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## SOCIAL AND NEW MEDIA IN SPACE PROJECTS AND NETWORKS: PRELIMINARY FINDINGS OF MIXED-METHODS ETHNOGRAPHIC RESEARCH IN AUSTRALIA, THE US, AND ONLINE

Danielle LeMieux\*

*PhD Candidate, Department of Anthropology and Development Studies, University of Adelaide, South Australia, Australia, [danielle.lemieux@adelaide.edu.au](mailto:danielle.lemieux@adelaide.edu.au) \* Corresponding Author*

### Abstract

In this paper I present some preliminary findings of my ongoing PhD research, exploring digitally-mediated communication and future-making practices within contemporary space projects and networks, with a particular focus on the use of novel social media to coordinate/deliver projects; to communicate information and media content; and to consume, receive, and use it. The project is primarily ethnographic, grounded in interviews and participant observation with a range of actors within the space industry, its networks and interested publics, and is supplemented with social media, social network, and discourse analysis. Fieldwork began in October 2016, and will run to March 2018, in Australia, the US, and online across sites. Drawing on preliminary data and analysis, I explore here: 1) The kinds of space-related projects, content, and information being communicated online for various goals (outreach, promotion, science, etc.) and how people in this field are using and relating to social and new media, with a focus on changing work practices, roles, skills, and access; 2) The ways ‘publics’ are conceptualised by various practitioners doing this work – I point to public relevance and utility as a resource as key axes structuring relations and understandings of ‘the public’; and 3) The possibility of changing roles for publics in the space industry, its projects and wider networks, in digitally-mediated contexts with specific technologies, affordances, and communicative and social modes. I conclude with observations about the utility of some theoretical approaches to social/new media, and of mixed-methods and multilevel research methods for best practice (in research and in actual projects with publics), and point to future research directions as fieldwork and analysis continues.

**Keywords:** (anthropology, publics, social media, science communication, methodology, human-computer interaction)

## 1. Introduction

### 1.1 The Project

This paper introduces my PhD research (H-2016-203) exploring the use of social and new media within the contemporary space industry, its projects and networks, and presents some preliminary findings.

The project is based in anthropology. It is exploratory and takes a multi-level or mixed-methods approach, but is primarily grounded in ethnography and structured around generalised interviews and observation, and those conducted more extensively in the context of key case studies. The ethnographic research is supplemented with social media and social network analysis, and larger-scale surveys, mapping, and discourse analysis to explore broader trends. The goal is to explore how various actors and groups in the networks of contemporary space fields (English-speaking, largely US and Australian contexts) *use* social and new media to do things: coordinate and deliver projects, produce, disseminate, consume, and use information and media content. I am interested in communicative, representational, and future-making practices and possibilities. Key research questions guiding the project in its early stages have been:

- What kinds of things are being represented/communicated (about or in space networks, projects, and fields online)?
- How is this done (ie., with what frames, stories, techniques)?
- What people, practices, understandings, infra/structures are involved (what people are doing, how, where, and why, with regards to practical, material, and social considerations)?
- Implications - What can this tell us about key topics (the space industry, publics, science communication, social and new media, best practices) and about our research methods and tools (methodological focus)?

### 1.2 The Contemporary Moment

The contemporary moment is a very interesting one with regards to considerations of space fields and their intersections with social and new media. The rise of the NewSpace industry and ethos in the United States, and the broader global shift towards the commercialisation and privatisation of space activities – Space 2.0 – is one key factor [1]. This has opened the landscape to a variety of new players in the US – large companies and small startup teams – and brought a number of projects and ideas back into the realms of possibility and public

discourse (Mars exploration, settlement, and colonisation, asteroid mining, etc.). And as talk of Australia's involvement and opportunities in the space sector have picked up in recent years, as well as debates about whether or not it's finally time for a space agency, many new projects, organisations, initiatives, and startups have begun to appear (a recent Australian Space Capability Database featured on the Space Industry Association of Australia website has over 450 space-relevant actors listed, though this also includes a variety of general (ie., non-space-specific) government and university bodies [2, 3, 4, 5, 6]. Information provider NewSpace Global estimates that the worldwide 'great innovation economy' of the NewSpace industry now comprises over 1000 dedicated companies [7]. Many nation-states are entering the space scene as players for the first time now as well, and there is much excitement surrounding new technological developments and their applications, such as cubesats, the Internet of Things, and the achievement of rocket reusability.

These shifts have taken place alongside huge developments in digitally-mediated communication. Recent years have seen the shift from the Web 1.0 model (non-interactive web pages connected by links) to Web 2.0 and 3.0, with an emphasis on participation, interaction, user-created content, social buttons and graphs, big data, and the Internet of Things [8, 9, 10]. In many areas of the world, but certainly in my areas of research, the US and Australia, personal portable computing and communications technology in the form of internet-enabled smart phones has become ubiquitous or at least very common [11, 12, 13]. The use of new and social media has also become normalised, with 68% of US adults using Facebook and 76% of those users checking it every day, and over half of US adults using more than one of the major social media platforms (Pew surveyed for Twitter, Instagram, Pinterest, LinkedIn, and Facebook) [14, 15]. Traditional media institutions now use Twitter as an information source, and many people consume news through social media (62% of US adults, a majority getting their social media-based news from only one platform, most commonly Facebook) [16]. I take *social media* to be those "web-based services that allow individuals, communities, and organisations to collaborate, connect, interact, and build community by enabling them to create, co-create, modif[y], share, and engage with user-generated content," including social networking, bookmarking, microblogging, blogging, media sharing, social news (voting), collaborative authoring, web conferencing, geolocation-based, scheduling and meeting sites and services [17]. I take *new media* to be that broader "cloud of technology, skills, and processes" that are digital and include not only social media, but more general processes and phenomena, like digital multimedia, websites, hardware, and ways of relating to data [10].

Our environment is digital, and the affordances and possibilities of this technology have led to new forms of sociality, new understandings, systems and behaviours, and new social issues, and their use generates further new artefacts in the form of metadata (eg. social graphs and the valuable big data contained therein).

