To appear in *Situatedness and Place: Multidisciplinary Perspectives on the Spatio-temporal Contingency of Human Life*, ed. T. Huenefeldt & A. Schlitte. Springer Nature. Please refer to published version before quoting or contact author.

Spatial Conception of Activities: Settings, Identity, and Felt Experience

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Abstract

The "situated" perspective in the analysis and design of socio-technical systems reveals how people conceive of activities as social-interactive *settings*, thus relating situated cognition to themes in the philosophy of place. In the socio-technical approach to developing technology, social scientists and computer scientists ground designs of automation (e.g., software, devices, vehicles) in ethnographic studies of how people interact with each other, tools and representations (e.g., computer displays), and their environment (e.g., facilities). These studies characterize people's *activities*—how they conceive of what they are doing in particular settings. A person's understanding of activities that a physical location affords for certain socio-technical purposes—the spatial conception of activities—makes a location a meaningful place. Technical knowledge and methods ("what I am doing now"), personal identity ("who I am being now"), and behavior norms (e.g., "how well I am doing now") co-develop in the activity setting. This paper elucidates the multi-dimensional physical, conceptual, and interactive nature of settings with examples from ethnographic studies of robotically mediated field science on Mars and analog expeditions on Earth. The felt and aesthetic experience of being in places that are Mars-like and working on Mars itself further reveals the emotional aspect of cognition that motivates and orients scientific work, exploration, and associated artistic expressions.

Keywords

Activity, Spatial conception, Setting, Situated cognition, Identity, Ethnography, Work Practice, Planetary Science, Analog environment, Socio-technical design, Aesthetic experience

Based on an invited presentation at the University of Eichstätt-Ingolstadt, Germany, June 2015, as part of a series of workshops, "Situated Cognition and the Philosophy Of Place." Paper submitted October 2016; revised July 2018.

1. Introduction

What is situated cognition and how does it relate to "place"? In this paper, I discuss the notions of "situatedness" and "place" in socio-technical studies intended to inform the design of artificial intelligence technology in software, devices, vehicles, and robots that help people do their work. These analyses, often called "workplace studies," (Anderson 1994, 1997; Harper 2000; Luff et al. 2000) focus on the logistics and circumstances of work – what people do, where, when, with whom, using what tools, etc. – that enables the routine workflow of tasks and information, called *work practice*. In contrast, other methods for designing work systems (e.g., "business process modeling" and "task analysis") more abstractly describe the *functions* people accomplish, often called *tasks*, modeling work as transformations of data and materials in the manner of a manufacturing assembly-line process. Studies of practice are about the *behaviors and beliefs of people* who at times are "at work." Workplace studies focus on how people interact with each other and their environment, including communicating, manipulating materials, using devices and vehicles, gesturing, and moving.

Work practice can be modeled as patterned behaviors called *activities*, which occur over time in some *setting* (Clancey 2002). The activity unit of analysis relates psychological and social-interactive analyses of people, settings, and activities, and thus reveals *how reasoning is "situated"* – that is, it occurs as experiences and interactive behaviors, rather than only being a mental process in the brain. Activity models capture circumstantial, logistic details that cognitive models ignore: where reasoning (inferring, calculating, imagining) occurs, where data and information are located (e.g., paper documents, graphics, displays), and under what circumstances reading and writing information occurs. This cognitive science research topic is broadly called *situated cognition* (Lave 1988; Clancey 1997, 2008). Models of activities holistically relate roles, procedures, records, automated tools, facilities, schedules, etc. In contextualizing work functions in this manner, work practice studies reveal temporal and spatial constraints on perception, comprehension, and decision-making, in addition to how impasses are resolved and incidental communications and assistance, all of which is highly relevant to the design of work systems (e.g., Clancey et al. 2013). Or turned the other way, applying the "situated" perspective to analysis and design of socio-technical systems reveals how people conceive of activities spatially, relating situated cognition to themes in the philosophy of place.

