Archaeologies: Journal of the World Archaeological Congress (© 2016)
DOI 10.1007/s11759-015-9286-7

RESEARCH

Culture on the Moon: Bodies in Time and Space

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ABSTRACT

This paper investigates whether the term 'culture' can be applied to the six Apollo lunar landing sites, and how the remains at these sites can be understood as the actions of bodies at a particular moment in space and time.

Résumé: Cet article examine si le terme « culture » peut s'appliquer aux six sites d'alunissage d'Apollo, et comment les vestiges de ces sites peuvent être considérés comme des actions de corps, à un moment donné, dans le temps et l'espace.

Resumen: El presente documento investiga si el término "cultura" puede aplicarse a los seis lugares de alunizaje del Apolo, y si dichos lugares pueden ser comprendidos como las acciones de organismos en un momento específico en el tiempo y en el espacio.

KEY WORDS

Space archaeology, Apollo 11, Toss zone, Soviet space program, Culture

Introduction

Between Earth and space there is a rich archaeological record relating to the development of global space exploration since World War II. Space archaeology investigates these artefacts and sites for what they can tell us about human behaviour, geopolitics, and the history of science and technology. The evidence they provide both complements and challenges the documented histories of space missions and places, and, critically, goes beyond the documentary record to investigate their abandonment and decay. Space archaeology is about the terrestrial and exoatmospheric materials, how they are used and discarded, and the social meanings they generate (Barclay and Brooks 2002; Darrin and O'Leary 2009: Fewer 2007;

Gibson 2001; Gorman and O'Leary 2013; Gorman 2012; O'Leary 2009; Rogers 2004; Spennemann 2004, 2006, 2007; Schiffer 2013; Staski 2009).

Mapping the distribution of space material culture through space and time is necessary as the background to a finer-grained understanding of its role in the human engagement with space. The examination of artefacts, machines and the built environment of space has much to offer in a reappraisal of the mechanisms of cultural and technological change in the late industrial world.

In this paper, I focus on twentieth century lunar landing sites, and how their materiality reflects or creates our relationship with Earth and space. The six Apollo sites could be described as a 'culture', sharing spatial features such as the 'toss zone' with terrestrial sites (O'Leary et al. 2002; Capelotti 2009, 2010). We begin with a brief survey of the material record, from places on Earth, to Earth orbit and on to the Moon, the only celestial body so far that humans have visited in the flesh.

Characterising the Human Material Record in Space

On Earth, rocket launch sites and tracking stations (the antennas that keep track of the location of spacecraft in orbit) are the most easily recognised 'space places'. They are usually associated with high technology and security, and are typically operated by wealthy industrial nations (Gorman 2007a). Space places in their most broad definition, however, also include residential complexes, computer centres, university campuses, laboratories and clean rooms, factories where components and materials are made, resource extraction sites, earth stations and satellite downlinks, and even domestic satellite dishes (Gorman 2009c:175). These are located across the globe in both space-faring and non-spacefaring nations. Because of the reliance of the modern world on satellite-provided telecommunications and positioning, navigation and timing (PNT), it could be said that almost every human-occupied landscape on Earth is now interacting with space.

Nevertheless, terrestrial space places are like all other industrial sites; they are still designed to take account of Earth gravity and climate. In space, requirements for people and machines are very different. Lack of atmosphere, extremes of temperature, low pressure, exposure to radiation and plasmas, microgravity, and high speeds in orbit have demanded the use of new materials and measures to protect delicate electronics and biologics (Darrin 2015).

People are even more vulnerable than machines, as cosmic rays rupture complex biomolecules, microgravity erodes bone density, and pressure and temperature extremes far outside our evolutionary comfort zone must be shielded against. Technology and materials make human interactions with the space environment possible. On the one hand, humans have colonised both sea and air using technology, so space exploration could be seen as a natural extension of this trajectory. On the other, it could be argued that the interplanetary environment is so radically different that terrestrial analogies do not apply.

Sputnik 1, launched by the USSR in 1957, was the first artefact of its type: an object designed to orbit the Earth while emitting a radio signal (Fewer 2009). Its very physical presence beyond the atmosphere changed forever the way we viewed the cosmos and our interaction with it. No longer the realm of speculative fiction or hopeful yet marginalised science, space was now attainable. In its tiny (58 cm diameter) aluminium body, Sputnik 1 encapsulated two characteristics that became hallmarks of technology on the new frontier: communication with Earth through intangible signals, and extreme isolation.