What does this have to do with space? People actively (professionally) involved in the space industry use social and new media (websites, social media applications, multimedia content and tools) to do things – internally, to coordinate, plan, collaborate on, and deliver projects; to find and interact with information and media content; to network; to create content and communicate to/with their publics for outreach, promotion, or other purposes. Involved publics (people following or interested in space-related fields and topics as a hobby or primarily non-professionally) use social and new media for many of the same things – to find information, content, and news; find, interact, and participate on projects of interest with others; network and form communities, create content, etc. in a variety of social contexts, including: volunteering on space-related citizen science projects, following and participating in space-focussed games, simulations, and shows and their online communities, accessing industry content, projects and events, like recorded launches and ISS livefeeds, subscribing to space news sites and feeds, interacting with news content by sharing, commenting, etc. We are in a moment of unprecedented access to certain kinds of technologies, and their communicative and representational affordances are fostering new sociocultural developments, and generating possibilities for new kinds of experiences, actions, and presence (of course foreclosing others as well). These affordances, possibilities, and access may be considered from a variety of angles: public understanding of science and science communication, media ecosystems and participatory culture, marketing and public-relations, work, sociotechnical imaginaries, networks, and infrastructures. What these technological and social systems look like, what they mean for space as it is "imaginatively [brought] into the here-and-now on a daily basis," and what they mean for our understanding of core concepts like publics, future-making, work, engagement, communication, access are pressing, current questions [18]. I explore this by researching how various actors across space projects, networks, scenes (across a spectrum of variously involved, interested, participating professionals and publics) are actually using social and new media to achieve things, and how they understand their practices.

### *1.3 Project Context, Participants, Sites*

Given the exploratory nature of the project, focussed on understanding the varied use of social and new media in US and Australian space scenes, the pool of

participants is broad. Key participants include aspiring astronauts, student and young professional organisations, space advocates, science communicators, scientists, popular social media personalities and content creators, consumers, fans and hobbyists, space journalists, artists and designers, who use social and new media for their work. Since fieldwork began in October 2016, I have been attending events in Australia and the US to observe and participate (public, educational, holiday/occasion-specific, industry, networking events), and conducted 20 separate semi-structured interviews face-to-face and online with Australian, US-based and some English-speaking international individuals, with more lined up in the coming months. I have been working more intensively with some groups and projects, which should form the basis of key case studies. Analysis is supported and deepened with additional methods (social media and social network analysis, larger scale industry and media mapping). Key cases so far have included:

- A lunar and Mars analogue simulation mission run by the Space Exploration Project Group of the Space Generation Advisory Council, the *Poland Mars Analogue Simulation Mission*, which concluded just last month. I had been interviewing team members, observing and participating as a member of the Media and Outreach Team from March this year.
- Interviews and observations with prominent space citizen science platforms and projects.
- Interviews and observations with teams and communities who make popular space-themed entertainment and educational digital content (a space simulation game, and several prominent space-themed live webshows).
- Interviews and observations with members of prominent space advocacy and networking organisations – public and student.

Fieldwork is scheduled to continue for another 6 months in Australia, US, and online contexts, though I hope to extend it by some months if possible.

#### 1.4 Contribution

The project is situated at the intersection of multiple pressing contemporary research questions and literature gaps. Firstly, it seeks to contribute to the literature in social studies of space - in particular the anthropology of space, which is a very small field at present but producing valuable and interesting work (notable examples would include the work and contributions of David Valentine, Valerie Olson, Janet Vertesi, Lisa Messeri, Debbora Battaglia, Lisa Parks, and Michael Oman-Reagan). Space programs, projects, and technologies are profoundly human, value-laden, social and cultural endeavours, making an anthropological approach both generative and

necessary, especially given the huge scale and scope of human space activities [18, 19]. Within the literature of anthropology of space (or work located in other disciplines that utilises ethnography as primary methodology), the focus has been on topics of:

- *Satellites as cultural technologies* (considering angles of media infrastructures and industries, security, surveillance, and access to satellite-view ‘datalands’) Eg. Parks [20, 21, 22];
- *The sociocultural processes that re/define human environment* (especially in extreme and beyond-human cases) Eg. Olson [23, 24, 19];
- *World-making and concepts of the human, home, and alienness/belonging in ‘out-of-the-way places’* (outer space) Eg. Battaglia [25, 26, 27, 28];
- *The role of place in scientific practice and technology development, especially in relation to Earth and experiences of familiarity and intimacy* Eg. Messeri [29, 30];
- *The social organisation of robotic spacecraft teams at NASA, practices and discourse around futures and scientific images* Eg. Vertesi [31, 32, 33];
- *NewSpacers’ imaginaries of future and capital in the industry context* Eg. Valentine [1, 18, 34].

The use of social and new media for space projects, networks and communities, therefore, remains largely unexplored from an anthropological perspective, and even more so in Australian contexts. I contribute to contemporary space anthropology, particularly by connecting space and space technology to the social media/digital technologies, objects, and infra/structures through which many people (viewers, fans, consumers, professionals, experts, etc.) now relate to, experience, and access it in contemporary social life. Relevant work not grounded in anthropological methods and theory have also informed my research, including the wider body of studies on astronomical citizen science and science communication through internet and social media [35, 36, 37]. Some exciting recent work has been done by Marta Entradas in the UK, exploring space communication amongst professionals, primarily through interviews (though not ethnographic fieldwork as participant observation), which I take as one positive example in my work [38].

Approaching the use of social and new media for space projects and networks from an anthropological perspective contributes to another complementary gap in fields of *social media research* and *digital anthropology*. A wave of research in the field of social media studies has accompanied the recent rise to ubiquity of social media and big data, and the hype surrounding them. However, these research methods and data do come with limitations (‘hashtag studies’

have been noted to lack standardisation in collection/analysis methods, and often do not track datasets or issues over long periods of time or in comparative cases) [39, 40]. Furthermore, the insights they generate are often not particularly *deep* – the conclusions that can be drawn from large-scale, platform-specific user metadata do not really allow the researcher to explain, understand, or confirm *why* people do the things that are being observed – *what those behaviours and phenomena mean*. Social media research that is qualitative, in-depth, interpersonal, and meaning-based (eg. grounded in methods of interviews, participant observation, fieldwork, focus groups, etc.), that bridges the online-offline gap, and goes beyond explorations of single platforms in isolation, is therefore being called for by many in the literature [17, 40, 41]. To that end, many researchers are advocating mixed-methods or multi-level approaches, combining the methods and benefits of both styles of research in the interests of triangulation, and generating new approaches [42, 43]. Some tools for doing so already exist, but are not familiar or comfortable for many social scientists. This is especially the case for anthropologists, and while there is a history of digital anthropological observation and fieldwork in bounded online communities on single web sites or applications, there is much less that can comfortably integrate the various contexts, data, and tools involved in understanding social life as it becomes increasingly augmented, digitised, and internet-connected 24/7, and as people move much more fluidly between infrastructures, devices, accounts, applications, and social media platforms (something like Undine Frömming, Köhn, Fox, & Terry’s ‘entangled fieldwork’ that attends to ‘digital materialities’)[44]. There is not a formalised approach for this kind of ethnography, and a real need for ‘data ethnographers’ that can use and make sense of this wealth of information and the newer tools that it requires. The “linking of data at different scales” and across time and contexts is also, more generally speaking in social media research, difficult to do, and remains a “major challenge” for researchers [42].

