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ON THE PRACTICES OF RISK RE-NORMALISATION: 'KNOWING' THE KNOWN UNKNOWNS IN PUBLIC DISCOURSE ON OUTER SPACE EXPLORATION

Abstract. *This paper outlines a series of observations about how public discourse is framed regarding the way risk assessment is conceived at the cutting edge of developing the scientific and technological frontier. Examining the newly emerging narratives concerning the future of outer space exploration and industry, particularly human missions to and settlements on Mars, I propose the concept of 'risk re-normalisation' as a major tool for reframing various aspects of the public discourse on risk through the premediation of visions and imaginaries. Specifically, as the risk-assessment discourse evolves, seemingly separate actors' under- and over-statements of hazards are used in public discourse to create a set of limiting parameters, thereby creating a more favourable risk governance environment for the further advancement of Space Exploration. This is underpinned by the discursive symbiosis of private and public spheres, once their rhetorical separation is achieved through boundary work.*

Keywords: *risk, governance, re-normalisation, premediation, space exploration, Mars*

Introduction

Work on frontier-breaking science and technology development relates critically to how (existential) risks, both personal and societal, are conceived (Moriarty, 2016). This is especially evident in the current public policy climate driven by risk-aversion, sometimes known as the emergence of the Risk Society (Beck, 1992; Jeffries, 2006). Some of these risks are completely unforeseeable (the 'unknown unknowns') and as such are not conceptualised much in public or scientific discourse. But, still, the ones we can describe as the 'known unknowns', i.e. those risks which can be conceptualised, are difficult to reliably model (particularly since they are socially

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constructed/dependent), are equally challenging and the 'risk management' discourse has emerged in order to engage with them (Zinn, 2010). The latter is also a central interest when critically engaging with the development and application of new technologies (Walport, 2015).

I therefore propose that certain techno-scientific (thought) leaders, often seen as 'entrepreneurs', seem to be engaging in a variety of risk 're-normalisation' practices, by attempting to shape the (public) discourse of risk (assessment) in favour of new exploration and utilisation programmes. Hence, in this paper I adopt a relational reading of the social construction of risk and examine the background of the risk-governance environment (International Risk Governance Council, 2008; Klinke and Renn, 2012; Rhodes, 1996). In response to the restrictive measures it imposes, I argue that stakeholders are engaging in a practice of 'risk re-normalisation', to borrow the concept from the natural sciences (Anon, 2019a, Anon, 2019b; Sutton, 2019), I argue that this is a two-step process: first, boundary work (Gieryn, 1983, 1995) is undertaken to separate 'private' from 'public' actors and their visions and imaginaries of space exploration and industry in public discourse (Macauley, 2012; Tutton, 2018). Second, these imaginaries are used as a premediation tool (De Goede, 2008; Grusin, 2004) to frame the new multi-dimensional risk assessment discourse so as to favour continuous public investment in scientific and technological development. This is done by foregrounding certain types of risks and neglecting others by selectively overestimating or underestimating them in the (public) discourse around visions and imaginaries of the future.

I illustrate this practice by examining the rhetorical separation of 'public' and 'private' Space Exploration narratives and their divergent risk assessments through the examples of Elon Musk/SpaceX's evolving plans for a private settlement on Mars (Grush, 2016; Lopatto, 2016), the Mars One global competition (Dickerson, 2015; Foust, 2019; Sample, 2015; Tutton, 2018) and recent science-fiction productions with films and TV series such as National Geographic's *Mars* (Akpan, 2016; Ghod, 2018; Guinnessy, 2016; Murnane, 2016). The proposals offered by these campaigns and creations are often termed "techno-scientific imaginaries" (Marcus, 1995; Tutton, 2018).

Specifically, by pitching technologically still unrealistic and what may be seen as morally questionable 'over-the-top' proposals, like one-way tickets to Mars (Sample, 2015), or the simple dismissal of certain environmental dangers such as radiation (Grush, 2016), such visions and imaginaries construct a set of limiting maxima parameters against which other future proposals will be assessed. The lack of certain other actors' contestation of these more risk-tolerant narratives, especially by 'public', official space-exploration organisations and agencies, reveals the complex and multi-faceted nature of the practice of risk re-normalisation occurring within the

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context of the premeditation of risk governance. In particular, the exercise is not limited to the proponents of any particular future vision scenario or imaginary, but through tacit acquiescence regarding its validity, albeit not necessarily endorsement, other actors count on re-normalisation of the risk tolerance framework to support their current and future interests. Hence, risk re-normalisation not only has a real impact on public discourse but a direct impact on the de facto formation of risk-mitigation practices with respect to the development of science and technology.