Over the past 30 years the socio-technical design approach to developing technology has matured as a partnership among social scientists and computer scientists (e.g., Greenbaum & Kyng 1991; Nardi 1996; Salvador 1999; Rönkkö 2010). Consequently, the research methodology combines ethnographic observation (Spradley 1980; Clancey 2006a), social theories of practice and cognition (Leont'ev 1979; Wertsch 1979), and often computer models and simulations, such as simulating work practice in Brahms (Clancey et al. 1998). Socio-technical design projects typically seek to automate work that is tedious, error prone, and costly, and may involve developing tools such as the mobile robotic laboratories on Mars that enable work that otherwise would be too dangerous or impossible to otherwise perform (Clancey 2012).

This paper considers developing tools for working on Mars either for future astronauts or for planetary scientists operating robotic physical surrogates remotely from Earth or Mars orbit. In these design projects, field scientists use the term "place" routinely in their work to refer to named geographic regions on a map (e.g., Meridiani Planum on Mars, Devon Island in the Canadian Arctic). In an activity-based analysis, the term "setting" refers to a *conceptualization*, how people in a given culture think about a place, including norms for who can be there, how we might dress and behave, and the suitability and adaptation of a place for certain activities (Barker 1968). In general, the notion of "setting" plays a central role in ethnographic studies for practical design projects.[1] Viewed through the metaphor of a theatrical play, the place is the stage where we experience a constructed world of rooms, decor, and props, constituting the setting, in which a story unfolds revealing the relationships among people, technology, and their environment.

In effect, a key purpose of this paper is to elucidate the physical, mental/emotional, interactive, and social nature of settings, based on ethnographic studies of field science on Mars and expeditions on Earth in places that physically resemble Mars (analog environments. In particular, I illustrate how people engaged in activities conceive of settings in terms of *spatial relations of physical geography* (e.g., a hill), *activities*, *social relationships*, and *things* (e.g., tents). These examples reveal that people's conception of activity and setting blends with their identity, and the mutual relations of action and meaning emerge in practice in an actor's conceptualization of "what I am doing (here) now" (Clancey 1997; Wenger 1998).

How we conceive of settings can reveal both the nature of conceptualization as well as how social, bodily, and activity notions pervade our concept of places. A fundamental notion that I wish to make clear throughout is that "situations" are *conceptual,* that is mental constructs, and our conception of activities relates many categories and feelings – social, logical, sensory, kinesthetic, and aesthetic. A "situation" for an actor is not only a physical place and what is perceived. Rather "the situation" is the actor's encompassing understanding at a given time of roles, responsibilities, setting, methods of interacting with the environment and other people (norms), tools, etc. that are guiding and giving meaning to his/her ongoing activities. Similarly, when we say an activity is "social" we do not mean that the actor is necessarily physically present with other people, but rather the activity is *conceptually social* – the manner in which it is done, what needs to be done, how it will be evaluated, etc. are affected by the actor's understanding of the norms, methods, knowledge, expectations, etc. of the social group in which the actor is participating, whether it be an organization, group of friends, or family members.

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[1] We can view "setting" in workplace studies as an *etic* term (a structural, conceptual distinction of the people in the culture being studied, which may or may not be in their lexicon), and "place" as an *emic* term (an analytic, culturally general distinction, named and often graphically related to other places as in a map). In human culture the place–setting distinction blends; for example, constructed (e.g., buildings, plazas) and natural places (e.g., lakes, mountains) alike are known as both physical places and cultural settings for activities. Of particular interest are settings in which only certain people are allowed to participate and activities are circumscribed, such as the settings related to Mars field science discussed in this chapter.

Such conceptions are often tacit, implicit in learned relations that are not necessarily ever reflected upon and articulated in descriptions about the self, world, and others. They constitute the “know how” of practice.

As I will show by several examples at the end, the situated cognition perspective also provides a way to characterize our experience of the “aesthetics of a place,” namely as a spatial conception that is both an action-orientation (physical) and a feeling (non-verbal experience). In my analysis, *conceiving* is inherently emotional, though this aspect has often been omitted entirely from cognitive models and artificial intelligence (Damasio 1994). One of my objectives in this paper is to provide an empirical, practice-based perspective on settings that others may perhaps analyze further to provide philosophical distinctions useful for design projects.