This project, which explores the use of social and new media by actors in (mainly) US and Australian space industry networks and projects through an exploratory mixed-methods/multi-level approach that bridges the online-offline gap, negotiates multiple platforms and research modes, and seeks to understand people and practices in terms of meaning, is therefore situated at a number of complementary and pressing gaps in the literature. The findings should be of use to researchers across several fields and at levels of both content and methods, and to relevant social and new media users more widely, with regards to best practice.

### 1.5 Structure of the Paper

The remainder of this paper will outline the research methods and approach in more detail (covering the project as a whole, and the specific research conducted so far – Section 2.1 and 2.2), before presenting and discussing some preliminary findings (Section 3 – Results/Discussion). In-depth findings will be restricted here to thematic analysis and some working insights drawn from interviews and participant observation (in-depth case studies and more general attendance, observation). Considering the various ways social and new media are being used by participants in the field to do things (public outreach, communication, space science, company and project promotion, social interaction, etc.), Section 3.1 discusses such use and practices through the lens of *work* – how practitioners interacted with and experienced such work, and what it means to them (with a focus on changing work practices, roles, skills, and access). In Section 3.2 I present several key *conceptualisations of ‘the public’/publics* operationalised in people’s digital space communication and representation work: *public as irrelevant* (3.2.1), *public as relevant/primary relation* (3.2.2), as *secondary relation/token obligation* (3.2.3), *public as a resource and workforce* (3.2.4). In Section 3.3 I discuss the possibility of *changing roles for publics in space in specific digital contexts* observed in the research, and note the importance of considering these technologies as material, social, and specific. This has implications for how concepts like engagement or outreach are cashed out, and therefore how we can best achieve them clearly as goals in actual projects and their digital and social contexts. I conclude with Section 4 and point to future research directions as fieldwork and analysis continues.

## 2. Material and methods

### 2.1 The Project

The project (ethics approval code H-2016-203) is primarily ethnographic, and so is grounded in interviewing and participant observation (where the researcher observes participants in context and participates with them as appropriate). The participant observation is conducted in person at relevant events, online in relevant networks and sites, and within projects and project groups that participants have permitted me to observe and participate in. Participants come from a variety of backgrounds, but all have active involvement in the broader space scene (particularly US and Australian networks) as their primary profession, interest, or hobby. Interviews are semi-structured, generally last from 1-2 hours, and are recorded only with permission. Interviewing and socialising in several cases led to more intensive co-participation over longer time periods (for example, being allowed to watch someone work, or volunteer at an event, or observe and participate in chapter meetings and projects, etc).

forming the basis of some key case studies. Observations and interviews generally focus on the communicative, creative, representational, and future-making practices that I see people do, how they access, use, and relate to key technologies (social and new media), what they say they do, what they think is important, their experiences, backgrounds, and key concepts, frameworks, and strategies (eg. concepts of the public, operational science communication or marketing models, understandings of the space industry, etc). Participation is voluntary and I anonymise by default except with explicit written permission.

Fieldwork is structured around a mixed-methods (and digital) ethnographic, and multi-level social media research approach (as described in Section 1.4). Those levels and methods additional to the core ethnographic interviewing and participant observation include:

- Large-scale media and topic mapping (using MediaCloud, and potential discourse, thematic, content analysis of popular and news content)
- Industry-level survey (snapshot of social media adoption/use in the Australian space industry, based on the SIAA's industry actor listings and an updated version of Styan et al's model for surveying social media adoption, in the Australian energy industry [2, 45])
- Social media analysis and social network analysis to explore topics/themes that emerge during research and develop case studies, using tools/programs like TAGS, NodeXL, Tableau, and Gephi (practices and networks can then be understood more comprehensively than would be possible simply looking at platform-specific metadata in isolation, or only asking the participant what they do/why – this process resembles 'data thickening' [46]).

## 2.2 The Project So Far

Since commencement of fieldwork in October 2016, I have conducted general ethnographic observation in-person at events in Australia & the US (mainly West Coast), and conducted 20 semi-structured interviews with participants from a range of areas in the field, online and face-to-face. After working with some participants, opportunities have developed to build case studies with their respective groups, sites, organisations, projects, etc. Examples include more intensive and in-depth interviewing, observation, and participation with space advocacy projects and groups, a Mars analogue simulation mission (The Space Generation Advisory Council's Space Exploration Project Group's *Poland Mars Analogue Simulation Mission*), citizen science platforms and projects, and popular space entertainment and educational game/show teams and communities. The case studies are developed further at multiple levels with social media and social network analysis tools, for

example, analysing the data pulled from a participant-project's public Facebook fan page, to see what content gets the most interaction from others in the network and what characterises that content, or mapping the Twitter network of a participant-user, their topics and tags to see what kinds of interactions and connections there are, who is influential or well-connected and what this means for the community and practical outreach strategies, etc. A variety of methods and tools are used in this exploration, but where possible models and examples already in the literature are followed, and all research processes, search queries, data processing and visualisation decisions are documented.

Some content from interviews, participant observation, and case studies is shared in the Results/Discussion section to follow. Interview notes and transcripts have been grouped for thematic analysis, but not systematically coded. Fieldwork will continue into early 2018, along with more intensive media mapping, completion of the industry survey, and exploration of digital methods and data, as described in Section 2.1.

