Participants also shared the fact that they took new knowledge from #onsci sessions, and applied it in a professional sense:

@is_chris: @onsci I've never budgeted for comms on a grant application. I will begin to. #onsci (May 17 2012)

@mwikramanayake: @onsci Would help me with greater understanding of a topic and also sources & ideas for new stories. #onsci (Oct 17 2013)

@BronwynHemsley: @onsci I just added the #ONSCI chat link tonight as innovative use of social media <http://pinterest.com/bronwynah/innovative-social-media-health-world/> ... (May 17 2012)

@cazdrop: Looks like #onsci was interesting tonight. I'm grappling w/ the challenge of delivering a primary industry RD&E strategy atm. Useful stuff. (May 17 2012)

Of course, the acquisition of knowledge within a community of practice is more than the transmission of knowledge within a group from the knowledgeable to the less knowledgeable. Co-creation of new knowledge (or understanding) is a crucial function of a community of practice. For some participants, #onsci gave them an opportunity to think or reflect on their own roles (or the roles of others) as science communicators:

@twinster: @heatherbray6 @is_chris thanks for that. New concept for me as not familiar with these outreach requirements when don't work for CRC #onsci (May 17 2012)

@dabeattie99: #onsci has been very useful for me for gaining scicomm contacts but the best bit is refining/developing ideas for scicomm (Oct 17 2013)

@Mozziebites: I think indirectly by making me aware of the work of sci journo/sci comm people and bring those aspects to my work @onsci #onsci (Oct 17 2013)

@dabeattie99: #onsci although it has helped me with a course I teach that focuses on communication skills for science (Oct 17 2013)

@Mozziebites: Often helps focus ideas on topics. Forces to give critical thought to subjects @onsci #onsci (Oct 17 2013)

Storify archives of chats were found to be a useful source to check up on elements of chats that may have been missed, or to track down links and resources:

@Mozziebites: @onsci #onsci A6. Yes. Particularly when there are rapid fire chats, I often need to go back and check what I've missed and follow up (Oct 17 2013)

@natashamitchell: Look forward to catching up later on the #onsci conversation touching on science media this evening...is anyone Storifying it? Ta. (Jul 18 2013)

@dr_krystal: .@onsci So sad I had to miss #onsci tonight - gutted! Looks like a terrific debate, looking forward to catching up on Storify @sciencesarah (Jul 21 2011)

@is_chris: Really enjoyed #onsci tonight - chatting about science and the future. Check out #onsci or, later in the week, the storified version. :) (Mar 7 2013)

In addition, because the #onsci hashtag can be used at any time, people frequently ask questions or post links to relevant articles using the hashtag outside of set chat times:

@onsci Here's also a great visualisation tool to explore the #onsci tags from tonight (thanks for developing @mhawksey) <http://bit.ly/wKPNZ3> #onsci (Feb 16 2012)

@cpezaro22 Jul Hey people, what are the best (and worst) science apps? What have you tried and found wanting? <http://www.staq.qld.edu.au/staq-journal-competition> ... #ozscied #onsci (Jul 22 2013)

@natashamitchell: Vale Peter Pockley. The start of dedicated science broadcasting in Oz & at the ABC was his doing. <http://www.australasianscience.com.au/article/issue-july-and-august-2013/vale-peter-pockley.html> ... #NatSciWk #Onsci (Aug 12 2013)

As mentioned previously, people that participate in the #onsci discussions come from a broad range of perspectives and experience. Through conversations, perspectives are shared, and participants often comment that they have looked at what they do through a different perspective:

@angelalush: OK great @sciencesarah thanks. #onsci has exposed me to topics I wouldn't normally think about - good for prof dev. (Oct 17 2013)

@dabeattie99: @sciencesarah #onsci an effective community of practice needs to be a level playing field - with all having an equally important voice (Oct 17 2013)

@nessyhill: It has helped with my work in terms of helping get feedback in what I'm doing or gaining insights from the community. #onsci (Oct 17 2013)

@turtlesatJCU: in my mind #onsci serves as a bridging community to help knowledge move (Oct 17 2013)

DISCUSSION

The #onsci *Twitter* chat, initiated to continue discussions spilling over from the Inspiring Australia conference in 2011, is now a well-known monthly opportunity for those interested in science and related fields to come together. We believe that #onsci displays elements of domain, community and practice consistent with a community of practice, in particular:

- Regularly bringing together individuals with shared interests and passions 'on science', including science communication, science online, science education, the politics of science, science writing, science in society, media and others;
- Creating a place for participants to come together and openly share their passions and professional expertise, and meet others with similar interests, but also be exposed to differing points of view;
- Creating and fostering #onsci as a place of knowledge exchange;
- Facilitating building of knowledge and providing a moderated environment to develop ideas further; and
- Providing a platform through which participants can touch base with each other and communicate outside of set chat times.

In addition, #onsci facilitates the movement of new members into the community and allows for easy identification of community members who are willing to share expertise. The @onsci account itself follows over 550 scientists, science communicators and others, and has created lists of participants that serve as guides on 'who to follow' (see <http://twitter.com/onsci/science-comms> and <http://twitter.com/onsci/aust-politics>).

By archiving the *Twitter* chats with *Storify* we have been able to document the information exchanged during the chats for use as a resource by the community. One collation, following the conversation on funding and research careers, formed the basis of a submission to the McKeon Review on Health and Medical Research in Australia. Others have been used to fuel development of content for other platforms, such as informing the creation of a session at the 2014 conference of the Australian Science Communicators, and reviewing ideas relating to National Science Week and A Big Snapshot of Australian Science. Although participants of the #onsci chats do clearly benefit in social and intellectual capacity from attending the chats, it is likely that only a few later refer to the *Storify* files. Further utilisation of this resource could be assisted by the development of easily accessed and digestible articles, providing a permanent reference source which would also reach those not active in social media.

Although social media has been around now for many years, many science communicators are still grappling with its nuances and implications. #onsci is one of many successful *Twitter* chats which showcase the incredible capacity of social media to bring people with shared interests and passions together as a community of practise. Given the nature of science communication in Australia, where individuals often work either alone or as solo operators within diverse institutions and businesses spread around our large country, the capacity to create a community of practice is of enormous social and professional value. We hope that #onsci can continue and be developed further to ensure diverse science communicators know each other, work together and build on the incredible body of knowledge we may not otherwise have the opportunity to share.

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RESEARCH COMMUNICATION FOR IMMEDIATE IMPACT: CLIMATE ADAPTATION IN AUSTRALIA

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KEYWORDS: applied research, end user, engagement, communication, climate change

ABSTRACT

Research into climate change adaptation is challenged by funding organisations to demonstrate immediate research impact through near term reference in sector-specific communication and policy documents. Critically, research funded to inform decision makers and current policy about adapting to climate change must engage with end users and implement communication initiatives that lead to research adoption. Moreover, researchers need to better understand the components that contribute to effective engagement and communication to plan successful strategies to engage with the range of vulnerable sectors affected by climate change. Given the importance of research application, Primary Investigators for National Climate Change Adaptation Research Facility (NCCARF) funded projects had to consider end user engagement and communication. This paper identifies some common factors in three NCCARF cases which successfully demonstrated swift access to climate adaptation research in three sectors; human health, emergency management, and settlements and infrastructure. Early and ongoing engagement between researchers and the intended knowledge users shaped both the research focus and output formats. Stakeholders involved in coordinated and sustained communication programs disseminated and promoted the research through multiple channels. These agents of dissemination included; funders (NCCARF, universities and industry bodies); information users (government agencies and professional bodies), and both mass media and social media.

INTRODUCTION

There is increasing awareness of the need to factor current and expected impacts from climate change into decisions that require long term investments, have long range consequences or that may limit adaptation options for the future (Boyd et al., 2011; Moser, 2011). The on-going divide between people who need evidence-based information to make decisions and those who do research to produce that new knowledge creates a communication barrier which has grave implications if it is not

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addressed explicitly from the outset of research design and investment (Besley & Nisbet, 2013; Gibbons et al., 2008; Maria Carmen, Christine, & Vijay, 2012; Suleski & Ibaraki, 2010). Due to the wide range of likely climate impacts which affect multiple sectors, there are many audiences for this information. Each have existing distinct and familiar communication channels and trusted sources (Myers, Nisbet, Maibach, & Leiserowitz, 2012; Nisbet, 2009). This diversity poses a significant challenge in Australia for nationally coordinated research communication such as that implemented by the National Climate Change Adaptation Research Facility (NCCARF). Answering a call in the 2007 Council of Australian Government (COAG) National Climate Adaptation Framework, NCCARF was tasked to 'provide governments, industry and the community with clear and reliable information to assess risks and develop adaptation strategies' (Council of Australian Governments, 2007). To appropriately deliver research suited to specialised users and to be seen as credible sources in the politicised environment surrounding climate science (Lupia, 2013), NCCARF researchers were encouraged to actively engage with identified research users.

According to the Department of Innovation, Industry, Science and Research review of publicly funded research, academic citations remain the dominant evaluation metric of research success, even for projects where stakeholder application is a primary objective (DIISR, 2011). However, a recent trial supported by Australian universities offers an alternative structure based on the UK Research Excellence Framework which uses case study assessments (ATN & Go8, 2012). Successful communication of new knowledge to support climate change adaptation could reasonably be gauged by the swift or wide dissemination of such knowledge in vulnerable sectors and populations, and through reference by decision makers in policy and business.

In this research paper we aim to gain a deeper understanding of effective communication with priority stakeholders in federally funded NCCARF research projects from the sectoral focused Adaptation Research Grants Program (ARGP). While the NCCARF sister program, Synthesis and Integrative Research, is essentially interdisciplinary by design, we chose cases from the ARGP which offer clear differences between users through its sectoral focus. We characterise the engagement and communication methods found in three ARGP climate adaptation research reports frequently accessed by information users. We then review the different elements of success depending on user needs, before proposing an approach for researchers to identify end users and communication strategies.

METHODS

We selected three cases from among the top ten downloaded ARGP reports from the NCCARF website as of 27 October 2013 (see Table 1). As reports have been published for differing lengths of time we expect that other projects will also achieve significant impact in the coming months, however, the reports featured here were selected because they have already attracted hundreds of users within six to twelve months post publication. These cases represent different sectors' stakeholders ranging from health and emergency managers concerned with heat waves, to local governments and roads asset managers, to policy makers and researchers accounting for the public's understanding of climate change and adaptation. We

Table 1: Case study research projects, download rank and objectives

Host Institution	Research Final Report	Down-loads by 27/10/13	Objectives stated in final report
CASE 1 Monash University	Loughnan, M. E., Tapper, N. J., Phan, T., Lynch, K., & McInnes, J. A. (2013). <i>A spatial vulnerability analysis of urban populations during extreme heat events in Australian capital cities</i> (p. 128). Gold Coast: National Climate Change Adaptation Research Facility.	Since 07/01/13 1620 (1 st)	"...to provide an analysis of the spatial distribution of vulnerability of urban populations to extreme heat events in Australian capital cities at the present time, and to estimate future vulnerability in relation to projected climate changes. "
CASE 2 University South Australia	Balston, J., Kellett, J., Wells, G., Li, S., Gray, A., & Iankov, I. (2012). <i>Quantifying the cost of climate change impacts on local government assets</i> (p. 219). Gold Coast: National Climate Change Adaptation Research Facility.	Since 14/11/12 1069 (2 nd)	"...to identify key Council assets vulnerable to climate change; determine the likely impacts of climate change on Council assets; undertake a financial risk modelling exercise to quantify in monetary terms climate change asset risk; develop the necessary modifications to existing asset management and financial sustainability tools so that Councils may evaluate various climate change action scenarios at the management planning level and ultimately guide service level standards."
CASE 3 Griffith University	Reser, J. P., Bradley, G. L., Glendon, A. I., Ellul, M. C., & Callaghan, R. (2012). <i>Public risk perceptions, understandings, and responses to climate change and natural disasters in Australia, 2010 and 2011</i> (p. 245). Gold Coast: National Climate Change Adaptation Research Facility.	Since 18/12/12 433 (7 th)	"...to document, examine and monitor public risk perceptions, understandings, and responses to climate change and natural disasters; the psychological and social (psychosocial) environmental impacts of the threat of climate change and natural disasters and, measuring and monitoring important psychological and social changes in the human landscape in response to the threat and unfolding environmental impacts of climate change."
CASE 3 Griffith University	Reser, J. P., Bradley, G. L., Glendon, A. I., Ellul, M. C., & Callaghan, R. (2012). <i>Public risk perceptions, understandings and responses to climate change in Australia and Great Britain</i> . Gold Coast: National Climate Change Adaptation Research Facility.	Since 10/10/12 347 (10 th)	"The multiple shared objectives of the UK and Australian surveys included documenting public perceptions and attitudes with respect to energy options and climate change considerations, as well as associated public understandings, concerns, and acceptance of policy alternatives. The Australian research also included a specific mandate to examine the nexus between climate change and natural disasters with respect to public perceptions, understandings, and responses."

identify the host research institution for each project as they are important stakeholders with the capacity to promote research findings through established communication channels. In addition we include the research objectives as briefly laid out in each final report.

The objectives stated in the final research reports offer insight into what engagement and communication programs best suit the purpose for both researchers and users. Although small, this sample set was selected to examine communication with vulnerable sectors that need information to adapt to the impacts from climate change. Primary Investigators of NCCARF research projects identified who will need to use the research to support adaptation to climate change and indicated how users would be involved in both the research and its communication (see Table 2). While researchers indicated how users would access the research during and after the project they were not required to plan promotion of research findings. 'Promotion' was included as an assessment criteria to understand why some projects were more frequently accessed than others. Aside from active promotion, some elements of chance contributed to public interest in topics depending on external events that affected media interest. We selected case studies to highlight how different communication methods were used to deliver information to end users with different needs, and we identified assessment criteria accordingly (Table 2).

Table 1 User engagement and communication assessment criteria

USERS	Identify users for the information the research will generate, considering policy, planning and management.
INVOLVEMENT	How will information users be involved in the project and its communication activities?
ACCESS	How will users access the knowledge your project will generate during the project lifetime?
DISSEMINATION	How will users access the knowledge your project will generate after the project is completed?
PROMOTION	How did the researchers and stakeholders promote the research findings?
UPTAKE	Was the research accessed and used to communicate?

Interests of divergent audiences were addressed within each project, while common factors in research plans influenced the process for user engagement and communication. Typically the plans: 1) identified users at the start who need the information for policy, planning and management, 2) involved stakeholders throughout the research process, 3) interacted with users as the projects progressed and 4) used existing user communication channels to deliver information. Using these common factors among projects we compare the engagement and communication activities and discuss their suitability for the intended information users and broader audiences.

CASES

While more than 33 institutions have hosted NCCARF projects and contributed differently to their engagement and communication, some factors are common to all. The NCCARF website (www.nccarf.edu.au) provided publicly accessible information about the projects during their research process, and after publication, linking research final reports to relevant materials. In addition, NCCARF arranged for all

research reports to be accessed on the websites of Terra Nova (the newly developed Australian Climate Change Adaptation Information Hub), Australia Policy Online (a research database for public policy development and implementation in Australia and New Zealand) and the National Library of Australia (NLA). In addition, the NLA archives the NCCARF website each year through its Pandora program, ensuring the government funded research information is retained and publicly accessible. Over the course of the research programs NCCARF held sector specific meetings initially for researchers, and then for policy and user communities. These facilitated understanding of climate adaptation requirements in Australia and promoted the emerging research findings to key stakeholders. Each year NCCARF also held an interdisciplinary conference where researchers, decision makers and practitioners came to exchange knowledge. Finally, the eight NCCARF Adaptation Research Networks also promoted adaptation research, fostered research capacity and held public meetings and workshops to raise awareness of climate change adaptation and disseminate research findings.

CASE 1 HEAT AND HEALTH

Report: *A spatial vulnerability analysis of urban populations during extreme heat events in Australian capital cities*

This project aimed to support climate adaptation strategies for extreme heat events by addressing the knowledge gap identified in the National Climate Change Adaptation Research Plan for Emergency Management: 'understanding the nature and location of the risks from climate change related natural disasters' (Pearce et al., 2009). As identified in the objectives the research findings were aimed to be useful to those involved in managing vulnerable populations exposed to extreme heat events in Australian capital cities through planning, implementing early warning systems and preparing prevention and response strategies for (see Table 3). To address a clearly identified and nationally articulated knowledge gap in public health and safety, this project engaged with the agencies intended as information users to provide research data, actively involving users in the research as stakeholders. The reference group included state and federal health departments while ambulance services contributed data.

This report stimulated intense media interest and was connected to new stories nationally and internationally for unusually long periods at a time where specialised science reporting in the media was diminished. Three communication initiatives supported this. Firstly, six months before publication, the Primary Investigator Dr Margaret Loughnan took part in the online media briefing, *Staying healthy in extreme weather*. Organized by NCCARF and the Australian Science Media Centre (AusSMC) to coincide with the 2012 Climate Adaptation in Action Conference, Dr Loughnan addressed the question 'How hot is too hot? What is the temperature for each Australian capital city above which heat-related mortality and morbidity increase?' (AusSMC, 2012). The resulting coverage was carried by the Australian Associated Press (AAP), Herald Sun and Nine MSN. Secondly, Monash University issued a press release on the publication through their Media Centre and Dr Loughnan made herself consistently available for interviews for over a week. Finally,

an article by Dr Loughnan titled 'Strategies for coping with extremely hot weather', appeared in The Conversation, a popular online source of news and analysis from the academic and research community.

Table 2 Engagement and communication evaluation – Case 1

Report Title	<i>A spatial vulnerability analysis of urban populations during extreme heat events in Australian capital cities</i>
Identified Users	General: Residents of Australian capital cities, especially those involved in preparing for and addressing extreme heat events Expert: Reference group: University of Sydney, NT Dept. of Health and Families, WA Dept. of Health, QLD Dept. of Health, VIC Dept. of Health, SA Dept. of Health, TAS Dept. of Health, Federal Dept. of Health and Ageing
User Input	NCAR Research Applications Laboratory Boulder, CSIRO, Council of Ambulance authorities, NSW Department of Health, VIC Ambulance Service, TAS Ambulance service, QLD Ambulance Service, NT Department of Health, St John's Ambulance WA, SA Dept. of Health, Canberra Ambulance Service, Department of Epidemiology and Biostatistics - State University of New York, CRC for Water Sensitive Cities, Monash University
User Involvement	Users were mainly included as data suppliers and contributors to the extensive literature review
Access	Access by users to information during the research process was through ad hoc contact with researchers in face-to-face meetings, email and telephone conversations.
Dissemination	NCCARF, APO, Terra Nova, NLA, sent directly to identified users, Cloud document hosting through Google Books and Yumpu. requested by colleagues and users, invited conference presentations
Promotion	AusSMC advance media briefing, Monash University press release, Margaret Loughnan interviews and article in The Conversation, additional production of Publicly accessible vulnerability maps
Uptake	In use by the CRC for Water Sensitive Cities; the Office of Living Victoria and cited in Australian Medical Association Answers to Question on Notice submission, Senate Inquiry, Recent trends in and preparedness for extreme weather events.

External factors played a role in the extensive media coverage this report attracted, such as the higher likelihood that health focused research findings get media attention as the most frequently reported science news is medical related (Suleski & Ibaraki, 2010). Additionally, by mapping vulnerability in all capital cities the report was locally relevant to a broad public from senior decision makers all the way to individual householders. The external event that most influenced media coverage at the time of publication was the extended, and record breaking, heat wave in Australia (BoM, 2013). The heat wave drew international attention to both public health concerns and the connection to expected climate change impacts. In Australia Dr Loughnan was quoted, or the report referenced, by most News Limited newspapers, including the Herald Sun and The Australian, as well as the ABC and a number of regional radio stations. Internationally, stories in the Jakarta Globe and Bloomberg online were linked to the Monash University press release. Mapping community vulnerability to heat and making those maps easily accessible made the data useful to a wide

audience. The focus on Australian capital cities and the spatial distribution of vulnerability in urban areas immediately made this information locally tailored for well over 80 percent of the Australian population. The vulnerability maps were generated by specialty software so the flattened images of the outputs published in the report did not allow access to the detailed data contained in each map. Recognising the great value of making this easily accessible to other researchers, decision makers and the public, additional funds were allocated to deliver spatial distribution maps for each city using a Google Map interface at <http://www.mappingvulnerabilityindex.com>.

Uptake

From 1 January to 27 October 2013, 331 new users came to the NCCARF website by landing on the Loughnan publication page directly, making it the 10th most frequent new entry to the site during that time. This report was cited in the Senate Inquiry, *Recent trends in and preparedness for extreme weather events* (Simon, 2013). It was part of the April 2013 Answers to Question on Notice submission by the Australian Medical Association to detail Australian studies or reports that 'quantify the relationship between extreme heat and mortality or morbidity rates' (AMA, 2013).

The report was referenced prepublication in the book *Schooling for Sustainable Development* (Robertson, 2012) and more recently in *The State of Australian Cities 2013* (Department of Infrastructure and Transport-Major Cities Unit, 2013) and the journal *Global Health Action* (Hansen, Bi, Saniotis, & Nitschke, 2013). Both maps and text have been used in an article on urban heat islands (Trundle, Bosomworth, & McEvoy, 2013) and a report on heatwaves and social vulnerability in Victoria (VCOSS, 2013).

According to an email to the authors, (M. Loughnan, personal communication, 28 October, 2013) the CRC for Water Sensitive Cities, a project partner, is using the work extensively for urban reform and heatwave mitigation. This includes urban planning, landscape architecture, and in the water industry across the country. The Office of Living Victoria requested a short report on the research and it's potential application. Additionally, the work has been linked online from the World Meteorological Association, Smithsonian/NASA Astrophysics Data System, Development Gateway, Zunia, and South Australia Policy Online.

CASE 2 LOCAL GOVERNMENT ASSETS

Report: *Quantifying the cost of climate change impacts on local government assets*

Part of the Settlements and Infrastructure theme, this ARGP research project developed a nationally applicable tool to help councils reflect climate change impacts on assets shown in financial and asset management plans (see Table 4). Addressing important climate adaptation issues is highlighted in the National Climate Change Adaptation Research Plan for Settlements and Infrastructure (Thom et al., 2010); the research is focused on roads and road works which represent approximately 80 percent of council assets in Australia (Balston et al., 2012). Researchers held detailed discussions with the Local Government Association South Australia (LGA SA) and the Institute of Planners and Water Engineers Australia (IPWEA) throughout the project.

In this case information designers became involved stakeholders who contributed to creating a tool they knew could be used in existing software and professional practice. Users were involved from the initial scoping meeting, sat on the steering committee and made use of an online information sharing website which was set up for discussion and to share documents including meeting minutes.

Table 3 Engagement and communication evaluation - Case 2

Report Title	<i>Quantifying the cost of climate change impacts on local government assets</i>
Identified Users	General: Council residents concerned about roads, asset costs and climate change Expert: Local councils in Australia, council asset managers and engineers, council financial managers
User Input	Local Government Association SA, Dept. of Environment, Water and Natural Resources (DEWNR)-SA, BoM Climate Division-SA, Institute of Public Works Engineering Australia (IPWEA), Murdoch University, Dept. of Planning, Transport and Infrastructure (DPTI) SA, Infra Plan, CSIRO, Municipal Associations of Victoria, WA Local Government Association, Shire of Esperance, Brighton Council, Bass Coast Shire Council, District Council of Tumby Bay, City of Port Adelaide Enfield, Campbelltown City Council, Wattle Range Council, Hume City Council
User Involvement	Bureau of Meteorology Climate Division South Australia, City of Onkaparinga and ten councils from SA, VIC , WA and TAS collaborated from early stages, attended stakeholder meetings, provided input to the methodology, asset and financial data and gave feedback on the tools developed
Access	During the research users met monthly for full day working sessions and accessed an information sharing website
Dissemination	Final project report posted to NCCARF, APO, Terra Nova and NLA websites, and sent directly to identified users, The tool developed through the project, a financial simulation model that calculates the impact of changes in temperature and rainfall on the useful life and maintenance costs for roads, was incorporated with widely used software system.
Promotion	Direct contact and peak body support, software integration and application workshops in three capitol cities, requested by colleagues and practitioners, invited conference presentations
Uptake	1069 Downloads as of 27/10/13. In use by majority of Local Councils in SA and many in Tasmania, Victoria, Western Australia.

Every month the entire research group met face-to-face with invited stakeholders and experts involved in issues relevant at the time. After the first six months a stakeholder engagement meeting brought everyone together to explain the project scope and preliminary findings and ask for user input about the research direction and output formats.

Research design was constantly influenced by user input. Closer to completion, another stakeholder workshop involved council representatives and Institute of Public Works and Engineers Australia representatives to discuss which results would be most valuable and what temporal and spatial scale and interface would be most useful. Once climate change scenarios were incorporated into the tool, it was demonstrated and tested with councils who supplied their data and feedback so

users had constant input into information delivery and selecting which outputs were actually useful to them (Balston et al., 2013).

In dealing with a large number of local councils, it was important that the research team formed a functional partnership with peak bodies influential with the users. State government support to integrate climate change impacts in planning for South Australia allowed the Local Government Association of SA to endorse the project and extend some financial support. On a technical level partnership with IPWEA was essential to design and calibrate the new module to fit with their existing asset management software. The project also benefited from financial and in-kind support by the 10 collaborating Councils.

Integrated into the national data set and financial modelling system, project results are now a nationally available plugin for all engineers and asset managers wanting to include climate change impacts into financial assessments concerning roads. Based on anticipated changes in temperature and rainfall, the methods could be extended to other assets or climate variables.

Uptake

From 1 January to 27 October, 2013, 133 new users came to the NCCARF website by landing on this publication page directly, more than half during the final 30 days. This surge coincided with increased software installation by local councils to apply the research in their planning system. This project was selected as a Climate Change Adaptation Good Practice Case Study which provides further detail and offers suggestions for future application (Balston et al., 2013).

After publication of the final report, three workshops were run across southern Australia in Perth, Adelaide and Melbourne with local government engineers, asset managers and financial managers. The outputs from these workshops contributed to an addendum that extended the findings of the original project. The addendum provides context to the original report, expands on the financial model, and in collaboration with IPWEA, enhances the decision support tools to include additional climate data sets for a total of 75 local government areas across southern Australia. IPWEA took on responsibility for the model and model updates and have integrated it into their system. Now anyone who uses the software sees an option to include climate change in forward projections for their council (J. Balston, personal communication, 10 October 2013).

Councils who provided data were the first to integrate the tool but some councils need to upgrade asset data to better reflect the quantity and types of road in the council area to use this new module. The need for data updates uncovered a benefit by clarifying to councils the sort of information needed to make informed asset management decisions taking into account climate change. In addition, recent legislation in South Australia requires councils to have long term asset management plans that rely on the improved data.

CASE 3 PERCEPTIONS, UNDERSTANDINGS AND RESPONSES

Report: *Public risk perceptions, understandings, and responses to climate change and natural disasters in Australia, 2010 and 2011*

One of the initial ARGP projects delivered the final report: *Public risk perceptions, understandings and responses to climate change in Australia and Great Britain* (see Table 5). The project coordinated national survey findings from a collaborative and cross-national research project undertaken by Griffith University (Australia) and Cardiff University (UK) (Reser, Bradley, Glendon, Ellul, & Callaghan, 2012a) .

Table 4 Engagement and communication evaluation - Case 3

Title	<i>Public risk perceptions, understandings, and responses to climate change and natural disasters in Australia, 2010 and 2011</i>
Identified Users	General: multiple organisational end users, interested individuals, and an international research community Expert: Federal and state government bodies, disaster engaged organisations, ie Australian Red Cross, the Australian Psychological Society (APS), Emergency Management Australia, and Municipal Councils such as the Cairns Regional Council. Also national and international research organisations and researchers including fellow climate change researchers, our funding bodies, federal and state level government policy advisers, the Pacific region authors of the Fifth Assessment Report for the Intergovernmental Panel on Climate Change (IPCC).
User Input	Study founded on survey responses from geographically and demographically stratified national sample of 4347 individuals and followed a similar survey of 3096 respondents conducted in mid-2010.
User Involvement	The initial funded program in 2010 involved considerable discussion and consultation with named end users. The subsequent study involved collaboration with the research community especially through the American Psychological Association Taskforce on Psychology and Climate Change and the APS Reference Group on Climate Change and Environmental Problems, as well as through other ongoing research collaborations.
Access	During the research process user access was mainly through survey responses and face-to-face presentations at forums, workshops and conferences with an initial interim research report generated and published by NCCARF following the 2010 survey, to meet myriad requests for these initial findings by government bodies as well as other researchers.
Dissemination	NCCARF, APO, Terra Nova, NLA, sent directly to identified users, requested by colleagues, invited conference presentations
Promotion	AusSMC advance media briefing, Griffith University press release, Joseph Reser interviews and article in The Conversation, related article in American Psychologist Special Issue.
Uptake	433 Downloads to 27/10/13 (+ 347 Downloads to 27/10/13 for <i>Public risk perceptions, understandings and responses to climate change in Australia and Great Britain</i>) Referenced in 2012 APS submission to the Productivity Commission Report on Barriers to Effective Climate Change Adaptation, Evidence to Senate Environment And Communications References Committee Extreme weather events, 20/02/13 in Hansard.

The follow-up study, *Public risk perceptions, understandings, and responses to climate change and natural disasters in Australia, 2010 and 2011* offered insight into the shifting nature of public perception of risks from climate change (Reser, Bradley,

Glendon, Ellul, & Callaghan, 2012b). Both studies placed in the top ten downloads out of more than 160 separate reports from the NCCARF website and their engagement and communication are treated here together. From 1 January to 27 October 2013, 543 new users came to the NCCARF website by landing directly on the web page for the later publication, making it the fourth most frequent entry to the site during that time, with the home page ranking first.

Although research end users are most often characterized as outside of the research community, this project counted researchers, especially those from fields other than psychology, as important information users and stakeholders. The foundation of this study was an interdisciplinary investigation of perceptions and behavior relating to environmental issues that arise from climate change. In addition to disaster and health management authorities, this study lists researchers as important information users, acknowledging the many communities involved in the interdisciplinary research needed to address climate change issues. While scientists traditionally build on each others' work and familiarise themselves with new knowledge through peer reviewed journals and discipline-specific conferences, few have time to look beyond their own field. Although social and decision sciences play a significant role in communicating uncertain climate risks (Pidgeon & Fischhoff, 2011) they are often neglected in climate change science research agendas and discourse. To address this, the report was couched in language that would engage researchers in other fields as well as policy makers and the interested public.

With such a broad range of eventual users for this information, effective face-to-face user engagement during the project mainly took place at meetings and conferences. To maintain a focus on bridging the boundary between psychology and climate science the work was presented at interdisciplinary conferences. An interim report was published which allowed the work to be cited in a special issue of the American Psychologist (Reser & Swim, 2011) in advance of the final report publication.

An active communication plan, including policy focused press releases for both reports by Griffith University, met with an interested audience for this report. The findings were relevant to political coverage, characterizing views on the reality and causes of climate change which has become a politicized topic. They also contradicted the commonly espoused idea that a substantial portion of the Australian public were sceptical that climate change is real. Professor Reser often made himself available for interviews and wrote three articles for *The Conversation*, one of which generated over 200 public comments.