This chapter begins with examples of settings and practices during Haughton-Mars analog expeditions in the Canadian High Arctic, illustrating the methods and analytic eyeglasses of socio-technical design. I then elaborate the story of these expeditions to include the notion of identity and explain the notion of activity with examples from a simulated mission in the Flashline Mars Arctic Research Station. This analysis is complemented by discussing how field science expeditions are possible on Mars today without being physically present: the Mars Exploration Rovers are not only physical surrogates but collaborative tools, designed to fit the social, embodied nature of human cognition. The final analytic section, on the felt and aesthetic experience of being in places that are Mars-like and working on Mars itself, emphasizes the emotional aspect of cognition that motivates and orients scientific work, exploration, and associated artistic expressions. This chapter concludes with a brief review of perspectives on urban and architectural design in the 1950s to 1970s that has strongly influenced socio-technical studies of workplaces by relating the physical, pragmatic-interactive, social, and felt dimensions of activity settings. Finally, the themes that organized the lectures and conference workshop in which the ideas in this chapter were first presented are revisited from the perspective of situated cognition, specifically in the context of workplace studies.

2. Settings and Practices in Haughton-Mars Expeditions

The Haughton-Mars Project (HMP, Lee and Osinski, 2005) is a multidisciplinary group that carries out scientific and engineering expeditions near Haughton Crater on Devon Island in the Canadian Arctic (**Figure 1**). The crater and its environs constitute a “Mars analog” because the island is undeveloped, almost entirely barren and without animals. The landscape is mostly breccia, a kind of rubble stone caused by the meteor impact, and mud, with ravines and hills shaped by a glacier that once covered it. Field scientists, chiefly geologists and biologists applying the method of comparative planetology, study this place to understand the geology and possibility of life on Mars, past, present, or future. For example, the “valley networks” seen on Devon Island are known to have formed under a glacier, and thus it is hypothesized that similar morphologies on Mars were formed in a similar way (e.g., thus explaining how water erosion could be possible despite Mars’ frigid temperature and thin atmosphere).

But Haughton Crater also constitutes a Mars analog setting of another sort. Insofar as it resembles Mars in the imagination and is devoid of every distraction of civilization, the place can be used for an activity called a "Mars analog mission." In particular, the participants of the expedition living in base camp or members of the Mars Society living in the nearby Flashline Mars Arctic Research Station (Zubrin 2003) can pretend that they actually are on Mars and constrain their activities accordingly, such as always wearing a simulated spacesuit outdoors. Thus, the environs of the Haughton Crater become a kind of stage setting for role playing, in which they come to understand what a Mars mission requires, developing roles within the crew, experimenting with tools such as drills, exploring and documenting the region, communicating with a remote "mission support" team, and so on. Thus, it should be apparent that in this activity of a "Mars mission simulation," the behaviors of the members are constrained by their *conception of the place as being Mars* – in their imagination, in the layout of the camp and their habitat; and through their actions they create and reinforce their understanding that "this is what being on Mars could be like."