There is also a large amount of human material beyond Earth orbit, in the rest of the solar system. On the Moon alone, there are over 170,000 kg of materials from predominantly US and USSR missions (Capelotti 2010:15). Table 1 shows a breakdown by year, nation and nature of missions that were intended to land on the Moon. (It does not show the number of flyby and orbiter missions, nor the failures, of which the USSR sustained approximately 40). What we can see is a pattern of impacts or crash landings over the first seven years, followed by successful soft landings, then Apollo human missions from 1969 to 1972. Following the end of the Apollo program, the order reverses: soft landings, a major hiatus of 33 years from 1975 to 2008, and then the most recent crop of impact missions. In 2013, the successful Chinese Chang-e lander marked a return to soft landings, with more missions planned.

In addition to the Moon, the planets Mars and Venus, the Saturnian moon Titan, comets 9P/Tempel 1 and 67P/Churyumov-Gerasimenko, and asteroids Itokawa and Eros have sustained soft or crash landings by spacecraft. In the Jovian atmosphere, perhaps faint chemical traces—such as plutonium and iridium—from the Galileo Orbiter and probe (launched 1989) remain in the layers of hydrogen and helium.

While the available catalogue data (not always accessible or unambiguous) allow us to draw some parameters around human material in the solar system, there is as yet no complete catalogue that can serve an archaeological or heritage purpose. O'Leary et al. (2002) catalogued the material present at the Apollo 11 lunar landing site at Tranquility Base using archives and astronaut accounts. Fewer (2002:117–118) has suggested lunar and Martian heritage catalogues based on the UN Register of Objects

Table 1 Successful lunar landing missions (including crashes, impactors, accidents and crewed missions)

Year	Mission	Nation	Outcome	Number of missions
1959	Luna 2	USSR	Impacted	1
1962	Ranger 4	USA	Impacted	1
1964	Ranger 6	USA	Impacted	2
	Ranger 7			
1965	Ranger 8	USA	Impacted	5
	Ranger 9		Impacted	
	Luna 5	USSR	Impacted	
	Luna 7		Impacted	
	Luna 8		Impacted	
1966	Luna 9	USSR	Soft landing	4
	Luna 13		Soft landing	
	Surveyor 1	USA	Soft landing	
	Surveyor 2		Impacted	
1967	Surveyor 3	USA	Soft landing	3
	Surveyor 5		Soft landing	
	Surveyor 6		Soft landing	
1967	Surveyor 7	USA	Soft landing	1
1969	Luna 15	USSR	Impacted	3
	Apollo 11	USA	Crewed	
	Apollo 12		Crewed	
1970	Luna 16	USSR	Soft landing	2
	Luna 17		Soft landing	
1971	Apollo 14	USA	Crewed	3
	Apollo 15		Crewed	
	Luna 18	USSR	Impacted	
1972	Luna 20	USSR	Impacted	3
	Apollo 16	USA	Crewed	
	Apollo 17		Crewed	
1973	Luna 21	USSR	Soft landing	1
1974	Luna 23	USSR	Soft landing	1
1975	Luna 24	USSR	Soft landing	1
2008	Chandrayaan 1	India	Impacted	1
2009	LCROSS	USA	Impacted	1
2011	Ebb	USA	Impacted	1
	Flow			
2013	Chang-e	China	Soft landing	1
Total				35
	USA 19 = 54%	USSR 14 = 40%	India 1 = 3% China 1 = 3%	100%

Sources: various

Launched in Outer Space. Capelotti (2010) provides summaries, based on NASA data, of human, robotic and orbital missions to the Moon, Mars, Venus, Titan and the Sun, the interstellar space probes Pioneer 10 and 11, Voyager 1 and 2 and New Horizons. Gorman (2005, 2009a, 2014) has discussed the general content of material in Earth orbit and its significance, and created a historical catalogue of whole satellites still in orbit between 1957 and 1963 (2007b). Orbital catalogues based on tracked data are maintained by several space agencies, and some versions of these data are publicly available, e.g. in the Heavens Above (2013) and CelesTrak databases (2013); however, these carry little information about the objects other than their year of launch, name or designation, and orbit. The compilation of this information is hampered by classified or unavailable data (particularly in Earth orbit), the limits of tracking and ambiguities and lacunae in the records. For an archaeologist, the purpose of cataloguing is to allow the identification of research potential, and to assess cultural significance, for which it is critical to know what is rare and what is common in the range of human material in the solar system (Australia ICOMOS 2013).