Uptake

The earlier study in case three and its Interim report have been referenced in the Australian Psychological Society (APS) submission (APS, 2011) to the Australian Government Productivity Commission Report on Barriers to Effective Climate Change Adaptation (Productivity Commission, 2012). In addition, Professor Reser gave evidence to the Australian Senate Environment and Communications References Committee regarding extreme weather events, in support of another submission by the APS which referenced this later report (APS, 2013). As Hansard transcripts of public hearings are made available on the internet when authorised by the committee, findings from this research are now publicly referenced in official

Hansard records (Official Committee Hansard SENATE, 2013). In terms of academic impact, an article in the 2011 American Psychologist special issue (Reser and Swim, 2011) referring to the earlier NCCARF report had been cited in 18 publications as of 27 October, 2013.

ENGAGEMENT AND COMMUNICATION STRATEGIES

While there are many overlaps, across the three cases we identified three basic strategies used to both engage users in the research and to communicate research findings (see Table 6). Here we characterize the engagement and communication methods found in the three climate adaptation research reports frequently accessed by information users. Firstly, users were involved in research as data suppliers and output designers. Secondly, researchers supported other stakeholders to disseminate information. Thirdly, practical communication products were developed and formatted to suit the user needs in that sector.

Table 5 Overview of engagement and communication strategies

Research Project	Strategies		
	Data	Dissemination	Application
A spatial vulnerability analysis of urban populations during extreme heat events in Australian capital cities	information sources as stakeholders	media interviews	Public access vulnerability map
Quantifying the cost of climate change impacts on local government assets	information designers as stakeholders	peak body partnership	integration with user software
Public risk perceptions, understandings, and responses to climate change and natural disasters in Australia, 2010 and 2011	Research community as stakeholders	media interviews	interdisciplinary publications and presentation

DISCUSSION

The purpose of our study was to use some of the most successfully communicated NCCARF research projects to characterize their engagement and communication methods and review how these methods align with information needs of the users and to put forward a strategic approach to user engagement and communication planning for applied research projects. This is important to both provide evidence of dissemination to key stakeholders and to enable research adoption by the intended users to inform decisions, policy and practice. While application of findings from academic publications is often measured through citations, there is usually a time lag of years, rather than months, between research and research publication and then again between research publication and subsequent citations. Similarly, applications of new knowledge by policy makers and industry or professional practitioners will progress in line with long term political, bureaucratic and business cycles and then, only if they are found to be useful and credible (Lupia, 2013).

In these cases early and ongoing engagement between researchers and the intended users of new knowledge shaped both the research focus and the useful format of the outputs. Additionally, by involving stakeholders in coordinated and

sustained communication programs, the research was disseminated and promoted through multiple channels by invested parties. These included; funders such as NCCARF, universities and industry peak bodies; information users, such as government agencies and professional bodies, and both mass media such as news services involved in print, radio and television and social media.

In the Cases above we found some practices common to all. Firstly, engagement with users was more than symbolic, to the extent that information users contributed substantially to the research, either as sources of data or by influencing design of communication products. Secondly, early adoption was matched by early communication that suited both the topic and the intended users of the research through media briefing, publishing an interim report and in many cases, conducting an inclusive face-to-face workshop. Thirdly, each project made use of invested stakeholders to promote the research, either through their host university media centres, peak body submissions to government or integration with industry programs. Finally, in addition to research dissemination arranged by NCCARF, each project ensured the reports were also accessible from a professional or university website.

We also found that Primary Investigators in each case committed considerable time and effort to take advantage of communication opportunities as they arose. Media attention often came to a research project because an external political or environmental issue generated requests for print, radio and television interviews in a short time. Similarly, it was helpful that Primary Investigators made themselves available for stakeholder meetings where research presentations reached senior decision makers who were influential in the user communities. In addition, engagement and communication with the users is ongoing as the researchers support knowledge adoption over time, referencing the work in the media, through conference and public presentations and in policy submissions.

Our first rough indicator of research impacts began with counting how many times the research was downloaded from the NCCARF website. While useful, this has limited value as we do not see how often a report was downloaded by each user, the volume of traffic on other sites where the research can be accessed, or if the reports have been used in any way. It is a simple metric however, which can be accessed on most well designed websites and so is widely available. Media attention is also one factor to indicate effective communication, especially when the greater public is an acknowledged user, as in Case 3. In both the United States and the UK, studies have shown up to a 63% increase in long term citations for research that drew significant media attention (Fanelli, 2012). In even this short time, we found evidence of research application in all cases through: requests for reports by user agencies; references to the research findings in submissions to government; application of the research in a professional practice, or in use of reports to inform adaptation research in other fields. As highlighted by behaviour studies such as those in case 3, adoption of climate adaptation related research faces issues beyond communication barriers to awareness and access to new knowledge. While the innovative measure of psychological adaptation posed by Reser and colleagues in the report for Case 3 is interesting in itself, it underscores the need for researchers to monitor the extensive adaptation to climate change already taking place across Australia and many other

countries, and could serve as a psychological indicator of public engagement with the issue.

From the cases we found that the elements of our assessment criteria as laid out in Table 2 form the basis for a strategic approach to researcher, end user and communication planning. The first four elements of our assessment criteria were explicitly addressed in each of our cases. This required a series of steps: identifying research users; negotiating how to involve users in the research, providing access to information while research progressed, and planning dissemination that suited the users. Of the last two elements, promoting the findings was treated in an ad hoc fashion that arguably benefited from the willingness of these particular Primary Investigators to engage with the media and stakeholder groups. Additionally, gauging uptake is essential as applying the research is the fundamental aim of the projects. From the outset it is valuable to articulate what uptake is expected, since the nature and speed of research uptake in adaptation planning varies considerably across the many sectors vulnerable to climate change.

CONCLUSION

Research to facilitate adaptation to climate change carries with it a sense of urgency that new knowledge be applied as soon as possible to address critical environmental, social and economic issues. In addition, the imperative to demonstrate swift research adoption comes from funding agencies whose reporting requires proof of near-term return on investment so agencies can compete for a share of shrinking budgets.

Importantly, research institutions and involved stakeholders supported quick and broad dissemination by actively promoting research communication, both within their sector and to the public. These final research reports were peer reviewed and had been published on the NCCARF website for between 9 and 12 months at the time this research was conducted. This is a very short timeframe to claim impacts from either academic citations by other authors or references in user or policy documents. Despite this, each of these research projects can demonstrate their use by stakeholders through reference in media reports and other publication, posting to user-specific websites, and in the case of asset management, extensive integration in planning and management processes.

In these cases considering stakeholders as information users and planning communication strategies at the beginning of research design have proven valuable. By maintaining an ongoing connection to stakeholders as sources of information during the research process these projects gained important insights into user information needs and also developed ongoing relationships which facilitated research communication and application when the final reports were published. Impact of NCCARF funded research will become more evident over time, and further evaluation will be required to address this effectively. Evaluating the uptake and impact of any future NCCARF funded research will be paramount.

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UNDERSTANDING INSECTS: WHY EXPLORE THROUGH SCIENCE AND ART?

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ABSTRACT

Visualising the world of insects is at an exciting and innovative stage. New resources and technology allow exploration of intricate and complex detail at the miniscule scale of internal and external microscopic examination. In this project, a unique collaboration between a scientist and an artist has unified scientific and creative research interests in visualising insects from the Australian National Insect Collection. This intersection of science and art, within the fields of computational informatics, material science and entomology has provided a creative catalyst for imagination, ideas and innovation, particularly through the technical and aesthetic processes in which scientist and artist collaborate. In general, science art collaborations are conducted in order to create an artwork which has elements of science within the work. However, this project used art to illuminate the science for the purposes of research. We discuss the results of this science and art partnership, including the resultant challenges and benefits for a large interdisciplinary research organisation and for nationally exhibited artworks. This collaboration provides a model for mutually beneficial science/art explorations in related fields.

INTRODUCTION

“Attack of the giant bugs” and *“Scientists create supersized insects”* are two of many news headlines covering the 3D insects starring in the *Enlighten Canberra Festival* (ACT Government, 2013) and *Embracing Innovation Volume 3* (Craft ACT: Craft and Design Center, 2013). The insects appear in artworks as large-scale architectural projections on the Questacon building and in the form of 3D printed titanium. These works are the result of a unique collaboration between Science Art Fellow, Eleanor Gates-Stuart and research scientist, Dr Chuong Nguyen at the Division of Computational Informatics, CSIRO.

These works were a response to a mutual research interest in visualising insects and although the individual research had a different focus, the fusion of our ideas and the opportunity to make something new for public viewing led to some very interesting

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directions for the work produced at the CSIRO. The interest in making something new for public viewing had unforeseen consequences for the communication of science to CSIRO researchers themselves, through the medium of art. Unlike previous art-science collaborations which have led to the production of works of art with a science-based content, such as those of artists Sophie Munns (Munns, 2013) and Francesca Samsel (Samsel, 2012), this collaboration resulted in increased understanding of the structure of the insects from an entomological perspective and enhanced techniques for understanding their internal structure.

Amongst the many models for science communication, that of Stocklmayer (2013) provides for science communication between artists and scientists, and artists and the lay public. This model features three possible intended outcomes from such interactions – one-way information, knowledge sharing, and knowledge building.

In the first case, the intended outcome is simply to inform, through presentation of science without structured provision for feedback and modification. The placement of art installations on the outside of public buildings might be considered to be in this category, since the *Enlighten* project was intended to interest and excite, but had no provision for specific feedback. This aspect of the project was, in many respects, similar to the works described by Wilson (2002) in his book about the intersections of science and art. Wilson describes the work of Herbert Duprat, for example, who creates strange hybrid objects through the metamorphic processes of insects. His art requires a detailed understanding of the insect's life cycle and behavior to create what are essentially 'sculptures'. Mark Thompson, on the other hand, has created installations based on bees, including live bees and their honeycombs. He uses bees to demonstrate political points about crossing borders. (Wilson, 2002, pp116-117). In all these cases, the artist (who is very familiar with the underlying science) uses the science to create an art work. This is the most usual process resulting from the intersection of these disciplines, as is also exemplified in Korsmo (2004) concerning print and film media and Frankel (2001) concerning photography.

In Stocklmayer's (2013) third case, knowledge building is intended to "create new meaning or understanding from different knowledge systems" (p.30). This outcome is the major focus of this paper, since the art-science collaboration we describe was a sharing of two very disparate knowledge systems. The outcome was a fusion of knowledge, to create a product which could not have evolved using only one of these systems. Further, the outcome for the scientist was a critical outcome for the partnership.

In this paper, we discuss how we came to develop and create these artworks, the influence on our own research directions, our collaborative results and interaction with other scientists at CSIRO. We argue that such science/art collaborations provide a valuable means to communicate science in an alternate and engaging way, enabling the research itself to be communicated to large audiences. This exposure differed from popular media, in that it reached large numbers of casual passers-by who observed the art covering the exterior walls of major national institutions. For the scientist, this method of communication enables articulation of the research in the public domain in a way that reaches people who do not seek to engage, as they

might with a television documentary or a newspaper article. The point here is that the public installation was portraying Nguyen's research in an accessible way, rather than some aspect of science being appropriated for an artistic outcome. As Nguyen experienced,

Technical publications at conferences and scientific journals are the main channels for a scientist to communicate their works to their peers. Occasional press releases are the primary means of communication with the public who support and benefit from such work. This has a limited effect, as it is produced by technical staff and is limited to research and technical communities. An artist can provide a powerful alternative interpretation and publication channel for the science. The artist's interpretation of the science work provides new exposure that can benefit not only the individuals involved in creating the artworks but the host institution, in terms of the much wider audience and impact. It also benefits the viewing public in terms of enriching their experience and improving their knowledge of contemporary science.

Although this aspect was highly relevant and was the initial drive for the collaboration, this paper focuses on the importance of the collaboration and the communication to the scientists concerned.

CONTEXT

Gates-Stuart's residency as Science Art Fellow at the CSIRO was awarded as the successful recipient of the 2013 Centenary of Canberra's Science Art Commission. The CSIRO residency bridged the Divisions of Computational Informatics, the Food Futures Flagship and the Australian Plant Phenomics Facility.



Figure. 1. Artwork, 'Jewels' by Eleanor Gates-Stuart

In the CSIRO's rare books collection, Gates-Stuart discovered the beautiful book plate illustrations produced for 'The Insects of Australia' (Nanninga, 1991). What followed was a series of artworks (Gates-Stuart, 2012), such as 'Jewel', as shown in Figure 1, that respectfully pays homage to the different techniques of visualising insects. This compositional approach of embedding content, layering images and merging visual artifact demonstrates Gates-Stuart's method of representing and exploring scientific information. Her interest in automated technologies, particularly with plants became the nexus to meeting Nguyen (Cross, 2013a), whose postdoctoral research focuses on developing and implementing methods that are fundamental to the automated (or semi-automated) interpretation of multiple 2D images and 3D measurements of organisms, specifically plants and insects. Our mutual interest in 3D imagery sparked a partnership that proved to be a creative catalyst for science-art ideas across CSIRO (Gates-Stuart et al., 2013) and the beginning to our exploration of visualising insects. As Nguyen recalls,

We began by capturing 3D shapes and colours of insects in order to present them visually and artistically to the public, but the unexpected outcome was that the research itself was illuminated. The connection between the artist and the scientist and the initial results of beautiful insect models sparked a special collaboration between us.

Our first collaborative work, 'Intervisble', combined 3D models of both plants and insects and was devised as a concept to enable a public audience to compare human and insect vision through an interactive exhibition, as shown in Figure 2. The 'Intervisble' installation was designed to let the viewer experience images as if looking through the eyes of an insect whilst the insect eye (in this case a Kinect camera) is viewing the visitors and detecting human movement. Using specialised computer software, the images are then projected back into the interactive space on another screen, thus revealing to the visitor that the insect is also watching them. Although this concept did not proceed to final production, it did catalyse an important step in cross-divisional collaboration through the combined efforts of researchers and scientists across Computational Informatics, Information Management and Technology, Entomology, the Australian National Insect Collection, eResearch Visualisation and the Australian Plant Phenomics Facility. From Nguyen's scientific perspective, this collaboration enabled and encouraged: a) a complementary role between science and art where science provides new materials for art to explore and art provides new interpretations (and publicity) for science; b) the thirst to explore new domains, that helps one learn as a scientist to better work with those domains, exploit their strengths and overcome their weaknesses); c) an approach to extending and strengthening new collaborations by removing possible friction due to human factors such as fear of sharing important information and unfair competition. CSIRO's large breadth of research makes it easier to go across multi domains, but this work was a special contribution to further counteract or neutralize these negative human factors. This third point is a major one because it helps to cultivate healthy collaboration not only between the artist and the scientist, but also between scientists themselves. As illustrated later in section "TITANIUM INSECTS", scientists gain new meaningful links between their isolated research activities and can later form collaborations beyond the original scope.

CREATING 3D MODELS

Insects are fascinating subjects and there has been a large number of creative works relating to them. Hand drawn illustrations and photographs of insects are common methods of capturing their shapes and colours. Creating 3D models of insects using 3D modeling software is another common modern method (König, 2009; Murakawa et al., 2006). Due to their small size, however, insects are difficult to scan to create a 3D digital copy. Attempts have been made to scan insects using laser scanners (David-Laserscanner, 2009; Mayrhofer, 2013) but the results have low resolution and have missing texture and colours. Laser scanning and image-based reconstruction methods have been used by Atsushi et al., (2011) to scan very small objects with some success, but the scanned objects are limited to simple geometries. Micro Computed Tomography has recently demonstrated high resolution 3D models of insects with internal structures (Metscher, 2009), but this method does not recover texture or colours of the object. This has proved a problem for the research, in that the interior structures of the insect cannot usefully be viewed while the external appearance plays a more important role.

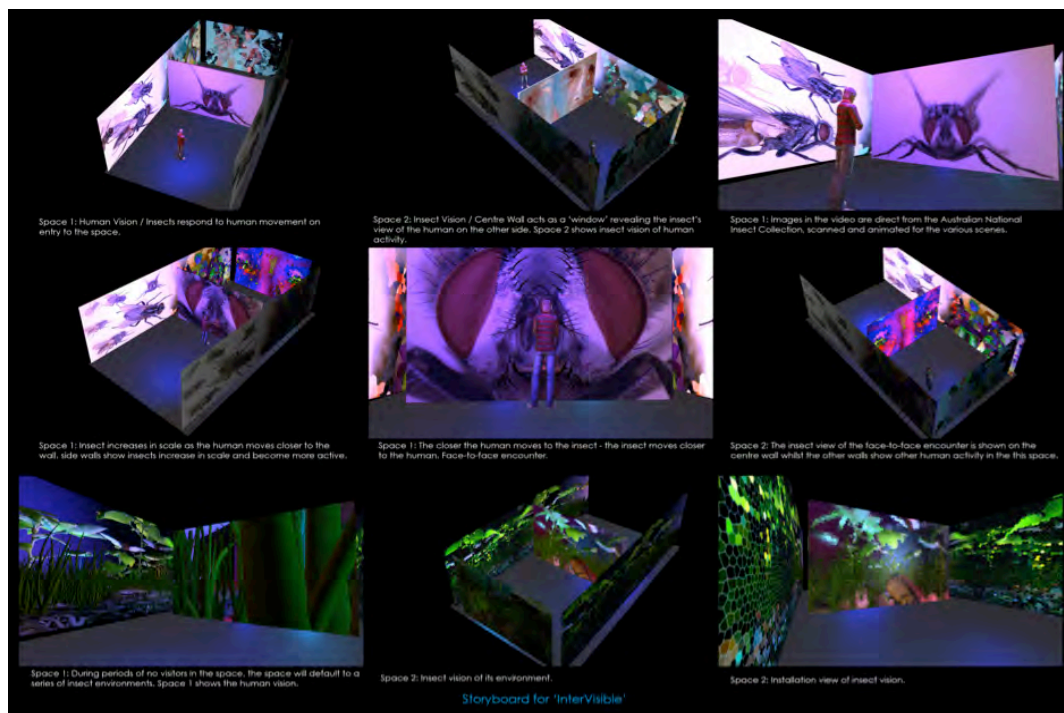


Figure. 2. 'Intervisible' Storyboard: Face to face encounters with an insect environment. Virtual Reconstruction of Insects from the Australian National Insect Collection and plants from the Australian Plant Phenomics Facility.

The method we used to create 3D insect models for our work (Figure 3) is somewhat similar to that of Atsushi et al. (2011) but the resulting 3D models have much higher resolution and higher structure complexity. Nguyen's system consists of a two-axis turntable, a DSLR camera with a macro lens, and a macro rail. The system can capture hundreds or thousands of multiple view images up to 21MP resolution. The macro rail is used to capture multiple focus images which are then combined into a single high quality, in-focus image. 3D reconstruction software was used to

automatically process multiple view images and create a 3D colorful model. Figure 3 summarises this process of 3D reconstruction.

This research increased our interest in producing insects for large-scale formats, setting a challenge to retain high-resolution detail of insects during 2D to 3D reconstruction. Nguyen's approach to scanning insects involved complex technical solutions, not only with hardware but in the preservation of insects during scanning as well. Figures 4 and 5 show our own use of the insect images.

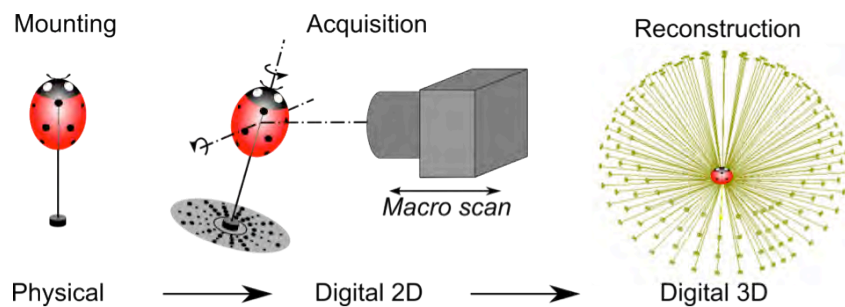


Figure. 3. Method of creating 3D models of insects

ART INSTALLATIONS & AUDIENCE RESPONSES

The opportunity to test 3D scanning of insects from the Australian National Insect Collection and use volumetric data from the Australian Plant Phenomics Facility was the catalyst in the creation of the *Bugs* and *Grassland* series, both of which were remodelled and transformed as architectural projections for Canberra's *Enlighten* public art event. The manipulation of 3D models and images transformed the insects into a new visual dimension, merging the intricate texture mapping of Nguyen's meshes and reworked through 3D animation software by Gates-Stuart which enabled the insects to "come alive".

Working effectively with scientists from different technical backgrounds was challenging for both partners and required particular technical skills. For Gates-Stuart, maintaining a lab notebook helped her to think and work like a scientist. Reading scientific journal papers and asking technical questions to make sense of scientists' work is another crucial skill. This deep understanding of the research enabled the development of the meanings behind several artworks, including the one in Figure 1.

To push this and other related collaborations to the highest level, strategies were developed to deal with negative factors that hindered genuine collaboration efforts. CSIRO, with its wide breadth of research domains, provides an ideal environment for multidisciplinary collaboration. Nevertheless additional efforts were required to maintain mutual trust and ownership of the project; these included due acknowledgement of contributions, sharing of information, and development of mutual care and regard.

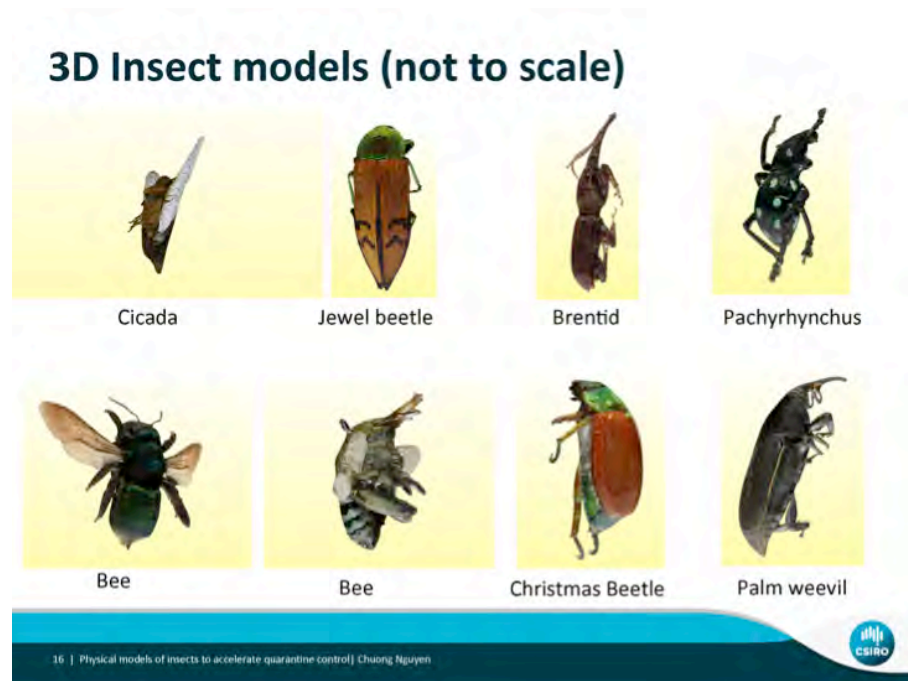


Figure. 4. Nguyen's 3D models of insects

An opportunity to preview a live screening of the 3D insects was presented at *Spectra, Conference of Art and Science* (Kennedy, 2012) early in the year of Gates-Stuart's residency. This showed the insects crawling around the CSIRO Entomology building (Gates-Stuart, 2013). The groups of insects were placed on a flat, vertical, visual plane that rotated horizontally through 90° until the plane became a single line

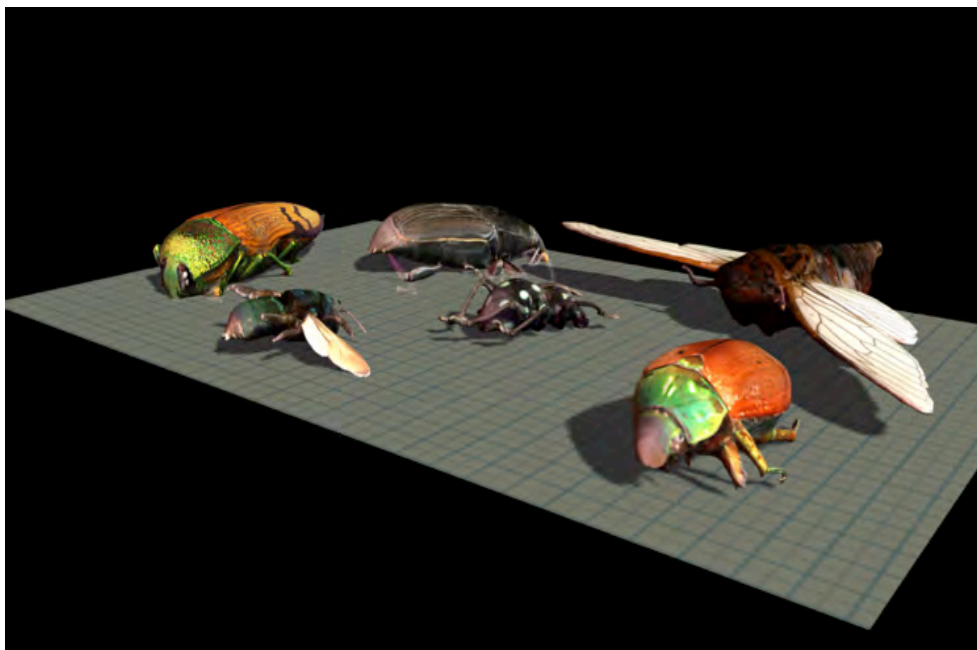


Figure. 5. Gates-Stuart's virtual reconstruction of 3D insects remodelled using animation software

(see Figure 6), at which point, the insects fell from one space into another. Influenced by *Flatland* (Abbott, 1992) and the n^{th} dimension character of images, the aim was to create the illusion of the crawling bugs suddenly disappearing, having flipped their spatial position through the line and disappeared into black space. Actually, there was no real black space, but an illusion was created of the bugs having dispersed into the building.

An eerie aspect of this installation was the illusion of bugs finding spaces to hide, in what seemed a familiar scenario for the public to recognise occurring in their home environment. It was interesting watching the audience twitch and scratch at themselves at the sight of the large scale insects. This included the sound of nervous laughter, as most people are wary of certain insects (Weinstein, 1994) and many comments related to the realism of the 3D bugs.



Figure. 6. Rendered Image: 3D ‘Bugs’ walking the line

In *Enlighten* (see Figure 7), the approach was modified because moving images were not an option for the event. As a result, we placed an emphasis on the insect’s body mapping the intricacy of their tactile bodies, detailing their shape and body markings across the surface of the building. The insects were enriched in colour and dense in visual information. The artworks were architecturally mapped and projected onto the Questacon building by *Electric Canvas* and gained wide media attention.

Reports emerged of giant bugs spotted in the parliamentary triangle area of Canberra crawling over the Questacon building (McKay, 2013) and media teasers included, “Does the thought of giant bugs crawling over Canberra’s National Institutions frighten or fascinate you?” (Kimball, 2013). Media interest in the insect artworks was evident; they were the only one of the five “Enlighten” installations on the Questacon building which featured these animals. The CSIRO Facebook album, *Enlighten Canberra Festival*, received the most ‘likes’ for the month of March (CSIRO, 2013), an interesting statistic given the range of exciting science news on CSIRO’s social pages for that month. Internally, our science art collaboration reached the division’s newsletter (Cross, 2013b) and caught the attention of the Chief Executive (Cooper, 2013), an important factor in raising cultural awareness of communicating science initiatives within the organisation.

TITANIUM INSECTS

This synergy between us, scientist and artist, enveloped other collaborators at CSIRO as we developed the opportunity to enhance other research areas. Armed with Nguyen’s expertise in capturing, assembling and interpreting data, we met with Zimmerman Fellow in Weevil Research, Dr Rolf Oberprieler, to discuss this species (*Sitophilus granarius*) in more detail and to have the opportunity to bring the insect into the public domain.

Our first attempt to achieve a low-cost alternative to Computed Tomography (CT) scanning involved digitally reassembling thin 2D sections obtained via microtome. It was unsuccessful as the tough tank like bodies of the weevil specimens tended to explode during sectioning. We were aware that successful reconstruction of the internal structures of weevils is also of scientific interest because the internal genitalia are a key discriminative character between weevil species (Honnicke et al., 2010), and it soon became clear that we would need the help of Dr Sherry Mayo, Senior Research Scientist in CSIRO’s X-ray and Synchrotron Science and Instruments team. At the Australian Synchrotron, Mayo scanned a weevil and produced an excellent 3D model insect. Mayo used *Drishti*, open source software developed by the Australian National University for 3D visualization of CT Data.

At 3-5mm long, the weevil easily became a motivation for the optical 3D model capture system that Nguyen was to later develop. However, at this time, and following the success of the architectural projections, we were approached to be part of the *Embracing Innovation Vol. 3* exhibition. This was a great opportunity to produce 3D models in titanium, given the strength and tough exterior we had attributed to the weevil body and this unique method of showcasing the insects with innovative 3D printing technology.

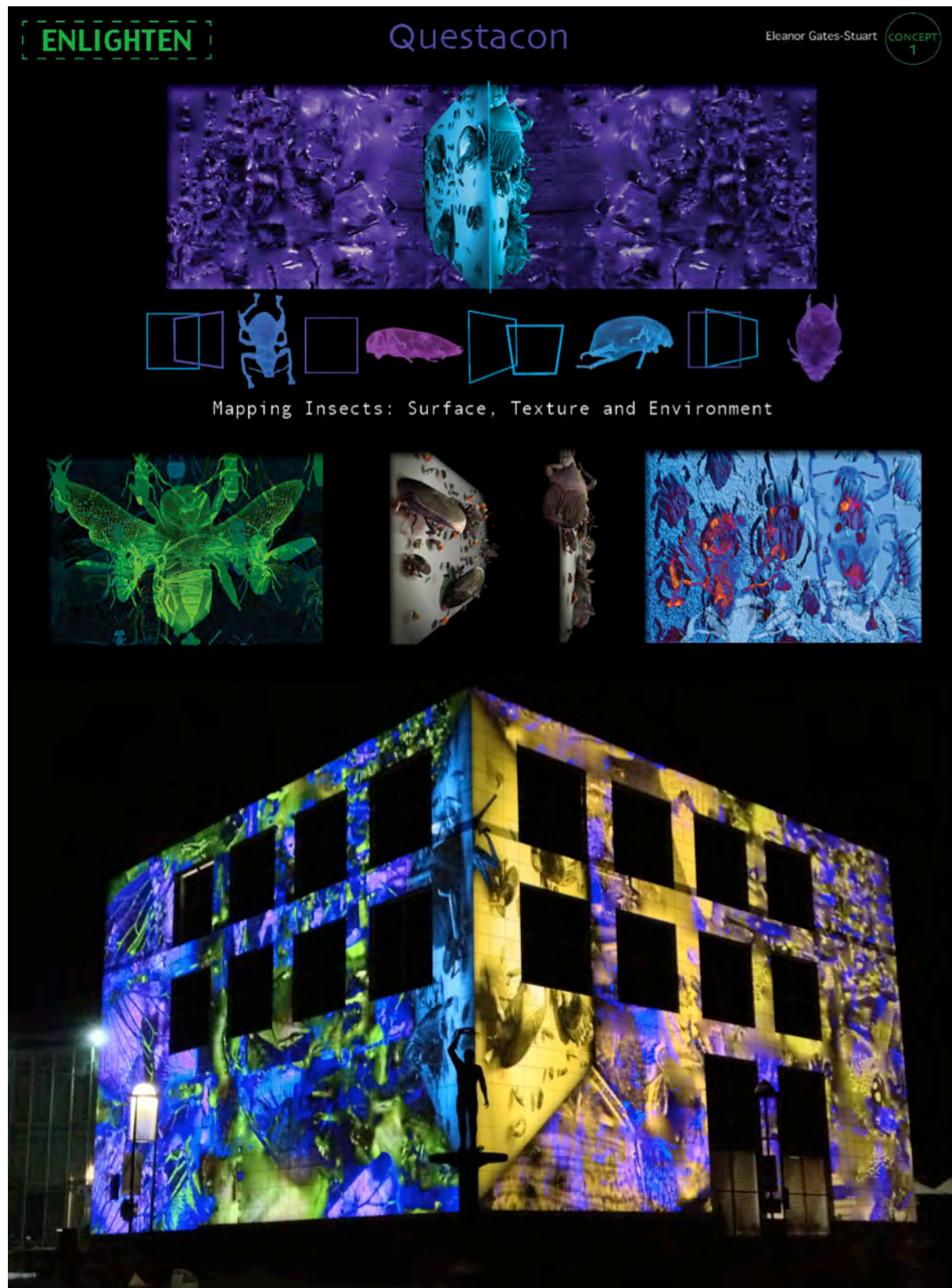


Figure. 7. Insect surface and mapping designs shown with the images of 3D models projected onto the Questacon Building.