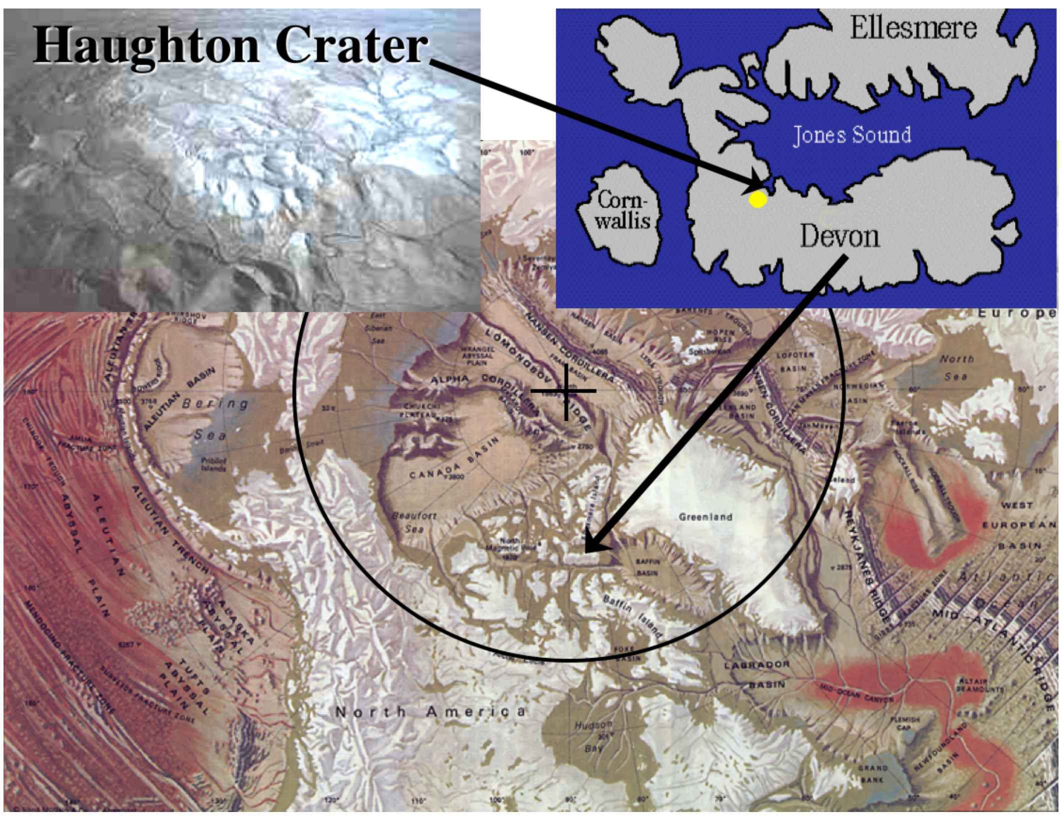

Figure 1. Geographic location of Haughton-Mars Expedition.

My ethnographic research in the HMP began in 1998 when we were camped along the Haughton River (Clancey 2001). My original objective was to describe the people and their roles, the setting, and activities of the expedition, particularly to elucidate the nature of exploration, a central topic for NASA. At that time, both cognitive and social studies of science focused on laboratory settings; indeed, information-processing psychological models reduced "discovery" to mental problem-solving processes, such as inferring equations to relate numeric data (Langley et al. 1987; Downes 1990). I wanted to show how people explored a place and how this activity related to scientific discovery.

One of my own first discoveries was how people parked the all-terrain vehicles (ATVs), orienting the vehicles' front to the power cord that ran from a generator by the river to the work and mess tents (**Figure 2**). In an ethnographic study it is useful to remind ourselves that whatever we observe could have been different. Nobody directed the group to park in this way. I never heard anyone correct someone for parking elsewhere. Yet there was plenty of open space and no important reason for lining the ATVs in this way. In seemed to me that the cord and how it was used resembled a curb in a street back on Earth. We say that the cord "provided a resource" for ordering people's parking behavior.