Space Cultures

While at present there may be many unknowns in characterising orbital and interplanetary space material, we are in a more fortunate position with regards to the Moon. The distinctiveness of the Apollo Program mission materials discarded on the surface has led Capelotti (2010:25) to characterise them in archaeological terms as a 'culture'.

This term has a venerable lineage in archaeology. In the era when archaeology and anthropology emerged from more generic naturalist science, the English anthropologist E.B. Tylor provided one of the earliest definitions: "Culture … is that complex whole which includes knowledge, belief, art, morals, law, customs, and any other capabilities and habits acquired as a member of society" (1871:1). As such, it encompasses Marxian ideology (Marx and Engels 1970), and concepts such as habitus (Mauss 1934; Bourdieu 1990).

The 'culture concept' acquired a more explicitly archaeological aspect in the early twentieth century, when the term was used to refer to systematic, chronologically defined suites of behaviours expressed through artefacts, structures and bodies:

> We find certain types of remains—pots, implements, ornaments, burial rites and house forms—constantly recurring together. Such a complex of associated traits we shall call a "cultural group" or just a "culture". We assume that such a complex is the material expression of what today we would call "a people" (Childe 1929:v–vi)

This form of culture was at the core of the 'culture history' framework that dominated archaeology until the 1950s (and is still prevalent in some parts of the world). Over time, some types of artefact or styles disappear, while others come to prominence. The sequence of changes, or seriation, through time and space could be mapped. A key feature of the culture–historical approach, as applied by Childe (1929), Grafton Elliot Smith (1933) and others (e.g. Bordes 1973), was the mechanisms proposed for this cultural change: diffusion, migration and 'independent invention'. Similarities in design, technology and style across a broad range of artefacts such as stone tools, ceramics, weapons, ornaments and buildings were used to argue that a cultural trait had been adopted from another ethnic group, whether through the movement of people or the more nebulous 'diffusion' of ideas. Alternatively, a technology may have been 'independently invented' without cultural contact. Clearly, chronology was critical to identifying the origin of a cultural change or innovation; yet chronologies were also defined by changes in style.

The advent of radiocarbon dating in the 1950s overturned relationships and chronologies painstakingly built by typological and stylistic comparison in the pre-war culture historical model, demonstrating that cultural change could not be accounted for solely by the mechanisms of adoption, migration and diffusion (Renfrew 1973). In the prehistoric record, 'culture' had no easy relationship with language or 'ethnicity'. Other critiques focused on the essentialist and static features of archaeologically defined cultures (Hicks 2010:27), and the divorce of artefacts from human behaviour: at its worst, this approach treated artefacts as if they 'begat' other artefacts with no human agency involved (Hicks 2010:38). A further limitation of this approach was the assumption that new technologies would be adopted because they were superior, as, for example, in the succession of stone, copper, bronze, iron and steel, a unilinear evolutionary trajectory in which progress led to the pinnacle of Darwinian adaptation, the white European male (Gould 1981:114-115; McClintock 1990:102)—exemplified, perhaps, by the twentieth century astronaut.

Succeeding models in the 1960s and 1970s emphasised material culture as adaptation across social, symbolic and physical realms (the so-called processual approach), drawing on the idea of culture as "man's [sic] extrasomatic means of adaptation" (White 1959:8). From the 1980s, such functionalist interpretations of material culture were tempered with the idea that objects were meaningfully and socially constituted, and actively engaged in creating culture rather than passively reflecting it, within specific historical contexts (e.g. Hodder 1982; Leone 1982; Miller 1987). The weighting given to actual physical material, as opposed to the cognitive, in explaining culture has veered back and forth in archaeological theory over the decades since then. Since the 1990s, the idea of 'culture' as a monolithic system encompassing a whole society has also fractured under the analysis of power differences based on race, gender, class and other categories. The concept of culture is still foundational in the development of archaeology as a discipline, but has splintered into myriad understandings spread across different intellectual traditions (Watson 1995). It is more common now to talk of material culture rather than culture (Hicks 2010).