Social construction of techno-scientific risks

In an interview given in 2006, German sociologist Ulrich Beck famously commented on the current state of society as "living in a world that is beyond controllability" (Jeffries, 2006). This post-modernist view of the social environment constitutes what the "Risk Society", a term coined by Beck and Anthony Giddens in the 1980s that is often described as "a systematic way of dealing with hazards and insecurities induced and introduced by modernisation itself" (Beck, 1992: 21). Similarly, while analysing risk discourse and citing a seminal text by Webber, Zinn (2010) notes that the

> *[..] fundamental shift towards a modern society is characterised by a new worldview of enlightenment indicated by a shift from beliefs in fate and god to the belief in a rational manageability of the world in principle (Weber 1948).* (Zinn, 2010: 120)

Zinn (2010: 108) states that such belief in the 'manageability' of risk, in both actual terms of preventing and managing hazards as well as in societal terms, through identifying and calculating its 'value' has attracted the attention of scholars for decades. A critical component of these 'risk management' regimes is their a priori assessment, i.e. their ability to predict risks before they eventuate. When speaking of the risks of emerging technology, this relates to the fact that science and technology are no longer treated as an infallible nor undisputed solution to all of humanity's problems, including dealing with risks. Funtowicz and Ravetz diagnose modern science as a place where the "facts are uncertain, values in dispute, stakes high and decisions urgent" (Funtowicz and Ravetz, 1991: 138). This is especially related to the wider cultural environment, with seminal work by Douglas and Wildavsky (1982) developing a matrix of 'ways of life' with regard to the level of collectivism and social ordering. They argue that controversies over risk 'value' between different outlooks are associated with tensions between ways of life more broadly.

So how is the risk (management) discourse responding to these (new) circumstances of growing uncertainty and the need for an a priori assessment? One key answer that has been proposed is to introduce the concept of 'governance' as the dominant political paradigm when dealing with emerging technology proposals (Rhodes, 1996) – adopting an 'egalitarian' model of risk culture (as per Douglas and Wildavsky). Moving away from either ideology-based state control or complete sub-ordinance to the market forces and/or public opinion, the governance model seeks to create a space for discussion amongst all risk stakeholders, i.e. scientists, interest groups, businesses and public(s). The gist of this approach is that through public discourse the bringing of all involved parties together will lead to a considered compromise solution being reached (Pierre and Peters, 2000).

Further, placing these risk management and governance processes into the public discourse via the media is specifically linked to what is conceptualised as a 'premediation' (Grusin, 2004), i.e. practices to "to imagine, harness and commodify the uncertain future" (De Goede, 2008: 159). However, as often stressed by this framework's lead developers, premediation is not about forecasting the future, but mapping out as many of its possibilities as possible (De Goede, 2008; Grusin, 2004). The idea of the approach is to create a cultural context within which all possible imaginaries have been explored so that, at the time of passing, "the future never happens" (Grusin, 2004: 36) because we have seen it all before that transpires. If all risks are accounted for in imaginaries of the future, then pre-emptive risk management can ensure they never materialise as actual hazards.

Here, more than ever, the critical issue of 'risk assessment' surfaces. A series of critical contributions on the issue identifies public discourse as both the originator and mitigator of risks. For instance, Ewald notes

> *Nothing is a risk in itself; there is no risk in reality. But on the other hand, anything can be a risk; it all depends on how one analyses the danger, considers the event.* (Ewald, 1991: 199)

Douglas (1990: 8) added that cultural concept of risk relates to how hazards are "politicised and negotiated"; hence, focusing on the political nature of risk assessment. This highlights the critical element of 'human valuation' as a central political negotiation in risk assessment. Hence, in several applied contexts risk is conceptualised as a type of real-world computation. In fact, this lies in the very core of any risk assessment procedure (Ni, Chen and Chen, 2010) used routinely by individual organisations of all kinds to manage risks. At the centre of this approach is a basic 'formula', defining risks as:

Risk 'value' = likelihood of hazard x severity of effect

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This conceptual formula is, for instance, used widely in the 'risk management' practice of creating "risk matrices" (Cox, 2008; Markowski and Mannan, 2008; Ni et al., 2010). Yet, as critical analysis shows, the resulting value matrices are often difficult to model in practice (Markowski and Mannan, 2008) and often produce misleading results (Cox, 2008), and are founded on a discursive framing of risk, which is very pervasive (Ni et al., 2010). In conceptual terms, when those quantities are agreed and certain, such computation should due to its discrete nature easily lead to a clear finite 'value', frequently called a "risk score" or "risk category", (Markowski and Mannan, 2008).