A discussion with Theme Leader, Dr John Barnes, in CSIRO Titanium Technologies, led to an exciting collaboration involving entomology, synchrotron science, computer vision, 3D reconstruction and 3D printing in titanium. This in turn created an interdisciplinary team across divisions. Our challenges ranged from retaining insect detail in the printing without over-simplifying mesh structures, authentic scaling of the insect relative to the printed size and real-life, the quality of surface structure through the printing process and its final finish. Aesthetic judgments balanced between the concept of an insect and the realism of the insect. For instance, if “art can be anything that you can get away with” (McLuhan, 1967), would this affect the communication of the science? In this case, the technologies and methods intrinsic to making the insects are important to communicate. These messages are visibly evident in the final result, as they might be in the viewer’s experiences and encounters with the actual insects.



Figure. 8. 3D wire frame beetle model (left) and titanium prototype (right)

The initial titanium prototypes resembled a fossil appearance (see Figures 8 and 9) and were almost grub-like with distorted features. It was only when the titanium bugs were moved under illumination that the jewel-like quality of their surfaces revealed itself and the magical iridescent effect, reminiscent of, but different from the micro and nanostructures found in real insects, became apparent. Once we rescaled the mesh to suitable sizes for printing, the first batch of insects was produced using four insect models replicating the following beetles: Christmas Beetle (*Scarabaeidae: Rutelinae*), Longhorn Beetle (*Cerambycidae*), Broad-nosed Weevil (*Gagatophorus draco*) and Wheat Weevil (*Sitophilus granarius*). Three of the insects were anodised to give colour and to group each set of species.



Figure. 9. 3D Titanium insects

COMMUNICATION OUTCOMES

The *Enlighten Canberra* event attracted over 115,000 viewers, contributing an estimated \$1 million to the Gross Territory Product (GTP) (Barr, 2013; Events ACT, 2013). As with the *Bugs on Buildings*, this collaboration generated considerable publicity which, in turn has led to further enquiries about the underlying research and methods. From the perspective of a multidisciplinary science organisation, however, one of the key benefits of the science/art collaboration process has been to make connections and communications between researchers from disparate fields: entomology, computer vision, tomography and materials science. This project was unique in its extensive collaborative reach across the organisation, clearly with multifaceted value and opportunity for all involved. In the words of the scientist, Nyugen:

We found that Science and Art greatly complement each other. By pushing this win-win synergy to its highest level, the collaboration led to spectacular outcomes beyond what could possibly be achieved from individual domains. The complementary roles between Science and Art in this project enabled a special approach for an artist to work successfully with scientists across multiple technically sophisticated backgrounds. This approach extended and strengthened new collaborations between artist and scientists and between scientists themselves by removing existing barriers originating from human and organizational factors.

Beneficial outcomes for the organization have been wide media exposure and public attention. New audiences have been reached through the Enlighten evenings on the

lakefront. Promotion via the Australian Broadcasting Corporation (ABC) helped to increase audience reach as ABC3 Behind the News (Davis, 2013) attracted over 500,000 viewers and local ABC 7.30 Report (Kimball, 2013) attracted 52,000 viewers. The CSIRO's support and resources given to the project, particularly in its promotion through CSIRO social media and science communicators' reports (Beggs, 2013; Long, 2013; McKay, 2013) led to national and international press attention, electronic and broadsheet copy. The internal value of the CSIRO communication was equally important as it facilitated wider participation for collaborative projects, positive feedback to divisional unit support, new co-authored publications and research credit to the scientists.

Following the success of the titanium insects, Nguyen's scientific research has received more attention. He has been encouraged by CSIRO to further develop his optical 3D model capture system for better quality of smaller insects such as wheat weevil. Nguyen also found opportunities to expand the applications of 3D insect modeling to quarantine control (Figure 10). This has caught the attention of the Department of Agriculture in applications that on-site quarantine officers can use (Nguyen, 2013). 3D models of known pests on a mobile enable decisions about whether a bug is harmful. 3D pest models help them make more accurate decisions than photographs.



Figure. 10. Nguyen: Better quality of smaller insects for biosecurity

For the artist, the benefits of working in science are evident, from the depth and insight to Gates-Stuart's practice and the open interaction her artworks generated in opinion and feedback from both scientists and the general public. This exchange of communication provided a valuable pipeline in the collaboration process and feedback to the CSIRO, particularly in response to making informative decisions and practical application of the work. Production quality and aesthetic judgments were balanced with research challenges in finding technical solutions and the need for

advancing science knowledge. This collaboration thus proved to be of benefit to both scientist and artist, a successful interdisciplinary relationship that promoted a positive value of having artists as integral team members in science organisations.

In conclusion, the aspects of this collaboration that we offer for a model of mutually beneficial science/art explorations in related fields are:

1. New ways to portray scientific research
2. Opportunities for cross-disciplinary science research and communication
3. Opportunities for the institute itself to extend its public outreach in non-traditional ways
4. Opportunities for publishing research in a wider range of journals and
5. Exhibition of artwork in non-traditional venues, e.g. science museums.

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STRAIGHT FROM THE HORSE'S MOUTH: HORSE OWNERS' UPTAKE OF RISK MANAGEMENT STRATEGIES FOR HENDRA VIRUS

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KEYWORDS: risk perception, risk communication, zoonotic disease, decision making, risk management, vaccination, disease prevention.

ABSTRACT

Hendra Virus is a potentially fatal disease transmitted from bats to horses and from horses to humans. This zoonotic virus (passing to humans from other animals) has a mortality rate of 54% in humans and over 75% in horses (McFarlane, Becker & Field, 2011; DAFF, 2013). With treatment options still experimental, risk minimisation strategies aimed at infection prevention are the mainstay for disease management. A vaccine for horses released late in 2012 has become pivotal in minimising risk of infection.

Because current risk management strategies rely on horse owners and trainers understanding and acting on preventative recommendations, it is vital to understand how these recommendations are received and acted upon by these stakeholders. Initial research suggests that there is a spectrum of responses from stakeholders concerning strategies they could adopt to protect their horses and themselves against Hendra infections (Kung et al, 2013). These responses range from understanding risk mitigation strategies and taking action, knowing risk mitigation strategies and not adopting them, to finding the strategies impractical and irrelevant.

What factors drive those at risk of Hendra Virus infection to implement risk management strategies? What impediments are there to stakeholders taking action to protect themselves and their animals? This project is exploring factors involved in stakeholder decisions about risk management strategies: whether to act or not. While this project specifically targets the risk surrounding Hendra Virus, it has far reaching applications in understanding the communication of science in risk management situations.

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BACKGROUND

Hendra Virus, of the *Henipavirus* genus, is a relatively new zoonotic emerging infectious disease, first isolated in 1994 after the death of over 20 horses and their trainer in Hendra, Queensland (Murray et al., 1995). The natural hosts are flying foxes which were found to have Hendra Virus antibodies (Young et al., 1996) and

Hendra Virus in their blood (Halpin, Young & Field, 1996). Horses are infected with the virus by ingesting food or water contaminated with virus from bat excreta, birth products or discarded food. Humans are infected through close contact with infected horses. Overall there have been seven human cases with a fatality rate of 54%; the mortality rate in horses is 75% (Field & Kung, 2011; DAFF, 2013). The disease outbreaks were attributed to spillover events, when a virus emerges from its natural host to infect a new, previously uninfected host (Murray et al., 1995).

The spread of disease from animals to humans is not a new occurrence. Jones et al. (2008) examined 335 emerging infectious disease occurrences from 1940-2004 and found that 60% were zoonoses (diseases that are transferred to humans from other animals). Wildlife was found to be involved in 72% of zoonotic disease events. Jones et al. (2008) report that this is a significant increase over time, even after controlling for better surveillance and increased reporting. Bats in particular are well known for their ability to carry disease while remaining unaffected. However, bats do not appear to be overrepresented as hosts for zoonotic diseases (Halpin et al., 2011).

In the late 1990s, bats were identified as the reservoir host for five new zoonotic viruses (Halpin et al., 2007). Of these viruses, Hendra Virus, Australian Lyssavirus and Menangle Virus are found in Australia; the first two cause fatalities in humans and are of great public health concern.

When new diseases emerge, infection risk minimisation strategies are initially the only protection against disease. There is a time lag between disease identification, and appropriate treatment or preventative measures. In many cases, such as with Hendra and Australian Lyssavirus, there is no treatment. Clear communication about how people can protect themselves from infection is important to minimise risk. Equally important is understanding how people make decisions in disease outbreak situations and how people evaluate and act on risk minimisation strategies.

Current strategies aimed at reducing the risk of Hendra infection in horses and humans include a vaccine for horses against Hendra as well as property management strategies aimed at reducing contact between bats and horses. Management strategies include removing fruiting and flowering trees from horse paddocks, stabling horses when bats are most active, and covering horse food and water sources to prevent contamination.

Communication about Hendra Virus risk minimisation does not necessarily result in uptake of this advice by horse owners. Initial transmission studies by the Queensland Department of Agriculture, Fisheries and Forestry have shown that while people are aware of the risks of Hendra and know about risk minimisation strategies, many are choosing not to adopt them or find the strategies irrelevant and inconvenient (Kung et

al., 2013). This research project aims to examine factors that impede or increase adoption of risk minimisation strategies.

RESEARCH PROJECT

Understanding human reactions and responses is one of the major challenges in disease outbreak situations. Bangerter, Green & Gilles (2011) suggest that when examining communication surrounding emerging infectious diseases, the interactions are complex and contradictory, involving scientific, public health, and political organisations dealing in abstract risk, sensationalised media reporting and a public that may respond with fear, doubt and lack of trust.

Bangerter et al. (2011) suggest that this area of research needs urgent attention because improved understanding of how people integrate emerging diseases into their thinking and decision making will result in better understanding of societal responses such as collective behaviour, trust in authorities and uptake, or rejection of risk minimisation strategies. Better understanding will then lead to improved risk minimisation strategies and communication.

The aim of this research project is to examine factors that determine horse owner adoption of protective risk minimisation strategies in areas with high risk of Hendra Virus infection.

METHODOLOGY

A phone survey of horse owners in areas of known Hendra outbreaks is planned, pending Human Research Ethics Approval. The survey contains both open and closed questions to examine respondents' current risk minimisation strategies and their current and intended action. There are also questions about respondents' personal connection to previous Hendra Virus outbreaks. From this sample, some participants will be asked to participate in an in-depth interview. The interviews are aimed at further exploring drivers of and impediments to decisions about risk minimisation.

Participants of the initial survey will be sampled using a number of techniques. Information about infected properties from the Queensland Centre for Emerging Infectious Diseases will be used along with contacts through local veterinary clinics to identify potential respondents. This research project complements the *Horse owners and Hendra Virus: A Longitudinal cohort study To Evaluate Risk (HHALTER)* project, a three year longitudinal project examining attitudes and opinions about Hendra risk awareness and mitigation strategies, led by the University of Western Sydney. Information from the HHALTER survey may also be harnessed to establish contact with horse owners who live close to previous infections.

The collected phone survey and in-depth interview data will be analyzed using NVivo. This will allow for a substantial amount of interview data to be examined, while maintaining auditability and transparency (Banner & Albarran, 2009; Bryman, 2012). Care will be taken to maintain contact with the interview material while not losing the advantages of the recorder and observer viewpoint (Richards, 1998).

The data will be coded according to the drivers of and impediments to decisions about Hendra Virus risk minimisation. The data will then be examined in light of several models and theoretical frameworks used to examine decisions made about health and risky behaviours. The first of these is the Transtheoretical model of behaviour change (TTM) (see Figure 1). This model has been used to explain the pattern of uptake and cessation of a range of behaviours that can have dire health consequences, such as smoking (Prochaska & DiClemente, 1983) and sunbathing (Borschmann, Lines & Cottrell, 2012).

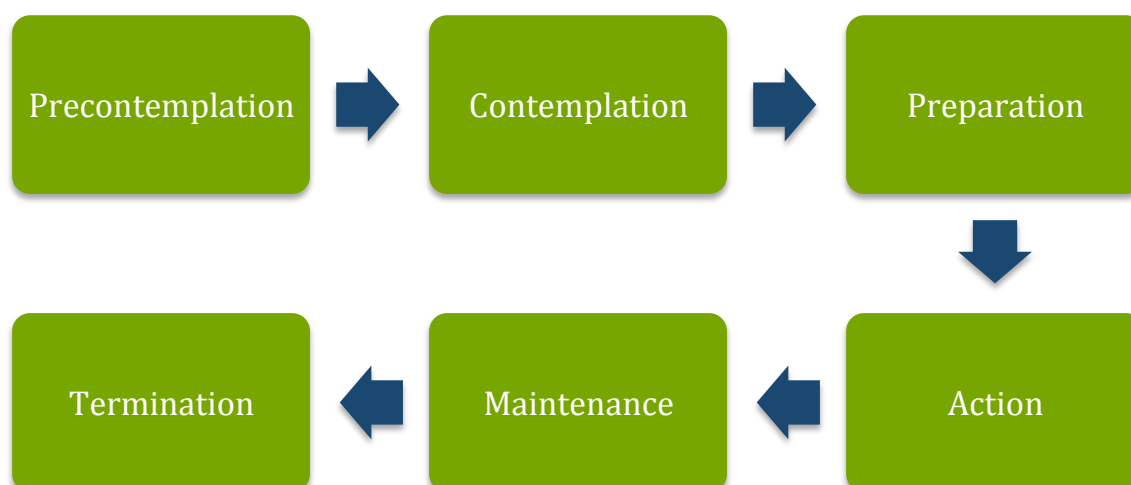


Figure 1: The six stages of the Transtheoretical model of behaviour change (Prochaska & Velicer, 1997)

The TTM is based on the idea that there are six stages that individuals go through when they are in the process of reducing risky behaviour. These stages range from precontemplation, with no intention of changing, through to termination, when the behaviour is changed with no relapses (Prochaska & Velicer, 1997). This model assumes that behaviour change is a process with different stages and that when at-risk individuals are in the early stages (precontemplation, contemplation and preparation) they will benefit from targeted interventions to assist in progress. The transtheoretical model also assumes that the majority of at-risk individuals will not be ready for action and that traditional health promotion campaigns aimed at action will fail (Prochaska & Velicer, 1997). Certainly this model is supported by current research into Hendra Virus risk and decisions concerning risk minimisation, where people know what they need to do but are not ready or willing to take action (Kung et al., 2013). Respondents' stage in the model will be considered in light of the preventative behaviours they are considering or adopting.

Another approach will be to examine the data in light of the Theory of Planned Behaviour (see Figure 2). Ajzen (1991) suggested that this theory can be used to predict behavioural intentions and actual behavioural changes based on the subject's perceived control over the behaviour, the attitude towards it and the subjective norms (the perceived social pressure surrounding an individual's response to a situation). In

light of the research that shows a low level of adoption of risk minimisation strategies against Hendra Virus (Kung et al., 2013), the possible effects of subjective norms and perceived loss of control over events will be examined.

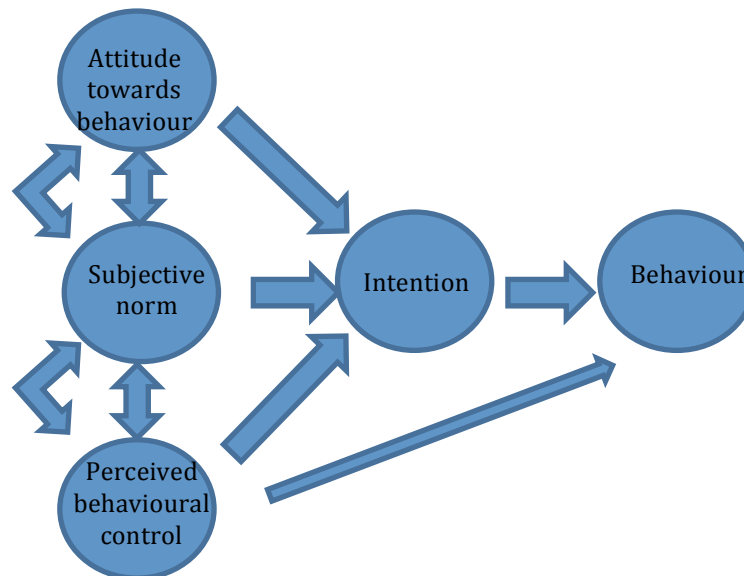


Figure 2: The Theory of Planned Behaviour (Ajzen, 1991)

The third approach will examine the data in light of the Theory of the spiral of silence (Noelle-Neumann, 1993). This theory examines how public opinion can be affected by the fear of isolation and the perception of current accepted thinking. The project will examine the data and consider how people react to widespread opinions (whether to vaccinate their horses or not). It will also examine how people place themselves using cognitive orientations to make up an undecided mind by going along with the crowd, how strategic orientations can be used to support their own view and how normative orientations can be adopted to avoid disapproval if their opinion is perceived to be in the minority (Lang & Engel Lang, 2012). The role social context plays in decisions about risk minimisation for horse owners is of particular interest, because of the social nature of horse ownership and competition.

A better understanding of how Australians make decisions concerning an emerging infectious disease outbreak is important to better deal with Hendra Virus and future outbreaks. The Hendra Virus outbreak and subsequent vaccination release for horses provides a unique opportunity for research of this kind in Australia and will benefit the progress of disease outbreak risk communication and will promote a more general understanding of uptake of risk minimisation strategies by communities. The findings from this project will assist in understanding the communication of science in other risk management situations.

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INSIGHTS INTO AUDIENCES: AN OVERVIEW OF HOW THEORIES OF HUMAN BEHAVIOUR CAN IMPROVE THE EFFECTIVENESS OF SCIENCE COMMUNICATION

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KEYWORDS: social science, audience studies, engagement, science communication, social psychology, Theory of Planned Behaviour

ABSTRACT

The effectiveness of science communication strategies can be improved through better understanding of the audience (Stern, 2011). This is often difficult for those charged with communicating science due to a lack of time, resources or expertise, resulting in ad hoc, untargeted communication (Nisbet & Scheufele, 2009). However, greater collaboration with the social sciences can help science communicators draw from research in this area to understand how people interpret and act upon scientific information.

Social scientists use theories of human behaviour to understand factors that influence behaviour. We can apply these theories to investigate the factors contributing to the target audiences' motivation to engage with science – or not. The Theory of Planned Behaviour (Ajzen, 1991) is the most widely applied methodological framework which identifies beliefs, attitudes and intentions that lead to behaviour. Many fields have used this theory to conduct audience studies for the development of persuasive communication strategies, but so far few applications of the theory have been published in science communication. This paper discusses the application of the theory to science communication and how such in-depth audience research can be used to better understand psychological mechanisms that are important to communication processes. By embracing social research, science communicators will be in a better position to develop communication strategies which enhance engagement with their intended audiences.

BACKGROUND

An increasing academic focus on science communication has identified challenges, opportunities and changes to the way scientific information is presented to the public (Brossard & Lewenstein, 2010; Gilbert & Stocklmayer, 2013; Lewenstein, 1991; Weigold, 2001). Despite increased efforts to communicate science to the public,

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surveys around the globe, particularly in western cultures, continue to detect widening gaps between scientific information and the public understanding of it (Hart & Nisbet, 2012; Marquart-Pyatt, Shwom, Dietz, Dunlap, Kaplowitz et al., 2011). For this reason, there has been a detectable shift in the thinking behind science communication strategies. Scholars of science communication now talk about a need to change from the predominate use of a 'top-down, one-way' approach for communicating scientific knowledge, often referred to as the 'deficit model' (Irwin, 2008; Schiele, 2008; Sturgis & Allum, 2004; Weigold, 2001), to one that focuses on audience dialogue, participation and engagement (Bauer, Allum, & Miller, 2007; Irwin, 2008; Metcalfe & Gascoigne, 2012; Nisbet & Scheufele, 2009). The aim of this latter approach is the co-production of knowledge (Bucchi, 2008), where each party contributes and is valued in the process. To reach these goals, science communication researchers, such as Metcalfe, Reidlinger and Pisarski (2008), Nisbet, Hixon, Moore, & Nelson (2010) and Ziman (1996), make the case for fostering better collaboration between the various fields of science, technology, social sciences, humanities, arts, philosophy and religion.

The challenge for science communicators is to understand how these different fields, and the field of science communication research, can assist them in creating communication strategies that are more effective and result in the engagement goals being aspired to. It is no longer sufficient to rely on passive communication pathways (e.g. media releases, web sites and newsletters) and hope that the information is picked up and understood by the audience. Such passive communication methods tend to only reach those who are already interested in science, and can widen the gap between the interested and uninterested (or 'disengaged') groups (Cormick, 2012; Nisbet & Scheufele, 2009; Tichenor, Donohue, & Olien, 1970). By embracing research into communication processes and the people they want to communicate with, science communicators are in a better position for enhanced engagement with their intended audiences. As Nisbet and Scheufele (2009) conclude from their research and experience in science communication:

'...any science communication efforts need to be based on a systematic empirical understanding of an intended audience's existing values, knowledge, and attitudes, their interpersonal and social contexts, and their preferred media sources and communication channels.' (p. 1767)

Regrettably many science communication practitioners are either not aware of, or have not engaged with, the large body of research into communication and behaviour modification generated by the social sciences and humanities. An understanding of theory can highlight reasons why some science communication strategies achieve their goals better than others. For example, social psychological research conducted by Markowitz, Slovic, Västfjäll, & Hodges (2013) provides insights into why some climate change science communication strategies have failed to change peoples' environmental behaviours because the message was not conveyed in a way that caused the person to *care* enough to act. Other science communication strategies have inadvertently made matters worse by misunderstanding social psychological mechanisms (for example, the role a person's social environment plays in attention to information) which encourage people to *ignore* the very information communicators are trying to transmit (Nickerson, 1998; Yang & Kahlor, 2013). The body of work on

psychology's contribution to understanding the communication of complex scientific information is continuing to expand rapidly (Hulme, 2011; Kazdin, 2009; Pisarski & Ashworth, 2013; Stern, 2011) and communicators are now faced with a wide range of methods and mechanisms for increasing the effectiveness of science communication strategies.

UNDERSTANDING SCIENCE COMMUNICATION THROUGH PSYCHOLOGY

There is no simple answer as to which method, theory or mechanism from social psychology is best to incorporate into science communication strategies (Kahan, 2014). Some theories will be more applicable in certain situations than others. In the areas of health, public safety and environmental communication where the desired outcome is a change in people's behaviour, effective communication strategies are often based on theories of human behaviour (COI, 2009). One of the most commonly used social psychological theories in behaviour change communication is Ajzen's (1991) Theory of Planned Behaviour (TPB). The TPB demonstrates that much communication focuses on actions rather than the attitudes and beliefs that give rise to these actions. This will be explored more fully later in the paper but it is important to first describe a sample of psychological research relevant to communicating scientific information; it is not exhaustive but is an illustration of the types of understanding we can gain of both the audience and the message. Science communicators need to be mindful of this area of research when conducting audience studies (including the application of TPB) or developing communication strategies as it will help them understand some of the barriers and opportunities for more effective communication.

AUDIENCE CAPACITY FOR PAYING ATTENTION TO MESSAGES

Finite Pool of Worry & Compassion Fade

When communication strategies are being developed, it is important to realise that people have a limited capacity to 'worry about things'. Termed the '*finite pool of worry*' (Whitmarsh, 2011), research conducted by Linville and Fischer (1991) shows that as concern about an issue increases, other concerns diminish. For an audience to be concerned about a new message or new information, other concerns must be replaced or reprioritised to lower levels in the audience's mind. For example, a person might make environmentally-friendly purchases that cost more than alternatives until they suffer financial distress such as a job loss. Their financial concern may then override their environmental concern and they begin to select the lower cost options.

In addition, cognitive psychologists such as Slovic (2010) have, for decades, been conducting research on risk perception. Their research helps explain why people become desensitised and do not respond to information about large-scale loss of human lives or natural disasters in ways that we might expect, simply due to our inability to fully process the enormity of the event (Kahlor, Dunwoody, Griffin, & Neuwirth, 2006; Slovic & Västfjäll, 2010). Communicators should also understand that bombarding audiences with too many worries can lead to emotional numbing or *compassion fade* (Markowitz et al., 2013), thus disengaging them even further from the message.

Confirmation Bias, Social Norms and Affect

To add to the challenges that science communicators face, people tend to pay attention to information that reinforces their beliefs or world-views (schema), and dismiss that which doesn't fit with their position (Lloyd & Boyd, 2013). Social psychologists refer to this as *confirmation bias* (Nickerson, 1998), and it has significant ramifications for the presentation of new or controversial scientific information. A person's social environment also plays an important role in information seeking or avoiding behaviour (Yang & Kahlor, 2013), so communicators need to take into account social influence (*social norms*) to increase response and acceptance of messages.

Research in judgement and decision-making over the last few decades also shows that *affect* (emotions) plays an important part in behavioural motivation (Finucane, Alhakami, Slovic, & Johnson, 2000; Yang & Kahlor, 2013). Affect is involved in the way people create meaning from information (Visschers, Wiedemann, Gutscher, Kurzenhäuser, Seidl et al., 2012). People require information to have meaning in order to make judgements and decisions about it.

Message Framing and Regulatory Focus

Communication research also reveals the way a message is constructed, or *framed*, is significant to the way the message is interpreted by the receiver (Nisbet, Maibach, and Leiserowitz, 2011). Ultimately, all information and knowledge is framed by the schema of the sender and receiver of messages (Lakoff, 2010; Lloyd & Boyd, 2013) but communicators strategically frame messages to help people make sense of information by structuring it in ways that give it meaning and align it with their mental models or worldview. *Framing* can also change the outcome of the choices people make (Kahneman & Tversky, 1984). *Regulatory focus* is a type of framing that considers differences in peoples' responses to information, depending on whether it is framed negatively or positively (Higgins, 1997). Some people will act if the information has a positive focus (I'm going to do this because it will result in something good), while others are more motivated by the same information when it has a negative focus (I'm going to do this to avoid a bad outcome).

AUDIENCE CAPACITY FOR RESPONSE TO MESSAGES

Single Action Bias and Default Decision Effects

When it comes to inducing responses (action) to scientific information, communicators need to be cognisant of the variety of behavioural responses that may be likely. One phenomenon is called the *single action bias* (Weber, 2006). People tend to take one initial step of action when they are concerned about something, and then are much less likely to take any further actions. The suggestion is that this first action reduces the amount of worry about the issue, and so it becomes less of a concern and people are less motivated to respond any further. Moreover, *decision research*, a branch of social psychology dealing with human judgement, decision making and risk perception, reports that it is easier for people to accept the status-quo (do nothing), or select the *default* option, than it is to act on information, even when the information indicates that action will result in a better outcome (Kazdin, 2009). From a communications perspective, Thaler and Sunstein (2008) remind us not to underestimate the 'power of inertia'.

The research illustrated above makes it clear that in order to reach audiences more effectively, science communicators need to understand their audiences' concerns and shape communication strategies accordingly. In the field of science communication, it is rare that audience research of this kind is undertaken. This isn't surprising given most science communicators, particularly in Australia, have a background in science or journalism (Metcalf & Gascoigne, 2012) so there is an apparent lack of practitioners with the specific social research skills required to undertake in-depth audience research. Social scientists strongly caution against relying on a communicator's intuition alone to guess at what the audience's needs, values, beliefs and attitudes might be (Cialdini, 2003; Greenhill, Leviston, Leonard, & Walker, 2013). Instead, instruments based on theories such as the Theory of Planned Behaviour can be used to elicit salient factors about the intended audience in relation to the communication of scientific information.

THE THEORY OF PLANNED BEHAVIOUR

As previously discussed, one widely applied methodological approach to understanding human motivations is the Theory of Planned Behaviour (Ajzen, 1991; Darnton, 2008). In essence, TPB helps to identify factors that influence people's behaviour. The theory is used to uncover people's beliefs about three key influences on behaviour: behavioural, normative and control beliefs (see Figure 1). In essence it takes the premise that that behaviour is the result of an attitude, which in turn is determined by an individual's belief system (Ajzen, 1991). In contrast, most science communication approaches disseminate information with the expectation that change will follow in reaction to the content of the information. This method of communication is done without consideration of the audience's belief systems, which are the very catalysts for responses to the information. Understanding the belief systems and developing strategies to address them is critical for achieving communication aims. Illustrating the importance of this Apps, Lloyd & Dimmock (2014), applied the TPB to research on appropriate diver behaviour around typically shy grey nurse sharks. The results brought about changes in the communication strategy with divers, which led to more positive shark/human interactions.

The role of beliefs in TPB

So what are the beliefs in the TPB framework, as defined by Ajzen (1991)? *Behavioural beliefs* are beliefs a person has about the outcomes of a particular behaviour. These beliefs lead to attitudes towards that behaviour. For example, if we consider composting, one behavioural belief might be that if I compost my food scraps, I will reduce emissions and waste at our local landfill. So I have a positive attitude towards composting. *Normative beliefs* are beliefs that there are certain expectations from other people about the appropriateness of a particular behaviour. These beliefs lead to subjective norms (the pressure a person feels to behave a certain way from others who are important to them). Using the composting example again, a normative belief might be that my friends and neighbours expect me to compost, which motivates me to set up a composting system at home. So the subjective norm is positive towards composting. *Control beliefs* are beliefs about the degree to which a person can actually perform the behaviour, and the strength of their control over performing the behaviour. These control beliefs may be different from *actual behavioural control* (whether the person can, in fact, perform the

behaviour), as they are based on a person's *perceptions* of control. For example, my control belief might be that I am capable of setting up a composting system. But what if my *actual behavioural control* is in opposition to my control belief? Perhaps I live in an apartment block where they do not offer options for composting. In this case, the *intention* to perform the behaviour (composting) is there, but the behaviour is unable to be performed due to the mismatch between control beliefs and actual behavioural control. If we apply this theory to the audience for science communication, it is the combination of these beliefs, intention and actual behavioural control that leads to a person engaging with scientific information (or not).