## 3. Results & Discussion

In this section I present and discuss some preliminary findings of my semi-structured interviews and observation/participation (general and intensive case study-based). Based on my experience as interviewer and participant observer across multiple contexts, and preliminary thematic analysis of current data, I highlight several key themes that have emerged in the field, with reference to illustrative examples and quotes. These themes will, along with other data and research questions, be explored further in ongoing fieldwork and analysis.

### 3.1 Social/New Media & Work (Practices, Roles, Skills, Access)

Learning with participants within one field, but across such a wide variety of contexts was a very valuable experience, and challenged my understandings with regards to categories of work, professionals, and publics. Often the boundaries between professionals and publics became blurry. We would probably call a scientist who works at NASA a professional, but in terms of this research project, they might mostly be a consumer of content on social media. What about someone who participates in online space-related game and simulation communities, primarily as a player/follower/fan, but is also training in the engineering field? Or someone with no formal education in space science or science communication, but who produces popular space educational or news content for large audiences online, as their primary job and/or passion? I tried to approach participants as *practitioners* (rather than as space industry professionals

or the public), and interact with them inclusively about their various practices (of use, production, sharing, communication, consumption), not just the part that is their profession, in the hopes of exploring the digitally-mediated space landscape with more nuance and depth. My practitioner-participants therefore come from a variety of projects and groups. I try to contextualise the examples provided here as much as possible given the limited space, but it is interesting that many common themes or angles arose across these multiple contexts.

Firstly, for practitioners active in the broader space field and involved in any kind of social communication, representation, or information-seeking practices, social and new media are increasingly central to doing their everyday work. This is changing what their work roles and practices look like, and standards and expectations of such use present significant challenges and pressures for practitioners – it is serious work, and feels like it too.

Participants who do communications work using social and new media (examples from my fieldwork have included an outreach coordinator for an advocacy group, a space news journalist, a creator of a popular space educational webshow, and the head of PR/marketing for a NewSpace company) have to regularly produce high-quality digital content for multiple contexts and media modes, and maintain at least one coherent presence online, maybe more. This represents a large amount of work and pressure (time, energy) and in many cases is also un- or under-paid work. The ability to do so constitutes a broad range of novel skillsets and literacies, and many participants are not officially trained or specialised in these things (eg. competencies with graphic design, search engine optimisation, marketing, public relations, coding, infrastructural characteristics of different social media platforms and their limitations, metrics, criteria, training in science communication, etc.). For many participants, despite being highly trained in a range of fields, and generally intelligent, confident, and capable individuals, it was often a struggle to stay on top of the sheer amount of commitments and expectations within an ever-changing digital/social landscape, and much of their day-to-day communicative and/or media work is taken up with things like reformatting the same content to satisfy the requirements of different platforms, scheduling posts in ongoing queues for approval and publishing, managing various information and content deadlines, commitments, and processes through yet more applications (through Slack, Hootsuite, or Google Calendar, for example). Those with extremely high degrees of technological literacy (who might have computer science qualifications, understood software and could code, etc.) described staying on top of incoming news and information and outgoing content with automation (inbox labels and rules, automatic

crossposting of content, etc.) and seemed to struggle less with the burdens of information-overload and being time-poor, but creative, social, and business/financial considerations remained pressing. The perception of this work as exciting and full of opportunity, but necessitating a large amount of constant effort, self-development, and networking (often in one's own time, for no pay or at cost to the individual) was a fairly common picture for participants (which might reflect a broader shift towards neoliberal flexibilisation of work, and rise of the creative class noted in the literature). Interview excerpts illustrate some issues and experiences participants active in the US and Australian space scenes described as central in their everyday work and life using social and new media. The examples below come from a range of space-related projects and work.

One participant, a North American space journalist who writes news articles and produces several popular multimedia space news/educational/entertainment shows online, described how much the work had shifted over the years, from researching and writing news articles as the primary activity taking up most of his time, to producing and managing digital content and objects and the various platforms and platform-specific production teams and inboxes that go with them, as well as staying socially involved with the content-communities, and monitoring the performance of all of these tasks with a data-driven approach:

*The old job was, I'd find interesting research and news, and then report it on the site. The new job – now, because of all the different platforms, and people want to be able to read on any one platform, all of our content needs to be native to all platforms. We now have production people, writers, video editors... and writers have to prioritise considerations for different platforms. We have 60 different distribution platforms. I personally have 30 different inboxes to stay on top of. And I'm reachable at all of them. I have to be checking them all, and consider the impact of the content we create across those 60 distribution platforms... It fries your brain. People prefer to see different kinds of content in different ways. You have to think about the echoes of content for different platforms for maximum efficiency [ie., translate one core item of content into many formats and across platforms] ... We have a literal checklist for each thing... And then you also need to engage, interact. You need to be a part of the communities [that interact with your content], because it's not enough to just produce, that isn't enough to generate community.*

His experiences with interaction inform the production process in combination with a data-driven approach that makes use of various platform-specific analytics services, what he calls “taking the pulse” of what's going on:

*I like to test ideas quickly. So if I have an idea, I'll test words, hooks, titles on Twitter first, to see if interest is generated. I'll use analytics to see what stories work well, and what stories people come back to. If there's lots of engagement and discussion, that suggests we haven't gotten to the bottom of that topic or issue yet, and so we'll make an episode or video addressing it.*

Interviews with two professional Australian space science communicators highlighted themes and issues of workload and time-management, and identity, brand/reputation expression and management, especially across social contexts (ie., communication with different audiences in different fields or on different social media platforms with varied social norms and expectations, whilst representing and being accountable to multiple entities other than themselves). For one young science communicator who works in traditional educational contexts as well as on her personal social media channels and on a professionally-produced space-themed live webshow, managing various expectations and pressures is an ongoing challenge:

*You need to project and maintain the right image, especially if you're representing organisations... This can be hard to stay on top of...*

*Social media takes up a central place in my professional life. Twitter in particular is where I shape my public persona – it's a way for people to know what you're about. I use it as a platform [for science communication] to share what people won't find elsewhere and hopefully communicate it to a wider audience [eg. by condensing facts and information into a "fast" form that is interesting and will fit in a Tweet]*

She told me how social media strategising is "tricky" and can backfire, especially when you are trying to balance different priorities and communication with different publics. She described an instance where she had tried to reach more people through one of the projects she works on – a space webshow – by using a more attention-grabbing ("clickbaity") title, but rather than achieving the intended effect, this move upset the show's existing viewers, who felt that such moves contradicted the show's image.