Despite the abandonment of culture history by most prehistoric archaeologists, nationality and ethnicity have remained important themes of investigation in historical archaeology, where oral and documentary records afford additional evidentiary strands for the interpretation of archaeological data. There has also been increased attention to these ideas in ethnoarchaeology. This approach has been particularly interesting in exploring identity in settler nations where archaeology is used to investigate the experiences of those who did not write the histories: Indigenous people, indentured or enslaved labourers, convicts, women and migrant groups (Orser 1996; Voss and Casella 2011). While acknowledging that nation-states are defining entities in the culture of space exploration, the material culture has the potential to illuminate how satellite technology has driven globalisation and undermined the coherence of the nation-state (e.g. Gorman 2005, 2009c).

Unlike the early culture historians, contemporary archaeologists are not solely dependent on stylistic and technological similarities to provide the sequences of technology transfer. The diffusion of technologies—the paths by which they move and the mechanisms by which they are incorporated into new contexts—can, in the case of space culture, be followed through the documentary record and the migration of both people and the artefacts themselves (e.g. Schiffer 2013). There is a very clear path of cultural and technological diffusion in the 1945 V2 rocket diaspora, which seeded space programs in France, Britain, Australia, the USA and the USSR, and the later 'independent invention' of rocketry by those nations, such as Japan and China, which did not have access to either German scientists or rockets as the spoils of war. Each national space program could be said to have developed its own style or interpretation of basic rocketry principles. Engineers, scientists and manufacturers also drew on older national traditions of technology design and applied them to this new artefact. The resultant style is what some archaeologists would call 'isochrestic' (Sackett 1982): it is an epiphenomenon of a series of technological choices, rather than being the desired outcome in itself.

Apollo Culture on the Moon

The remains of the Apollo human spaceflight program on the Moon could well be called an archaeological culture as suggested by Capelotti (2009, 2010), much as we might once have spoken of Bell Beaker or Kurgan cultures. Apollo 'culture' on the Moon is unique, in that it is precisely bounded in both time and space—beginning in 1969 with Apollo 11, and ending in 1972 with Apollo 17 (see Binford 1964:431; Trigger 2006:233). Apollo culture is Cold War and nationalist (Gorman and O'Leary 2007; Launius 2007), if not actually 'ethnic'. (An investigation of how the Apollo culture represents humanity, opposed to USA culture, could be illuminating). It could even be called 'primitive' compared to today's space technology. On Earth, it had deeper antecedents, for example in the WW II V2 rocket program, and it evolved into the Apollo Applications program, which led to the first US space station Skylab (Hitt et al. 2008). On the Moon, however, Apollo culture, and its series of behavioural events or occupations of sites, is an isolated suite of materials, movements and traces in the lunar regolith, capturing the motivations and embodied ideologies of its time. Six landing sites exhibit a "constantly recurring … complex of associated traits… the material expression of what today we would call "a people" (Childe 1929:v–vi).

There are several archaeological approaches that could be applied to these sites:

(1) Examination of each individual site. What happened there? What material culture was brought there, what was discarded and why (e.g. O'Leary et al. 2002)?
(2) Comparison of the six sites. Do they demonstrate an evolution of understanding of the lunar environment? What are the similarities and differences between them?
(3) The impact of the space environment on human behaviour and use of space
(4) How the Apollo sites express "the knowledge, belief, art, morals, law, customs, and any other capabilities and habits acquired as a member of society" (Tylor 1871:1), particularly in the context of the Cold War.
(5) Comparison with similar terrestrial sites. O'Leary argues that "one important task for archaeologists is to compare how space exploration sites are different from or similar to other past sites" (2015:17).
(6) Comparison of human landing sites and traces with the far greater number of lunar robotic landing sites.

As national prestige (Hays and Lutes 2007) has been a major driver of space exploration, looking at the 'culture' that is evidenced in assemblages such as those on the Moon can be productive. However, with no human landing sites created by other nationalities on other celestial bodies, there is nothing else in space comparable to the Apollo planetfalls.