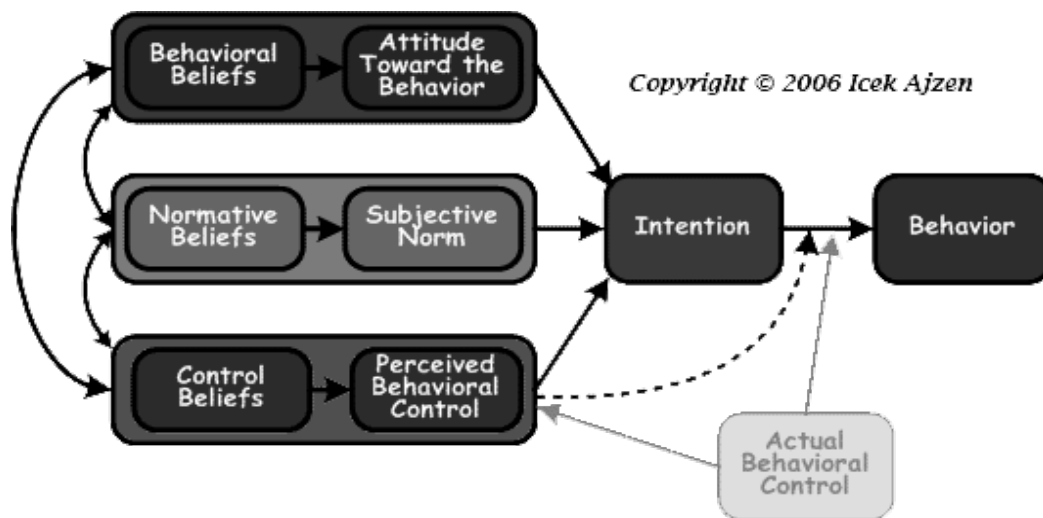


Figure 1. Model of the Theory of Planned Behaviour

Application of TPB

When social researchers use the TPB framework to study human behaviour, the first step is to establish what the salient beliefs of the study group are. This is called the elicitation phase. Rather than relying on a researcher's intuition about which questions to ask in a survey (Stoneman, Sturgis, & Allum, 2013), it is important to work with a sub-sample of respondents to identify those beliefs that are readily accessible in the group. During this first stage of the research, focus groups and/or semi-structured interviews are used to distil this information. In this way, the audience research becomes relevant and meaningful, and gives the researchers a much clearer picture of the beliefs, attitudes and barriers faced by their audience in relation to the study question.

A questionnaire is then developed to elicit people's behavioural, normative and control beliefs to help researchers understand the underlying reasons for people's beliefs about the behaviour. Measures of people's attitudes, subjective norms, perceived behavioural control, intentions, actual behavioural control and behaviour are also obtained. The results are then subjected to various statistical analyses to determine the relative strength or contribution of the different factors that influence behaviour.

Following this work, the link between intentions and actual behaviour needs to be made by making sure people can actually perform the behaviour – that there are no

barriers outside their control. The final step is to develop a plan with the respondents outlining how and when the new behaviour is performed.

Validity of TPB

The Theory of Planned Behaviour is not the only theory that is useful in understanding the audience in science communication. There are numerous other tools that may be more applicable to certain circumstances and strategies. However, the strength of the TPB is that it has been applied and tested in a wide variety of situations and while many have argued for alterations or extension of the theory, Ajzen (2011) counters that many of these proposed changes are not necessary as they are able to be incorporated in the existing framework. While it is not perfect (no model ever is) TPB has withstood testing, remaining relatively intact for over two decades, and continues to predict intentions and behaviour quite well (Armitage & Conner, 2001; Cordano & Frieze, 2000; Fife-Schaw, Sheeran, & Norman, 2007). Adding to its strength is the fact that TPB was developed from earlier theories of human behaviour, predominantly the Theory of Reasoned Action (Fishbein & Ajzen, 1975) which was itself grounded in earlier or more simplistic theories studied since the 1970s (Darnton, 2008).

DISCUSSION

When the audiences' values, beliefs, attitudes and preferred media are well understood, communication strategies can be designed to take into account psychological phenomena such as *finite pools of worry*, *default decision effects*, *confirmation bias* and so on. Social research can inform the ways that scientific information may be framed or transformed into messages and stories that will connect with people's core values and resonate strongly with audiences. Audience research is critical for more effective science communication because, as Cialdini (2003) and others reveal, relying on intuition or imposing your own knowledge or assessment of other's knowledge may result in not just missing the communication mark and wasting precious time and resources, but there is a very real danger of backfiring and distancing people even further (Lupia, 2013; Nickerson, 1999). The point of using the Theory of Planned Behaviour for the development of science communication strategies is not necessarily to change behaviour, but to create better connections with the audience. TPB can help to gain insights into the personal beliefs that are likely to impact on the effectiveness of science communication with people from a wide variety of target audiences. As we have seen from this overview, the beliefs, values and attitudes of audiences are critical components to consider for the development of more relevant, meaningful and effective communication strategies.

Although audience research can be costly in time and resources, the targeted communication of scientific information to the public will have a far greater impact when the intended audiences are well-understood (Malbach, Leiserowitz, Roser-Renouf, & Mertz, 2011). Strategies that communicate science in more creative, interactive and accessible ways that respect the audience, while keeping scientific credibility intact, are likely to help increase audience engagement levels. When this happens, we can expect to see positive outcomes in the way different groups relate to scientific information.

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THE ROLE OF LISTENING IN RECONCEPTUALISING CLIMATE COMMUNICATION

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KEYWORDS: climate communication, strategic listening, public opinion, scientific consensus

ABSTRACT

Efforts to communicate the urgency, seriousness and reality of climate change have been extensive in many developed countries. Yet, public opinion remains divided on whether climate change is human induced, and for policies addressing climate change. The implications of a divided public on effectively responding to climate change have persisted and intensified over time. Scientific consensus on climate change (97.1%), sits at odds with recent research trends of stagnating and falling public concern in many countries. With significant divides in public support for climate policies, greater understanding of associated social and communication sciences is fundamental to recognising the ambiguities, voids, and blind spots hindering public recognition and support. The purpose of this essay is twofold. First, I discuss a number of studies from the climate communication literature that are central to a reconceptualisation of climate communication, focusing specifically on: 'deficit' assumptions and the mediating influence of values, the science of framing, tailoring, targeting and segmentation, and trust in science. A key focus of this evaluation is to assess current research; as a result, many key studies discussed here were published within the last year or two. Second, I aim to argue the case for listening as a strategic tool in this reconceptualisation.

INTRODUCTION

Despite sustained efforts to communicate the scientific reality of climate change, recent research indicates a striking tension between 'scientific consensus' and 'social consensus' (as termed by Hoffman, 2011). Cook et al. (2013) provided a comprehensive analysis of scientific consensus on peer-reviewed climate change literature, finding that 97.1% of studies maintain the anthropogenic nature of climate change (supporting previous findings by Anderegg et al., 2010), and the number studies found rejecting the human cause (2.9%) is waning. In contrast, recent studies point to stagnating public support and widespread passivity towards climate change in many developed economies (Leiserowitz, et al., 2012; Leviston, et al., 2011; Morrison, et al., 2013; Oliver, 2013), and disturbingly that, 'Belief in climate change and its anthropogenic drivers has waned in recent years' (Leviston et al. 2011, p. 10).

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Studies suggest that ideological and partisan polarisation of public beliefs, concerns, and support for climate change and policy action is the root cause (Baldassarri & Gelman, 2008; Kahan, 2013; Leviston, et al., 2011; Leviston & Walker, 2011; McCright & Dunlap, 2011).

The current standstill in public engagement with climate change led Moser and Dilling (2011, p. 161) to concede, '[the] state of public opinion raises critical questions as to the effectiveness of twenty or more years of public education, outreach, and engagement approaches used to render a complex scientific issue meaningful and actionable'. Climate change has historically been communicated through mass communication channels which succeeded in raising the issue on the international agenda, however, considering that the percentage of Australians who think that 'global warming is serious and pressing problem' has declined from 68% in 2006 to 40% 2013 (Oliver, 2013), there is a dire need to rethink how climate change is communicated and effectiveness of that communication. This does not ignore the fact that many people do in fact accept the anthropogenic basis of climate change; it highlights the fact that for a large proportion of the public current communication strategies are failing to engage them into supporting progressive climate policy. If we are to truly develop social consensus, and transformative change, then we must search for more comprehensive engagement between science and society.

Johnson (2012) points to the role that science communicators have played in failing to convince significant sections of the public of the reality and gravity of climate change. Raising the legitimate point that ignorance of the science of science communication, the use of blind intuition and an unscientific approach to communicating climate change has impeded success, which could not be more clearly demonstrated by the constant reliance on the notion that simply providing information will turn the tide (e.g. Somerville, 2010). Science communication scholars have argued the failings of this model for close to 20 years, yet it still remains the prevalent approach (Besley & Nisbet, 2013; Sturgis & Allum, 2004).

This persistent trend potentially underlines a failing of science communication researchers in communicating their own research. Success in communicating climate change could depend as much, on communicating the science of science communication to communicators, as communicating climate science to the public. Several studies outline what social science has revealed about communicating science to diverse publics, which challenge prevailing assumptions about science communication (Nisbet & Mooney, 2007; Nisbet & Scheufele, 2007; 2009). I contend, along with others (Pidgeon & Fischhoff 2011), that there is an urgent need for introspection in the science communication community to assess and utilise the best available knowledge, from psychology, sociology and the communication sciences, about how complex issues that have become part of widespread public conjecture are best communicated.

Pidgeon and Fischhoff (2011, pp. 38-39) stress, 'Climate science has always taken a long-term integrated approach. The communication of that science must be just as strategic in its analysis, design, implementation, and evaluation.' Evaluation is fundamental, a line argued by many social scientists in the field (Fischhoff & Scheufele, 2013; Pidgeon & Fischhoff, 2011; Scheufele, 2013a; Whitmarsh et al.,

2013). It is exemplified by Dan Kahan in his interview with Luers (2013), 'Don't guess about what to do; treat insights as hypotheses then observe, measure, and report the actual effect of strategies you use.' There is an imperative on climate communication researchers to systematically open communicators' eyes to the immense amount of work that can directly inform strategies and practices for communicating climate change.

The purpose of this essay is twofold. First, to discuss a number of studies from the literature that are central to a reconceptualisation of climate communication, focusing specifically on: 'deficit' assumptions and the mediating influence of values, the science of framing, tailoring, targeting and segmentation, and trust in science. Second, I argue the case for listening as a strategic tool in this reconceptualisation.

A DEFICIT OF VALUES

The assumption that providing people with more information can alleviate divisions in scientific and social consensus on climate change has repeatedly been shown to be inadequate. Additionally, a second assumption that public division stems from widespread public scientific illiteracy, and the solution is therefore a more science literate public is widely disputed (Kahan et al., 2012; Scheufele, 2013a). Advocates of science literacy as the solution argue that a public who think more scientifically, who understand the principles and methods of science, will be better equipped to discern scientific credibility and align with the normative view of science. Although advocating scientific literacy is laudable, research suggest that it won't be science communication's saviour.

Kahan et al. (2012) directly counter these two assumptions, finding that divisions in scientific and social consensus on climate change fall in line with cultural worldviews, with peer influence the 'most consequential effect' on beliefs. Scientific literacy and numeracy has been shown cause further polarisation people's views, not alleviate concern (Kahan et al. 2012). Kahan's cultural cognition thesis holds that, irrespective of both access to information and the degree of scientific literacy amongst the public, new information is interpreted through filters biased towards existing predispositions or worldview (Kahan et al., 2007; 2012). Support for this thesis has been found for not only climate change, but also in studies of polarising issues from nanotechnology, vaccination, through to gun control (Kahan et al., 2007; 2009; 2012; 2013; Corner et al., 2012; Leviston & Walker, 2012; Lewandowsky et al., 2013; McCright & Dunlap, 2011; Morrison, et al., 2013).

Underlying these findings is argued to be the process of motivated reasoning. Scheufele (2013b) highlighted that motivated reasoning has seen a modern renaissance, however, it has been a long-standing phenomenon in social psychology. Festinger arrived at an essentially identical conclusion over 50 years ago (Festinger, 1957). Motivated reasoning refers to the cognitive process where information is confirmed or disconfirmed through either a motivation to arrive at an accurate conclusion or a motivation to reach a particular directional goal (Kunda, 1990). Many researchers argue that goal oriented motivated reasoning is the root of current polarisation of climate change beliefs, where individuals are motivated to cling to views that support preexisting beliefs and values, particularly when one's individual or group values are threatened (Chen et al., 1999; Cohen et al., 2007;

Kahan et al., 2012; Kahan, 2013, Lord et al., 1979). Kahan (2013) identified 'ideologically motivated cognition' as a means for individuals to process information that promotes individuals' interests in forming and maintaining beliefs that indicate their commitment to important groups (Kahan, 2013). Therefore, there is a propensity for individuals and groups to seek information that confirms their beliefs and discount information that contradicts their beliefs (confirmation bias).

Kahan (2013) examined interactions between heuristic-driven information processing, ideological or cultural values, cognitive-reasoning styles, and motivated reasoning. The study yielded two results that have practical implications for science communication and combatting polarisation. Firstly, that engaging in 'high-effort systematic reasoning' amplified motivated reasoning, contrary to the assumption that stimulating deeper analytic information processing will alleviate polarisation. As Kahan (2013) states, this assumption sees polarisation stem from individuals' reliance on heuristic-driven information processing, where it is argued that beliefs about complex information are filtered through cultural and ideological predispositions (Marx et al., 2007; Weber & Stern, 2011). Yet, deeper cognitive information processing was found to magnify polarisation and identity-protective cognition; put down to the fact people can better fit information in line with their preconceived values (Kahan 2013). Chen et al. (1999) argue that this conscious information processing allows individuals to develop a greater understanding and ability to make sense of competing claims and counterarguments in order to strengthen their protective cognition of their particular worldview (Chen, et al., 1999).

In contrast Nisbet et al. (2013) revealed that exposure to conflicting information elicited conscious information processing and deliberation of a broader range of factors in open-minded participants. In this case open-mindedness enabled more systematic information processing, preference to move from the status quo, increased perceptions of risk and increased perception of mitigative benefits. Nisbet et al. (2013) contend that closed-minded individuals preferred to hold onto their pre-existing beliefs, avoid change and avoid deeper information processing. Whether motivated reasoning was amplified in closed-minded participants, or whether polarisation increased or decreased are important questions that remain.

Drawing on Popper (1959), Kahan (2013, p. 418) acknowledges in his paper, 'the findings of this single study do not conclusively demonstrate that the disposition to engage in reflective rather than heuristic-information processing invariably magnifies ideologically motivated reasoning. Empirical studies, when valid, merely supply more evidence to believe or disbelieve a hypothesis, the truth of which must be assessed on the basis of all the valid evidence at hand and thereafter reassessed on the basis of any evidence generated by future valid studies'. Kahan's (2013) and Nisbet et al.'s (2013) research demonstrate the need for future research to investigate the influence and interactions between open- and closed-mindedness and motivated reasoning on polarisation of climate change beliefs. This highlights a critical point in the reconceptualisation of climate communication: the need to employ an approach to climate communication that is not only grounded in science, but reflects, measures and actively seeks to build on the current knowledge base.

Yet, the research discussed has practical implications for how science communicators can combat current polarisation. Bridging current divides in scientific and social consensus will fail if championing science literacy is science communication's sole strategy. To alleviate polarisation, science communication cannot assume that supporting deeper information processing and exposure to counter-attitudinal evidence will bridge current divides. It must seek to understand the dynamics and interactions influencing beliefs. Climate communication researchers have shown that the impinging influences of ideology, worldview and values are far more influential on public beliefs. Therefore, any reconceptualisation of science communication must attend to and seek to understand the ideological stances, worldviews and values of individuals and audiences.

FRAMING, SEGMENTING, TAILORING AND TARGETING

Evidence of the mediating effect of values on how people perceive information has driven social scientists to explore distinct characteristics of polarisation in order to develop more effective, tailored, and targeted communication strategies (Bostrom et al., 2013; Hine et al., 2013; Leiserowitz, et al., 2012; Morrison, et al., 2013). As Nisbet and Scheufele (2009, p. 1767) state, '...any science communication efforts need to be based on a systematic empirical understanding of an intended audience's existing values, knowledge, and attitudes, their interpersonal and social contexts, and their preferred media sources and communication channels.'

Segmentation studies represent a starting point to in effect listen, and understand motivations, judged by a combination of: climate change beliefs; issue involvement; and societal, psychological and behavioural responses (Hine, et al., 2013; Leiserowitz, et al., 2012; Morrison, et al., 2013). As Hine et al. (2013, p. 230) outlines, 'Once an audience is segmented, interventions can be tailored to match each segment's psychographical profile.' For instance, we can draw on previous framing research to tailor communication strategies that have as a target distinct segmented interpretive communities (alarmed, concerned, uncertain, doubtful and dismissive) identified by Hine et al. (2013). One example is to remove terms of 'climate' and 'climate change' and to frame climate mitigation as an opportunity to promote interpersonal warmth and scientific and technological progress to people identified as dismissive (Bain et al., 2012). Additionally, self-affirming unconnected identities and values have been shown to reduce confirmation bias and increase open mindedness (Cohen et al. 2007).

Borah's (2011) recent review of framing studies uncovered the scarcity (only 3.2%) of studies that explore the effect of multiple frames or competitive framing that present both sides of the issue. Most studies focus on single frame manipulations, e.g. gain vs. loss (Spence & Pidgeon, 2010). Given the political nature of debate about climate change, and polarisation of public beliefs about climate change, future research can usefully reveal the influence of framing considering the real world reality of competing and divided opinion. Again, Nisbet et al.'s (2013) study on the effect of competitive framing and open-/closed-mindedness forms a foundation for such future work, finding that attitude change was minimal for frames presented in both non-competitive and competitive environments. Arguably this is due to the sustained polarised state of climate change discourse in which frames are treated as new

information that are either confirmed or disconfirmed given pre-existing beliefs and values.

Future research, as outlined by Kahan (2013) and Bostrom et al. (2013), must examine how identity protective cognition interacts with and influences response to competitive and noncompetitive framing and targeted and tailored communication strategies that stem from current segmentation research. This supports Nisbet et al.'s (2013) call for future framing research that seeks to understand how open and closed mindedness interacts with self-affirmation, need for closure, dogmatism and motivated reasoning. Science communication can be more effective if it utilises the mounting body of research focused on framing, segmenting, tailoring and targeting communications, while recognising that there is much work to do¹.

COLD HARD TRUST

A number of dynamics not yet discussed in this paper also offer potential avenues to reconcile current polarisation. In this section, I touch briefly on trust in science, scientists and science communicators.

Social and behavioural science has recognised the influence and relationship between trust and source credibility (Earle, 2010). Trusted communicators generate high levels of concern, risk perception and adaptive behaviours among their audiences (Reser et al., 2012a; 2012b). However, as with biased assimilation of evidence in line with pre-existing values, people trust those whom they assume share their values (Fiske, 2013).

Fiske at the recent Sackler Colloquia, 'The Science of Science Communication II', stated that scientists have public respect but not public trust, contending that scientists and researchers are viewed as competent but cold by the public. Based on previous research, Fiske argues that trustworthiness is a product of perceived warmth (related to perceived intent) and competence (related to perceived ability) (Fiske et al., 2007). Importantly for science communicators, research suggests the dimension of warmth is not only observed before competence, but also is more influential on affective and behavioural responses (Fiske, et al., 2007). So, if communication is ineffective without trust, warmth and competence are fundamental for effective future communication.

A CASE FOR LISTENING

To alleviate the divisions in scientific and social consensus of climate science in order to garner support for public policy and action, science communication requires new strategies.

There needs to be a strategy of foresight, helped by research into new ways of reaching those who currently are indifferent. A gulf will remain, however, unless scientists are brought into the discussion as players, not captains in the debate (Rennie & Stocklmayer, 2003, p. 770).

¹ See Nisbet and Scheufele (2009) and (2009) for reviews of framing and Bostrom et al. (2013) for a meta-analysis of targeting and tailoring.

Review of the literature highlights that effective climate communication is aided by three core factors. First, a need for communicators to pay attention to ideology, worldviews and values. Second, science communication must hold itself to the same 'evidentiary standards as the science being communicated' (Fischhoff & Scheufele, 2013, p. 14032). Third, climate communicators need to counteract the cold image the public has of scientists and science communicators. Central to this reconceptualisation of climate communication, is strategic listening.

Burleson (2011) refers to listening as an activity of interpreting communicative behavior in the effort to in turn realise the meaning of that behavior. Listening offers a direct mechanism to examine why people hold the beliefs that they do about climate change, and importantly the cognitions and values that underpin their expressed beliefs and behaviour. The process of listening gives climate communicators the potential to grasp, comprehend and contextualise ideological stances, worldviews and values from the 'intentional communicative expressions of others (Burleson 2011, p. 30),' to gain a deeper understanding of intentions and motivations. This is not to say that listening will simply elicit all the information communicators seek, particularly as the influence of ideology, worldviews and values are often subconsciousness. But given the influence of identity-protective cognition, time and resources are wasted by ignoring the mediating effects of ideology, worldview and values.

Greater understanding of individual's or group's values and how these values interact with conflicting evidence will enable science communicators to utilise communication strategies relevant to how different people see the world. This strategy relates directly to the discussion of framing, tailoring, targeting and segmentation, where listening can be employed to identify and assess relevant values, beliefs, issue involvement and psychological and behavioural responses. Subsequently, communication can be tailored to target distinct values relevant to identity-protective cognition. For example, one can listen for cues and then self-affirm salient values that potentially counteract cognitive biases and identity-protective cognition (Cohen et al., 2000; Cohen, et al., 2007). Scheufele (2013b) argues that communication is 'not just about knowledge'; success depends on systematic efforts to connect science to audiences' pre-existing values that are relevant to their daily lives.

Listening can also counteract the cold public image of science in a way that can enhance respect, humility and trust of scientists. Bodie and Fitch-Hauser (2010) found that competent listeners are able to develop more productive interactions and heightened satisfaction. Listening and engaging with the public removes the connotation that the public is a commodity that hinders rather than facilitates science. As Fiske (2013) concludes, displaying 'worthy intentions' is fundamental in shifting from cold to warm on the warmth dimension. Scientists and science communicators must incorporate greater awareness of social science into communication that will not only negate notions of coldness and untrustworthiness, but enhance the image of competence that science claims.

Listening should be incorporated and considered as a tool integral to any communication strategy. It can ingrain adaptability and versatility into approaches and safeguard against perpetuating the failures of past climate communication. The

challenge for the science communication community is how to develop an integrated and applied approach to communication, whether it is one-way or more complex dialogic approaches. Pidgeon and Fischhoff (2011) and Scheufele (2013b) advocate for formal linkages between science communication researchers, science communication practitioners, and scientists. As Scheufele (2013, p. 14046) attests, 'academic institutions, funding agencies, and the federal government will have to prioritize institutional capacity building and infrastructure at the science–society interface'. Fundamental to the development of science communication itself, is communicating its own science to its audience: science communicators.

Ensuring that listening, the communication of science communication research itself, and ensuring a scholarly approach to science communication are fundamental in overcoming public division on climate change. Future research examining how listening is and can be utilised and incorporated in practical capacities across the spectrum of science communication in order to strengthen the effectiveness of communication and bridge current polarisation is desperately required.

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INSIGHT RADICAL: WHERE SCIENCE MEETS ART

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ABSTRACT

In 2012 the ARC Centre of Excellence for Free Radical Chemistry and Biotechnology initiated a project, called Insight Radical, to give the public an alternative way to approach the science of free radicals and encourage people to think about them with more freedom and creativity.

The main objective of Insight Radical is to create a dialogue about free radicals between scientists and artists, then tell this story to the community via a series of exhibitions and public workshops.

Six Australian artists - Tony Lloyd, Steve Lopes, Anna Madeleine, Natalie O'Connor, Peter Sharp, and Ruth Waller - were invited to complete residencies in the Free Radical Centre's laboratories in Melbourne, and respond by creating works for exhibition.

Insight Radical opened in August 2013 at the Griffin Gallery, London, and will begin its Australian tour at MCLEMOI Gallery in Sydney at the end of November 2013. Workshops have been held in Broken Hill, Cairns, Canberra and Newcastle with further planned for Alice Springs and South Australia.

This presentation will discuss the lessons learned through the Insight Radical project regarding:

- engaging with artists, corporate art organisations, and galleries,
- creating and curating science:art projects, and
- managing budgets and conducting robust evaluation.

SCICOMM

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ABSTRACT

Science communication rests on the primacy of fact, yet facts are only part of what drives human affairs. We are still strongly influenced by the emotions and instincts hard-wired into us by evolution. Despite Enlightenment hopes of a more rational world, irrationality – in less pejorative terms, the triumph of emotion over fact – still exerts a huge influence over human societies.

That throws up some anomalies that would have dismayed Enlightenment thinkers. Climate change, a phenomenon whose existence is supported by record quantities of data, remains a fuzzy issue in the minds of many. That is not a fault of the science: there is a communication problem.

Marketers and politicians have long realised that "data dumps" are not effective at shifting perceptions. The most effective stories, whether they are told by advertisers, Hollywood or radio "shock jocks", engage emotions. So do the best science stories. This presentation, more an enquiry than a lecture, looks at how perceptions are shaped, and looks at how short-form journalism might more deeply engage its audience through emotion.

USING TRUST DURING PEER TO PEER COMMUNICATION ABOUT A CONTENTIOUS ISSUE: CLIMATE CHANGE AND FARMERS

Sarah Cole

Econnect Communication

ABSTRACT

The issue of climate change can be contentious for Australian farmers. Adapting will likely require incremental and transformative change using knowledge from new research or innovative practices. Diffusing innovations, Rogers asserts (2003), is a complex communication process. Trusted face-to-face information sources who share similar attitudes and values can be a critical and accelerating factor when people are learning about something new. A strong body of evidence regarding technology transfer in forestry workers also supports this concept. An example of a program that relies on strong peer-to-peer learning is the Climate Champion program. The program aims to help farmers manage increasing climate risk in Australia through better on-farm decisions, and the 37 participants demonstrate real-life examples of these strategies. Chosen (in part) as good communicators in their regions and industries, they particularly communicate with other producers about these issues. This Masters research case study explores how trust in Climate Champion participants' communication contributes to the program's objectives, how Climate Champion participants create trust, and how trust can contribute to learning in those farmer networks. With added insights into how people convey climate risk knowledge, we may be able to identify people who will likely be trusted communicators in their networks.

WHAT THE AUSTRALIAN PUBLIC REALLY, REALLY THINK ABOUT SCIENCE AND TECHNOLOGY?

Craig Cormick

CSIRO

ABSTRACT

We know some people really, really like science and technology, and we know that some people really, really don't. But we do know enough about why? And as audiences and media continue to fragment, and people increasingly follow only those media that support their own personal values, how do we best align our messages with audiences?

CSIRO has just completed a major study into public attitudes towards science and technology that builds on previous major studies conducted by the ANU, Victorian Government and Innovation Department, to dig deeper into the values that drive different attitudes. The study provides great insights into the key values that define different segments of the community, as well as preferred information channels. The data allows science communicators to better understand what messages, via which media, work best with different people by aligning with their key values.

DEVELOPING PRINCIPLES FOR CITIZEN SCIENCE

Craig Cormick

CSIRO

ABSTRACT

One of the outcomes of the Big Science Communication Summit held in early 2013 was to develop a draft guide for citizen science. Towards this the CSIRO has undertaken a stock-take of its citizen science projects and developed a set of principles to guide citizen science and to feed into a guide for citizen science.

The purpose of this session is to share CSIRO's citizen science principles with a wider audience, through a structured conversation, seeking both input to the principles, and discussing how other people or organisations might use or adapt them.

BUILDING THE ‘Y’ OF SCIENCE COMMUNICATION: INSIGHTS INTO A COLLABORATIVE STRATEGIC NARRATIVE

Gary Ellem and Danielle Lloyd-Prichard

Tom Farrell Institute, University of Newcastle

ABSTRACT

Building a future we all want to live in is a key challenge for humanity and is framed by the constraints of sustainability. One of the enablers of sustainable societies is that they have adaptive capacity – the ability to identify challenges, consequences and opportunities, and be able to respond positively with an appetite for innovation and new ways of being.

The Hunter Valley Electric Vehicle Festival is a collaborative community engagement platform contributing to a strategic narrative of building dynamic and innovative sustainable societies. The Festival has a series of three events – the EV Policy Workshop, the EV Prize race day and the community EV Show, that target specific audiences around the narrative of sustainable transport and cleantech industry development in a resource intensive region. The targeted audiences are industry and government policy makers, current and future innovators as well as the broader community.

The approach of the Festival has been to immerse the target audiences in the challenges and cocreation of solutions. The success of the program has been as an interactive demonstrator for the ‘process’ of science where creativity and the development of new possibilities meets the reality of performance in the real world.

CAFE SCIENTIFIQUE: A CASE STUDY IN INNOVATIVE SCIENCE TALKS

Jane Fenton-Keane

Inspiring Australia, Queensland

ABSTRACT

This session discusses the design, delivery and evaluation of the Café Scientifique Program rolled out through Queensland's Inspiring Australia Program. The session presents a case study that shares details of how and why the series was designed and delivered in its current format and the opportunities that emerge from it for science communicators. Those interested in transforming science talks into public events will be provided with insights into audience reception of the cafes to use for planning their events. Café Scientifique in Queensland is using an innovative approach to science engagement and building an evidence base for science talks held in partnership with Inspiring Australia.

POP CULTURE INFLUENCES ON TERTIARY PHYSICS ENROLMENTS

Tom Gordon, Chris Stewart, Lindy Orthia and Merryn McKinnon

Presenting Author: Tom Gordon

School of Physics, University of Sydney

ABSTRACT

Popular culture offers a variety of opportunities and avenues for potential tertiary students to become engaged in physics. These include programs such as “The Big Bang Theory”, or “The Wonders of the Universe with Brian Cox”, personalities such as “Dr Karl”, video games such as “Portal” and web comics such as “xkcd”. These pop culture products are generally not aimed at boosting tertiary enrolment but at entertainment, while still conveying some strong physics concepts and processes. There is anecdotal evidence to suggest that some individuals have enrolled in tertiary science degrees because of pop culture influences, and some historical increases in science enrolments have been linked to popular culture (notably the boom in university forensic science courses in the early 2000s, precipitated by popular crime television programs). But the reach and strength of pop culture’s influence on science enrolments has not been systematically studied, particularly with respect to physics.

The aim of this project was to examine the influence of popular culture on secondary students’ ambitions to enrol in tertiary physics. We surveyed secondary school students in NSW about what influences their subject choices. The survey considered pop culture influences such as television programs, video games, web comics, and more. In this presentation we will share some preliminary results, and discuss the potential for capitalising on popular culture to encourage further enrolments in tertiary science.