For another Australian space science communicator, being consistently and coherently 'on-brand' online was an important part of doing his job as a public figure and communicator correctly. He worries that his content sometimes "lacks coherence," and described tensions and different communication styles in different parts of his work life (working for himself, being part of and representing a larger, global space project and organisation, communicating with schools and corporations): "I think it boils down to personal identity...it's a challenge. I struggle with what my online identity is."

Another participant, the head (and previous Outreach Coordinator) of a US-based student space organisation chapter that carries out rocket design and launch projects and space advocacy and outreach saw social media presence as a priority for their chapter in terms of the outreach component of their projects going forward, and was concerned that this required certain social kinds of skills, abilities, or awareness that they felt many of their chapter members lacked at present:

*Our social media presence... It isn't where we'd like it to be. It's definitely an area we're deficient in. (Social Media Officer is an elected position in the chapter) I want the person elected to be one of our social members... The engineering community isn't super social.*

More 'social' members would be those from areas outside of engineering, especially those majoring in fields like business and marketing, who the chapter head felt would have a better sense of how to cultivate and communicate the particular kind of social media presence desired for the chapter. Social and new media networks, applications, and tools were very important to the group's work in planning, coordinating, and carrying out their team engineering projects, especially over the summer whilst the team members were unable to regularly meet and work together in their usual shared workspace. They also reflected some of the team member's values regarding open -access and -source programs, designs, and knowledge. However, they struggled to settle on a limited number of social media platforms (many people had different preferences) and used many for different tasks, perhaps not always optimally. This was a source of logistical confusion and redundancy in the project whilst I was observing. Optimising their choice and use of communication systems/platforms and procedures was therefore a priority, but one that seemed difficult to translate into outcomes, perhaps partially due to the amount of work involved in maintaining, transferring, and setting up new accounts and all the file and data management that accompanies it. The intentional use of multiple social and new media applications as a 'toolkit' to support varied goals and tasks, and the challenges this entails for practitioners was a recurring theme and one that, drawing on Quan-Haase, Young, & McCay-Peet's framework (2010, 2017) of social media as toolkit, will be explored further in the research [17, 47].

Technological and material literacies, skills, and access was a theme raised by several participants, in relation to their own work, and in relation to wider issues of publics and social equity. For example, a US-based participant who was an aspiring astronaut, space advocate, and science communicator (particularly in relation to space exploration and astronomy topics), described a number of concerns and frustrations he had in delivering his 'virtual classroom' and 'virtual

fieldtrip' outreach programs. The programs are aimed at cultivating "a one-on-one experience and making it as impactful as possible," educating, inspiring, and involving students in space fields and projects, and by delivering them in a virtual format, their reach - the number of students that get to access this content - is increased dramatically (more students and schools across large geographical distances, in less time, often running several synchronously and joining remote class groups together). Having a well-running and tested program and system does not solve all the problems related to access and equity, however:

*The hardest one [is] teachers who have never done Hangouts before, don't know what it is or what tech [hardware and software] you need. You then have to spend lots of time explaining.*

They try to mitigate such difficulties by providing easier, more comprehensive, but also brief and appealing briefing and activity packets including multimedia for the students, but some schools don't even have access to the basic/supporting hardware that their program requires and may never even realise that these digital services exist. He described an example of a virtual classroom event that they had to run off of a teacher's personal smartphone, serving as the interface for the entire class, because the school lacked the minimum hardware and infrastructure (internet connection, computers, projectors, etc.). He expressed concern around outreach efforts given such barriers to digital access: "there are huge gaps in technological literacy now, and access to technological literacy now is the main foundation of inequality."

### 3.2 Conceptualisations of Publics

A key topic that has emerged from interviews and fieldwork has been that of publics. Two interesting insights that I will share here concern *conceptualisations of 'the public'* amongst professionals and practitioners in space fields using social and new media for their work, and the *(changing) roles of publics* in space fields and projects, through social and new media. Firstly, the ways that people I worked with do and understand their communicative and representational work vary significantly, given the breadth and exploratory nature of the project. The terms in which practitioners see their publics (as viewers, audiences, students, subscribers, fans, customers, clients, stakeholders, peers, etc.) is therefore something that I have sought to explore in fieldwork and interviews. Research interactions and data suggest some interesting frameworks and axes along which practitioners' conceptualisations of publics and 'the public' seem to be structured, depending on their roles, and the relations and responsibilities these roles are seen to entail. Key examples of these conceptualisations are discussed here, with reference to specific participants'

words and experiences. They build on and also diverge from other findings in the literature.

Marta Entradas' (2016) exploration of constructions of 'the public' amongst practitioners of 'space' communication (eg. decision-makers, professional science communicators) in the United Kingdom found several key conceptualisations of the public, dependent on context and role: the 'knowledgeable and sophisticated public,' and that of the public limited because of: 1) 'knowledge deficit', 2) ability to be 'manipulated', and 3) ability to be 'misled' by 'values and beliefs' [38]. Working with participants, I often did find a perception that 'the public' doesn't always understand the space industry, its issues and projects properly, partially due to the complexity of these technological and social systems, the large amount of specialist scientific knowledge required to make sense of them, and the interest and dedication that attaining that requires. Many space science communicators described public understanding in terms of the interest and relevance space holds for the public - ie., many people don't know much about space technology and projects, or value it, because they simply don't realise how much it affects and is present in their everyday lives. Making these things personally important and real to people, by revealing how they are already central to everyday life, especially through storytelling and narrative, was a priority for the space science communicators I worked with, with regards to addressing knowledge/understanding gaps amongst laypeople. To some extent this resembles the knowledge-deficit conceptualisations of the public that Entradas found amongst various space communication professionals in the UK. The conceptualisation of 'the public who doesn't know or understand enough' appeared to be shared by many different practitioners in different contexts in my research as well, but in many conversations with participants, this didn't seem to be the central issue structuring perceptions - conversations often revolved more around ideas of *public relevance* and *utility* as key (whether the public is relevant, and how they can be useful in space projects/to the industry), and this often in terms of *practitioner-public relations* and roles.