On Earth, however, there are parallels in exploration sites from prehistory to the present. Human movement across the planet left many places where people ventured into an alien environment, not knowing what to expect, and used their technology to grapple with unfamiliar problems of survival. Some of the Pleistocene-era sites are now submerged by the rising seas of the Holocene after about 10,000 years before present. Closer to the contemporary era are the landscapes of European colonialism, dating from the fifteenth century. The exploration and establishment of permanent occupation in the Antarctic took humans into a previously unknown environment. Often, however, these places are also where Europeans first encountered Indigenous people (the symbolism of claiming 'virgin' *terra nullius* was explicitly invoked with the placement of the US flag on lunar soil in 1969 (Gorman 2005; Platoff 1993)).

An example is Captain James Cook's first landing site in Queensland in 1770, his second in Australia. At Bustard Bay, the crew went ashore, and botanists Joseph Banks and Daniel Solander collected specimens from the bush on the edge of the beach before they returned to the *Endeavour*. Gooreng Gooreng people, who had watched the proceedings but not interacted with the Europeans, must have noted the unusual traces this scientific activity left in the bush after the departure of the vessel: the entry of the pinnace along the beach and the booted footprints (soon washed away by the tides), the plants severed with metal knives where specimens were removed. Although it is not recorded, perhaps the crew left rubbish behind as they sailed away, as the Apollo missions also did on the lunar surface. In the Space Age, the journals Captain Cook kept of his epic voyages inspired the creation of the Apollo Lunar Surface Journal (Jones and Glover 1995–2013).

Of the Apollo sites, we know most about Tranquility Base, created over 21 h in July 1969 by two astronauts, and one of the most documented events of the twentieth century (O'Leary 2015:7). Through it, we can begin to discern the beliefs and customs that shaped a distinctive type of culture.

The Toss Zone: Tranquility Base as an Initial 'Occupation' Site

In the Lunar Legacy Project, O'Leary et al. (2002) catalogued the materials and traces that were left when the Apollo 11 Ascent Module left the surface of the Moon. Over two hours and 15 min, the two astronauts set up scientific experiments, walked over the terrain, and collected samples. More than 106 objects were abandoned, joining the pedestrian traverses, trenches, scoops and furrows marking the regolith. Notable objects are the Landing Module, the Lunar Laser Retroreflector (an ongoing experiment), the scoops and trenching tool used to remove samples from the regolith, the TV system that conveyed images back to Earth and the components of the Portable Life Support Systems which kept the astronauts alive outside the spacecraft. Many items not needed to sustain life on the return journey were abandoned or jettisoned in order to lighten the Ascent Module for return to Earth, as was the Ascent Module itself when it reunited with the Columbia Space Module.

Figure 1 shows a map of Tranquility Base drawn as an archaeological site (O'Leary et al. 2002). In Figure 1 O'Leary calls the area where material was jettisoned from the Ascent Module a 'toss zone' (O'Leary et al. 2002; O'Leary 2006). In this, she is drawing on a classic spatial study of contemporary hunter-gatherer site formation (Binford 1978, 1983). In 1971, during fieldwork with Nunamiut people of Alaska, Lewis Binford recorded the distances travelled and the spatial distribution of different items around a men's hunting stand. He observed that materials entered the archaeological record through being dropped, tossed or placed in areas around a group of hearths. Dropped items were detached during the course of an activity, and allowed to fall; on completion of an activity, items like empty food containers were tossed away. A drop zone occurred where numerous men sat around the hearths to drink and eat; the toss zone lay behind them. Other items were positioned or rested to allow easy access when they were needed or to keep them out of the way (Binford 1978:345–346). When people left the site, they collected dropped or resting items and dumped them outside the camp perimeter. One side of the hearth area was always kept clear, and this seemed to be because it represented the location of the sleeping area if the hearth had been inside a house.

In a similar way, Capelotti notes the residues of terrestrial spatial relationships in human movement on the lunar surface:

> Numerous images taken during the Apollo series of expeditions show roadway tracks made by the lunar rover vehicles. One such image shows an astronaut walking alongside the path made by the rover. Even though the human can make any pathway he wants, he walks *alongside* the freshly created roadway, imitating the behavior of pedestrians avoiding those areas frequented by motor vehicles on his home planet (Capelotti 2010:5).