WHY DO CITIZENS DONATE TO CITIZEN SCIENCE PROJECTS? MOTIVATIONS OF THE SKYNET VOLUNTEERS

Kirsten Gottschalk^{1,2}, Will Grant², Kevin Vinsen and Alex Beckley

Presenting Author: Kirsten Gottschalk

¹ International Centre for Radio Astronomy

² Australian National Centre for the Public Awareness of Science, Australian National University

ABSTRACT

We investigated the motivations of volunteer citizen scientists from the astronomy based distributed computing project 'theSkyNet.'

Since its launch in 2011, theSkyNet has grown to approximately 19,000 members, who together donate between 20 and 35 TFlops of computing power to astronomy research (equivalent to a mid level supercomputer dedicated to astronomy data processing).

Understanding the motivations of citizen scientists can inform future projects and help recruit further volunteers, as well as retaining current donors. In this presentation we'll discuss the results of a survey conducted on theSkyNet's volunteers, asking why they joined theSkyNet and questions about their frequency and method of donation, as well as providing a brief history of theSkyNet.

COMMUNICATION VERSUS KNOWLEDGE TRANSLATION; WHAT'S THE DIFFERENCE?

Tamika Heiden

Knowledge Translation Australia

ABSTRACT

This poster will examine the intersection between science communication and knowledge translation (KT). Where do these specialty areas align? Where do they differ? Where is the line between what's considered KT versus communication, how do they work or don't they work together, and how can they be complimentary? This confusion can lead to unnecessary reactions and competition to the introduction of KT as its own science and speciality. The debate around the terminology and these two specialties is happening internationally and is sure to happen locally as Australia moves toward a greater emphasis on research translation and impact.

This poster will tease out the differences and similarities to create further debate and discussion around these closely aligned areas. An understanding of how these two specialties can work together to create impact from research is vital for the further development and expansion of both fields. If we continue to consider that communication is KT then we may be missing some valuable tools, methods and frameworks in the science impact pathway.

The poster will pull information from both peer reviewed and grey literature around these two specialties and the ongoing debate. It is hoped that by presenting this information, to an audience of communication specialists, a common understanding and appreciation for the value of both science communication and knowledge translation will occur for the betterment of research impact.

WHAT DOES THE MEDIA MEAN TO SCIENCE? EXPERT USE OF MEDIA AND MEDIA INFLUENCE ON PUBLIC OPINION IN AUSTRALIA

Vanessa Hill

CSIRO

ABSTRACT

We explored the interaction between science, public media channels and society in an evolving media landscape. We examined this interaction in three dimensions: scientists' personal use of public media channels to follow news and information about scientific issues; their assessment of the impact of scientific information in these channels on public opinion about science; and their assessment of the impact of such information on science-related decisions made by policymakers. We conducted an online survey with scientific researchers based at an Australian institution. Our results show that few Australian scientists source information about scientific issues from print media, differing from media use in the general Australian population. Australian scientists do not consume a lot of news and information about science in comparison to scientists surveyed in previous studies in the US and Germany. There was a difference in demographic consumption of media where those under 40 were more likely to use blogs and social networks. Scientists expected the general public and policymakers to use print, online and social media channels more often than they do, and they perceived these audiences to be susceptible to influence by media channels.

CONVERSATIONS WITH SCIENCE GIANTS

Diana Jasudasen and Nancy Longnecker

Presenting author: Diana Jasudasen

Science Communication Programme, School of Animal Biology, University of Western Australia

ABSTRACT

This study explored the views of eminent Western Australian scientists about science communication and provides insights into factors that motivate or deter them from communicating their science with society.

Semi-structured, face-to-face interviews were conducted with 17 winners and finalists of the Western Australian Scientist of the Year, Early Career Scientist of the Year Awards and eminent scientists who have been inducted into the WA Science Awards Hall of Fame. Most interviewees were current university academics. Interviews were audio recorded, transcribed in full and analysed.

All participants reported thinking that science communication is important and valuable to society. The most commonly reported constraint to their communication was lack of time:

Time is the biggest barrier...and everything else that is swallowing my time.

Many interviewees also noted that the current academic structure discourages scientists from communicating with the general public as much as they would like to:

"We're now getting more and more constrained to...bring in enough grants, publish enough papers...in the top ranked journals. There's nothing about communicating your science."

We discuss respondents' views about the benefits of communicating with society and make a case for explicit reward for effective science communication by scientists in academic and other research workplaces.

‘THE BLOOD AND THE BONE’: REPRESENTATIONS AND MISREPRESENTATIONS OF FRONTIER VIOLENCE AND ANTHROPOLOGY IN COLONIAL AUSTRALIA.

Peter McAllister

Griffith University

ABSTRACT

Museum holdings of Australian Indigenous skeletal remains have been the focus of intense debate in recent years, primarily over the ethics of their collection in colonial times and the propriety of ongoing study based on those remains (now largely repatriated). Two allegations are frequently raised: firstly, that colonial anthropologists, museums and collectors frequently abetted frontier violence, particularly that of the Native Mounted Police, and often obtained remains from this source, and secondly, that anthropology in the 19th and early 20th Centuries furnished a theoretical rationale for repressive violence towards Indigenous people Australia. To test the first of these allegations we conducted a quantitative analysis of a major Queensland assemblage of Indigenous skeletal remains, the Roth collection, to determine their origin, finding a surprisingly small contribution (2%) from victims of colonial violence. To test the second we scrutinised the documentary evidence advanced in Paul Turnbull’s 2008 ‘Theft in the Name of Science’, finding it an unreliable guide to the real views of 19th and 20th Century anthropologists, whose work mitigated, rather than facilitated, colonial violence. We finish with a brief discussion of why bioanthropological research is vulnerable to misrepresentation as a ‘predatory’ science and how its positive mission might be better communicated.

MATHS AND SCIENCE – THE ORIGINAL FRENEMIES

Patrick Mahony and David Shaw

Presenting Author: David Shaw

CSIRO Publishing

ABSTRACT

The Inspiring Australia strategy includes mathematics in its definition of science as ‘a field of study in its own right, as well as an essential tool of the sciences’. However, science and mathematics are still often referred to as two distinct fields, such as in the Australian Curriculum.

CSIRO Publishing produces Science by Email and Maths and Stats by Email, which have similar target audiences: children aged 9 to 13, and their teachers, parents and the general public. Through these publications, CSIRO Publishing is in a unique position to investigate the public’s perception of mathematics, science, and the relationship between the two.

Surveys of both newsletter audiences allow analysis of the differences between these science and mathematics groups, comparing how readers engage with the newsletters and the impact the newsletters have on them. Data from the mailing list software includes open rates and click rates as measures of reader engagement. The combined data gives insight into how these audiences overlap, and shows any key differences in how the readers interact with the newsletters. This helps us better understand the intersection of science and maths communication, and how to deliver greater impact for our publications.

CLIMATE CHANGE ‘EXPERTS’ ON THE INTERNET SOAPBOX: DEMOCRATISING SCIENCE AND THE MEDIA THROUGH BLOGS

Jenni Metcalfe

Econnect Communication

ABSTRACT

The rise of the blogosphere in the last decade has lead to a proliferation of digital voices on politicised scientific issues such as climate change. However, this does not mean that the ‘ordinary’ person, as compared to mainstream media representatives or scientific experts, has more engagement or influence in such issues than before the emergence of Web 2.0 technologies. The followers of issues-based and increasingly politicised blogs have tended to follow the elites – educated, mostly male bloggers with a background in journalism or writing.

My research is finding that the dominant voices in the blogosphere conversations appear to be deniers of anthropogenic climate change with strong links to vested media and commercial interests. These links to vested interests make it harder for ordinary people to participate with expert scientists in the digital debate about climate change science. Despite this, there are opportunities for climate scientists to participate more actively in the blogosphere by being prepared to provide quick clear information about the latest climate science. Ordinary people can also participate more effectively in the blogosphere to increase their impact and voice by developing interest groups of concern and by networking and linking with influential groups, including mainstream media.

CELEBRATING 50 YEARS – BRINGING TOGETHER A SCHOOL

Cecily Oakley

School of Biological Sciences, University of Sydney

ABSTRACT

Two households, both alike in dignity; the University of Sydney is where we lay our scene... The lovers were not exactly star cross'd but from the vantage of 50 years we could reflect on the joining of Botany and Zoology into the School of Biological Sciences. This anniversary, which occurred in 2012/2013, encouraged reflections on the past and musings on the future. It also provided a valuable communication exercise in bringing together a School that is physically quite separate.

Through a museum exhibition, public lecture series and 'birthday' party, the School of Biological Sciences was celebrated. The activities for this anniversary resulted in several positive outcomes, including connecting with alumni and promoting a sense of belonging to staff and students in the School.

From visualising the world of insects to taking on climate change, our Aussie science communicators are doing amazing things. At this year's ASC poster exhibition you can meet others working in overlapping areas, look for inspiration (and ideas to borrow) and find out a little more about what's going on around the country. On Monday evening between 6pm and 8pm our poster speakers will be manning their creations and taking questions, so come and find out more the projects on display and the people behind them.

Biomass Producer – Bioenergy Information for Australia's Primary Producers

Mary O'Callaghan

CSIRO Publishing

ABSTRACT

Australia lags behind many countries in using bioenergy (energy from plant material) as an alternative to fossil-fuel-based energy.

In 2012, on behalf of the Rural Industries R&D Corporation, we conducted research to help us understand what people in primary industry in Australia wanted to know about getting involved in bioenergy and how they liked to receive their information. In response to the findings, in 2013 we were re-engaged to develop an online portal which directs people to useful and relevant information about producing biomass that can be converted to energy, getting into the bioenergy supply chain, and starting a bioenergy plant.

Our work included:

- managing the project
- engaging and briefing a graphic design company
- identifying the top tasks that the portal needs to support
- creating the information architecture
- sourcing content from credible sources
- selecting and liaising with a content approval panel
- selecting and liaising with a group of representative users to identify the top tasks, create the
- architecture and test the usability of the portal
- writing a short paragraph about each link approved for publishing
- developing four case studies (text, video, photos)
- publishing the content
- testing the portal.

Biomass Producer was launched at the Bioenergy Australia annual conference in November 2013.

This poster showcases the portal and our approach to developing it, which was based on best practices for developing websites, adapted for a modest budget.

INFORMATION DESIGN FOR SCIENCE AND TECHNICAL PUBLICATIONS — IT'S MORE THAN JUST WORDS AND MORE THAN JUST DESIGN

Janet Salisbury and Richard Stanford

Presenting Author: Janet Salisbury

Biotext

ABSTRACT

Information design is about arranging the text and look of a document to make it as readable, attractive and effective as possible. This is often thought to be something for designers to worry about, but we have shown that the best results come from integrating writing, editing and design. This process starts at the earliest stages of document development and follows three stages:

Large-scale analysis and organisation of the content ('the story'), so that information has structure, is engaging and flows logically. This assists readers to understand the main purpose of the information.

Medium-scale mapping of the elements of the story, creating visual concepts and revising the text to help readers navigate and understand the content.

Fine-scale styling and presenting the content, including text, fonts, colours, graphical elements, figures, tables, graphs and diagrams, in a way that will focus readers' attention on the details.

Preparing science and technical publications involve complex tasks at each level. In this poster we present case studies from Biotext's large portfolio of science and technical publications to illustrate how we integrate writing and editing with design work at each level to create effective information design.

BAN THE BOOK OR MANAGE THE RISK? HOW TO HANDLE ASBESTOS PRODUCTS IN THE HOME - A CASE STUDY IN RISK COMMUNICATION

Janet Salisbury

Presenting Author: Janet Salisbury

Biotext

ABSTRACT

Because of the large number of homes in Australia that include some asbestos building materials, there is an ongoing issue for homeowners, hobby renovators and members of the public about how to safely handle asbestos products. In 2009, Biotext was appointed by the Australian Government Department of Health and Ageing on behalf of the Environmental Health Subcommittee (a committee made up of representatives of all states and territories) to write and design a booklet for homeowners about the risks of asbestos for householders and the general public.

Our brief for the booklet were twofold:

- To communicate the health risks associated with low levels of asbestos exposure, such as occur in a home environment.
- To provide guidance on how to safely handle asbestos products in the home.

The first aim of the booklet—risk communication—was a major challenge. As with many other environmental agents, there is no level of exposure that can be identified as 'no risk' and risk communication for this issue involved the difficult task of providing clear information to promote the necessary precaution without over- or understating the danger. To convey these difficult concepts, we developed simple text and infographics to illustrate different risk factors and levels of risk, and designed an overall theme for the booklet based on a visual concept of dandelion fluff.

The second aim of the booklet—guidance on safe handling—was also challenging because of the wide variety of asbestos products that have been used in buildings and the number of different situations when exposure can occur. To achieve this aim, we used simple text, infographics, photographs, hypothetical case studies and action-focused information.

After many drafts, committee haggling and approvals, focus group testing, and sign-off by state, territory and federal chief medical officers, the booklet was published in 2012. Its publication caused an immediate outcry from asbestos disease sufferers support groups leading to 'ban the book' demonstrations in Victoria in late 2012. This was followed by revision of the booklet and publication of a new edition in 2013.

This talk will explore what happened, including our role as science communicators in this highly contentious policy area.

THE SCIENCE OF CHOCOLATE OR THE ART OF CHOCOLATE – WHAT’S IN A WORD?

Carly Siebentritt and Chris Krishna-Pillay

Presenting Author: Carly Siebentritt

CSIRO Education/ Inspiring Australia project officer

ABSTRACT

Inspiring Australia (IA) aims to engage all Australians with science. Many people in the Victorian community express an interest in science and technology but don't actively seek it out or search for information about science. The following is a case-study of an attempt to attract a science-disengaged audience to a science-art event.

We worked with the community group Laneway Learning which coordinates a series of evening 'classes' in a multitude of subjects. We ran two such identical classes, one titled 'The Science and Art of Chocolate' and one titled 'The Art of Delicious Chocolate.' Importantly, the content of each session was identical and each was advertised in the same way. Following the session short evaluation sheets, again identical, were filled in by event participants. In this presentation we will present the profile of the participants from each class and suggest that, in order to engage the science-disengaged, we need to consider the impact of the word 'science' when promoting events and engagement opportunities to attract a less engaged audience. Self-explanatory? Perhaps, but how often do we practise what we preach?

SCIENCE AND THE MEDIA: THE CLIMATE CHANGE DEBATE IN AUSTRALIA

Alexandra Soderlund, Richard Kingsford, Collin Chua, Peter Steinberg and Ezequiel Marzinelli

Presenting Author: Alexandra Soderlund

School of Biological, Earth and Environmental Science, University of New South Wales

ABSTRACT

There is strong scientific evidence for anthropogenic climate change, but public opinion in Australia does not reflect this. We investigated the role of the media in communicating the science of anthropogenic climate change by comparing coverage across scientific journal papers, newspaper articles, television broadcasts, blog posts and Twitter. We sampled from 2003-2012, using multivariate statistics to examine three variables (Science View, Opinion Source and Frames) with respect to media type and year. Media types consistently and strongly differed across the three variables with surprisingly little temporal variation in these differences across the decade. Scientific papers differed notably from all other media, with a 95% acceptance of the science in scientific papers, compared to 50-60% or less for other media. Scientific papers relied on scientific sources at least three times more than any other medium, which were dominated by 'no source' of opinion. Patterns were less clear in regards to frames. All three variables were also significantly correlated, indicating that the science of anthropogenic climate change cannot be viewed or communicated in isolation. Communication of climate change must therefore use cultural and social values – not just the science per se - to effectively communicate the science of anthropogenic climate change.

TO JAB OR NOT TO JAB: THE ROLE OF INFORMATION SEEKING IN HORSE OWNER DECISION MAKING AROUND VACCINATION

Melanie Taylor¹, Jennifer Manyweathers², Nicole Schembri¹, Kate Sawford³, Jenny-Ann Toribio³, Navneet Dhand³, Nina Kung⁴, Hume Field⁵, B. Moloney⁶ and Therese Wright⁶

Presenting Author: Jennifer Manyweathers

¹ Centre for Health Research, University of Western Sydney;

² Centre for Science Communication, School of Animal Biology, University of Western Australia;

³ Faculty of Veterinary Science, University of Sydney;

⁴ Queensland Department of Agriculture, Fisheries and Forestry; ⁵ Ecohealth Alliance; ⁶ NSW Department of Primary Industries

ABSTRACT

With the emergence of Hendra Virus as a zoonotic disease risk for horses and their owners, examining the decision making process that horse owners undergo when deciding to adopt risk management strategies, or not, is of importance when considering how the risk is communicated. A three year project entitled 'Horse owners and Hendra Virus: A Longitudinal cohort study To Evaluate Risk' (HHALTER), is examining the attitudes and opinions of horse owners about Hendra Virus and changes in their uptake of recommended risk management strategies; i.e. vaccination of horses, safe practices around sick horses, and property management to keep horses away from flying foxes (the source of the virus). Some initial findings will be presented in this poster about early uptake of vaccination and horse owner intentions to vaccinate. This will be discussed in the context of sources of information sought by horse owners, and include exemplary comments made about their views on Hendra virus communication.

GETTING TO KNOW YOUR GENOME: CHANGING THE FACE OF GENOMIC LITERACY IN AUSTRALIA

Bronwyn Terrill

Garvin Institute of Medical Research

ABSTRACT

Background: The human genome contains an enormous amount of information about an individual, encoded within 3,000 million DNA letters or bases. There is information that can be used for identification, to delve into ancestry, to understand drug response, to predict the risk of complex disease (for the individual or their offspring) or resistance to infectious disease.

Motivation: As it becomes cheaper and quicker to sequence genomes, the world has seen a steadily increasing number of people seeking personal genomic information, to satisfy their own curiosity or to identify health risks. Some expect that genomic medicine – where clinicians use knowledge about an individual's genome to diagnose or inform treatment – will become a standard of care. If this medicine continues its shift into the clinic, there is a growing need for people to 'get to know the genome' and understand the potential and limitations of the information contained within (and our current knowledge).

Intent: Unlike the UK and USA, there has been no Australian body funded to develop a nationwide strategy for genetic/genomic education. As a specialist genetics and genomics communicator, I have been mapping the landscape of communicators, educators and agencies currently engaged in genetics or genomics education. I'm also developing (overlapping) networks of formal, informal and health sector communicators and educators who may be interested in discussing approaches and potential collaborations about public engagement with genetics and genomics.

COMMUNICATION BETWEEN AGRICULTURAL SCIENTISTS IN INTERNATIONAL TEAMS FOR RURAL DEVELOPMENT

Wesley Ward and Lisa Given

Presenting Author: Wesley Ward

Institute for Land, Water and Society; Charles Sturt University

ABSTRACT

This paper reports research findings on how agricultural scientists working on research and development projects in South East Asia communicate with each other. Successful communication between scientists was shown to be vital for building effective relationships and outcomes from scientific projects implemented in developed countries, particularly as it enhanced trust and respect between team members. However, this contention has not been tested for international research teams from developed and developing countries working on collaborative projects in developing countries.

Qualitative interviews were conducted with 30 agricultural project managers, research scientists and communication specialists from various disciplines in agriculture, livestock production, fisheries and forestry in Australia and in Lao People's Democratic Republic (PDR) in 2011 and 2012. Interviewees cited informal face-to-face communication via meetings, field trips and, to a lesser extent, email as the most important forms of communication. Stronger relationships developed between team members when communication modes used non-verbal cues and verbal message content, which led to more nuanced and 'richer' communication that improved professional relationships.

Formal communication through the production of co-authored referred journal and conference papers played a very minor role in communication between these scientists as the donor organisation and Lao institutions placed little importance on them. Therefore, the continued strategic use of face-to-face communication would enable and enhance effective management and outcomes from international collaborations for agricultural and rural development, while further research is required into the effectiveness and future uses of digitally mediated communication between scientists collaborating over geographic and temporal boundaries.

THE REPRESENTATION OF SCIENCE AND SCIENTISTS ON POSTAGE STAMPS

Chris Yardley

Australian National Centre for Public Awareness of Science, Australian National University

ABSTRACT

No-one has studied science on postage stamps as a communication medium. Yet stamps incorporate a literate and a visual communication message that governments have used to elucidate ideological ideals and policies, for civic education, for nation building and to advise on matters of public health. Within every stamp image is a permanent record that preserves that message information from the date of issue through many generations.

I explore paths and into how and why a country visualises and publicises its place locally and to the outside world.

'Science' as represented on postage stamps defines the state of science and technology at a set point in time, the date of issue, and provides a commentary on society and a set of activities, functions or needs. Events and anniversaries are the prompts for many issues. Government's hand is shown when the message is political, is nation-building and often in advice of public health issues.

This study analyses how, through stamp issue, the current perspective of science is shown by the context in step with the movement understood as the public understanding of science evolving into the public awareness of science.

CHARISMATIC COCKATOOS

Mandy Bamford, Mike Bamford, Shannon Ducker and Simon Cherriman

Presenting Author: Mandy Bamford

Bamford Consulting

ABSTRACT

A sign from the Agora Interactive Bushwalk at Trinity, in Western Australia. The design includes elements of a feather and Banksia cone to integrate with information and scientific illustration of Carnaby's Black-Cockatoos and Banksia trees. A QR code links to sound and video of the Cockatoos, created for the project by a local film-maker.

This sign is from the newly created Agora Interactive Bushwalk at Trinity, in Western Australia. The design includes elements of a feather and Banksia cone to integrate with the information and scientific illustration of Carnaby's Black-Cockatoos and Banksia trees displayed on the sign. A QR code links to sound and video of the Cockatoos, created for the project by a local filmmaker.

In all, there are twelve interpretative signs in the Agora Bushwalk series including 'Solar-Powered!', a sign about ectothermic reptiles and 'Down to Earth', a sign about the watersensitive urban design.

Each sign links to web-based content. The information provided may be accessed by scanning the QR codes at the bottom left hand corner of the sign. Although local schools are the main target audience, the website may be accessed by anyone with an interest in conserving bushland.

Other features of the Bushwalk include a playground using natural materials, a seating node to encourage the public to sit and observe the bush and some innovative displayed items to enhance visitors' enjoyment and opportunities for learning as they undertake the walk.

An education package is being developed for the area and will be launched shortly.

STEM FUTURES: AN INNOVATIVE APPROACH TO GUIDING CAREER CHOICES FOR HIGH SCHOOL STUDENTS

Maria Barrett

Science and Engineering Faculty, QUT

ABSTRACT

The recent position paper from the Office of the Chief Scientist has called for a strategic approach to science, technology, engineering and mathematics (STEM) in the national interest (Office of the Chief Scientist, 2013). To reverse the declining trends in STEM participation at all levels of education, the paper recommends students be guided in their study decisions by highlighting the need for an increasingly diverse and well qualified STEM workforce. Much has been written about the importance of using STEM professionals as role models to steer school students towards STEM careers (e.g. NFER 2013, Ware & Stein 2013). There is also a focus on presenting career options to senior secondary school students to guide their tertiary study choices. However, the declining numbers of students studying sciences and mathematics as senior subjects means that there is already a lower pool of students to make the progression to tertiary studies in STEM areas. The STEM Futures model has been developed by the Science and Engineering Faculty as part of the QUT Widening Participation program to build aspirations for tertiary STEM studies for students from disadvantaged backgrounds. The program works in conjunction with science and mathematics departments in target high schools to showcase STEM-based careers to students in year 10. By demystifying the tertiary study required for these professions through presentations by currently enrolled student ambassadors, the program endeavours to increase the number of students undertaking science and mathematics in senior school in preparation for their progression to university STEM studies. The premise of the program is based on a continuum of career decision making, particularly for those 'first in family' students, with the decision to undertake senior science and mathematics a requisite to successful transition to the tertiary studies associated with their desired STEM-based career. Results to date have been very positive, with targeted schools reporting an increased interest and level of enrolment in senior sciences and mathematics subjects. This program also has broader application, with requests to host STEM Future events from schools outside the Widening Participation network.

PICS AND FLICKS – COMMUNICATING NATURAL RESOURCE MANAGEMENT TO OUTBACK COMMUNITIES

Teresa Belcher

Rangelands NRM

ABSTRACT

Rangelands NRM WA is a not-for-profit, independent community-based organisation that works to coordinate projects throughout the rangelands of Western Australia that assist land managers to look after their natural resources, enhance land use and achieve good environmental outcomes. One of 54 Natural Resource Management Groups in Australia, Rangelands NRM covers the huge 'outback' region of WA which includes the Kimberley, Pilbara, Gascoyne, Murchison, Western Desert, Goldfields and Nullarbor.

Our audience is diverse, ranging from pastoralists, Aboriginal groups, state government departments, community groups and the general public. Communicating to people living in the remote outback of Western Australia has its challenges.

Given their diversity, the message and approach is important. As technology improves, more individuals living in the rangelands of Western Australia have access to the Internet and the benefits of social media including Facebook and YouTube.

Since 2011, Rangelands NRM has been running a photo competition with the five 'Schools of the Air' encouraging children, the future managers of the rangelands, to submit photos of 'their rangelands' and what it means to them to live in the remote outback. Parent and teacher support has been valuable with this project, with over 70 children submitting photos with a chance to win the first prize of an SRL camera with runner up prizes relating to science, environment and photography.

In 2013, we also started filming footage in the Western Desert, Pilbara and Kimberley, and speaking to individual land managers, community groups, and Aboriginal rangers about the work they undertake in weed control, monitoring of endangered species, fire management, sustainable land management and feral animal control. These short films are being posted on our YouTube channel (www.youtube.com/rangelandsnrm).

Communicating about Climate Change: How Having Design and Audiovisual Skills Can Improve Your Choice of Words When Producing Case Studies about Climate Change

Alison Binney and Robbie Mitchell

Presenting Author: Alison Binney

Econnect Communication

ABSTRACT

This poster will outline how telling stories about climate change research can be less about the words and more about the visual and audio components. Earlier this year, Econnect Communication was asked to produce case studies on climate change research being done across islands in the Pacific and Southeast Asia region. The work involved producing content for brochures, fact sheets, posters and videos. Although the bulk of the research was over by the time we were contracted, and we had to rely on research reports for a lot of insight, we were able to travel to the research locations and capture images and interviews. During the development of the text content, it became evident that the text-based documenting of the work would change tack based on the strong imagery. We learnt that having the skills to both 'see' a story and 'design' the communication products in-house were invaluable for the outcomes of the project.

COMMUNICATING BIOSECURITY RISKS IN NEW ZEALAND

Oriana Brine

The Ministry for Primary Industries, N.Z.

ABSTRACT

The Ministry for Primary Industries (MPI) is the lead government agency that manages biosecurity responses in New Zealand. MPI operates in an environment where biosecurity risks and political pressures must be managed. Effective communication is crucial for all post-border responses. Scientific information guides decision making and helps determine risks associated with non-indigenous species. This presentation will describe a case study and provide insights into how science communication can affect the success of a response. In March 2013, MPI was notified of imported flyscreens with undeclared sand and soil as a ballast. The flyscreens were distributed across Australasia and although the laboratory confirmed they were low risk, MPI carried out a public recall. This case study illustrates that effective science communication can mitigate political and reputational pressures, and ensure appropriate outcomes.

THE SEEC (SCIENCE, ENGINEERING, EDUCATION, COMMUNICATION) COOPERATIVE

Terry Burns

University of Newcastle

ABSTRACT

In general Australian science communication and outreach events tend to have a very short term focus and an ad hoc approach. This is not to say that we don't do anything good; quite the opposite. We generally provide excellent freestanding programs and events but with several common pitfalls. For example, events/programs frequently:

- focus on "Isn't science fun" rather than "You could do this"
- are inadequately resourced
- are not ongoing
- work in competition with each other
- are often not focused on a specific (and therefore measurable) outcome
- provide very little scaffolding for participants. i.e. they often fail to show where participants fit in or how the event is relevant to them

The University of Newcastle has developed a platform known as the SEEC (Science, Engineering, Education, Communication) cooperative. SEEC provides an innovative and structured sequence of interactions with young people a numerous occasions through their schooling, as well as a context for them to continue to engage with STEM as they grow. SEEC relies on an active partnership between family, community, business and government.

The SEEC cooperative is proposed as a very practical way to increase STEM* engagement, science communication, and young people's interest in science and engineering careers.

In the session the existing SEEC programs at the University will be briefly introduces and to opportunities for further growth and cooperation explored.

*STEM is an acronym for Science, Technology, Engineering and Mathematics

FUTURE JOURNALISTS LEARNING TO GET SCIENCE RIGHT

Tamzin Byrne

Science in Public

ABSTRACT

Is science fiction bending your view of reality?

What makes someone volunteer for a one-way ticket to the Red Planet?

Could your morning coffee be quietly killing you?

These are just a few of the questions posed in a summer science podcast series produced by journalism students from RMIT University with help from Science in Public.

The most important stories of this century are science-based and there's not enough understanding of science among journalists.

So, science communicator Tamzin Byrne and radio journalism lecturer Alex Wake worked with a class of third-year journalism students at RMIT University to produce a series of summer science podcasts on the theme of Inspiring Australia and communicating science.

The project was about giving smart young people an opportunity to find the science behind everything, training them to report science accurately and encouraging them to explore the role of science in society.

The first podcasts are already up at <http://inspiringaustralia.net.au/category/rmit/> and by the time the conference is on, the series will be nearly finished, with 20 podcasts ranging from the science of music to the art of making a baby with IVF, from drug-testing drinkware to the dangers of your morning coffee.

The project also involved working closely with students to produce the midday radio news bulletin for Melbourne community station 3RRR, teaching them to file quick and accurate reports on science news.

The poster will consider the successes and difficulties of this project and share examples of the students' work.

Supporting information:

- Podcast archive: <http://inspiringaustralia.net.au/category/rmit/>
- Full playlist of podcasts: <https://soundcloud.com/scienceinpublic/sets/inspiring-australia-rmit>
- Original brief to students: <http://www.scienceinpublic.com.au/rmit/science-journalism-project>.

UNDERSTANDING COMMUNITY CONCERNS ABOUT HYDRAULIC FRACTURING

Tsuey Cham and Peter Stone

Presenting Author: Tsuey Cham

CSIRO

ABSTRACT

Hydraulic fracturing has been the focal point of widespread and global public debate. While the resources sector typically sees hydraulic fracturing as a low-risk method for accessing the coal seam and shale gas reserves required to meet growing public demand for energy, some in the community perceive it as an unmanageable and unacceptable risk. Concerns about hydraulic fracturing and the coal seam gas (CSG) industry include the health impacts of chemicals used, contamination of water supplies from fugitive gas after hydraulic fracturing, equity of land and water access, long term impacts on groundwater, and the full life cycle emission of greenhouse gases from CSG compared to that of coal.

In Australia, there has been an increase in coal seam gas (CSG) production over the last five or so years and in some cases this has occurred in locations that previously had no gas or oil production. The rapid growth in the CSG industry coupled with the concerns around the use of hydraulic fracturing has lowered community trust in the industry and government. This presentation highlights the main psychological drivers behind some of these concerns and a possible approach to effectively address them.