#### 3.2.1 Irrelevant public - the public has no role

For some participants who worked in the space industry (as engineers, scientists, entrepreneurs) and used social/new media to do and share their work publicly, there was a sense that 'the public' did not have enough or 'the right' knowledge and interest about space sciences, technology, and projects (deficit), but that this was not a real issue or priority, because 'the public' was seen as irrelevant or having no significant role to play, either in the industry in general (which will work regardless of what the public thinks), or in relation



to the individual participant's company/project (which are primarily accountable to customers or clients who are seen as separate from the general public). Spending money, time, or energy on engaging, communicating, or building relationships with a broader public was therefore seen as a waste of resources.

For one Australian space entrepreneur and engineer, 'space' was primarily a financial and career opportunity, and he actually didn't think "getting the public involved matters all that much... Lots of people don't know or don't care about STEM and space in particular," and even if they did, "the industry should stay fairly small," with resources being focussed on getting engineering majors business-ready, making 'the public' largely irrelevant to and separate from the functioning and priorities of the space industry in his opinion.

Similarly, a US-based entrepreneur and engineer running a successful space startup out of California described how he was focussed on satisfying customers and investors and not on educating or engaging 'the public' in general, and his approach to his website and social media presence/use reflected that:

*My website and social media are not that important. I only need to impress customers and investors, so it really doesn't matter what the public thinks. So I have the website and the Twitter [for the company], but I don't use it too much. What I post [ie., on his personal Facebook], is more about lightly exciting the public and portraying an interesting way of life. Until [the company] starts actively trading public stock, it's not that important. Actual company developments probably happen only every 3 months or so, so it's really just about updating investors. This [social media presence, public communication and engagement, etc.] is something to be thinking about though, because the fame will come, and I need to ... be ready for it, not get distracted. Because for example [another space startup] is very cool [in terms of public, media, and social media presence], and they've been cool for ...years, but they're still not flying. So the most cool thing is flying – success, [rather than] education, because it's an endless propagation, where everyone is educating but no one's building. I need to get things into service – start service, start function.*

A perception that the knowledge and interest of general members of the public has no relevance or bearing on the space industry at large, or for individual companies and projects, recurred in conversations with participants, particularly where their work was understood in terms of relationships with customers, clients, stakeholders, and investors – in these cases, it didn't particularly matter to them what 'the public' did or didn't think or know, because they are irrelevant and outside of this relationship, and tools, strategies, and goals that were structured in terms of concepts like publics, public engagement, education, understanding,

outreach, were perceived as having little relevance to their work practices and diverting resources away from their projects.

### 3.2.2 *Public has/is of primary relevance*

At the other end of the axis of relevance, many participants understood their work in terms of a *primary relationship and responsibility to 'the public'*, which structured the ways that they interacted, created, and communicated content. For many participants in space companies, education and advocacy organisations, who are science communicators, entertainment, popular content, and news creators and providers, their relationship with 'the public' is central (their primary customers, clients, stakeholders, viewers, audiences, fans, followers, targets). What it was that they were providing was often framed in our conversations more in terms of concepts of *interest, attention, relevance, and inspiration, through content, experiences, and stories, than in terms of straightforward knowledge/information provision or education – changing people's perspectives, inspiring them, giving them an interest in space, making news and developments accessible, entertaining them, etc.*

For example, as mentioned in previous Section 3.1, one space science communicator framed her work primarily in terms of translating already existing scientific content into palatable and entertaining forms that are native to social media, in order to reach more people, spark their interests, and make that content 'real' to them (increasing access through demonstrating relevance, and generating interest through stories). Another participant, who co-led and supported an analogue mission, was informed by background and knowledge in psychology and marketing, and suggested that goals of general public interest and engagement, or changing public perceptions around key issues in space, may be more easily realised by focussing on communicating or selling positive new and different stories, rather than challenging people with facts:

*I am just in the starting process of exploring what makes the public "tick" when it comes to space. But I will argue that humans will engage or disengage more according to method than to themes... [You should] assess your core demographics, find the motivation, tap into emotions and make the engagement easy and structured.*

Similarly, the head of marketing and communications at a US NewSpace company saw the company and project as global, with a responsibility or focus on humanity as a whole, and goals of inspiring people, changing their perspectives, and "making space accessible" to them were pursued through media-based marketing (showing, exciting, interesting people, more than telling, arguing, or informing): "[Our strategy revolves around media and] making the most of the

gravitas of [the company]... It is already something that is inspiring and a great story, we just have to *show* it to people". And through the content and presence that they cultivate as a brand online and in interaction with their publics and customers, they hope to "curate" particular kinds of experiences for people, which will give them access to new perspectives (ie., through stories, profound experiences, emotional investment, paradigm shifts). A participant who worked on a citizen space science platform hosting several space science projects as well as educational content targeting learning outcomes for volunteers, emphasised to me the central role of the public and public experience on their platform. The platform team's core role and responsibilities, more than educating the public or even doing the science, revolved around cultivating and providing positive and "deep" experiences for their public/users – "In the end we must be first public/audience centred. We won't get anything done if the public doesn't use the thing."

Words and concepts like *content*, *interest*, *attention*, *inspiration*, *experiences*, *engagement*, and *relevance* were often at the core of conversations with participants who use social and new media in their work to interface with publics and who see their communication and representation work as public-focussed/for the public. Additionally, social media, networking, and marketing language often dominated, more than language of education, for example, and this buzzword element introduced an interesting tension: it can be hard to distinguish between projects genuinely targeting public outreach and engagement (teaching, inspiring, involving, enabling people in space industry and projects) and those with good advertising and marketing teams who don't have that goal, or who are just "phoning it in"/making token effort, when they often look the same and use the same language and strategies. A space scientist, aspiring astronaut, and communicator suggested to me that "there are some good examples [of space communication online] with a sense of genuinely trying to communicate and share outputs" and others "who are phoning it in" but it can be difficult to distinguish between intent because of the pressure on actors to be "advertising all the time" so even good examples "probably don't look very different to the PR-selling online."