The lunar sites could be interpreted in a similar way, with each remaining item categorised as dropped, placed or tossed. As in Binford's (1978)

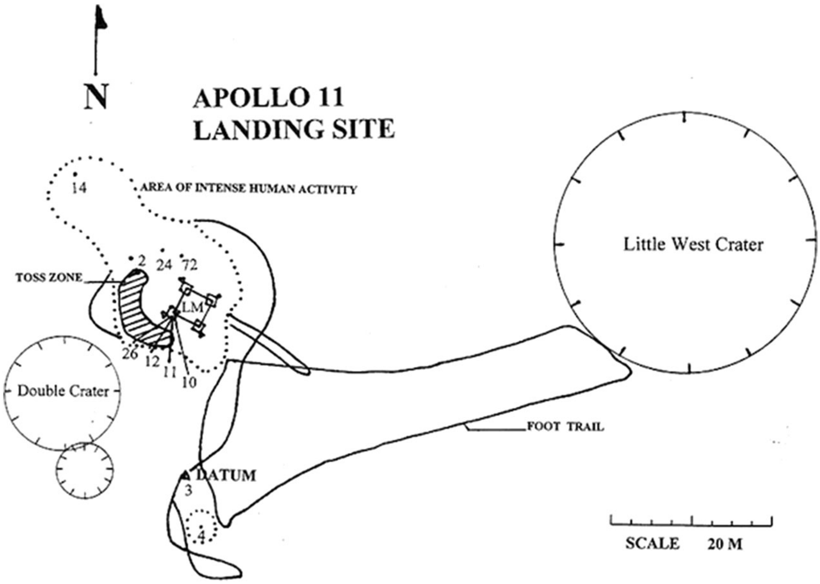

Figure 1. The archaeological site of Tranquility Base. Source: O'Leary et al. (2002), based on the U.S. Geological Survey Apollo II Traverse Map

study, each category reflects a relationship with time and space. Such an approach invites comparison across the six Apollo landings in terms of how knowledge derived from each mission informed the technology, experimental program and astronaut experience of the next. The thousands of images from the Apollo missions (artefacts in their own right), combined with detailed descriptions in the Lunar Surface Journal, could enable areas associated with the performance of different activities to be mapped and compared. One could hypothesise significant differences in the spatial patterning of artefacts and traces remaining from each mission, with the most significant between Apollo 11 and the final landing mission, Apollo 17, in 1972. Variables for each mission included different locations (maria/valley/highlands); increasing surface mission length (from 2.5 h to 3 days); the introduction of more complex elements like the lunar rovers; increased size of the lunar modules and different personnel, including a non-military scientist on Apollo 17. Inter- and intra-site spatial patterning, together with the artefacts discarded, show the evolution of Apollo culture until the last people left, never to return.

It's also noteworthy, although rarely remarked upon, that the lunar sites are gendered. In her treatment of the human body as material culture, osteoarchaeologist Joanna Sofaer observes that

> Underlying Binford's description of the spatial distribution of the objects is a concern with the needs, capabilities and limitations of the male body; how far he can go, how strong or lazy he is, and what the needs of the body are for food or warmth (Sofaer 2006:15).

This would be a familiar concept to the astronauts, whose movements and actions were choreographed to maximise the scientific outcomes of the mission within the limitations of an unknown environment and the restrictions of cumbersome spacesuits (NASA 1969). In recognising what the astronaut bodies are, we can also think about what they are not, and how both presence and absence shape the sites.

Stevenson (1985) took Binford's model a stage further by postulating that the nature and location of litter could be correlated to the initial, exploitation or abandonment phases of site occupation. If the Apollo sites represent initial occupation, the next phase could be centred around lunar mining, providing an opportunity to test this model in a unique environment.

Culture Expressed Through Material Culture: Automation Versus Autonomy

The influence of environmental factors on human behaviour, cultural change and variability has been a persistent question for archaeological investigation, and perhaps no place has the potential to untangle these strands than another world. Soviet lunar architecture was very different from Apollo, but both were aimed at putting human bodies on the surface of the Moon. To what degree might the common requirements of survival in such an environment cross-cut or overwrite cultural differences in how the socialised bodies of the astronauts and (hypothetical) cosmonauts moved and interacted within the lunar landscape?