However, an arguably bigger issue arises when the values for likelihood and severity of hazards are uncertain. This moves beyond the more common case of a disagreement over quantities based on value judgements, something described as a two-partite challenge of dealing with

> *[...] 'objective uncertainties' which arise from a random character of the assessment process (variability), and 'subjective uncertainties', arising from limited and partial knowledge and information (imprecision).* (Markowski and Mannan, 2008:152)

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There, the most extreme values can be taken as limiting maxima and the uncertainties can be subjugated to produce a finite risk value through either conceptual or mathematical tools (Markowski and Mannan, 2008). But with risk framings (i.e. no reliable quantifiable likelihood or severity value) that are almost entirely uncertain, the quantitative unboundedness makes the risk assessment equation functionally infinite. If one cannot put a value on either the probability of a hazard occurring, nor on what its effect might be, the risk will be labelled 'infinite' and hence 'unmanageable'.

At this point, the 'precautionary principle' is often used, i.e. when risks are deemed 'unbounded' the default approach is to not undertake the 'risky' action. Yet, this effectively means that under such a (high) evidence standard, potential risk-takers must demonstrate the (relative) safety of their proposed actions, i.e. 'innocent until proven guilty' is re-framed under such a risk assumption as 'guilty until proven innocent'. This has been extensively analysed across a variety of contentious issues in emerging technology, perhaps no more so than in the debates in the life sciences, particularly genetics (Malpas, 2008; Mittra, 2007; Tait, 2001).

However, I argue that potentially new practices are emerging to challenge such 'risk-averse' regimes via attempts to confine the unbounded uncertain values within the premediation of risk assessment in public discourse, through a controversial presentation of assumed limiting maxima, the practice of 'risk re-normalisation', as outlined in the section below.

Risk re-normalisation

In order to distinguish this emerging practice from previous attempts to 'normalise' risk, I draw a specific parallel between bounding infinite risks and the procedure of 're-normalisation' that originates from applied mathematics and quantum field theory (Anon, 2019a: Anon, 2019b; Sutton, 2019). It is defined semantically as

> *[...] a process by which infinities may be removed from the solutions of equations by redefining (limiting) parameters within the equations.* (Anon, 2019a)

Specifically, through re-normalisation

> *[...] divergent parts of a calculation, leading to nonsensical infinite results, are absorbed by redefinition into a few measurable quantities, so yielding finite answers.* (Sutton, 2019)

As such, various 're-normalisation factors' are already used in many computational methods of risk assessment where they provide limiting parameters with a typically statistical probability basis (Brunner et al., 2009; Costa et al., 2016; Srivastava, Mock and Gao, 2011).

However, I propose here that the conceptual framing of such a re-normalisation practice lies at the core of any multi-partite governance processes' risk assessment, including that of emerging technologies, where through the practice of premediation unbound hazard projections resulting in infinite risk values are the imposed limiting maxima parameters. The concept of 'normalising' hazards has already been discussed in the context of the politics of risk, including premediation, noting the arising complexities beyond the 'normal' being pitched against the 'exception' (Aradau, Lobo-Guerrero, and Van Munster, 2008). Yet, the critical move is not to 'simply' 'normalise' the risk as normal, but to establish what 'normal' means in the context of a specific risk. By doing so, not only is the risk 'normalised' with respect to the risk environment, but it can also make an 'infinite' risk environment 'normally' finite.

I propose 'risk re-normalisation' as entailing a two-stage practice:

First, the initial step in re-normalisation practice is the demarcation of the various actors who are proposing conflicting risk-value positions, and the multiplicity of their imaginaries. Enabled by the distinction between governance actors established through a boundary-work-based demarcation of 'the arbiter' and the 'risk-taker', this approach becomes a critical tool for imagining multiple possible futures of technological development, thereby

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providing a set of benchmark parameters against which future risks are to be assessed. This is often developed along 'private' (risk-taker) vs. 'public' (regulator/authority) lines. However, this benefits the risk re-normalisation practice because by 'private' actors advocating a very lax risk-assessment framing, this becomes premediated as the limiting maxima for public opinion and is then also utilised in 'public' risk assessments. Hence, when specific techno-scientific proposals are put forward, the risk value associated with them is not measured against an 'infinite', unbound hazard, but against a concrete example of an extreme vision/imaginary of the future, as previously outlined by 'private' protagonists.

To theoretically analyse this demarcation between 'private' and 'public' protagonists, one can refer to the seminal contributions on 'boundary-work' by Gieryn (1983, 1995). In essence, Gieryn abandons the idea of a rigid and fixed boundary between science and non-science in favour of an interpretation where boundaries are ideological constructs serving specific purposes (Gieryn, 1983) – the main objective of boundary-work is to advantageously position science within the context of wider public discourse. Further, a key aspect of boundary-work noted by Gieryn is the extraordinary flexibility of the arguments scientists use to create the said boundaries (Gieryn, 1983). This is largely based on 'cultural repertoires', namely, the common resources from where scientists can pool characteristics used to self-construct ideologies about what is the difference between their work (science) and all things they believe should be excluded (non-science) (Gieryn, 1983). The demarcation between 'public'/state-controlled/'scientific' and 'private'/entrepreneurial-commercial/ 'non-scientific' risk actors can be constructed in the same way.