### 3.2.3 Token Outreach – Relating to publics and "phoning it in" online

In the course of fieldwork thus far I have also seen, experienced, or had shared with me by participants instances in space projects and companies of actors holding or claiming to hold the kinds of positive views about public importance, role, and involvement in space and express the work/outreach/communication goals outlined in the previous subsection, but treating it as

somewhat of a token obligation. Public engagement, outreach, community, or communication work are understood lightly, and receive secondary relevance, resulting in content and work that is, in the words of one participant, "phoning it in". In my experience so far observing and participating more intensively on a number of projects, this often correlated with lite or poor understanding of the work involved in doing communication and representation using social and new media – ie., work load and practices actually involved in content creation, running social media campaigns, creating and achieving outreach goals – and what platform-specific metrics like 'engagement' or 'reach' actually meant in context. For example, on some projects, using a project group's social media presence to 'do some outreach' or 'do more outreach' was a checklisted goal. While this is a valuable and commendable goal, it was often challenging to realise fully when objectives, steps, and tasks were not clearly understood or formulated (and many of these goals as terms, like 'engagement' are defined differently by different social media platforms, and generally only cover certain *behaviours*, which misses other key components of engagement recognised in the literature on public and customer engagement, like cognitive, emotional, and social investment [48, 49]. Understanding the actual, practical work involved in using social and new media, what it means, doing communication and representation, and interfacing and interacting with the public, as well as the value of that work, often seemed to also correlate with opinions of social science and other kinds of social work, like marketing, communications, or psychology (ie., lite understanding with low opinion). Doing such work in space projects and companies could therefore sometimes be a challenge for participants whose roles were that of communicator, content creator, etc.

The head of marketing and communications for a NewSpace company in the US described facing many difficulties in conveying the value of his social media-based work and targets with regards to public engagement, and in carrying out that work in his early years with the company. He suggested that people in the field do not always 'see the point' of interacting with the public, creating content, communicating it, cultivating a presence on social media, etc., and often do not realise how much intensive and scheduled work it requires. These misconceptions and devaluing can make it difficult to achieve outcomes around engagement, promotion, and outreach, and result in missed or wasted opportunities:

*I had an uphill battle here at first, having to convince people that social media matters. The engineers and [similar staff] didn't really see the relevance, and I had to actually go and formulate arguments to demonstrate it. Obviously it matters, you*

*have a brand, people care about it, and it's a way to instantly communicate. [Since starting to pick up new customers specifically through social media channels]... it's starting to demonstrate its usefulness now. It was hard though, we got on [a major publication] and at that point our website didn't have any links to social media channels so it was really a big waste of some big opportunities. I think things are getting much better now... [Social/new media is important to the space industry because] it's where consumer attention is. You can use it to access attention. And we need to have the right people in the companies and in the industry, who understand how to use it.... How are you going to achieve your goals, if you're not where people's eyes are? It is becoming more natural for us, and comes back to the question of why you're doing it [the specific projects]. For [the company] specifically, we're in a position where we do need to engage with public audiences, for our customers, and we're also under a spotlight. It's going to be a challenge for the industry, how to get people in the companies to do social media and to realise that you need to do it.*

#### 3.2.4 Public as resource for work

In a number of space-related projects, particularly those grounded in digitally-native content like space-themed news and entertainment shows, and space and astronomy-based online citizen science projects and platforms, the boundaries between professionals and publics began to blur, and practitioners using social and new media to actualise these projects often conceptualised publics (their audience/user-publics or the general public) not just as constituents, viewers, consumers, or students to be communicated to or with, but as a *resource*, which could be leveraged and harnessed for work and to make projects happen. 'The public' is reframed as a resource and potential workforce with interest, attention, creative and practical power that can be utilised to great effect if it is mobilised and channelled, and to make otherwise impossible large projects and workloads possible. Members of the public are seen as *useful* to the space industry and space-related projects without needing to be professionals or necessarily trained in fields of engineering or space science.

A participant who works on a digital citizen science platform with several astronomy-focussed projects, described publics in terms of the work that volunteers do for the projects, and how they as the team at the core of the platform prioritise such citizen-work. Outsourcing the actual work of science to volunteers means that big projects get completed that would otherwise be impossible for smaller research teams of experts to carry out – recruiting large numbers of the public for small classification tasks means “having the power to process datasets that large,” and at speed.

Beyond their utility as ‘processing power’, the participant and his platform team valued the potential for “novel” and “serendipitous discoveries and research questions” that were generated through interaction and collaboration between citizen scientists/volunteers in the platform’s social spaces (like discussion areas and forums). The entire platform is built around facilitating the doing of scientific work by members of the public, and maximising the efficacy and impact of any work/actions done by individual volunteers. Their team mantra is: “don’t waste people’s time:”

*We try to make sure that while people are on the site, everything they do, every click counts, and that makes a big difference.... There are so many things we can do to increase engagement [from existing volunteers]. What we're trying to focus on now is how to utilise the people we've got in the best way.*

Utilising members of the public also involves offloading community management and communication work, which is otherwise an overwhelming task for the research teams running individual projects:

*We urge the research teams to answer all questions and to push themselves. But then there are also lots of people and often small teams, so it can be a lot to expect of researchers. It's good to enlist volunteers to take on this work. A good, healthy community has volunteers as mods and is self-policing. We get the researchers to put in lots of effort at the start, involve the community, and then to identify and recognise those who are involved, committed, and knowledgeable volunteers, and offer them positions as mods. This gives the researchers good people, the mods are talking to the volunteers, and volunteers are feeling heard. You're more likely to sustain a healthy community if you're talking to your volunteers the whole time... Another thing we've done is that we've started asking involved community members to move up [the ranks in projects, to take on more active and official roles inside of specific project research teams]. We're seeing really healthy communities that allow volunteers to expand and take on roles of more responsibility... It's an absolute no-brainer, they want to help. So we've got to give them the support and help that they need to do that.*

Offloading the social work of maintaining and liaising with communities onto involved members of the public was a strategy similarly utilised by the designer of a widely popular space simulation game/application. Besides dealing with key issues on the community’s technical forum threads, he outsources the rest of the social work (updating community-members/users/fans about developments, interacting with them, building relationships) to a few other users who act as liaisons: “Otherwise it would take entire day to communicate there, leaving no time for [the application’s] code.”