COMBATING TWO DECADES OF MISINFORMATION AGAINST THE SCIENTIFIC CONSENSUS ON CLIMATE CHANGE

John Cook

Global Change Institute, University of Queensland

ABSTRACT

The Skeptical Science website refutes climate misinformation with peer-reviewed science. We achieve this by embracing a diversity of message formats, delivered through social media and smartphone apps, delivered to hundreds of thousands of people each month. To cater to a diverse audience, myth rebuttals are available at advanced, intermediate and beginner levels, from detailed, technical treatments to tweetable one-liners. While social media has been an effective medium, we experimented with an alternative model in 2013, employing the strategic combination of open-access peer-review, mainstream media outreach and social media marketing. This strategy was adopted with the release of a paper quantifying the level of agreement on human-caused global warming in published climate papers, designed to reduce the influence of a two decade misinformation campaign manufacturing doubt about the scientific consensus. The campaign resulted in global mainstream media attention as well as acknowledgement from key public figures such as President Obama, Al Gore and the UK Minister for Energy Edward Davey. Another measure of impact was a strong backlash from opponents of climate action, with over 150 online articles attacking our research in the 100 days since publication. Our approach was informed by psychological research into both the importance of scientific consensus and how to reduce the influence of misconceptions. While multiple methods of delivery are important, equally important is the construction of the messages themselves. I will examine the science of crafting compelling messages and how combination with diverse message delivery can lead to impactful communication outcomes.

Fireballs in the Sky – Reaching for Space with Citizen Science

Emma Donnelly

Curtin University

ABSTRACT

Fireballs in the Sky (FITS) is an Inspiring Australia supported citizen science initiative that provides a way for the public to work alongside research scientists studying meteorites. The focus of the project is to improve the people's understandings of planetary science research and enhance their attitudes to science.

Here, an emphasis will be placed on the people being included in the research process, improving their scientific literacy. It is an innovative program because it involves the public in authentic science research activities and will engage Indigenous and non-Indigenous people in remote and regional areas of Western Australia and South Australia. The project is being delivered by Curtin University, but has the following partners: Kalgoorlie Boulder Visitors Centre; Ninti One; Science Teachers' Association of Western Australia (STAWA); Scitech; South Australian Museum; Western Australian Museum.

Underpinning the Fireballs in the Sky (FITS) project is the Meteorite Fireballs – Illuminating the Origins of the Solar System (MFIOSS) research program led by ARC Laureate Fellow, Professor Phil Bland of Curtin University. It uses cameras, the Desert Fireball Network, to capture images of incoming meteorites. In 2007, a meteorite was the first specimen to have its origin determined – a ground-breaking event in planetary science.

FITS is combining planetary science and citizen science with technology through its new smartphone app (available for android and iPhone). This is the first of its kind and the process of working with a software company, scientists and communicators was an interesting one. We'd like to share what we learnt with fellow communicators.

NOT JUST A LOAD OF RUBBISH: YOUNG PEOPLE'S PARTICIPATION IN EARTHWATCH'S MARINE DEBRIS CITIZEN SCIENCE PROGRAM

Jean Fletcher, Zarin Salter and Nancy Longnecker

Presenting Author: Jean Fletcher

Science Communication Programme, School of Animal Biology, University of Western Australia

ABSTRACT

Aims of a marine debris citizen science program were to inspire students with participatory fieldwork, increase understanding of the scientific process and increase awareness and knowledge of the impacts of marine debris. The program meets relevant key learning areas of the Australian Curriculum.

Schools participating in this citizen science program had two options: 1) a talk with scientists visiting the classroom or 2) the talk plus a beach excursion in which students do a beach walk to collect and classify debris and provide data to an online database.

The talk and beach walk was more effective than the talk alone in increasing students' knowledge and increasing their practice of pro-environmental behaviours. One favourite aspect of the program was participating in an authentic science experience.

My favourite part of the ... day was that I felt like a real scientist and that it felt like I participated in a global problem.

Student comments demonstrated that doing something positive doesn't have to be sexy to appeal. One favourite aspect of participation was collecting and sorting rubbish.

I liked doing the beach survey because it was making the environment healthy and I found it amazing seeing how much rubbish was in 50m only!

I'M A SCIENTIST: GET ME ENGAGED

Dervise Halil

Bridge8

ABSTRACT

I'm a Scientist, Get Me Out of Here! is a two-week online program where students ask scientists questions through forums and live text-based chats. The students then vote for their favourite scientist, and the scientists are evicted one by one until there is a winner! The winning scientist receives \$1,000 to spend on further public outreach.

I'm a Scientist has been running in the UK for five years. Since 2011, Bridge8 has delivered five I'm a Scientist events across Australia, engaging 75 scientists and 4000 students from across 60 schools. The event is specifically designed to be student-led inquiry, to highlight general appreciation of science as well as STEM careers and to provide a platform for organisations and scientists to engage with schools. Feedback from participants indicates it also meets other objectives including improving communication skills, engaging disengaged students and building confidence. The online environment also allows engagement to be quantified.

This presentation, based on the submitted poster will demonstrate how I'm a Scientist, Get Me Out of Here! meets a diverse range of needs for students, teachers, scientists and institutions across multiple goals in STEM and public engagement.

COMMUNICATING SCIENCE THROUGH NARRATIVE

Kohei Ishigami¹, Nancy Longnecker¹, Mzamose Gondwe¹ and Tess Williams²

Presenting Author: Kohei Ishigami

¹ Science Communication Program; School of Animal Biology; University of Western Australia;

² English and Cultural Studies; University of Western Australia

ABSTRACT

Narrative is not widely used in formal science education. This may be because narrative communication is considered to lack objectivity due to use of elements such as character and storyline. Nevertheless, study of advantages of narrative in communicating scientific information is important and a theoretical background is being established.

We report quantitative measures of effectiveness of narrative by comparing student recall of scientific information delivered via a narrative or a list of facts. Students in a large first year university class (n=443) were provided the same information as either a story or as a list of facts. They answered an online quiz three times to test their recall of information over the short term (immediately and one week later) and medium term (after eight weeks).

Short term, students who received the information via the story had similar quiz scores to those who received the facts via the more traditional, didactic list. This indicates that reading the story did not 'distract' from the purpose of learning. After eight weeks, students who received information via the story had better quiz scores, supporting the claim that narrative can be a valid manner of communicating scientific information, even in a formal education setting.

THE VALUE OF BLOGGING FOR A DEVELOPING SCIENCE WRITER: A CASE STUDY

Sarah Keenihan

sciencesarah.wordpress.com

ABSTRACT

Although science blogs are popular amongst scientists and non-scientists, their value for professional career development remains a source of conjecture. Here I present a case study of a year-long science blogging project entitled ScienceforLife.365. Each day for 365 days between Australia's National Science Week in 2012 and 2013, I published a post and accompanying image to a wordpress site (scienceforlife365.wordpress.com) and a Facebook community (facebook.com/scienceforlife365) and shared through my personal twitter and Facebook accounts. Across the year, the blog had approximately 20,000 views across both platforms, with interest varying considerably between platforms and according to the subject of each post.

Positive outcomes from the ScienceforLife.365 blogging project include:

- Developing a daily habit and discipline to write;
- Refining writing style and 'finding a voice';
- Seeing and working with nuances in audience preferences;
- Using social media to attract readership and market professional capabilities;
- Connecting with online writing and science communities;
- Demonstrating passion for subject matter and providing a portfolio for attracting paid work.

In summary, this case study shows that blogging can offer many benefits to the developing science writer.

LYING TO CHILDREN: DEFINING THE LIMITS OF SCIENCE AND EDUCATION

Jasmine Leong

CSIRO Double Helix

ABSTRACT

Popular science writers Ian Cohen and Jack Stewart wrote, “A lie-to-children is a statement that is false, but which nevertheless leads the child’s mind towards a more accurate explanation, one that the child will only be able to appreciate if it has been primed with the lie.” Science education is full of examples of such ‘lies-to-children’, from Bohr’s model of the atom to how genes lead to phenotypes.

By better understanding the history and philosophy of science, science educators can discuss their views on how to contribute to the community’s efforts to educate people in science. This talk will present the changing focus between CSIRO Publishing’s print magazines – *Scientrific* (for children) and *The Helix* (for teens) – as a case study in how a philosophical structure informs decisions in how to communicate complex topics to a scientifically naive audience.

YOU SAY ‘EVALUATION’, I SAY ‘RESEARCH’: LESSONS FROM INTERVIEWS WITH EVALUATION EXPERTS

Melanie McKenzie

The University of Queensland

ABSTRACT

Efforts aimed at determining “what activities work when” in science communication typically focus on evidence that is provided in evaluation reports to funders. However, this evidence is heavily influenced by the contexts in which these reports are written.

To examine these contexts, I conducted a series of interviews with science communication “evaluation experts” from Australia and the UK. These interviews represent a range of perspectives in science communication evaluation including policymakers, academics, consultants and funders (including government). Based on these interviews, I will discuss several assumptions about evaluation that influence how science communication evaluation is performed and interpreted. In particular, disagreement about what it means to “evaluate” and how or whether “evaluation” is different from “research”, may have important implications for establishing an evidence base for science communication.

I will also introduce some of the differing perspectives offered in my interviews, and discuss some possible ways of overcoming these differences. These possible solutions centre around clarification and acknowledgment of multiple and potentially conflicting evaluative perspectives, improvement of evaluation through research on (as opposed to practice in) evaluation, and a change in evaluation models for science communication.

IMPACT: IS THE ANSWER COMMUNICATION, NOT COMMERCIALISATION?

Fiona McNee

BigPic, Brisbane, Queensland, 4068, Australia

ABSTRACT

As science communicators, our purpose is making science accessible for wider audiences. More than any other sector of the science community, we understand modern science's audiences are both multiple and diverse in their nature, with motivations ranging from curiosity to profit, and the meaning of life to its immediate preservation. Indeed, we can be seen as the true front-line of science - its interface for translation, uptake, interest and support. It is remarkable, then, that we are often least heard on questions of science impact, perhaps the issue where communication of science's multi-faceted nature is most vital. Impact is a complicated measure, often made political by its links to public funding, and by its connotations to values and fundamental beliefs.

The continued emergence of science communication could offer a way forward that transcends both the traditions of the scientific method with its strictures of peer review citations, and the minefield that is higher education policy. What is our role in advocating a more complete understanding of the meaning of "impact", and more importantly, what could it be? This facilitated forum is the culmination of an online conversation in the months up to the conference ignited by a number of short popular and academic readings.

TRAINING PNG WOMEN IN AGRICULTURE HOW TO COMMUNICATE SCIENCE

Jenni Metcalfe

Econnect Communication

ABSTRACT

This poster will outline a series of science communication training we conducted for women involved in agriculture (leading farmers, advisors, NGOs and scientists). In particular, it will look at:

- The purpose of the workshops
- The research we did prior to each workshop to find out participants specific experiences and needs
- The process of the workshops – what worked and what didn't
- The 'train the trainer' element of the workshops
- Workshop evaluation.

SMARTEN DOWN THE MESSAGE

Brogan Micallef, Peter Newman and Lisa May

Presenting Author: Brogan Micallef

Australian Herbicide Resistance Initiative, The University of Western Australia, WA, 6009, Australia

ABSTRACT

If you ever find yourself in the situation where you are catering for a group, and you are wondering how much food to prepare, the best thing to do is to prepare a little extra, just in case. The last thing you want to do is run out. Believe it or not, you've just read two sentences that describe exactly how some herbicide resistant crop weeds counterattack the commonly used herbicide, glyphosate. The focus of the Australian Herbicide Resistance Initiative (AHRI) is profitable farming, and to help growers achieve this we convert the high level science our researchers perform into simple, easy to understand messages.

As we will demonstrate, we layer levels of information and “smartened down the message” using the SUCCEs principle (Simple Unexpected Concrete Credentialed Emotional Story). Layer one appeals to growers by fitting science into their world. Layer two adds more detail to the story, appealing to agronomists. The third layer targets the scientific community, or those who are after the full scientific detail in the form of a paper. In workshops and media, we follow the principle of growers talking to growers through our “key influencer” farmers. Essentially, we provide the story, not just the science.

@ASTA_ONLINE: ENGAGING TEACHERS OF SCIENCE WITH ONLINE TECHNOLOGIES

Nigel Mitchell

Australian Science Teachers Association

ABSTRACT

Since April 2011 the Australian Science Teachers Association (ASTA) has been developing resources and working to equip teachers of Science throughout Australia to benefit from online technologies in their teaching and professional development. The project has included engagement through social media, webinars, and face to face workshops. ASTA has engaged with other organisations including DEEWR and Education Services Australia to develop and promote online resources and to host these online. A current major project is Science ASSIST, a helpline and FAQ service to assist teachers and school laboratory technicians which will be beta tested during early 2014 and officially launched in July. A portal website using Moodle has been developed as the keystone of the project, and all other elements are linked through the portal.

This paper will include a description and demonstration of the ASTA_online project, as an example of science communication targeted to a particular and strategically significant group within society. The paper will include an outline of the strategies that have been found successful, some that have not, and future plans for the project through 2014 and beyond.

iNATURE – DEVELOPING A BIODIVERSITY STRATEGY FOR GOLD COAST CITY COUNCIL

Robbie Mitchell

Econnect Communication

ABSTRACT

We (Econnect Communication) were contracted by the Gold Coast City Council in 2012 to develop an urban biodiversity program.

Into Nature or iNature for short, is a new program that will engage Gold Coast's urban residents and visitors with the city's significant natural features by increasing support provided through existing Council conservation programs and developing new initiatives to fill current gaps.

We will present the concept and talk about the process we used to develop the strategy and implementation plan which included conducting a desktop review of similar programs around the world, listening to key partner groups within council and the community, work-shopping concepts and tactics that align with the overall objectives of the project.

A LITTLE-KNOWN CONTRIBUTION IN THE HISTORY OF SCIENCE COMMUNICATION: LITTLE BLUE BOOKS

William Palmer

SMEC, Curtin University, Perth, Australia

ABSTRACT

More than 500 million Little Blue Books with 2300 different titles were produced between 1919 and 1978 with the greater part of that production being prior to 1951. Little Blue Books covered a wide range of human interests but there were many Little Blue Books on science topics. These were not aimed at a technically competent audience, but rather at providing a general education to Americans at a very low price. This study will explain how Little Blue Books started, their scope generally, the areas of science covered, the quality of scientific information in Little Blue Books and some salient biographical background about the authors of Little Blue Books. Due to the enormous numbers of Little Blue Books printed, it is considered likely that they played a major role in the scientific education of American children and the scientific knowledge of adults between 1920 and 1950.

CAMPAIGNING THE SCIENCE: ON THE ROLE OF SCIENCE IN GREENPEACE AUSTRALIA PACIFIC.

David Ritter

Greenpeace Australia Pacific

ABSTRACT

Greenpeace is a science-based campaigning organisation whose purpose is to stand up for the environment. We detect and understand the environmental problems we face through science, and depend on science and technology to provide solutions to environmental threats. Greenpeace is thus in the (not-for-profit) business of communicating science. In his presentation, CEO of Greenpeace Australia Pacific, David Ritter, will outline Greenpeace's approach to science communication, drawing out some of the tensions and overlap between public science and public campaigning.

THE IMPACTS OF AN ECOLOGICAL CITIZEN SCIENCE PROGRAM ON VOLUNTEER PARTICIPANTS

Philip Roetman and Christopher Daniels

Presenting Author: Philip Roetman

Barbara Hardy Institute; University of South Australia, Adelaide, SA, Australia

ABSTRACT

Citizen science, a burgeoning field of research, involves the participation of the public in scientific projects. These projects require a bilateral exchange of information between scientists and the wider community. Scientists commence the exchange by providing educational information about the project and the taxa or phenomenon of interest. Data are then collected or analysed by the community and submitted to scientists. Once these data have been analysed or compiled by scientists, the results must be presented back to the community. Globally, there are hundreds of thousands of volunteer participants involved in citizen science projects. We describe the impacts on participants of an ecological citizen science program operating over six years in South Australia. Individual projects were focussed on local wildlife taxa, including bluetongue lizards, possums, Australian magpies, spiders and koalas. We have found that many participants have learnt about these species, including how to identify them. Many participants have also developed an increased interest in these wildlife and some have changed their behaviour as a result of being involved in our program. We discuss the importance of the bilateral exchange of information in generating the impact on participants. We also propose ways to increase the impact of projects, with a focus on innovative styles of data collection and methods of presenting results back to the community.

LITTLE SCIENTISTS – SCIENCE, TECHNOLOGY AND MATHEMATICS FOR PRESCHOOL CHILDREN

Christine Schneyer

Little Scientists Initiative

ABSTRACT

'Little Scientists' is a not-for-profit initiative designed to facilitate children's curiosity for science, maths and technology through child-appropriate, fun and playful experiments already in their early years. Every education and care service, preschool and kindergarten in Australia that works with children from 3 to 6 years of age can join the programme and become an accredited "Little Scientists' House". Teachers and educators will be trained through the initiative and are encouraged to implement the programme together with the children in their care. The 'Little Scientists' programme is an excellent tool to meet a range of requirements of the National Quality Framework (NQF) and the Early Years Learning Framework (EYLF).

SHARING SCIENCE IN LOCAL COMMUNITIES; A TWO PRONGED APPROACH

Renee Sizer

Scitech, Perth, Western Australia

ABSTRACT

The community wants to hear more science, learn more science and do more science. ScienceNetwork WA (SNWA) has used its capabilities to promote science at a very local level and across the globe through regional community science engagement.

In line with Inspiring Australia recommendation 13, “National Framework, Local Action”, SNWA’s online presentation of WA regional science, through local journalists and engaging regional community science groups has ensured science is being communicated from the ground up, while promoting its discussion and renewed focus within communities. We present the eight non-metropolitan areas of WA with locally specific science events, recounts of science activities on community pages and science information links in addition to our presentation of science news; covering a diverse range of topics from agriculture, environment, industry, social science and innovation.

Success in collaborating with regional newspaper editors to republish SNWA news stories in print has further encouraged science dialogue, while illustrating our ability to spark change in media processes. We recognise in remote and regional areas, community papers are widely read and central to the information sharing system. Delivery of science news and activity through both online and print avenues is working to compound science values in these communities and beyond.

IMMUNISATION: INFORMING THE NATION

Kylie Walker

Australian Academy of Science

ABSTRACT

In 2011 the number of 'conscientious objectors' to immunisation was on the rise. The Australian Academy of Science identified a need for unbiased, easily understood and scientifically sound information on immunisation. Over 12 months a working group of the nation's top experts in the field put together the Science of Immunisation: Questions and Answers booklet, designed to assist Australian people to make an informed decision about immunisation. A carefully designed and executed launch and communication strategy yielded excellent results: widespread coverage across news, entertainment, features, and social media; endorsement and uptake by key leadership groups; booklet readership in the millions; consumer-driven immunisation information initiatives; and a national conversation which has led to legislative change.

In presenting this science communication success story, I'll outline the communication strategy, implementation and results, including the longer-term impact on both quantity and quality of media coverage of the issue, and promising signs of behavioural change in Australian society.

ON THE PLUS SIDE: WHAT PEOPLE LOVE HEARING ABOUT MATHS

Carrie Bengston and David Shaw

Presenting Author: Carrie Bengston

CSIRO

ABSTRACT

Dine with us on a light but informative smorgasbord of recent successes in communicating maths and what we as science communicators can learn from them. Take-aways encouraged!

This presentation offers an entertaining romp through maths communication, education and social media. Using 'how to count fish' (or 'fishery stock estimation') as a case study, we'll explore engaging ways to communicate mathematical concepts to a range of audiences.

We'll look at maths communication from the educational to the entertaining in a range of media including video, online newsletters, blogs, performance. We'll discuss why maths is important, why mathematicians do maths in the first place, why we think everyone should know a bit more about maths and what it does.

As we move around the buffet table, we'll touch on maths and The Simpsons, and explore why people go crazy on social media about dates like 5/8/13, 31/8/13 and 5/12/13. That just about sums it up really.

CREATING AN INTERACTIVE CHEMISTRY WORLD- FROM CONCEPT TO PROTOTYPE

Anne Brant and Sherwin Huang

Presenting Author: Anne Brant

Queensland University of Technology

ABSTRACT

The Cube, at QUT's Garden Point campus, is one of the world's largest digital interactive learning and display spaces. Part science lab, part digital engagement, the Cube aims to be the hub of scientific exploration for high school students, the QUT community and the wider public.

The demand for authentic and useful learning experiences using digital technologies is increasing all the time. The introduction of the Australian Curriculum has presented the opportunity to develop new and innovative technologies to support education and learning in the classroom. As part of QUT's commitment to work with high schools and support the introduction of the new Australian Curriculum, the concept of a Chemistry World was proposed to provide an interactive learning tool for students and the community.

This presentation will take you on a journey of how a curriculum-linked digital, interactive chemistry application for The Cube has progressed from concept to project prototype. It will outline the consultation process, the range of stakeholders that have participated in the project so far, and share some of the difficulties and the challenges encountered to meet the needs and demands for education and entertainment.

The chemistry world prototype will be available for participants to engage with and participants will be given the opportunity to become "user testers" and provide feedback and input into the final development stage of the project.

EARTHSCI – A NEW TOOL FOR COMMUNICATING EARTH SCIENCES THROUGH 4D DATA VISUALISATION

Bobbi Cerini

Geoscience Australia

ABSTRACT

EarthSci is a powerful new tool for visualising earth science datasets in four dimensions. This 'virtual Earth'-style web application was originally developed by Geoscience Australia to assist its researchers describe, understand and present their findings. As demand for accessible data visualisation has increased, the tool has been redeveloped to increase its stability, useability and flexibility as a presentation and promotional tool.

Importantly, EarthSci allows underground features such as groundwater, stratigraphy, mineral systems and faults to be visualised together with surface features such as topography, land cover and satellite data. Presenting them together in a single visualisation environment enables powerful stories about the history, evolution and geophysical construction of our continent to be told. This ability makes EarthSci stand out from other virtual globe environments.

The latest version of the tool is designed to be shared, with features that support the visualisation of many different data formats, an in-built animation function that enables fly-throughs to be generated from within the tool and a presentation mode that enables journeys through the virtual globe environment to be constructed.

Due to be launched in the first half of 2014, EarthSci is a fully customisable software package that is freely open to developers in any field. Geoscience Australia welcomes collaboration with all those who may be interested in extending its use as a scientific, communication and visualisation tool.

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FARMERS CHAMPIONING CLIMATE RESEARCH: INNOVATION IN COMMUNICATING ABOUT ADAPTATION

Sarah Cole and Jenni Metcalfe

Presenting Author: Sarah Cole

Econnect Communication

ABSTRACT

The Climate Champion program, which is a very participatory and participant-driven way of disseminating relevant and local climate-related research to farmers through other farmers. This program also includes much contact with researchers at various stages of their research, to ground-truth and test research priorities or products. As we head into the second 3-year phase of this successful program (and I can present data from an independent assessment of the program), the format, strengths and challenges of such a program deserves attention for sci-comm practitioners looking to work with users to look at complex and, at times, controversial information.

MOOC (MASSIVE OPEN ONLINE COURSE)

Pahia Cooper

Global Change Institute, University of Queensland

ABSTRACT

MOOCs (Massive Open Online Courses) offer a brilliant opportunity for educators, science communicators and scientists to collaborate and interact with a large international audience of web users.

The Global Change Institute, University of Queensland is about to release 'Tropical Coastal Ecosystems', an online course that is expected to be one of the largest free courses ever run in Australia. Included in this course is a virtual fieldwork component: diving on the Great Barrier Reef via Google Maps.

What are the advantages of using MOOCs to access large international audiences? Can we use MOOCs for other science communication outcomes?

A review of our experiences with engaging, educating and collaborating using new media.

COMMUNICATING SCIENCE THROUGH THEATRE: A NEW WAY TO REACH NEW AUDIENCES

Jo Elliott¹, Graham Walker² and Lisa Bailey³

Producer: Jo Elliott

¹ Science Communication, School of Animal Biology, University of WA;

² Australian National Centre for the Public Awareness of Science; Australian National University;

³ RIAus

ABSTRACT

If we argue that the public needs to be informed about science (e.g., Pedretti, 2002), then it is necessary to communicate science in an engaging and accessible manner. This can be achieved through the use of interactive theatre. Pedretti (2002) discussed the ability of drama to evoke emotional responses in audiences, arguing that emotional engagement creates a memorable experience.

In this session, we will:

- Discuss the theory underlying the use of theatre to communicate science, with a particular focus on engaging new audiences and arousing emotions;
- Present research on theatre featuring science demonstrations ('science shows') that aims to motivate and influence audience behaviour related to climate change and health (exciting demonstrations will be used to illustrate key points);
- Present a case study of "The Clock", an interactive theatre performance designed to engage regional Australian audiences with science in a way that is both accessible and entertaining;
- Discuss the evaluation of "The Clock" and its impact on audiences.

STELLRSOPE: EXPLORATIONS THROUGH SCIENCE AND ART

Eleanor Gates-Stuart

Australian National Centre for the Public Awareness of Science; Australian National University

ABSTRACT

Over the last twelve months, a unique collaboration has occurred between CSIRO scientists and artist, in unifying their scientific and creative research interests. This poster, StellrScope: Explorations through Science and Art, will describe the process and challenges of my research in establishing StellrScope, Centenary of Canberra's Science Art Commission and its related works. This intersection of science and art, within the fields of computational informatics, food futures and entomology is truly a creative catalyst for imagination, ideas and innovation, particularly through the technical and aesthetic processes in which scientist and artist collaborate.

This poster highlights extracts relating to the production of the works, such as, the StellrLumé Domes and In the Spotlight that use Spatial Augmented Reality (SAR) techniques to bring computer graphics into the human-scale physical environment. The audience became active participants in order to experience the entire narrative of wheat experimentation and food crops, whereas the StellrScope holograms using 3D data as the foundational component of the hologram, entertained the audience by trying to grab the virtual seeds from the picture.

The 3D printed titanium insects, a result of researching the weevil insect as pest in wheat, provides another case study of this collaboration bringing together expertise across CSIRO, including the Australian National Insect Collection, Computational Informatics and Future Manufacturing.

VISUALISING INSECTS: AN EXPLORATION THROUGH SCIENCE AND ART

Eleanor Gates-Stuart¹, Chuong Nguyen²

Presenting Author: Eleanor Gates-Stuart

¹ Australian National Centre for the Public Awareness of Science; Australian National University;

² Computational Informatics, the Commonwealth Scientific and Industrial Research Organisation (CSIRO)

ABSTRACT

Visualising the world of insects is at its most exciting and innovative stage of science exploration with resources and technology to envisage intricate and complex detail, explicitly from the miniscule extremes of internal and external microscopic examination. Over the last twelve months, a unique collaboration has occurred between CSIRO Scientist, and artist, in unifying their scientific and creative research interests of visualising insects from the Australian National Insect Collection. This intersection of science and art, within the fields of computational Informatics, material science and entomology is truly a creative catalyst for imagination, ideas and innovation, particularly through the technical and aesthetic processes in which scientist and artist collaborate. We discuss the results of this Science and Art partnership, including the challenges and benefits we have experienced both for a large interdisciplinary research organisation, (The Commonwealth Scientific and Industrial Research Organisation – CSIRO) and for National exhibited artworks.

THE IMPACT OF SCIENCE COMMUNICATION TO DRIVE THE PROMISE OF STEM CELLS IN MEDICINE

Daniella Goldberg

NSW Stem Cell Network

ABSTRACT

The turn of the century saw the derivation of pluripotent stem cells, capable of forming all cell types of the adult human body. The media attention that followed revealed the promise of new organs and body parts generating hope in patients with incurable disease.

Today, ethical controversies and strict regulatory challenges continue to stunt the progress of stem cell research, generating frustration in both researchers and patients actively pursuing the stem cell promise.

The NSW Stem Cell Network (Network) was formed following the initial debate in the Australian Senate in 2002 about the use of excess IVF embryos for pluripotent stem cell research. After much consideration, the Senate enabled this controversial research to go ahead. It was however clear that better communication between scientists, clinicians, patients, ethicists, patent attorneys, Government and the public would be required to reach the potential of stem cell therapy in Australia.

The Network has played a vital role in connecting a range of stem cell stakeholders in NSW as well as many national players. As a growing body of over 500 members, the Network organises regular Stem Cell Workshops and other programs, managed by a science communicator in consultation with an executive committee.

The Network has provided opportunities to advance in three key areas:

- Networking for Innovation
- Regulation
- Public Outreach

As stem cell clinical trials for a variety of disorders progress in Australia, the success of these trials will depend on support from groups like the NSW Stem Cell Network.

YOUTH-PRODUCED FILM RELATING SCIENCE AND CULTURE

Mzamose Gondwe and Nancy Longnecker

Presenting Author: Mzamose Gondwe

Science Communication Programme, School of Animal Biology, University of Western Australia

ABSTRACT

Visualisation through the process of filmmaking can enable dialogue and deeper understanding of connections between science and culture. Our research explores the process and effect on young people of producing films that connect science and culture. Students from three schools, two in Western Australia and one in Malawi, Africa participated in this study. Participants were provided with filmmaking equipment and taught how to shoot and edit films. Working individually or in small groups students produced short films on their interpretation of the connection between science and culture. Films were shown during a community screening where family and friends were invited. Following the screening, students and teachers were interviewed. Analysis of interviews and the films students produced revealed that linking science to community, family and out of school activities empowered these students to see science as accessible and relevant to their everyday lives. Filmmaking on science and culture motivated and engaged students and enhanced relationships between families and schools. In future use of this activity, scaffolding and guidance should be provided to guide investigation of the connections between science and culture. In the context of multicultural Australia, students researching, documenting and sharing stories of science and culture, may promote meaningful intercultural understanding.

APPY DAYS: A CASE STUDY OF SOILMAPP

Claire Harris and Peter Wilson

Presenting Author: Claire Harris

CSIRO Sustainable Agriculture Flagship

ABSTRACT

There are now 40 billions 'apps' downloaded to portable devices worldwide. Almost half (8.7 million) of adult Australians own a smart device, such as a tablet or mobile phone and during June 2012, 4.45 million adult smartphone users downloaded a mobile app.

The opportunities apps provide for greater, easier access and interaction with information and other people is undeniable. Many research and government agencies realise this and are supporting the development of apps for internal and external audiences. There are many factors that government agencies, like CSIRO, need to explore to develop and distribute apps.

This case study outlines the experience of the CSIRO team involved in the final development, release and promotion of SoilMapp, CSIRO's first official app. SoilMapp for iPad provides access to the best nationally consistent soil databases available in Australia.

This case study will provide an overview of: 1) the processes and inputs required for releasing SoilMapp (including from information technology, legal, business development and communication specialists), 2) the communication objectives, activities, and resources required, 3) challenges and learnings and what could or should have been done differently, 4) the impacts — both expected and unexpected — from the app, including for communication, research and project collaboration.

BUILDING A COMMUNITY OF PRACTICE IN FOOD SECURITY RESEARCH

Joanna Hicks¹, Wolf Wanjura² and Claire Harris³

Presenting Author: Joanna Hicks

¹ Australian Centre for International Agricultural Research;

² CSIRO Sustainable Agriculture Flagship, Ecosystem Sciences Division;

³ CSIRO Sustainable Agriculture Flagship

ABSTRACT

In 2013, a project between four Australian government agencies began. The Food Systems Innovation project aims to more effectively apply evidence-based approaches to agricultural development and food security policy and programs. Interestingly the project has a strong focus on learning, knowledge exchange, capacity building and communication.