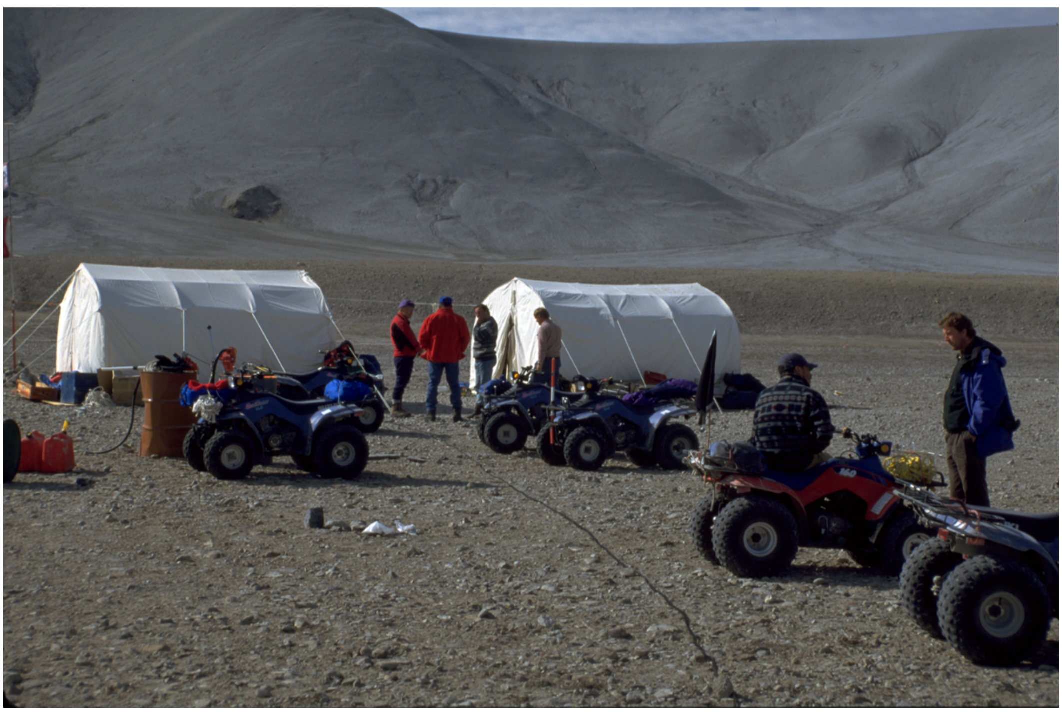

Figure 2. ATV parking area near work tents
(Credit: NASA Haughton–Mars Project, William J. Clancey).

Parking ATVs in this manner emerged entirely at this place and time during a few weeks in this particular 1998 expedition; it became the practice of the group. This practice can be interpreted as having both pragmatic and socially important aspects. The ATVs are shared and so parking them by personal tents would be inconvenient to others and appear to claim ownership. Parking the ATVs near the shared tents makes them ready-at-hand for their use, which was almost always organized and planned with the group leader. We can also see in the photo that this emergent organization is exploited in providing a convenient place to sit outside while talking to someone; this is a good place to meet and interact, just as other members of the expedition pause to talk in the space created between the work and mess tents.

In summary, the organization of the shared tents, power cord, and ATVs on this river plateau emerged in practice as a setting for the expedition; it is a place socially ordered by activities with different levels of abstraction and purposes, which we might name, "carrying out an expedition," "laying out base camp," "parking ATVs," "sitting/standing and talking." We can observe directly in this setting that practices develop from mimicked, recurrent actions – individuals independently create patterns (the line of ATVs) that others perceive, prompting their own actions that confirm and strengthen the pattern (e.g., driving up and parking alongside an ATV). Thus, practice and setting emerge through precedent – every individual action provides a context for future action and reinforces the group's patterning of "what you can do here," "how we use this place." Such norms develop and are reinforced in activity.

Tying this back to the socio-technical design perspective: Just as the members of the expedition were not instructed about how to park ATVs and do not even necessarily reflect on what they are doing, a robotic ATV, to fit the expeditions practices, would need to discover and follow the patterns in the behavior of people and other robotic ATVs. The robotic system must regulate its behaviors according to precedent, to follow what other actors are doing; in particular, the conception of functional use of space ("what you can do here") is common to the members of the group and robotic actors must be capable of detecting and adapting to this conception as it develops in practice. This is not to preclude explicit instruction or discussion, but simply to note that not all behavior needs to be planned and verbally expressed in procedures; it can be learned through activity. Ryle's (1949) distinction of knowing how and knowing that is fundamental to making robots or software programs ("agents") into social actors.

Figure 3 provides a broader perspective revealing other social relations that constitute the HMP-99 expedition setting. Here we see that personal tents, where individuals sleep and store their belongings, are aligned along the edge of the river plateau. I recall asking the group leader where I could place my tent (the blue tent on the right); he suggested to put it near his (on the far right). The organization of personal tents is not haphazard. Again it illustrates that members of the group seek, respect, and create patterns, and indeed that visible order is important in the HMP-99 community of practice. The use of the place, this river plateau, also respects visible physical boundaries; the shared white tents and ATVs are more or less in the middle, the personal tents as far away as practical, but separated for some privacy. The yellow-orange tent in the foreground is the latrine – far enough away to respect its special purpose, but still conveniently close. Another white wall tent on the left is a kind of office for the expedition commander; its separation shows that it is not shared and open for improvised use like the work and mess tents. In short, common ideas of private and public spaces and different functions in designing homes and offices are visible in the layout of the HMP base camp. But the expedition, by being remote from existing facilities, roads, etc., makes salient how shared experience and recurrent behaviors develop to exploit, interpret, and adapt a physical place to create settings for different personal, joint, and improvised activities.