The producer of a popular space news platform and multiple space news/education/entertainment webshows

described how opening various parts of the content planning and production process up to their viewers and fans through specific social media platforms (like Slack, Discord, and Patreon), reduced workload and community maintenance issues:

*The thing I've learned – on Patreon, no one really cares about [receiving] rewards [for monetary donations], they just want to contribute and support. Another Slack [that we have]... is very active and engaged. Part of the solution to the brain frittering problem, is pushing a lot of the work out onto the fans there – get them to contact and solicit the guests that they want... It helps me, and it makes it more of a partnership, so the shows continue to develop in directions people want, and makes the fans feel more involved – they help craft the show, and this gives them a sense of ownership. I love that, and it's a solution to be able to do more, because otherwise a project at that scale just isn't possible. An observation I've made over time is that there are people who are fans who deeply understand the content (eg. astronomy, physics), but they don't have the PhD. But, they want to contribute. So if we can provide tools to help them engage we can harness and unleash so much energy and effort. And these research projects [citizen science projects] need the power and effort they bring.*

If sparked, harnessed, leveraged, or mobilised with the right digital platforms, projects, task design, and content, the attention, interest, and labour of 'the public' is a resource that can be used to make projects happen. This idea was reflected in conversations with users of social/new media for space-related projects across a range of areas (popular news and entertainment web shows, citizen science platforms, game/simulation creators, entrepreneurs, etc.) and reflected an interesting relation with the public extending beyond that of scientist/communicator and public-to-be-communicated-to, and into realms of consumer, stakeholder, co-worker, where publics were at the core of a range of professional and scientific projects that would not work without them.

### 3.3 Changing Roles off/for Publics, Digital Infrastructures & Affordances

This levelling and opening-up of work processes through easily accessible digital platforms that I encountered in some cases in the field, suggests *changing roles for publics in some space projects*, as people who might otherwise be consumers, viewers, fans, or not involved in space science or projects at all, became insiders, workers, co-producers, practitioners, co-creators of content, projects, knowledge, and information. What this means for publics, for the space industry, its projects and networks, and what this means about digitally-mediated sociality, are interesting questions that will be explored as fieldwork continues. I

am particularly interested in the particular communication and social modes that use of varied platforms and applications facilitates, and what this can tell us about effective practice for project- and communication- work in space-related contexts. I expand on this briefly here, drawing on cases presented in previous subsections.

Firstly, we are seeing cases where publics have increased access to personal connections, involvement, and identification with projects (science, shows, games, etc.) – they feel that they are a part of a show, or are emotionally invested in the scientific outcomes of a project, and feel partial ownership of content that is produced. This is grounded in their having opportunities for active roles in projects, whether by doing classification work in an online citizen science platform, or commenting and interacting with webshow hosts in real time through chat functions embedded in the livefeed, or by helping to plan and produce an educational/entertainment show by pitching ideas in teamworking applications to producers, and then working to actualise those ideas (finding links, contacting people, organising guests, etc.). Models of receiving or consuming publics, or publics located outside of elite cultural or scientific fields and whose opinions/knowledge are secondary or lacking, seem to be less relevant here. Publics are also acting as practitioners and even valued co-workers (concepts like Jenkins' 'prosumer' in a digitally-connected/online 'participatory culture', and 'networked narratives' as co-created stories facilitated by social media may be helpful here) [50, 48].

Such collaborative work seems to be grounded also in *particular communication/social modes*, and to favour *particular digital platforms and applications*. On citizen science projects, there is "no community without communication," according to one participant, but even if the goal is just getting the science work done (prioritising classifications and task completion over social formations and experiences – 'community'), their research team has still found that "communication that goes both ways" is most effective (ie., as opposed to broadcasting models of interacting with their publics). Dialogical, flat, symmetrical 2-way communication seemed to be valued and being used in several online science/research, engineering, educational, and entertainment projects, as a way to relate to their publics who took on co-worker and insider roles, and was facilitated by the use of particular platforms, services, and applications (notably Google Docs, Discord, Slack, and Twitch, Patreon, and also discussion boards and forums on projects' own sites/platforms). This tendency reflects findings in the wider public understanding of science and public relations literature suggesting that dialogical/symmetrical 2-way communication styles are best for achieving public and customer engagement and

building relationships with organisations [51]. It also raises questions for me about how people in these publics experience these digital and social contexts, and suggests the utility of a ‘social media as toolkit’ theoretical approach (multiple different applications with different interfaces and communicative and social affordances, audiences, conventions/styles are preferred and used for different tasks) [17, 47]. A participant in a leadership role on another space citizen science platform also described how by creating opportunities for people to participate actively in projects and interact with one another, the public/volunteers become active and engaged ‘storytellers’ co-creating the present moment in space – the ideal goal would be for everyone to become a storyteller, but this depends largely on the affordances of social media platforms and new media technologies (eg. many platforms are not optimally suited to science communication work), and on members of wider publics having the relevant literacies and skills to navigate and use them (and not all platforms are equally preferred, used, or accessible to all sections of the wider public).

The role that specific digital contexts and their particular affordances play in projects, and their implications (eg. facilitating certain communication styles, supporting community, building collective or ‘networked’ narratives, generating engagement, etc.), will be explored further, as the central but misunderstood or underappreciated role of material/digital infrastructures and their affordances has been a recurring theme in the field.

#### 4. Conclusions and Next Steps

In this paper I have introduced my ongoing PhD research project exploring the use of social and new media in Australian and US space projects and networks, and discussed some preliminary findings grounded in thematic analysis and data from the interviews and participant observation undertaken so far. Key themes have been the implications of social/new media for *work* (changing practices, roles, skills, access), the *conceptualisations of publics* operationalised by practitioners in the field using social/new media to do communicative and representational work (along axes of *relevance* and *potential utility as a resource and workforce*), and the possibility of *changing (active) roles for publics* in space in relation to specific *digital contexts and affordances*. I emphasise the importance of attention to specific digital/social contexts and materialities (and utility of a social media as toolkit theoretical approach) for both understanding what practitioners are doing, and engaging in better and more intentional practice in actual projects.

As fieldwork continues in Australian, US, and online/digitally-native contexts, I will further explore these themes of sociality, digital infra/structures, access,

communication and representation, and story- and future-making. Scope of analysis will be widened by additionally: finishing the survey I am currently conducting of social media use/adoption by actors of various types in the Australian space industry; beginning larger-scale media and topic mapping to explore media framing and public perception with regards to space online; and continuing social media and social network analysis to deepen case studies and evaluate methodological tools/approaches. Contributing to the development and communication of mixed-methods/multilevel digital research tools and approaches (especially including methods that are qualitative, interpersonal, and cover multiple platforms and contexts) will be a priority as the project develops, especially with regards to the noted gaps in social media research and digital and space anthropology.

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