Autonomy was a much-debated cultural difference between the capitalist and communist approaches to space. Both programs had to arrive at a philosophical position on the interface between human and machine. The Mercury, Gemini and Apollo astronauts fought a constant battle in the early development of the lunar missions to be allowed manual control of the spacecraft (Mindell 2008:160–161). While similar tensions existed in the Soviet space program, cosmonauts were given far less agency, with training focused on following orders from the ground and withstanding physical stresses (Gerovitch 2007:141). The bodies of both were the expressions of ideology. The US astronauts were meant to embody "the age-old American icons of control and mythologies of individuality and autonomy, from cowboys to sea captains" (Mindell 2008:5, see also McCurdy 1997). For the story to work, Mindell argues, the astronauts had to be in control, to have mastery (2008:12). Some astronauts equated loss of the pilot role as a threat to their masculinity (Mindell 2008:14).

This was very much an arena where masculinity was defined for the future of space. Automation and lack of control were equated with femininity. US experts cited Valentina Tereshkova's successful orbit in 1963 to mean that the heavily automated Vostok vehicle did not require a skilled operator. Margaret Weitekamp argues that "Demonstrating that a woman could perform those tasks would diminish their prestige" (2004:3). So strong was this ideology that the USA did not send a female astronaut into space until Sally Ride became a crew member of the space shuttle Challenger for STS-7 in 1983.

By contrast, cosmonauts were the epitome of the "new Soviet man" (Gerovitch 2007), the 'cog in the machine' celebrated in Bolshevik political and poetic imagination. Sergei Korolev, the leader of the Soviet space program, was opposed to any active role for the cosmonauts, but as they, like the astronauts, were drawn from a test pilot background, the battle to preserve the aviation role of pilot was similarly played out. The unknowns and technological constraints of creating a successful lunar mission led to the development of similar human–machine interfaces and similar levels of autonomy in both programs (Gerovitch 2007). At this level, at least, evidence suggests that a hypothetical USSR lunar landing site might reflect many similarities to the US series.

The Apollo 11 surface mission was highly choreographed and scripted (NASA 1969), but at that point no person of Earth knew exactly what the experience of being on the lunar surface would be like. In the gaps between the script and the actual actions of the astronauts, there is a window where minds and bodies express their individual and cultural differences. Where there was choice, what did the astronauts choose to do? What determined those choices?

Conclusions

Until recently, archaeology has been predominantly geocentric, focusing on the surface of the Earth and the layers beneath. The inclusion of places and objects in orbit and throughout the solar system has required reconceptualising the relationship between Earth and space (Gorman 2009b, 2014). A corollary of this is understanding the implications of the engagement with space: increasing interfaces with technology make us question how the human body and the traces it leaves in Earth and space can be understood.

In the context of Apollo culture, robotic landing craft from Luna 2 in 1959 to the most recent, China's Chang-e lander and rover Yutu, are almost evidence of a new species. Between 1969 and 1972, 12 bodies walked on the surface of the Moon; but many more over the decades have experienced it by remote sensing through robotic interactions. The traces created by static and mobile robots provide evidence of an ongoing evolution of technology beside the defunct lunar Apollo culture.

Digging deeper into the conceptual foundations of Capelotti's proposed Apollo culture, the examples of the toss zone (O'Leary et al. 2002) and the autonomous astronaut bodies support the idea that the space environment creates a cohesive culture defined by a repeated suite of artefacts and embodied behaviours. Trigger has argued that distinctions between culture-historical, functional-processual and evolutionary archaeology are being eroded (Trigger 2006:535), and this is perhaps particularly true for the contemporary past. Here, a Binfordian adaptationist model and a Tylorian "complex whole" approach combine to allow lunar landing sites to be analysed as archaeology—raising questions beyond the scope of standard space histories.

Acknowledgments

I thank the reviewers for their highly thoughtful and useful comments, and Alan Kerlin for generously reading the penultimate draft.

Compliance with Ethical Standards

Conflict of interest The author declares no conflict of interest.

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