Figure 3. Layout of the tents at the Haughton-Mars Expedition 1998
(Credit: NASA Haughton–Mars Project, William J. Clancey).

Looking inside the work tent (**Figure 4**) we can discern more patterns that a robotic system would need to know. To begin, the term "work tent" doesn't completely characterize how this place is used. Again, functions emerged in practice, which is to say that the shared understanding of this setting was constructed through individual actions, with precedents establishing a conceptual (and visible) norm, that are reinforced or adapted by subsequent actions. People have dedicated work areas on tables whose boundaries are loosely marked (e.g., the upright brief case in the upper-left photo) and are not always negotiable. Other aspects of the social order include not sitting in or moving someone else's chair; mostly working alone and quietly; storing large personal items under the table; not removing someone else's charging device; and dedicating one table for storing exploration tools, etc. As needs develop, certain adaptations might require mentioning what you are doing, such as borrowing an extension cord; the request makes note that you are aware of the norm and provides an opportunity for objection or a suggested alternative. A bipedal robotic participant would need to know all this.

As is well known, design of workspaces like this tent benefits from being flexible so the organization and purposes of the place can develop in practice. Here the expedition leader provided tables and power outlets; the rest was constructed by the group, with the layout and practices constraining the people who arrived in subsequent "rotations" of the expedition. Understanding emergent order has been fundamental to the notion of "human-centered design." Traditional work systems design (e.g., of facilities and software tools) typically began with "functions" (idealized roles for people), "requirements" (e.g., a priori description of procedures and protocols), a design (often involving automation), interfaces (i.e., means for people to interact with the facilities and tools), and finally training for the workers in using the provided workspace and tools. In contrast human-centered design involves the workers as co-designers, provides flexibility for adaptation (along with structure to prompt uses), observes and learns from practice, and then iterates again with the workers to improve the work system design (roles, procedures, tools, furniture, etc.). These principles are applicable whether designing a robotic laboratory on Mars, a workplace office building (or a Mars habitat), a self-driving car, or a voice-commanded "agent" on a mobile device. In each case, the people, activities, and settings will develop in practice. Or to pick up this dynamic by one thread pertaining to this book's theme – how a place becomes a setting for people engaged in activities is itself a situated activity, involving different levels of pragmatic interactions, reflection, and often deliberate redesign experiments.

how to work undisturbed and respect privacy

where it's okay to store materials and tools

how to share space with others

where to find the camp manager

Figure 4. Ethnographic observations of a "Work Tent" – what a robotic assistant would need to know (Credit: NASA Haughton–Mars Project, William J. Clancey).

3. The Relation of Identity to Activities and Settings in Mars Expeditions

The notion of identity provides an essential link between psychological and social analyses of people (Clancey 1999, Chapter 1): on the one hand, the neuropsychological nature of consciousness in coordinating perception, conceptual understanding, and action enables people to be social actors (i.e., the physical "mechanism" that enables learning and intelligent behavior); on the other, a person conceives "what I am doing now" in terms of his/her roles and activities in a group (i.e., the conceptual "content" that constitutes practical knowledge). Identity is thus both a neuro-psychological and social phenomenon.

Identity at HMP and in the Mars Society is reified by patches and blazoned across our chests (**Figure 5**), a distinctly human way of expressing membership. This impromptu picture of the author pokes fun at the iconic photographs of mountain-climbing explorers, but it also signifies something real about the pride and joy of *being here, in this place, at this moment*. In a playful way, this little pile of rubble symbolizes a mountain towering above the crater, and standing tall on this high point claims a degree of personal accomplishment in the expedition. Put another way, recording participation in the expedition through this photograph expresses an identity, which conceptually blends the social fact of membership with an emotion and aesthetic perception of the place.

Figure 5. People express their identity as members of expeditions and space exploration missions through patches and clothing. Explorers stand on hilltops to mark their accomplishment.