The project team is working across agencies and many different disciplinary backgrounds: from biophysical and socio-economic science, to knowledge management and adult learning. This has presented a confronting yet fruitful environment for exploring what is, in the eyes of project supporters, critical to ensuring future impact of research for development.

This presentation will summarise some of the activities underway in the project centred around knowledge brokering and communication to improve the creating, sharing, and use of knowledge. Some of these activities include:

- understanding how people, with diverse backgrounds, for example scientists working in CSIRO and program staff working in AusAID, learn and apply knowledge
- developing a knowledge management system, building on the experiences of other projects around the world, as the basis of the online engagement within the Community of Practice
- establishing cross-organisation communication and engagement approaches and priorities.

CONTEMPORARY NEW ZEALAND INNOVATION STORIES

Paula Lourie, Rachel Douglas and Jenny Mangan

Presenting Author: Paula Lourie

Faculty of Education; University of Waikato

ABSTRACT

We are creating video stories of contemporary New Zealand innovations for the New Zealand Science Learning Hub (www.sciencelearn.org.nz/innovation).

Four Innovation stories have been published during 2013; YikeBike, BioSpife, Zealong Tea and Revolution Fibres. These stories, focusing on science and technology innovations, form the core of our collection of online multimedia Innovation resources.

Each Innovation story features the innovator(s) telling the story of their innovation. Their stories reveal the value of having or developing a deep knowledge base in science or technology, as well as giving insight into the process of innovation and the development of their cutting-edge product or business. Supporting the stories are articles, activities and shorter video clips.

Designed for teachers and their students, these unique Innovation resources support young people in developing an ability to recognise how innovation happens, to understand the value it can bring and, in doing so, to develop skills, attitudes and values that better prepare them for contributing to our fast-changing world.

Innovation is part of the Science Learning Hub, funded by the New Zealand Ministry of Business, Innovation and Employment and managed by the University of Waikato.

THE ART OF SCIENCE: THE ROLE OF THEATRE PERFORMANCE IN GETTING THE MESSAGE ACROSS

Michael Mills

Barbara Hardy Institute, University of South Australia, Adelaide, SA, Australia

ABSTRACT

In a multi-media presentation, that includes several excerpts from a number of recent performances, the role of music and theatre is explored in how it can illicit key emotional responses in its target audience. Music, in particular, has a key role to play in anchoring memories and engaging an audience in ways that no other art form can. Utilising music and theatre is consequently an extremely powerful tool in science communication. Through Heaps Good Productions, Michael Mills has developed a significant body of work in communicating scientific concepts and inspiring audiences to engage in science. This presentation will explore the role and kinds of performance, and how they can be used, as a part of science communication and citizen science programmes. It will include work Michael has been involved with in a range of scientific and cultural institutions, as well as recent work he's been engaged with as part of his new role as an Adjunct Research Associate at the Barbara Hardy Institute. With performances by several of Michael's most successful characters, including singing palaeontologist Professor Flint, this presentation will provide both a theoretical base for its central thesis, and a memorable theatrical experience for conference delegates. And as with all good theatre, will leave the audience wanting for more!

VIZBIPLUS – VISUALISING THE FUTURE OF BIOMEDICINE

Kate Patterson

Garvan Institute of Medical Research

ABSTRACT

'VIZBIplus: Visualising the Future of Biomedicine' is a new project funded by the Inspiring Australia government initiative, the Garvan Institute of Medical Research, the Walter & Eliza Hall Institute, and CSIRO. The project is being led jointly by Dr Kate Patterson at the Garvan Institute, Dr Sean O'Donoghue at CSIRO and Garvan, and molecular animator Mr Drew Berry at the Walter and Eliza Hall Institute.

The goal of VIZBIplus is to create awe-inspiring and scientifically accurate 3D animations that explain the latest medical research in a way that inspires and engages a general audience.

Animations are an effective way to communicate with various audiences. The complexities of science and biology can be easily communicated with visualisation by including the visual detail but avoiding the verbal scientific jargon that can be met with boredom and confusion. VIZBIplus biomedical animators use state of the art three-dimensional animation software, similar to that used by global animation studios such as Pixar, with dedicated software extensions that allow for raw scientific data to be imported directly. This means the structure of molecules such as DNA and proteins can be re-created exactly, according to the scientific data, which not only adds credibility to the animation but can also help inform new research questions.

AUSTRALIAN SCIENCE AND TECHNICAL STYLE MANUAL UPDATE —BIOTEXT BITES THE BULLET AT LAST!

Presenters: Janet Salisbury, Richard Stanford and Malini Devadas

Presenting Author: Janet Salisbury

Biotext

ABSTRACT

Janet Salisbury, Rob Morrison and others have been promoting the idea of an Australian science style guide since the early 2000s. In 2007, this was discussed at a science editors 1-day workshop Janet ran as a satellite of the 2007 World Conference of Science Journalists in Melbourne. Various options were considered but never went ahead because of the enormous volunteer effort involved. Janet has also had similar discussions with the editing community —with the same enthusiastic response but no capacity for developing the manual.

Meanwhile, Biotext has been working at the coalface of science writing and editing and has developed its own in-house science and technical style resources, which we are currently developing into an Australian science and technical style manual to bring to the market later in the year as a printed (book) and online resource.

It seems that this product requires a commercial basis (as evidenced by the fact that it has never go off the ground without it) and, after years of procrastinating, we are getting on with the job. However, to be a useful and respected Australian resource, we would like to engage with ASC and other science-based institutions, as we move through the final development stages.

At this very informal session, we will describe our concept and progress to date and discuss how ASC members can get involved in the next stages. It will also be a chance to air your pet likes and dislikes so as to ensure we include those in the manual.

LITTLE SCIENTISTS – SCIENCE, TECHNOLOGY AND MATHEMATICS FOR PRESCHOOL CHILDREN

Christine Schneyer

Little Scientists Initiative Australia

ABSTRACT

In this session you will be introduced to the ‘Little Scientists’ initiative that was launched in Australia at the beginning of 2013.

‘Little Scientists’ is a not-for-profit initiative designed to facilitate children’s curiosity for science, maths and technology through age-appropriate, fun and playful experiments already in their early years. Every education and care service that works with children from 3 to 6 years of age can join the programme and become an accredited “Little Scientists’ House”. Teachers and educators are trained through the initiative and encouraged to implement the programme together with the children in their care.

You will hear about the initiative’s establishment in Germany in 2006, its success story by now and how the ‘Little Scientists’ offer a sustainable, long term solution to skill shortages in scientific, technological and mathematical professions.

This session will also give you information on how you can become a part of the initiative and help to make the programme available to all children across Australia.

‘Little Scientists’ is a not-for-profit initiative of FROEBEL Australia and the “Little Scientists’ House Foundation” in Germany.

REAL SCIENTISTS: A CASE STUDY OF A ROTATIONAL CURATION TWITTER ACCOUNT TO CREATE ENGAGEMENT AND ACCESS TO SCIENCE DIRECTLY THROUGH SOCIAL MEDIA

James Smith, Upulie Divisekera¹, Sarah Keenihan² and Bernard Kealey

Presenting Authors: Upulie Divisekera and Sarah Keenihan

¹ Real Scientists/ Monash University;

² Science Writer

ABSTRACT

Can social media play a role in maintaining and even increasing engagement with science, especially access to hard science, the kind of basic research carried out in laboratories? Taking a cue from successful, nation-based rotational curation accounts on Twitter, we created a rotational curation account for scientists, science communicators, writers and clinicians to tweet their work live. The aim of this account was to create a space for engagement in the real-time world of Twitter: to allow direct access to scientists, assist scientists in communicating their work to stakeholders and to display the breadth of careers available to science graduates.

After six months with over 26 scientists and communicators from five countries, the account has garnered over 5000 followers, has successfully translated live twitter engagement to engagement with primary schools, with media including regular interviews on radio and engagement with journalists, networking between scientists themselves and recruitment to other science communication platforms. We examine how the platform successfully increases engagement and reduces perceived inaccessibility of hard science through direct contact between the scientist and the lay public, and how the account functions as a resource for teachers, journalists and communicators. We consider how the project can be expanded and used to increase direct access to actual research performed by scientists.

CAN WE CHANGE BEHAVIOUR USING YOUTUBE?

Miriam Sullivan and Nancy Longnecker

Presenting Author: Miriam Sullivan

Science Communication Programme, School of Animal Biology, University of Western Australia

ABSTRACT

YouTube videos are commonly used to communicate science to the general public. However, there is little evidence to show whether short, entertaining videos actually have any impact on viewer behaviour.

We conducted an innovative experiment to measure the impact of short Youtube clips on aquarium owners care of their pet fish. Two 50-second videos were created, one that was positively framed and one that was negatively framed.

Results showed that participants (n=197) who did not watch a video did not improve their aquarium care in the following month, even when they had intended to. Watching either one of the videos significantly improved aquarium care, but only if the viewer had a pre-existing intention to do so. There was no difference in behaviour between the positive and negatively framed videos, but participants who watched the positive video had increased recall and understanding of the key message.

Our research suggests that Youtube videos about pet care should be positively framed and target people who wish to change their behaviour but have not yet taken action on those intentions.

BLOOD, BODY SLAMS AND BICEPS: WHY SCIENTISTS SHOULD PUT DOWN THE PIPETTES AND WATCH PROFESSIONAL WRESTLING

Steve Ting

Centre for Science Communication, Department of Zoology, University of Otago, Dunedin, New Zealand

ABSTRACT

For many scientists, reaching out to the public world can be daunting, difficult and an often frustrating exercise. It is a world filled with irrational thought, conspiracy and denialism - cold hard facts just don't cut it.

Science needs to learn a few lessons in effective communication through unconventional means. Science needs to put its feet up and learn from the most successful forms of storytelling on the planet: professional wrestling.

I will use my knowledge of professional wrestling and background in the television industry to introduce you to the fundamentals of creative storytelling. I will show you that a well-executed piledriver is more effective in sharing your message than a just another factoid.

INTRODUCING GLOWHUB – WHERE SCIENCE AND NATURE COLLIDE

Siouxsie Wiles

Department of Molecular Medicine and Pathology, University of Auckland

ABSTRACT

As a publicly funded scientist I am committed to engaging with the public to raise awareness of the relevance of science to society. In 2011 I collaborated with the graphic artist Luke Harris to produce a short animation explaining why fireflies glow and how I use their light in my research. Uploaded to YouTube in Dec 2011 (http://youtu.be/kP_RaHo1Pmw) our video has had over 5,200 views to date. The sequel, about fireflies and NASA (<http://youtu.be/UUUytRol-5g>) has had over 6,400 views, and was shown at the 6th Imagine Science Film Festival held in New York in October 2013 (www.imaginesciencefilms.org/2013/09/20/from-fireflies-to-spaceinvaders/). In 2012, I was awarded a Public Engagement grant from the UK Society for Applied Microbiology to tell the story of how bacteria communicate using quorum sensing. Uploaded to YouTube in March 2013, the quorum sensing animation, featuring the Hawaiian bobtail squid (<http://youtu.be/KCobcWsYOS8>), has had over 6,500 views to date and led to a collaboration with artist Rebecca Klee for Auckland's annual Art in the Dark festival in November 2013 (<http://artinthedark.co.nz/2013-artists/rebecca-klee-siouxsie-wiles>).

As a result of winning the NZ Prime Minister's Prize for Science Media Communication, in 2013 I plan to make more animations and develop a dedicated website (GlowHub) to glowing nature-science animations alongside more information related to each creature and scientific application.

CAN WE LEARN FROM THE SCIENCE-BASED PUBLIC DEBATES OF THE PAST (AND PRESENT) AND USE THAT KNOWLEDGE TO SHAPE THOSE OF THE FUTURE?

Panellists: Kristin Alford¹, Craig Cormick² and Will Grant³

Producer: Bronwyn Terrill⁴

¹ Bridge8;

² CSIRO;

³ Australian National Centre for Public Awareness of Science, Australian National University;

⁴ Garvan Institute of Medical Research

SUMMARY

Have you ever wondered how past science debates might have played out 'if only...' the right messages had hit home, the right people were engaged, and the right responses had been given at the right time? What could have been achieved if the first GM crops had consumer benefit, people knew what 'nanotechnology' meant, that report hadn't been leaked, or people other than activists had been engaged?

Futurist Kristin Alford, communicator Craig Cormick, and researcher Will Grant try to design the scientific debates of the future, using insight from the past and present. Help our 'judges' (TBC: it could be you!) to push the panellists' scenarios to the limit. Make your vote count for the Science Policy with the ASC2014 'X-factor'.

ARC, NHMRC, CSIRO: THE LEADERS GIVE THEIR PERSPECTIVE ON SCIENCE COMMUNICATION IN 2014

Panellists: Warwick Anderson¹, Aiden Byrne², Oona Nielssen³

Facilitator: Niall Byrne⁴

¹ National Health and Medical Research Council;

² Australian Research Council;

³ CSIRO;

⁴ Science in Public

SUMMARY

The leaders of Australia's peak science agencies will address: What are their communication goals and how are they changing? What excites and frustrates them about the changing media landscape? What are they doing to support and/or change science communication to suit their organisations' needs.

THE NEW SCIENCE EVANGELISM: BOON OR BANE FOR SCIENCE COMMUNICATION?

Panellists: Anna-Maria Arabia¹, Rod Lamberts², David Ritter³ and Paul Willis⁴

Facilitator: Will Grant²

Producer: Rod Lamberts

¹ Inspiring Australia, DIISRTE;

² Australian National Centre for Public Awareness of Science, Australian National University;

³ Greenpeace Australia Pacific;

⁴ RIAus

SUMMARY

“We fear not your gods, our strength flows from science” anon

Traditional scientific communities in Australia are becoming more and more interested in the benefits of communicating with the community at large. This burgeoning communication-consciousness is leading to an encouraging upsurge in scientists’ appeals for science communication. While it’s brilliant that science communication is on more agendas, there is also a troubling downside.

Accompanying the increased interest in getting science ‘out there’ is a revival of old-school deficit approaches to science communication. We all know this litany:

1. the more science facts people know, the more they will support and accept science across the board,
2. proclaiming the awesomeness of science will convert the unbelievers, and
3. the best public communicators of science are scientists themselves

What is it that science wants from science communication? If it is simply to make people like science, are we in danger of becoming the propaganda arm of the great revivalist church of science? Would that be a bad thing? Do we want to be the happy-clappers of science, or is there higher, more noble calling to which we should all aspire? Join our panel of wildly-experienced, ever-so humble science communication and policy luminaries as they brawl over the pros and cons of science evangelism in the public domain.

Repent ye, for the scientists are coming. And they want you for their own.

HOT AIR OR HOT ACTION: HOW COMMUNICATION CAN HELP TRANSLATE RESEARCH INTO ACTION IN AREAS SUCH AS CLIMATE CHANGE

Panellists: Jaelle Bajada¹, Lyndal Byford², John Gardner³, Alvin Stone⁴ and Corey Watts⁵

Facilitators and Producers: Simon Torok⁶ and Claire Harris⁷

¹ National Carbon Capture and Storage Council;

² Australian Science Media Centre;

³ CSIRO Ecosystem Sciences;

⁴ ARC Centre of Excellence for Climate System Science;

⁵ The Climate Institute;

⁶ CSIRO Marine and Atmospheric;

⁷ CSIRO Sustainable Agriculture Flagship

SUMMARY

The challenges of communicating climate change have been talked about for years, including at past ASC national conferences. For the last decade at least, sectors of the economy have been getting on and responding to climate change, energy demands, a carbon price and wider economic changes. How have organisations and individuals tracked the scientific and societal developments to implement climate mitigation and adaptation policy and practices?

This session will draw on perspectives from a diverse group of speakers with expertise ranging from psychology to media to government policy. This session will provide attendees with upbeat views of how to move forward with communicating in controversial arenas, using climate action as the catalyst for discussion. Participants will hear examples of moving from climate science to action, moving from traditional media to social and digital media, and moving from the deficit model of communication and conduit metaphor to more interactive dialogue. With this dynamic panel and in the lead up to the release of the IPCC's Working Group 2 (Impacts and Adaptation) report at the end of March 2014, we are expecting plenty of audience discussion.

LEARNING FROM/ WORKING WITH OTHER DISCIPLINES

Panellists: Gabriele Bammer¹, Mel Kettle² and Lilly Lim-Carmacho³

Producer: Corinna Lange⁴

¹ National Centre for Epidemiology & Population Health, Australian National University;

² Communication and Social Media Consultant;

³ CSIRO Science into Society Group;

⁴ Pear Communication

SUMMARY

Many problems facing society are complex—global climate change; managing natural resources such as water; obesity and other public health issues—and cannot be fixed by good scientific research alone. Science communication practitioners are increasingly looking to other disciplines to inform and improve their practice. The speakers in this session will each present some insights from a different discipline that might support what you are already doing, or could be incorporated into your science communication practices.

THE VALUE OF VISUALISATION IN SCIENCE COMMUNICATION

Panellists: Drew Berry¹, Bobby Cerini², Shilo McLean³, Kate Patterson⁴ and Mary Rosengren⁵

Facilitators: Signe Cane⁶ and Tim Dean⁶

Producer: Kate Patterson

¹ Walter and Eliza Hall Medical Institute;

² Geoscience Australia;

³ Enmore Design Centre;

⁴ Garvan Institute of Medical Research;

⁵ LaTrobe University;

⁶ Wonder

SUMMARY

What is the role of science-inspired art in science communication? ie. what is the cultural artistic value of science visualisation and how is this balanced with the monetary value and communicative value? Hear from the panel as they share their thoughts and experience on this, as well as how they approach balancing artistry and accuracy and, how to weave visualisation with words in practice and then quantifying value/ impact.

BUSINESS AND INDUSTRY, COMMUNITIES AND CONTROVERSY: WHAT ROLE DOES SCIENCE COMMUNICATION PLAY IN PUBLIC ENGAGEMENT

Panellists: Geoff Brooke¹, Kurt Heidecker², Jacqui McGill³, Suzanne Miller⁴ and Jason Prior⁵

Facilitators and Producers: Julia Martin⁶ and Claire Harris⁷

¹ GBS Venture Partners;

² Gladstone Industry Leadership Group;

³ BHP Billiton Mitsui Coal;

⁴ Queensland Museum Network;

⁵ Institute for Sustainable Futures; University of Technology Sydney;

⁶ Freelance Writer and Researcher;

⁷ CSIRO Sustainable Agriculture Flagship

SUMMARY

Business and industry communicate about science and technology and conduct community engagement for many different reasons. Featuring a diverse panel of business, industry and engagement leaders, this session will explore:

- why and how business and industry gets involved with science communication and outreach activities
- the importance of connecting and engaging with audiences (in ways you wouldn't have imagined)
- building meaningful relationships through science engagement
- how business and industry think about impact and the value of communicating
- what works, what doesn't for building effective partnerships and why relationships are so important.

Those attending the session will hear from and be part of a discussion with the innovators working at the complex nexus between business and industry, communities, investors, government and science itself.

DELIVERING INTEGRATED REPORTS FROM INTERDISCIPLINARY PROJECTS

Panellists: Heinz Buettikofer¹ and Becky Schmidt²

Producer: Maryam Ahmad³

¹ Cartographer;

² Accredited Editor;

³ CSIRO

SUMMARY

How can over 100 authors produce a suite of integrated and consistent interdisciplinary reports that clearly communicate the outcomes of scientific research, adequately visualise these outcomes and address stakeholder needs? CSIRO has been delivering reports in such environments for years and has developed innovative and adaptive workflows to achieve this end. These workflows involve the skills of editors, mapmakers and data visualisation experts. These reporting experts need to work together to ensure the consistency and quality of the final product and do so using tools (such as reporting standards), collaborative software (such as Microsoft SharePoint) and diligent file versioning protocols.

The team will present a panel discussion, including a role-playing session and an open question and answer session. The role playing session will illustrate how a common reporting issue is raised and resolved including the flow-on implications that it has on every aspect of reporting. The panel will also cover issues regarding the needs of the report's authors, reviewers and audience and how they shape each specific report to ensure maximum clarity of communication.

SCIENCE AS NEWS

Panellists: Lyndal Byford¹, Bridie Smith², Jake Sturmer³

Producer: Niall Byrne⁴

¹ Australian Science Media Centre;

² The Age;

³ ABC;

⁴ Science in Public

SUMMARY

Science news reporting is changing rapidly in Australia. There are fewer specialist reporters and those that are left are working in different ways. Their stories are more likely to be syndicated –used across multiple publications. And they're often filing across platforms: for print, radio, video, and social media.

But news is still news.

Our panel of journalists covering the science round will discuss what turns science into news for them and how their rounds are changing

SOCIAL MEDIA IN SCIENCE: HERO OR VILLAIN?

Panellists: Tamzin Byrne¹, Elizabeth Finkel², Will Grant³, Damian Harris⁴, Vanessa Hill⁵, Rod Lamberts³, Merryn McKinnon³, Jenni Metcalfe⁶ and Natasha Mitchell⁷

Producer: Ian McDonald⁸

¹ Science in Public;

² COSMOS Editor in Chief;

³ Australian National Centre for Public Awareness of Science, Australian National University;

⁴ Department of Science, Environment, Engineering and Technology, Griffith University;

⁵ CSIRO;

⁶ Econnect Communication;

⁷ ABC;

⁸ Science communication professional

SUMMARY

Facebook, Twitter, YouTube, Instagram - social media has landed in our lives, transforming the way we communicate and connect with new and larger audiences. But it's also a world occupied by anonymous trolls, aggressive flammers and short attention spans. Now everyone's got an opinion and a soap box to spruik it on. Is social media a hero for science communication - better allowing communicators to connect, share research, and promote open public dialogue and debate? Or is it a villain - tempting us to oversimplify, get distracted by flame wars, and lose sight of wider audiences? Six savvy science communicators will go tweet to tweet in a debate for our times!

SCIENCE INTEREST THROUGH THE ‘DIFFICULT YEARS’

Panellists: Craig Cormick¹, Tom Gordon², Kelly Matthews³, Yvonne Van Der Ploeg⁴ and Graham Walker⁵

Producer: Simon Carroll⁶

¹ CSIRO;

² School of Physics, University of Sydney;

³ Teaching and Educational Development Institute;

⁴ BioLAB: The Victorian BioScience Education Centre;

⁵ Australian National Centre for Public Awareness of Science, Australian National University;

⁶ Scitech

SUMMARY

The “difficult years” are the years characterised by a decline in participation in formal science study as well as substantial competition for the time and energy towards science-related activities in general. These correspond with transitioning through “youth”. Many organisations focus on young people in these years, and many struggle with them.

This panel session will draw on the expertise of a number of people and their organisation’s approaches to strategies and actions that have been undertaken or are planned to address this concern.

THE NATIONAL ENGAGEMENT STRATEGY, FROM INSPIRING AUSTRALIA TO INSPIRING NEXT DOOR

Panellists: Allan Dale¹, Keely Quinn² and Kylie Walker³

Producers: Simon France⁴ and Claire Harris⁵

¹ James Cook University;

² Inspiring Australia, Northern Territory;

³ Australian Academy of Science;

⁴ Inspiring Australia, Department of Industry, Innovation, Science, Research and Tertiary Education;

⁵ CSIRO

SUMMARY

The Inspiring Australia Strategy is one of only a handful of national science engagement strategies in the world. Developed in consultation with a wide range of science communicators, educators, journalists and scientists in all states and territories, the strategy provides a platform for national coordination and leadership for science engagement across Australia. But how did the strategy get to where it is today, who is involved and what effect is it having?

Hear from Professor Allan Dale, Kylie Walker, and Keely Quinn in this interactive session which will be an opportunity to examine the strategy, to look at what has worked and what hasn't, as well thinking through how it could be improved.

Topics such as how the strategy came into place, how the national framework has been built, what online tools and training are being developed, how national grants are allocated, how the partnerships and infrastructure of the Inspiring Australia Programme were implemented, who is doing what under the programmes or what is evolving within the Science Sector Group are all up for discussion in this session. Bring your questions and ideas for this discussion with staff from the Inspiring Australia Programmes and communication and science representatives from other science agencies.

SCIENCE JOURNALISM UNDER THE MICROSCOPE

Panellists: Leigh Dayton¹, Jenni Metcalfe², Graham Readfearn³ and Ian Townsend⁴

Facilitator: Natasha Mitchell⁴

Producers: Bianca Nogrady⁵ and Sarah Keenihan⁶

¹ Science writer and broadcaster;

² Econnect Communication;

³ Independent journalist and blogger;

⁴ Australian Broadcasting Corporation;

⁵ Freelance science journalist and author;

⁶ Freelance science writer

SUMMARY

Journalism. Communications. Public relations. Advocacy. When it comes to presenting science in the public sphere, all have an important part to play.

But are boundaries becoming dangerously blurred? Science - like any human endeavour - is shaped by powerful vested interests and agendas. Is the vital role of science journalism as a source of independent, investigative analysis being lost? At what cost? As jobs dry up, many journalists need to take on science PR work. Scientist bloggers or communicators writing for clients see their output as journalistic too. In controversies over climate change and public health, some journalists have become advocates in their coverage - is that their role?

What's journalism, what's not and does it matter anyway? Is a hybrid future possible?

KNOWLEDGE BROKERING IN AUSTRALIA: INFLUENCING POLICY AND PRACTICE

Panellists: Dorean Erhart¹, Stefan Kaufman², Suzanne Long³, Jean Palutikof⁴ and Liam Smith⁵

Producer: Eve Merton⁶

¹ Local Government Association of Queensland;

² EPA Victoria;

³ Terrestrial Ecosystem Research Network;

⁴ National Climate Change Adaptation Research Facility, Griffith University;

⁵ Monash Sustainability Institute, Monash University;

⁶ La Trobe University

SUMMARY

This session will bring together current and potential knowledge brokers, practitioners and researchers, for presentations from influential speakers, and a mini-write-shop on best-practice in influencing policy and practice. Researchers, practitioners and policy makers will be paired for lively presentations about their experiences — what works in the research-into-policy arena, research use or non-use and knowledge brokerage. Although knowledge brokerage is becoming recognised as a field of practice and an area ripe for academic study, knowledge brokers have tended to operate in isolation from each other, particularly in Australia. A network and community of practice to bring together knowledge brokers to discuss theory and practice is overdue. The potential for a national network will be explored in the second part of the session.

SCIENCE COMMUNICATION AND LEADERSHIP (Parts 1 & 2): LEARNING FROM OUR JOURNEYS

Panellists: Susannah Elliott¹, Cathy Foley², Misty Jenkins³, Léonie Rennie⁴ and Sue Stocklmayer⁵

Producers and Facilitators: Sarah Lau⁶ and Claire Harris⁷

¹ Australian Science Media Centre;

² CSIRO Division of Materials Science and Engineering;

³ Peter MacCallum Cancer Centre;

⁴ Curtin University;

⁵ Australian National Centre for Public Awareness of Science, Australian National University;

⁶ ChemCentre;

⁷ CSIRO

SUMMARY

Part 1: An effective science communicator needs to be an effective leader – persuading, engaging, communicating a vision and delivering action. In part one of this session, hear some of Australia's most influential women in science and science communication as they share their leadership journeys and experiences influencing others.

Part 2: Attendees take on an active role, as a facilitated discussion translates the leadership lessons from the first section into initiatives and actions to help build a culture of science communication. With guidance from the leadership panel, attendees will discuss useful approaches to developing relationships, promoting successes, engaging others and enhancing impact.

EVOLUTION OF SCIENCE COMMUNICATION IN AUSTRALIA AND NEW ZEALAND

Panellists: Jean Fleming¹, Toss Gascoigne² and Ian Lowe³

Facilitator: Jenni Metcalfe⁴

Producer: Toss Gascoigne

¹ Centre for Science Communication; University of Otago, Dunedin, New Zealand;

² President, Public Communication of Science and Technology;

³ Griffith University;

⁴ Econnect Communication

SUMMARY

This session will offer insights to the development of science communication in New Zealand and Australia. It will link research, good practice and the reality of practice by including speakers with backgrounds in academia, journalism and science communication. Speakers will provide insights on the development of science communication as both art form and academic discipline, including a timeline to the emergence of modern science communication in both countries, with supporting infrastructure, funding, events, organisations and festivals. It will also be an opportunity to celebrate and reflect on where we've come from and where we are at.

ACROSS THE TASMAN: SCIENCE COMMUNICATION IN NEW ZEALAND

Panellists: Jean Fleming¹, Fabiana Kubke² and Siouxsie Wiles³

Facilitator: Jenni Metcalfe⁴

Producer: Christine Ross⁵

¹ Centre for Science Communication, University of Otago;

² School of Medical Sciences; University of Auckland;

³ Department of Molecular Medicine and Pathology, University of Auckland;

⁴ Econnect Communication;

⁵ NAIT

SUMMARY

So what does happen in this not-so-far-away land? A great deal, it turns out. Science communication started in New Zealand over 20 years ago, and has changed considerably from the early days. From living as a scientist in the public eye, to teaching budding neuroscientists to communicate by engaging with everything from Wikipedia to parliamentary submissions, New Zealand science communicators are going from strength to strength.

WORKING WITH SCIENTISTS IN DEVELOPING COUNTRIES TO COMMUNICATE SCIENCE

Panellists: Toss Gascoigne¹, Michelle Kovacevic² and Cathy Reade³

Producer: Jenni Metcalfe⁴

¹ President, Public Communication of Science and Technology;

² Centre for International Forestry Research;

³ Crawford Fund;

⁴ Econnect Communication

SUMMARY

This session will use the experiences of the speakers and specific case studies from Africa, Asia and the Pacific to look at how scientists working in developing countries can create the most impact from their research. This is particularly important given the goals of such research to help with food security and alleviate poverty. The session will provide insights for participants about the specific needs and opportunities for communicating science in developing countries.

OPEN OR PERISH: LONG LIVE THE NEW KING

Panellists: Mark Hahnel¹, Richard Jefferson², Fabiana Kubke³, Clive Morris⁴ and Pia Waugh⁵

Producer: Maia Sauren⁶

¹ figshare;

² Queensland University of Technology;

³ School of Medical Sciences; University of Auckland;

⁴ National Health and Medical Research Council;

⁵ Australian Government CTO;

⁶ ThoughtWorks

SUMMARY

With new ARC and NHMRC guidelines, research in Australia is fast moving towards open publishing as the default. Initiatives like GovHack are finding new and innovative ways to analyse, visualise and distribute the newly publicly available government data. Researchers are publishing their work in progress and engaging with the public before, and often as an alternative to, established publication routes.

This session will discuss how the move to open research and open science is changing the way science is done and communicated.

THE IDIOT, THE DISENGAGED, THE COUNTERPUBLIC: RETHINKING AUDIENCES FOR SCIENCE COMMUNICATION

Panellists: Gay Hawkins¹, Fabien Medvecky² and Maureen Burns³

Producer: Joan Leach

¹ Centre for Critical Cultural Studies, the University of Queensland;

² Science Communication Program, the University of Queensland;

³ Media Studies, the University of Queensland

SUMMARY

Despite the move to ‘third wave’ science communication focusing on engagement, there is still substantial anxiety in policy discourses guiding funding for science communication and among science communication practitioners. This anxiety centres around those who are seen to be ‘opting out’ of science communication or engagement activities. This panel is a focused collection of some of the latest theory and research across disciplines (sociology, media and cultural studies, economics, social studies of science) that addresses this anxiety and offers new ways of thinking about audiences for science communication.