Second, by various protagonists selectively under- and/or over-stating certain aspects of a risk assessment in their imaginaries, for instance, the risks to the individual vs. risks to humankind, a multi-dimensional parameter space is opened for premediating divergent future risk management solutions. In particular, the proposed mitigations are not directly related to the hazards identified, but to the re-normalised risk values, i.e. if a risk is overestimated, its mitigation is disproportional to the underlying hazard. Depending on the way in which the re-normalisation process plays out, the resulting risk management framework can therefore be highly contested yet, despite (political) contestation, these positions form the limiting maxima on previously unbounded risk values.

In the second half of this paper, I present a case study using three examples, which in different ways elucidate the risk assessment and management discourse concerning space exploration to Mars, and illustrate and contextualise the practice of risk re-normalisation.

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Unpacking the risk discourse – a case study

Space Exploration is not unique as a case study, but is one of the more fruitful, not least due to its significant media profile based on its (deliberate) positioning as humanity's "final frontier" (Genta and Rycroft, 2003), making it an excellent illustrative case study (Tight, 2017). I focus on Mars as a destination for interplanetary travel since it has been considered one of the most significant targets for Space Exploration, at least since the mistaken interpretation of astronomer Giovanni Schiaparelli's observation of "canali" on the surface of Mars which, instead of natural "channels" was translated as "canals" – a supposed sign of intelligent life on that planet. Film production has been premediating travel to Mars since 1910 (Zorpette, 2015), building on the earlier history of (science fiction) literature (Crossley, 2011).

In order to illustrate the features of boundary work and multi-dimensional risk assessment as part of the risk re-normalisation practice, I examine the most recent bout of interest in travelling to the 'Red Planet' occurring between 2009 and 2019, a decade in which arguably a 'mental shift' was made (Tumlinson, 2015). My thematic analysis is based on examining the critical differences between three example points of view as expressed in 'techno-scientific/industrial', 'entrepreneurial/visionary' and '(science) fictional' protagonists' statements and the reactions to them.

I concentrate on the discourse surrounding the 'one-way ticket' to Mars. I tracked press releases issued by 'private' actors like SpaceX, Mars One while noting the (lack of such from) 'public' agencies like NASA. The material presented here generally focuses on reports in popular mainstream media, such as the Guardian, Los Angeles Times, Forbes, the BBC etc.; and in Space/science-themed outlets, chiefly Space News, Space.com, the Verge, and Gizmodo. This summative narrative analysis (Mello, 2002) of 'private' proponents' public statements is contrasted with the existing position held by the 'public' space programme (NASA's *Journey to Mars* (NASA, 2015)), as well as to the 'pure' premediation using the TV series "*Mars*" in which both of these 're-normalisation' steps are carried out almost explicitly.

My analysis builds on the thematic discourse of 'cost/price' and 'funding', as per boundary work, as well as 'risk' and 'danger' as per risk assessment and management, and the contrast between scientific and technological risk values in perspectives and narratives within the examined companies' press releases and media production.

A Potemkin village on Mars?

From the outset, human Space Exploration has been clearly associated with great risks for all involved (Moriarty, 2016). In particular, critical issues

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related to the use of extreme forces and access to extreme environments have established Space Exploration as a high-risk activity with significant challenges to basic survival. Technologically, this was already a notable concern during the un-manned spaceflight experiments with rocket and satellite systems, but the stakes grew exponentially when human spaceflight was introduced.

These early days of Outer Space exploration are often synonymously associated with the Space Race, the pivotal competition between the United States of America and the Soviet Union (USSR) (West, 2001). This race was both well-funded and applied a military-type, objectives-led framing of risk assessment, allowing much faster development and a more lax attitude to the possibility of serious danger to the astronauts and cosmonauts (Koman, 1994). In the setting of a war-like situation (even during the 'uneventful' Cold War) young, white, male, fighter-pilots were willing to sacrifice themselves on the altar of the greater good (Siddiqi, 2010) – scientific and technological dominance over the opposite state (block), with specific reference to existing cultural contexts (Harrison, 2013). However, as the Cold War drew to a close, the Space Exploration programmes became more benign in their objectives, although the risks expanded and materialised in genuine accidents, such that the initial military-driven risk framework collapsed and nearly took Space Exploration with it.