During Mars mission simulations in an analog environment, we are designing and experimenting with habitats, tools, and practices for surviving and exploring in a harsh landscape (**Figure 6**). The future-oriented interest of computer scientists in developing technology for Mars is enhanced and supports the interest of planetary scientists in investigating and understanding Mars. We are learning how we might live and work on Mars by co-constructing activities and settings, as well as our identities as space-faring explorers. By role playing Mars missions in a simulated habitat in an extreme environment we can use our imaginations to design and experiment with technology, operational procedures, roles, schedules, space suits, vehicles, and facilities we might use on Mars. We include remote support teams, exploration traverses of the landscape, logs and records, and so on. We create a simulated Mars setting, such as placing the habitat on the edge looking out over the crater, to prime our creativity, and through the physical and social interactions of activities inside and outside the habitat, we learn what works and discover new problems. It is a place for creative play, in which we pretend we really are crew members on Mars. The ethnographic "participant observation" method of observing and recording thus naturally involves contributing to the expedition's scientific and technical activities, adopting the identity of an expedition member. This identity is in large part earned by being an analyst and designer who helps realize the vision of exploring Mars.

Figure 6. Flashline Mars Arctic Research Station (FMARS), a setting for Mars mission simulations constructed by the Mars Society on the rim of Haughton Crater (Credit: William J. Clancey).

The relation of activities to settings is fundamental and merits elaboration. To begin, an activity, like a task, is a unit of analysis, a way of interpreting, "chunking," and labeling human behavior. A key part of an ethnographic study is categorizing what people are doing, where, when, with whom, how, etc. as activities. One of the common activities in FMARS is working alone together (**Figure 7**). The individuals are quietly working on their own projects. They are not collaborating, but cooperating, sharing a common resource (the hab space) and respectful of each other's need for silence to concentrate.

Figure 7. Working alone together. A group activity that is not collaborative—realizes common activity. FMARS, July 2000 (Credit: William J. Clancey).

Activities are consciously choreographed behaviors in the world (Clancey 2002). Participating in this group requires regulating one's behavior by an understanding "What am I doing now?" that blends both "Who am I being now?" and "How am I behaving now?" That is, besides attending to the substance of one's personal activity (e.g., the Discovery Channel photographer is reading a novel; the biologist to his left is reading a scientific article), one must attend to the implicit norms of this group, such as not making many outloud remarks to share interesting ideas. To be a social actor, the personal and social aspects must be both immediate and always present in each person's understanding of the activity. That is, their conceptualization is coordinating multiple levels or dimensions of their behavior simultaneously, involving their choice of what to do at this time, their manner of doing their work, and even how they are sitting. Notably, the photographer and biologist could have worked in their staterooms just behind their chairs, with the doors closed. Instead, they have chosen to be near the two people working at the table, angled as if to show their conceptual orientation of being part of the group, forming a unit.

More generally, an actor's ongoing conceptualization of an activity determines roles, communications, attention, schedule, problem-solving methods, tools, etc., that are appropriate for the given setting. For the analyst, understanding how the actors conceive "the situation" enables detecting and appreciating how they are interacting with each other and their environment. During joint activities such a meeting or preparing meals, the group's interactions involve different *modes of interaction* such as monitoring, cooperating, waiting, not interfering, and face-saving. Even sitting quietly is a form or mode of interaction. In short, a situated cognition perspective enables analyst–designers to view this floor of the FMARS habitat as a social-interactive place, a setting that prompts, reinforces, and is constructed by individual actions. The norms are visible in how the place is used (i.e., behaviors), how it becomes a stage for socially meaningful activities (Clancey et al. 2005).

As we saw in the camp and work tent layouts, the patterns of behavior in the FMARS habitat are emergent, tacit, and orderly. The crew members express their identity by respecting and reconstructing these norms moment by moment. Each person knows which chairs can be used (those at the table are shared) and where they are expected to be placed; but these patterns don't need to be discussed or regulated by rules unless a breakdown occurs ("Do you know where my chair is?").