HITCHHIKER'S GUIDE TO THE DIGITAL UNIVERSE

Panellists: Bernie Hobbs¹ and Jenni Metcalfe²

Producer: Alison Leigh³

¹ ABC Science Online;

² Econnect Communication;

³ World Congress of Science and Factual Producers

SUMMARY

For some time now, science on television has been an endangered species, with traditional outlets for science documentary disappearing like the arctic ice. Yet the appetite for science has never been greater – witness the explosion of blogs and podcasts across the digital universe. Everyone can be a broadcaster in this brave new world and the new generation of science communicators is spreading the word that geek is cool and science is awesome. From the classics to the quirky, from the landmark series to the one off little gem, The Hitchhiker's Guide brings you the good, the bad and not so ugly world of science broadcasting 2013-4.

CORPORATE STORYTELLING

Shawn Callahan

Presenter: Shawn Callahan

Anecdote Pty. Ltd.

SUMMARY

Stories are how we make sense of the world. This session is about oral storytelling in a work setting. We all do it but most of us are unaware of our storytelling skills. And when we become aware and build our skills we can increase our ability to influence, engage and inspire the people around us.

In this session you will learn the following:

- how to spot oral stories. Amazingly we see people talking about stories but not actually telling stories. This is a fundamental skill because you don't get the benefits of storytelling unless you are telling stories
- how to find stories to tell and ways to manage your story collection
- how to use stories to make a connection and build a relationship with an audience or one-on-one
- the features of oral stories and what makes them so memorable, engaging and why they can inspire action.

And because storytelling is a skill there will be plenty of opportunity for the participants to try out the techniques. The major outcome from the session is that participants will return to work with the enthusiasm to find and tell stories, the confidence to give it a go and help others give it a go, and the knowledge that it's an effective way to communicate face to face.

This session is based on Anecdote's storytelling for leaders program (<http://sotrytellingforleaders.com>).

EDITING SCIENTIFIC CONTENT (PARTS 1, 2, 3)

Malini Devadas

Presenter: Malini Devadas

Biotext

SUMMARY

All science communicators need editing skills to edit their own or other people's work. By the end of this three-hour workshop, you will understand the three stages of the editing process that professional editors use:

Substantive editing — In part one we will discuss methods to analyse the structure and substance of a piece of writing. We will look at individual paragraphs, explaining how to ensure that a paragraph contains one idea and that the sentences in the paragraph flow logically. We will also look at individual sentences and discuss tips for identifying common errors in writing.

Copyediting – In part two we will look at how to create and follow an editorial style guide. We will discuss current trends in capitalisation, punctuation and spelling as well as issues unique to science writing.

Proofreading – In part three we will discuss the proofreading process and practise hardcopy markup (including discussion of proofreading symbols).

GETTING PUBLISHED IN SCIENCE

Hilary Hamnett

Institute of Environmental Science and Research Ltd

SUMMARY

This session is for anyone who wants to know more about successful science publishing. Having worked in science journals and books for five years and handled thousands of manuscripts from submission to publication, I have picked up numerous hints and tips for would-be authors. The session will cover: preparing your manuscript (*i.e.*, what to put in each section and effective use of figures and tables); choosing the right journal; and strategies for getting your paper past the editor. There will also be time for questions and discussion of attendees' experiences with publishing.

SCIENCE COMMUNICATION ON THE INTERNET – A BEGINNER’S GUIDE

Alex Jurkiewicz

Australian Science Communicators

SUMMARY

The web is the future of science communication! ...unfortunately, it is also characterised by an ever-changing zeitgeist and geek-oriented tools. So what’s a science communicator without their own IT department to do?

Join Alex Jurkiewicz as he presents pragmatic advice and real-world examples showing the “what” and “how” of managing a science-oriented web presence. We’ll go over the big decisions you’ll want to make early on, survey the major services you’ll want to consider joining and then dive into the technical nitty gritty of what, exactly, you need to do.

This presentation will cover recommended approaches, providers and more for managing technical resources, from domain names to websites to the multifarious social media services popular today. More general questions will also be answered, like, “when will a social media account add value to the business?”, and “should we have individual accounts, or a single corporate one?”

Bring a laptop (or tablet) and your own questions!

INSPIRING AUSTRALIA'S DIGITAL ENGAGEMENT SESSIONS: TOPIC 1 DIGITAL STRATEGIES TOPIC 2: ARE YOU A DIGITAL OPTIMIST OR PESSIMIST?

David Keane

Griffith University

SUMMARY

Irrespective of whether you're a government organisation, from private industry or an individual the digital space is a key element of strategic and operational activity. The force of the digital impact on many facets of business operations, human resource management, corporate knowledge, web and social interactions etc, will need to be tightly bound to your major vision, objective and strategic statements. In the session we will review the elements of a good digital strategy highlighting the diverse impacts that it can have within an organisation.

Awareness, consideration, favourability and loyalty to your message are not just a matter of quality information. There are approximately 50 major concepts to consider in obtaining a quality digital product whether it is a website, blog or app. The top 15 of these will be reviewed in terms of evidence based reasoning rather than accepting hype and urban myths.

FROM CONCEPT TO SCREEN: NAVIGATING THE ANIMATION PROCESS AND GETTING THE BEST RESULTS

Adrian King

Redboat

SUMMARY

This session offers a unique inside view of the animation production process, getting right down to the nitty-gritty details. No matter what your involvement with animation is, the principles and practices shared in this workshop will prove valuable.

Visualising scientific concepts and stories has become increasingly important and popular. Animation offers one of the most effective and versatile mediums for achieving this. Understanding the process makes a huge difference to the resulting audience appreciation and how much fun you'll have making it.

In this workshop Adrian will unpack 15 years of running an animation business, selecting, employing, managing and directing teams of animators and visual-fx artists.

You will explore how to navigate the stages of animation production from initial concept all the way to the screen. You'll learn the ingredients to getting the job done on time, on budget and to everyone's satisfaction.

This session is for:

- Communicators wishing to use animation or visual effects to tell stories and convey messages
- Managers seeking to make efficient and effective use of the medium of animation.
- Professionals who need to work with animation companies or animators.
- Animators seeking to improve their project management skills.

COLLECTING EVIDENCE TO DETERMINE IF YOU HAD AN IMPACT

Nancy Longnecker, Jo Elliott and Mzamose Gondwe

Science Communication Programme, School of Animal Biology, University of Western Australia

SUMMARY

In this workshop, you will consider evaluation tools developed by the presenters in a project supported by Inspiring Australia. This work contributes to the Inspiring Australia objective of developing the evidence base for science engagement.

The presenters will provide examples of different evaluation tools, show illustrations of results from their use and lead a discussion about choosing evaluation tools. Attendees will consider evaluation for the sometimes competing requirements of reporting and learning what is needed to improve activities as well as compatibility of different tools with available resources and audience constraints.

Opportunities will be explored to establish or build on collaborations that facilitate evaluation of different programs.

COMMUNITY JOURNALISM SERIES: ART AND PRACTICE OF STORYTELLING, PARTS 1, 2

Facilitator: Susan Rooney-Harding¹

Producer: Kali Madden²

¹ Inspireevery1 Productions;

² Australian Science Communicators

SUMMARY

Sharing stories is possibly one of the most important ways we have of communicating with each other. It is how we share our hopes and fears, dreams, and passions and what we believe and value as well as what we do not. We discover and make sense of our lives by telling the stories we live and we find out about other lives by listening to the stories they tell.

This workshop will cover all the essential elements to capturing a great story as well as a practical section to help you put storytelling into practice for your not-for-profit.

Join this workshop to discover:

Finding the story

- What makes a good story and why
- The most important thing of all when catching stories

Bringing the story out

- Interviewing technique
- The 6 steps to an awesome interview
- The best questions

Storyboard creation

- What is a storyboard
- How to make a storyboard

Video interviewing

- The 4 elements to a great video interview

Story capturing put into practice

- Practical section
- Practice makes perfect

COMMUNITY JOURNALISM SERIES: ART AND PRACTICE OF STORYTELLING, PART 3

Facilitator: Susan Rooney-Harding¹

Producer: Kali Madden²

¹ Inspireevery1 Productions;

² Australian Science Communicators

SUMMARY

iPad/iPhone movie making using your iPads and iPhones.

Learn how to create a short video from your iPad/iPhone. You no longer need expensive cameras, editing suites and audio recorders! All you will need is an iPad or iPhone, a few cool apps and some inexpensive tools and you have yourself a onestop media creation kit. In this day course you will learn how to use your iPad/iPhone to create a short video piece. Hosted by The Edge, State Library of Queensland.

In this workshop we will cover:

- Apps – what apps are needed and some cool tools that are available to get
- the best audio and footage,
- Making a Short Video - How to shoot great footage and capturing clear audio,
- Editing and publishing your work.
- What you will need to bring:
 - iPad, iPhone.
 - Apps to install on iPad/iPhone:
 - Install iMovie app

DO YOU SPEAK COMMERCE?

Fiona McNee

BigPic, Your Commercial Foundations

SUMMARY

After years of focus on your technical disciplines, the commercial world can seem like another planet – remote, avoidable and best left to others who are interested in dealing with it. But, like any foreign country, the commercial world has much to offer a traveller, whether you and your internal stakeholders are looking to run their own company, their own laboratory or their own research agenda.

Your Commercial Foundations provides innovators with an immersion course in the language and culture of the commercial world. YCF take a new approach to uptake skills that isn't solely driven by sales, but encompasses the broader outcomes of industry productivity and public good. Moreover, we've founded our modules on the unique and particular needs of our specialty audience – innovators and creators – in contrast to existing programs whose starting point is the content they can provide.

This workshop will provide attendees with an introduction to the basic concepts of Conversational Commerce - the language school equivalent to being able to find the right train station to the airport, with a cup of decent coffee to savour on the way. At its end, you'll have a new way of looking at your audiences, their motivations and your mutual interests - a new appreciation for what you do and how you do it.

You don't need to emigrate to get the benefits of a new horizon. Take the first step from tourist to traveller – dip your toes into Conversational Commerce.

SPECTRUM SCIENCE-ART EXHIBITION OPENING

Presenter: Signe Cane¹

Producer: Kate Patterson²

¹ Wonder;

² Garvan Institute of Medical Research

SUMMARY

From artwork to illustration to diagrams, visuals play a significant role in science communication. They tell stories, emphasise points, and convey messages. They also engage you, inspire you and give pause for appreciation.

This year, in ASC's 20th year, we host yet another science art exhibition "SPECTRUM" to explore the range of art inspired by science, science communication enhanced by artists' tools and reflections of the sci comm community.

CHARISMATIC COCKATOOS

Mandy Bamford, Mike Bamford, Shannon Ducker and Simon Cheriman

Bamford Consulting

CONCEPT

'Charismatic Cockatoos' is one of 14 signs and associated web content created as part of the newly created Agora Interactive Bushwalk at Trinity, in Perth, Western Australia. The bushwalk aims to educate residents, visitors and local schoolchildren about the value and conservation of Banksia Woodland.

Each sign links to additional content on the Agora Bushwalk website. Information on the web may be accessed by scanning the QR code at the bottom left hand corner of the sign or by visiting www.agorabushwalk.com.

To complement the signage, an education package is being developed for the area and will be launched shortly.

The design of 'Charismatic Cockatoos' includes elements of a feather and Banksia cone to integrate with the information and scientific illustration of Carnaby's Black-Cockatoos and Banksia trees displayed on the sign. The QR code links to sound and video of the Cockatoos, created for the project by a local film-maker. The film may also be accessed by visiting www.agorabushwalk.com/signs/cockatoos

EARTHSCI – A NEW TOOL FOR COMMUNICATING SCIENCE THROUGH 4D DATA VISUALISATION

Bobbi Cerini and Norman Mueller

Geoscience Australia

CONCEPT

Seeing water through time

The Water Observations from Space image is a colour-scale of how many times water was detected from the Landsat 5 and 7 satellites over central Australia from 1998 to 2012. The area covered includes Lake Eyre (at left), Cooper Creek (right of centre) to the Paroo River (bottom right). A standard rainbow colour scheme (red-orange-yellow-green-blue) is used to show range, from a very low number of times water was detected (red) to a very high number of times (blue). This means that red areas are hardly ever wet while blue areas are more permanent water features such as lakes.

SPLENDOUR AND IN THE MIX

Eleanor Gates-Stuart

Australian National Centre for the Public Awareness of Science; Australian National University

CONCEPT

These works are part of the 'StellrScope' Project, a Science Art Commission by the Centenary of Canberra and residency with the CSIRO. The images are science influenced and are an investigation into wheat research over the 100 year in Australia.

BugBox, BugDome, BugPrep, BugTxt

Eleanor Gates-Stuart

Australian National Centre for the Public Awareness of Science, Australian National University

CONCEPT

These images are science inspired artworks that were used as series of backdrop sketches for 3D Holograms. The images combine photographs of insects from the Australian National Insect Collection (ANIC), sketchbook notes and a reference to 3D modelling. The aim was to create a lively set of artworks to attract the viewer for a closer look at insects (directing them to ANIC & CSIRO) whilst creating an interesting artwork.'

I work with scientific collections to produce artwork that embeds information and layering of artefacts as a process of 'collapsing time' in bringing new meaning. Artworks are drawn from various references including science, literature, technology and nature, for example, Bugs, have been gathered from the Australian National Insect Collection (ANIC) and reconstructed through 3D scanning and animation rendering.

THROUGH A SCIENCE LENS

Paula Lourie and Meredith Ross

Faculty of Education, University of Waikato

CONCEPT

Welcome to our project, [Through a Science Lens](#).

What we're doing

We're exploring science through words and images. We take our prompt from the [Wordpress Photo Challenge](#). Every week, working independently, we take a photo in response to the week's Challenge. We write the story of our own photo, incorporating an element of science. And then we publish our work side by side on this blog!

Who we are

We're Paula Lourie (@paulalourie) and Meredith Ross (@meredithross), two scientists who met while writing for the [Science Learning Hub](#). We're in New Zealand - Hamilton, to be exact.

How we started

Through a Science Lens began as a structured way to help us both improve our digital photography. It still fulfils that purpose – but it has evolved into a broader project of exploration and connection-making with a science focus.

What we're loving

The weekly surprise of juxtaposition: between photo and text, and between our two voices. The licence to tell our own stories, and in the first person. The buzz of displaying our work on an interactive 'gallery wall'. The discipline of a shared weekly task. And the freedom not to seek perfection in every post, but instead enjoy the process of developing each one.

THE EDGE

Jenni Metcalfe
Econnect Communication

CONCEPT

This is a close up photograph of a crystalline salt at the edge of Lake Eyre, South Australia, taken in July, 2011 with a Nikon 2H camera, when the lake was filled with water after heavy rains. The photograph is part of a larger exhibition of photos, entitled The Edge, on display at Kurilpa Studio in West End Brisbane.

Edge

A line, a door opening or closing, in a corner.

Sea thrusting into sand
on a flooding tide.

A rainfall gradient
in the desert, etching
stripes in the sediment.

The pale horizon surrounds
the broad, empty sea.

Riverbank reflections
mirror and stretch
towards each other.

They are all an edge
of sorts.

Not necessarily
straight or well defined.
Often a blur of transition
between one place
and another.

A gathering abundance
of food for birds, fish
insects and crustaceans.
As life and death
play out at the margins.

Lantana thickens the
disturbed rainforest.

A million pieces
of plastic mingle
with the pumice.

Debris strewn across
the collapsing sand.

The earth hardens
and cracks.

As signs of human
destruction shrink the
edge inwards.

DNA AND NUCLEOSOMES

Kate Patterson

Garvan Institute of Medical Research

CONCEPT

DNA and Nucleosomes is a still image taken from an animation about how thousands of molecular mistakes can occur in cancer and that cancer is not one disease. Our DNA encodes the genetic information needed to make molecules such as proteins, which are the building blocks of our bodies. This image shows the DNA strand wrapped around proteins called histones, which creates a nucleosome. These structures are derived from crystallography information, imported from the protein databank to Molecular Maya, a 3D modelling and animation tool for biomedical animators. This animation is part of a larger project called VIZBIplus: Visualising the Future of Biomedicine'. VIZBIplus is funded by the *Inspiring Australia* government initiative, the Garvan Institute of Medical Research, the Walter & Eliza Hall Institute, and CSIRO. Its goal is to train three scientists to create scientifically accurate 3D animations that explain the latest biomedical research in a way that inspires and engages a general audience.

LIVING LIGHT

Siouxsie Wiles and Rebecca Klee

Department of Molecular Medicine and Pathology, University of Auckland

CONCEPT

In 2013 I collaborated artist Rebecca Klee on an installation for the Auckland Art in the Dark festival. Our work was based on an animation I had made with graphic artist Luke Harris about the Hawaiian bobtail squid animation and its bioluminescent bacterial partner. The artwork featured 3D printed squid filled with glowing bacteria. We also blogged about the project as it developed and made a time-lapse movie of the bacteria growing and glowing on petri-dishes (<http://labtothepark.wordpress.com/>).

VARIETY

David Wong

Freelance Photographer

CONCEPT

This image was created as part of the Meet Your Neighbours initiative, an international project that aims to put the spotlight on the species all around us. Inspired by the out-to-white style made famous by Richard Avedon, the living subjects are photographed *in situ* on a bright white background using a “field studio”. The aim is to move viewers to care about the subjects just as they may respond to a human portrait. This image is a composite of a number of images captured using this technique.

The image was part of a Meet Your Neighbours - Canberra exhibition that was shown in a local gallery in Canberra and as part of National Science week. Children participating in the activities at science week were encouraged to draw an ecosystem on a whiteboard next to the images.

More information on Meet Your Neighbours can be found at <http://meetyourneighbours.net/>

SCINEMA SCREENING: BEST USE OF VISUAL IN SCINEMA ENTRIES FROM THE PAST FEW YEARS

Speaker: Damian Harris¹

Producer: Kate Patterson²

¹ Department of Science, Environment, Engineering and Technology, Griffith University;

² Garvan Institute of Medical Research

SUMMARY

A curated screening of some of the most outstanding SCINEMA films from the past few years. SCINEMA is an international science film festival that explores ways to enhance communication to raise public and stakeholder excitement and trust in science through the medium of film, while also celebrating the scientific advances in film technology itself. Feast your eyes (and thinking heads) on some visually stimulating SCINEMA samples while contemplating what makes a film a science film? What role should art play in a science film? How well do the SCINEMA clips communicate science / attract your interest / teach you something? How would YOUR science look on the big screen?

SCIENCE CABARET ENTERTAINMENT

Performers: Phil Dooley, Professor Flint (aka Michael Mills) and Graham Walker

Producer: Phil Dooley

SUMMARY

Sci. com. gets emotional

We've all felt interested, but what's actually going on in our head when we experience different emotions like interest, enjoyment, surprise and curiosity? And how can we use these emotions to create more engaging science communication?

This fun and interactive cabaret act will bring these emotions to life using a series of astonishing demonstrations – from water that appears to defy gravity through to vacuum cleaner powered marshmallow bazookas! We'll also share insights into the theory and psychology that underpins these emotions, which was the presenter's PhD topic.

Grass should be Purple - A sciencey fairytale. The great story tellers of our culture, literature and religion are not constrained by facts or truth. Phil Dooley explores whether science needs to be, either, as he explores the wonderful colours of our world.

Get set to travel back to a time when dinosaurs ruled the Earth; when dinosaurs walked across this ancient land. Prepare to join an interactive musical adventure with Prof Flint and discover some of the the unique, prehistoric animals that are part of the Australian story.

SPEED NETWORKING

Producers: Joan Leach, Tom Dixon and Robbie Mitchell

SUMMARY

It can be hard work to get around and meet everyone at a conference. Join 79 other delegates at the BCEC for this coordinated speed networking session. Participants meet and chat with over half of the attendees as you shift between tables of 8 people.

Sponsored and hosted by: The University of Queensland and the South-East Queensland Branch of the Australian Science Communicators

Appendix 1: Programme of ASC2014

Pre- and post-conference events

SUNDAY 2nd february



10:00-13:00 **Community Storytelling Series (part 1)** #S1 Lab 2, The Edge, State Library

bit.ly/1maNEOf

Telling stories with images using smart phones and tablets

A free 3 hour afternoon workshop for delegates facilitated by Susan Rooney-Harding and hosted by The Edge, State Library of Queensland

15:00

The Storytelling of Science: A triple anniversary celebration

#S2 Edge Auditorium, The Edge State Library

bit.ly/1i5oW3S

The ABC, the Australian Academy of Science, the Australian Science Communicators, and BrisScience are bringing Australia's top scientists and communicators together to explore the storytelling of science. See the best in the nation tell their own story of science, and drive their discussion on the stories behind cutting edge science. From the origin of the universe to the exciting technologies that will change our future, this event is one story you will want to hear.

FEATURING:

Prof Tim Flannery, Chair of the Climate Council
Prof Jenny Graves, Australian Academy of Science Secretary for Education and Public Awareness
Lynne Malcolm, ABC Science
Dr Jesse Shore, Prismatic Sciences
Prof Peter Adams, The University of Queensland
Hosted by Dr Andrew Stephenson, BrisScience
Produced by Kali Madden and Andrew Stephenson
With guest bloggers from CitizenJ

THURSDAY 6th february



9:30-17:30 **Community Storytelling Series (part 3)** #TH1 Lab 2, The Edge, State Library

bit.ly/1avyBuW

iPad/iPhone movie making using your iPads and iPhones

Learn how to create a short video from your iPad/iPhone. You no longer need expensive cameras, editing suites and audio recorders! All you will need is an iPad or iPhone, a few cool apps and some inexpensive tools and you have yourself a one-stop media creation kit. In this day course you will learn how to use your iPad/iPhone to create a short video piece.

COST: \$150. Limited to the first 20 RSVPs

NOTE: "The art and practice of story capturing" on Wednesday is a pre-requisite for this course
Hosted by The Edge, State Library of Queensland

Check out the other social events and special ASC2014 delegate invitations online: bit.ly/1k5CLx4

Add the session
#hashtag and #ASC14 on
all your tweets to join the
conversation

To access the Conference wifi,
please use the following details:
SSID: **ASC2014**
password: **csiro111**

MONDAY 3rd february



8:30-9:45 **Opening Session** #M1 Auditorium

bit.ly/1maNBBZ

Welcome to Country
ASC welcome and Conference opening **SPEAKER:** Joan Leach
KEYNOTE SPEAKER: Ian Lowe The evolving challenge of science communication
THE IAN LOWE ADDRESS: Geoff Garrett AO, Queensland Chief Scientist
On conflict, change and creativity – the role of 'Communication Cubed'

9:45-10:45 **Plenary** #M2 Auditorium

bit.ly/1fEXx0

ARC, NHMRC, CSIRO: The leaders give their perspective on science communication in 2014

10:45-11:15 **Morning tea** - Interview booth available bit.ly/1jhN8QT Foyer

11:15-12:15 **Auditorium** #M3 **Room B1** #M4 **Room B2** #M5 **Room B3** #M6

bit.ly/1jaBkx

Open or perish: Long live the new king
Business and industry, communities and controversy: What role does science communication play in public engagement?
Science interest through the 'difficult years': A panel discussion with the audience
Science Communication on the Internet: A Beginner's Guide

12:15-13:30 **Lunch** - Interview booth available bit.ly/1jhN8QT Foyer

13:30-13:45 **Plenary** #M7 Auditorium

bit.ly/1b1R0WE

Simon France The Inspiring Australia strategy and outcomes: New in 2014

13:45-14:15 **Plenary** #M8 Auditorium

bit.ly/1eQj23z

Susannah Elliott Science and the information big bang

14:15-15:15 **Auditorium** #M9 **Room B1** #M10 **Room B2** #M11 **Room B3** #M12

bit.ly/1f4Hm7

Science journalism under the microscope
Science communication and leadership (part 1): Learning from our journeys
Learning from/ Working with other disciplines
Storytelling for Leaders (part 1)

15:15-15:45 **Afternoon tea** - Interview booth available bit.ly/1jhN8QT Foyer

15:45-16:45 **Auditorium** #M13 **Room B1** #M10 **Room B2** #M14 **Room B3** #M12

bit.ly/1driiB7

The new science evangelism: Boon or bane for science communication?
Science communication and leadership (part 2): Shaping our culture
Science as News
Storytelling for Leaders (part 2)

16:45-17:00 **Break**

17:00-18:00 **Debate** #M15 Auditorium

bit.ly/1eGEvty

Social media in science: hero or villain?

18:00-19:00 **Welcome event** #M16 Foyer

bit.ly/1aclxNb

Official SPECTRUM Science-Art Exhibition opening
SCINEMA Screening: Best use of visual in SCINEMA entries from the past few years
Poster Exhibition Session

19:00-20:00 **Speed networking** #M17 Room B3

bit.ly/1i5qgnw

Appendix 1: Programme of ASC2014

TUESDAY 4th february



7:00-8:30	SCANZ-ASC Breakfast Event #T1 Rydges South Bank		
bit.ly/1jaSb5C	Evolution of science communication in New Zealand and Australia		
9:00-9:15	Visual fast forwards #T2 Auditorium		
bit.ly/1eOk3sp	A taster from Sci-Art SPECTRUM exhibition.		
9:15-9:45	Plenary #T3 Auditorium		
bit.ly/1pQDTc	Drew Berry Seeing is believing: Why showing the nitty-gritty details is key to public engagement and excitement		
9:45-10:30	Auditorium #T4 The value of visualisation in science communication bit.ly/1czXN1c	Room B1 #T5 Across the Tasman: Science communication in New Zealand	Room B2 #T6 Case studies and papers: Contributions of books to sci comm history, creative storytelling inspired by wrestling, igniting curiosity in pre-school children
		Room B3 #T7 Working with scientists in developing countries to communicate science	
10:30-11:00	Morning tea - Interview booth available bit.ly/1jhN8QT Foyer		
11:00-12:00	Auditorium #T8 Hitchhiker's Guide to the Digital Universe bit.ly/1maQAlj	Room B1 #T9 Communicating science through theatre: A new way to reach new audiences	Room B2 #T10 Case studies and papers: Use of online and print media channels by scientists and communicators, local to international engagement
		Room B3 #T11 From concept to screen: Navigating the animation process and getting the best results	
12:00-13:15	Lunch - Interview booth available bit.ly/1jhN8QT Foyer		
12:15-12:45	Australian science and technical style manual update Biotext bites the bullet at last! #T12 Room B3		
13:15-14:00	Auditorium #T13 The national engagement strategy, from Inspiring Australia to inspiring next door bit.ly/1dKh7Y	Room B1 #T14 Impact: Is the Answer Communication not Commercialisation?	Room B2 #T15 The emergence of modern science communication in Australia and New Zealand
		Room B3 #T16 Getting published in science	
14:00-14:15	Break		
14:15-15:15	Auditorium #T17 Case studies and papers: Communicating in the mix of hard data, perceptions, advocacy and emotions bit.ly/1i5rhfq	Room B1 #T18 Case studies and papers: Better understanding audiences	Room B2 #T19 Case studies and papers: online communities of practice, science represented on stamps, what impedes scientists communicating?
		Room B3 #T20 Editing scientific content (part 1)	
15:15-15:45	Afternoon tea - Interview booth available bit.ly/1jhN8QT Foyer		
15:45-16:45	Auditorium #T21 Developing the evidence base: Inspiring Australia supported research bit.ly/1phS4C	Room B1 #T22 Knowledge brokering in Australia: influencing policy and practice	Room B2 #T23 Inspiring Australia's Digital Engagement sessions
		Room B3 #T20 Editing scientific content (part 2)	
16:45-17:00	Break		
17:00-18:00	Auditorium #T24 Case studies: On-ground Inspiring Australia projects bit.ly/1kGonzE	Room B1 #T25 Case studies and papers: Science-art, engagement events	Room B2 #T26 Case studies and papers: Films, theatre, YouTube, interactive digital learning
		Room B3 #T20 Editing scientific content (part 3)	
18:00-19:00	Break		
19:00-21:00	ASC2014 Conference dinner #T27 Boulevard Room		
bit.ly/1KnfJFc	Special guest speakers, the Unsung Hero of Australian Science Communication Award presented by Robyn Williams, Science Cabaret Entertainment		

WEDNESDAY 5th february



8:45-9:00	Sci-Art SPECTRUM #W1 Auditorium		
bit.ly/1KnfoAE	Sci-Art SPECTRUM exhibition summary and awards		
9:00-9:30	Plenary #W2 Auditorium		
bit.ly/1d8jmCB	Lloyd Godson Tik and Bubbles: The evolution of an underwater superhero		
9:30-10:15	Auditorium #W3 Making science accessible: Learning science outside of school bit.ly/1dXkZH6	Room B1 #W4 The Idiot, the Disengaged, The Counterpublic: Rethinking Audiences for Science Communication	Room B2 #W5 How we can learn from the science-based public debates of the past (and present) and use that knowledge to shape those of the future?
		Room B3 #W6 Do you speak Commerce?	
10:15-10:45	Morning tea - Interview booth available bit.ly/1jhN8QT Foyer		
10:45-11:45	Auditorium #W7 Hot air or hot action: How communication is part of responding to controversial debates such as climate change bit.ly/1i5sjYH	Room B1 #W8 Delivering integrated reports from interdisciplinary projects	Room B2 #W9 Case studies and papers: Citizen science
		Room B3 #W10 Community Storytelling Series 2 (part 1): Art and practice of story capturing	
11:45-12:00	Break		
12:00-12:45	Auditorium #W11 Case studies and papers: Evaluation, research, narrative, children's education bit.ly/1pjiB	Room B1 #W12 Case studies and papers: Agricultural audiences, apps, messaging and visualisation	Room B2 #W13 Case studies and papers: Climate change, adaptation and trust
		Room B3 #W10 Community Storytelling Series 2 (part 2): Art and practice of story capturing	
12:45-13:45	Lunch - Interview booth available bit.ly/1jhN8QT Foyer		
13:45-14:30	Auditorium #W14 Case studies and papers: Engaging different audiences: Maths communication, events and entertainment bit.ly/1cA0fEK	Room B1 #W15 Evaluation workshop: Collecting evidence to determine if you have had an impact	Room B2 #W16 Case studies and papers: Communicating risk and tackling misinformation
		Room B3 #W10 Community Storytelling Series 2 (part 3): Art and practice of story capturing	
14:30-14:45	Break		
14:45-15:30	Auditorium #W17 Case studies and papers: Influencing enrolments and career choices, young people and students in high school and university bit.ly/1f8vYD	Room B1 #W18 Case studies and papers: International agricultural research, collaboration and interaction and engaging with audiences online	Room B2 #W19 Case studies and papers: Communicating risk and tackling misinformation in human and animal disease and biosecurity
		Room B3 #W10 Community Storytelling Series 2 (part 4): Art and practice of story capturing	
15:30-16:00	Afternoon tea - Interview booth available bit.ly/1jhN8QT Foyer		
16:00-16:30	Formal Conference wrap up #W20 Auditorium		
bit.ly/1mg3YOb	What has transpired at ASC2014? This session will highlight reflections from the diverse community attending ASC2014.		
16:30-17:00	Conference networking #W21 Foyer		
bit.ly/1avhWWo			

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