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It was especially state-controlled investment and regulation that led to more conservative risk-management regimes being applied to Space Exploration. On top of this, the programmes' ever greater technological advancement/complexity, as well as the numbers of human spaceflight missions, saw the first significant accidents with a high loss of life. Most notably, the USA's fatal Space Shuttle accidents, the loss of the Challenger and Columbia spaceships with all 14 astronauts on board, placed the critical launch programme on pause for years (Moriarty, 2016) and contributed to the eventual de-commissioning of this flagship type of vehicle, even though the main reason for cancelling the programme was likely its cost (Adler, 2015).

Moreover, more than any particular decision, the effects of the risk-averse 'indecision' concerning the next steps to be taken by the Space Exploration programmes led to a stall in planning and hence the USA's recent slow progress in developing new imaginaries for future objectives and missions. Only in 2019, after an almost decade-long gap, the USA is now launching a commercially-developed 'replacement' human spaceflight technology, having relied on Russian partners for this critical infrastructure since 2011. It is here, however, that two new modalities are emerging. On one hand, the discourse has been complemented by 'new' 'commercial' players filling this gap with their own imaginaries and proposals and, on the other hand, state

actors (like NASA) are promoting a dividing line between 'public' and 'private' interests in the area of Space Exploration.

In the autumn of 2016, SpaceX's Elon Musk announced plans for an Interplanetary Transport System to transport humans to Mars, which includes 200 'seats' per vehicle at potentially USD 200,000 a ticket (Misra, 2016). This was based on previous calls by Musk for an 80,000-people-strong Martian 'colony' (Coppinger, 2012). Yet, as these plans are unpicked many questions remain to be answered (Grush, 2016) and specific doubts about parts of the project have already been expressed (Masunaga, 2016), particularly on safety grounds (Lopatto, 2016). The tone of, and reaction to, this announcement resonates with the discourse surrounding the announcement of the Mars One project (Sample, 2015), another Outer Space 'colonisation' ambition with a commercial interest. This plan included a private Mars mission with two teams of four competitively selected citizen-astronauts who would embark on a one-way journey to the 'Red Planet', raising revenue for the project from advertising and broadcasting rights, by streaming the development live in 'reality TV' fashion (Anon, 2015; Sample, 2015). On top of doubts about its commercial viability and unethical approaches (Dickerson, 2015), after the initial enthusiasm died down the project's targets were revised and, while up until very recently the mission remained nominally on track, it no longer occupies centre stage in planning of the future of Space Exploration. Moreover, the company behind the commercialisation of Mars One proposal went bankrupt in early 2019 (Foust, 2019).

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I argue that these projects, often dubbed PR exercises (Crane, 2017), are perhaps more meaningful than cynical self-promotion attempts for the individual proponents and their respective companies/organisations. What such imaginaries do is to set new norms and expectations and, the closer we are coming to actually bridging the famous gap of 'landing on Mars is 50 years away', the more important the content of these proposals may be (Tutton, 2018). In many ways, the success of these visions and their public announcements was as guaranteed from the start as was the failure of most of the actual proposals – because space exploration easily catches the public imagination, it is no surprise that such 'news' becomes discussed in both science and the mainstream media (Murnane, 2016). But even when the actual mission fails (Dickerson, 2015; Foust, 2019), the imaginaries of possible Space Exploration futures are still defined. A critical part of this premediation is its effect on the public discourse about the governance of risk, above all through multi-dimensional risk assessment.

Hence, the public discourse occurring within the premediation-based governance of risk involved in the human exploration of Mars is an excellent arena to look for some of the key re-normalisation processes that are deployed. The exploring of Mars provides a critical reference point in both

techno-scientific ideology (Levine and Schild, 2010) and popular culture (Crossley, 2011), although it did/does not command any significant level of support in public opinion (Launius, 2003). As such, the re-normalisation of risk through premeditation outlines several competing imaginaries which, in turn, propose limiting maxima on the risk assessment parameters, especially to do with the health and well-being of individuals and collectives.

In the next two sections, I analyse risk re-normalisation activities with respect to the exploration of Mars. I first outline the rhetorical boundary work for separating 'public' and 'private' actors in the narrative of Space Exploration, before moving on to exposing the multi-dimensional risk assessment practice used to bound the uncertainty in the emerging risk assessment.

Demarcation between 'public' and 'private' in the 'new Space Race'

Economic globalisation gives an excellent cover for the new narratives of 'commercial'/'private' driven collectivism and universalism, two claims which have in fact been notionally present from the early days of the Space Race (Harrison, 2013; Siddiqi, 2010). Thus, individuals, groups and organisations calling for greater space exploration stress the need for such action for humanity's survival, while also lauding its 'privatisation' and 'commercialisation' as the 'natural' evolution of this area of human activity and a sign of the maturity and future sustainability of these endeavours. The involvement of non-state actors in supporting these narratives is not new, with the amateur-run British Interplanetary Society having been a critical advocate of Space Exploration activities in the early (pre Cold War) stage (Macauley, 2012).

The growing calls for 'private' and 'commercial' Space Exploration initiatives are supposedly aimed not at furthering any national interest, but a global economy-drive and humanity-wide enterprise. Yet, they are proposed by the very same state-led space actors (NASA, ESA etc.), who are also significantly (majority) funding those emerging 'commercial' projects. For instance, Elon Musk's SpaceX has raised USD 2.4 billion in private investment (Anon, 2019c) and has several leading corporate clients like the satellite telecommunication giants Iridium and SES; still, in comparison, its income from just two major NASA contracts alone has so far topped USD 4.2 billion (Howell, 2018). This is in addition to other government contracts, especially military satellite launches (Semangdal, 2017) and state subsidies (Hirsch, 2015).

Further, the idea of 'public-private partnership' in Space Exploration is not novel since most of American space technology has been designed and built in private corporations under sub-contract to the space programme.

However, unlike the 'new kid on the block' – the 'entrepreneurially' marketed SpaceX – the traditional players such as Lockheed Martin, Boeing, Northrop Grumman etc., are (too) deeply associated with the state-controlled military-industrial complex. Hence, by presenting SpaceX and other emerging actors as a new, different phenomenon economically, and demarcating the boundary between their 'private' operations/objectives and the state's 'public' (NASA) visions, a dividing line between the actors is constructed, even if the boundary itself is purely rhetorical.

In fact, it may well be that the state actors are actively conspiring to create and maintain this demarcation, partly because it suits their attempts to (re-)frame the discourse on risk to protect the already volatile public investments made in science and technology. With the 'private' nature of the 'entrepreneurial' space players in particular, risk-management regimes are moving further away from state-controlled regulation and into a different, more open (public) discourse. This is a vital step for ensuring a 'multiplicity of voices' within the risk assessment governance arena, now poised to combine the competing visions and imaginaries to establish a new risk framework, specifically one aimed at constraining the unbounded risk values.

The limiting maxima and multi-dimensional risk assessment of travelling to the Red Planet

Many different kinds of perceived risks are associated with the increased scientific exploration, technological development and economic utilisation of Outer Space, including the journey to Mars. Here, I group them in two categories to separate the inherent risks of Space Exploration itself (i.e. outward risks) and risks to our society from Outer Space and its exploration (i.e. inward risks)[1]:

1. *Outward risks:* risks to explorers in Outer Space (technological, biophysical, social isolation, ETI encounters etc), risks to other life in Space from us (bio-contamination, adverse-environment manipulation etc.).
2. *Inward risks:* risks to society on Earth from Outer Space (meteorites/hostile intelligent life etc.) and from any development related to or spun-off from Space Exploration (hostile artificial intelligence, political power imbalances, ecological carelessness etc.)

Notably, the associated risk values change over time along with both societal and technological development. Examining some of the previously

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[1] *This classification is based on a series of previous classifications of risk in/from Outer Space; for instance, the "terrestrial" vs. "extra-terrestrial" risks (Gibson, 2015), the "natural hazards" vs. "societal challenges" (Wilman and Newman, 2018) and the risks of "forward" and "backward" (astro)biological contamination (Race et al., 2015).*

mentioned imaginaries pitched within the 'private' Space Exploration actors, however, points to one central emerging feature – the risks discourse is often out of step with their scientific grounding in predicting the likelihood of hazards and their impacts, in terms of both over- and under-estimation.

This is highlighted by controversial statements made by the 'private' sector developers of these projects, like the one-way ticket to Mars advocated by the Mars One project (Anon, 2015; Sample, 2015), funding the trip to the Red Planet by selling TV rights to the journey (Anderson, 2012), or Elon Musk's remarks disparaging the need for radiation protection for the spaceship he pitched as the transport system delivering a one-million-people-strong Martian colony by 2100 (Grush, 2016)[2]. These emerging and controversial risk assessment proposals are explicitly supported by these projects' dedicated fans and followers, who are happy to see themselves as the new generation of heroes (and martyrs) sacrificing their safety at the altar of 'scientific and technological progress' and 'societal advancement' by moving further into Outer Space. Specifically, the Mars One project is a one-way ticket from the outset. No return to Earth means that 'survival' becomes a very relative term. If you are to die on Mars anyway, does it matter if you die on descent due to the catastrophic failure of underdeveloped or untested live support systems? If SpaceX is shipping hundreds of people to the Red Planet, does it matter if a few die en route from acute radiation sickness? The somewhat dismissive attitude to such questions recently shown by Musk (Paoletta, 2018; Pengelly, 2018) and to some extent, the Mars One creator, Dutch entrepreneur Bas Lansdorp, is perhaps precisely the intended effect.

In particular, while analysing these statements made by leading proponents of these rhetorical imaginaries, we notice the trend of underestimating risk relates to the 'outward risks' with an overestimation of the 'inward risks', which in fact become framed as the risks of *not* pursuing the Space Exploration agenda. These discrepancies and their framings are outlined in Table 1. A critical example of the risk assessment imaginary behind both the Musk/SpaceX plans and those of Mars One is the desire to safeguard human species against potential future destruction on Earth by becoming a multiplanetary species (Musk, 2017; Tutton, 2018). In fact, the prioritisation of the inward risks over the outward ones has an added implication that outward risks apply to selected individuals, whilst the inward risks are collectively shared. Thus, Musk and Lansdorp argue that any risks taken individually are

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[2]   *Although in this paper I primarily focus on the headline proposition of risk as related to travelling to Mars, Musk (and others) have made a series of other controversial statements about other aspects of Mars exploration and "colonisation". Perhaps one of Musk's more controversial suggestions is to explode nuclear material above the poles of Mars, to "heat" the surface and release the water and oxygen reserves from the polar ice caps (Grush, 2015; Walls, 2019).*

a necessary sacrifice in the preservation of a much bigger interest at stake – 'minimising the existential risk' to our species (Drake, 2016).

Most interestingly, however, these emerging conflicting assessments within Space Exploration risk assessments are not being aggressively challenged by the majority of scientific and technological experts or governmental agencies nominally responsible for managing the risk regimes in Space Exploration contexts. One somewhat cynical explanation for this abstention from the surrounding public debates is that, whilst not explicitly endorsing such extreme levels of risk tolerance, these 'public' actors are engaging in an exercise of risk re-normalisation in order to further their own current and future programmes. If the outward risks associated with the next stage of Space Exploration are initially 'brushed off' as unproblematic by 'private' actor(s) in their various public statements, such as Musk's off-hand dismissal of the dangers of radiation noted earlier, this could pave the way for a completely different risk perception when a much more realistic proposal from a 'public' actor later comes along. Better than shocking the public with radical (and unrealistic) proposals is focusing on messages of collective urgency, rather than individual fear or legitimate concerns. When an official and 'public' assessment of risk values is proposed, it will be benchmarked not against actual precedents like NASA's Shuttle programme, where each fatal accident stopped all flights for years (Moriarty, 2016), but against these new risk-assessment frameworks whose limiting maxima are defined by the more extreme, 'private' sector imaginaries.

"Mars is made in Hollywood..."

Making these imaginaries literal, in National Geographic's combined science fiction and documentary series "*Mars*" (Akpan, 2016; Murnane, 2016), the construction and subsequent use of 'public-private' boundaries as well as the risk assessment and management discourse epitomise the practice of re-normalising risk via premediation. Through very public media production, the actors involved are outlining a variety of relevant parameters for the imaginary future, whilst also proposing their limiting maxima. The premise of the series is on one hand to explore a fictional mission to the 'Red Planet', led by an international consortium of private and public actors, whilst simultaneously documenting the visions and technological development of current private and public actors in this arena (Guinnessy, 2016).

The intermeshing of interviews with thought leaders from SpaceX, NASA and several other advocacy groups in 2016 with the fictional narrative of the 2033 'Dedalus' mission creates a synergic documentary and imaginary account of a possible future. This clear example of premediation, clearly references the boundary between fact and fiction through the time-juxtaposing

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as it switches between the two accounts, as well as reinforcing the dividing line between the various players involved in the 'real' Space Exploration discourse in the documentary analysis. However, while the 'private' and 'public' actors are clearly rhetorically separated, they do appear side by side as mutually recognised legitimate players. Further, the fictional account constitutes a composite vision between the more aggressive and risk-tolerant 'private' imaginary and the more cautious, inclusive and risk-averse 'public' one. For instance, great care is shown for protecting the health and well-being of the astronauts, even though through a series of accidents and unexpected hazards several have been injured or lost their lives – a likely overestimation of the likelihood of such occurrences. This becomes more contentious as the series moves into the second season, which centres on the tension between 'public' exploration and 'private' exploitation – and an overestimation of the critical need for both (Ghod, 2018).

It is also important to note that the fictional story initially revolves around the crew of a spaceship called 'Daedalus'. This may be seen as referring to another set of premediation imaginaries, especially the technical project about interstellar travel and exploration run by the British Interplanetary Society in the 1970s, as well as its consequent reference in the iconic science-fiction franchise Star Trek. The name's origin in Greek mythology is also significant because it was Daedalus who through his knowledge, ingenuity and craftsmanship built wings from wax and feathers for himself and his son Icarus to escape from captivity. Although the flight was successful, Icarus flew too close to the Sun, thus melting the wax and losing his life. The mythological narrative can be seen as another subtle reference to both the technological prowess and mortal danger of Space Exploration and the perceived compromise needed between the two, as proposed in these premediated imaginaries.

As such, the TV series Mars represents an excellent summary of the multi-dimensional risk assessment emerging from the discourse on a 'one-way' ticket to Mars (as shown in Table 1 below). With rhetorically separated actors acknowledging each other's stake in the project and then proposing diverging risk values, all possible scenarios are presented as valid points of view – regardless of their over- or under-estimation in comparison to the techno-scientific assessment of potential hazards. In particular, as there might be hazards that are un-known (i.e. unbounded risks or known unknowns), the disproportionate risk valuations create a re-normalised risk assessment environment that favours the techno-scientific proposals.

Table 1: SYNOPTIC ANALYSIS OF THE MULTI-DIMENSIONAL RISK ASSESSMENT DISCOURSE

Proponents	Proposed Risks	Risk Value Deviance (compared to science/industry)	Proposed Mitigation
science / industry *NASA Journey to Mars*	Outward Risks Inward Risks	/	Scientific and engineering procedures Monitoring and advancing protection systems
pitched visions *SpaceX / Mars One*	Outward Risks Inward Risks	Underestimated Overestimated	Shaping public opinion Pursue 'global' technological advancement
science fiction *'Mars'*	Outward Risks Inward Risks	Overestimated Overestimated	Heroic action

Source: Author's own analysis.

Conclusion

Overall, the proposed two-step process of re-normalisation risk may be seen as a novel and original approach to understanding the framing of risk (assessment) discourse within the public governance of techno-scientific development. By premediating a variety of imaginaries, in particular by over-estimating certain risks and underestimating others, a set of limiting maxima is established resulting in a new set of risk assessment benchmarks. This process is framed as a multi-dimensional, multi-actor contestation, although it depends on the constructivist boundary-work demarcation of the lead proponents and arbiters. However, the work presented here is merely a conceptual outline of this practice and thus extensive theoretical development as well as empirical validation of risk re-normalisation is required.

I also wish to note the above conceptualisation of the process of risk re-normalisation is far more politically important than may seem on the surface. First, imaginaries may be seen as a key driver of actual technological development in general and especially in Space Exploration (Macauley, 2012; Tutton, 2018). Second, the practice of risk re-normalisation can be used to obscure the actual processes of risk assessment and risk management. Third, premediation enables the risk discourse to be re-framed so as to expand the realms of society's acceptance of controversial topics in public discourse, which can be manipulated.

Taking each of these points in turn, it has been suggested that the considerable science-fiction production during the 1940s and 1950 was crucial for the eventual start and development of the Moon landing programmes, particularly in the USA (Macauley, 2012; Ordway, 1992). The public discourse at the time also included risk re-normalisation through premediation,

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when the inward risks of the technologically and scientifically superior USSR were contrasted with the outward risk to the Apollo crews (Koman, 1994). Moreover, the actual processes of aspects of risk management may be obscured by the dominant risk re-normalisation discourse. For instance, due to the much more stringent public research funding regime in place since the financial crash of 2008, public funders in the USA have been unable to invest in more 'risky' technological development such as a fully state-developed orbital cargo system. Instead, they engaged in the 'public-private' distinction to act as cover for continuous funding through the 'commercialisation' of operations, as outlined earlier with regard to SpaceX's 'public' contracts for the US government, principally NASA.

With respect to the potential for manipulation, the risk assessment discourse on Space Exploration was recently expanded with US political leadership expressing visions for Space Activities beyond the currently agreed (international) frameworks. Specifically, by mentioning the further militarisation of space through the potential establishment of the "Space Force" (Durkin, 2018), a new reference to earlier military risk-assessment regimes is made and signed up to by the key 'new' players like Musk (Foust, 2018). Even though likely illegal under international law, this has also not been forcefully or consistently contradicted by other 'public' and/or 'private' actors given the vested (financial) interest in expanding investment in Space activities and since it fits with the mix of high-end limiting parameters seen within the risk re-normalisation agenda. Moreover, the players concerned appreciate that, on one hand, the full deployment of such imaginaries is unlikely to occur in practice and, on the other, that the USA is already investing heavily in military space technology, mainly for intelligence and communications purposes (Erwin, 2019).

Hence, I believe the risk re-normalisation practice deserves further conceptual development and active analytical deployment to ensure the appropriate level of understanding of the emerging risk discourse framings within the field of emerging technologies and their future imaginaries, including those in the area of Space Exploration.

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