Figure 8 shows two examples that vividly illustrate how what we do in different places is conceptually regulated. To be sure, riding around on ATVs in the Arctic wearing white canvas suits with garbage can lids on your head is quite a feat of the imagination! Here imagination and creativity have produced an activity that is very far from civilized life, yet seems perfectly natural when role playing "being a member of a crew on Mars." The landscape, weather, vehicles, and clothing mutually constitute the setting, afforded by this unmarked, unbounded place for driving and exploration. Our behavior is mediated by how we are thinking about our activity, so the context is conceptual, coordinating our perception and actions – "What I am doing now" is imagined and enacted, meanings and possibilities for social interaction in this environment feeding each other.

Simulated missions provide an ideal opportunity to study the scientific practice of exploration in gathering data about, categorizing, and theorizing about a place; understanding this activity is fundamental to the design of mobile robotic laboratories for field work on other planets. Notice also that "exploring" has an open quality that a task analysis would need to gloss, as the opportunistic processes of poking around, probing with instruments, making notes, etc. is not well expressed by a fixed, step-wise procedure. Rather, the activity of exploring is interactive and circumstantial, an emergent product of the physical geography, perception, tools, interests/expertise, and time available. Explorers are always re-evaluating "What is the quality of the work I am doing now?" "What are the opportunities (or challenges) posed by this place for my exploration interests?" And socially orienting to the scientific community: "Am I gathering sufficient and appropriate data for presentations and publications?" When the various factors harmonize, interest increases, and the activity focuses, such that the place becomes a setting for perhaps prolonged work of applying instruments, sampling, data recording, and systematic survey that a task analysis can describe well. In paleontology and archaeology, which share characteristics of planetary field science, the setting will be formalized in a visible shared coordinate system and every found item (bone or shard) labeled and recorded in a database. People are assigned places to excavate and slowly the place becomes an ancient historical setting for reconstructed events (animals collected in the bend of a muddy river; rooms of homes in a village). Understanding the morphologies of Mars' landscape in terms of historical climatology is similar.

Figure 8. Two activities: exploring and working (or resting) at your workstation. FMARS, July 2001 (Credit: William J. Clancey).

To elaborate the psychological and social aspect of activities and identities, consider two crew members working on their computers in the shared FMARS workstation area (**Figure 8**, right). While Vladimir is awake and working, Katy has taken a moment to rest. If we were to rouse her and ask, "What are you doing now?" She might say, "I'm tired, I'm contemplating." "Why don't you rest in your stateroom?" "I'm not done yet; I'm still working on my email." "What do you need to do?" "I'm a geophysics graduate student at MIT, I have ongoing projects back in Cambridge where I live." Pressed further by a journalist perhaps, she might add, "I'm an American just visiting here in Canada as part of the FMARS crew." Crucially, each of these descriptions is simultaneously true and each characterizes what she is doing now and who she is being now. Her identity as a crew member, a student, and a citizen are blended and may affect how she carries out FMARS activities. For example, a journalist may seek to highlight her story because she is a woman–scientist, or she might volunteer to be responsible for certain exploration activities in a role that complements her Ph.D. research.

Consider how robotic systems and agent assistants as they are currently constructed lack such histories of nested activities and identities. We might model activities and give roles and responsibilities to computer systems, but still the robot/agent must observe, learn, and adapt because practices are prone to change. Furthermore, the social license for adaptation is challenging to formalize: Why can't a worker at a telephone call center rest with her head against the desk, although it is perfectly allowable in FMARS? What social understandings do we tacitly share that makes obvious that norms are radically different in "being at work in an office" and "being a crew member in a Mars habitat"? How are common self-regulatory needs such as resting accomplished in different settings?

Bringing this back to the theme of the philosophy of place, a setting for a person is always both personal and social, both physical and conceptual, and often both visually perceived and verbally named. Settings are bound to our identity, who we are, the activities in which we participate. An end-of-mission portrait of the FMARS 2001 Rotation 2 crew (**Figure 9**) shows how each person has a "sense of place," what is theirs, where they belong, and each know (and can see) that they share this understanding and the effect is cooperative (I'll respect your privacy knowing you will respect mine). The photograph also shows a more basic level of coordinated action – they have chosen to stand by their rooms and are mimicking each other in holding onto a door or the wall, signifying that they know and possess their place. This plays out in much more sophisticated ways in carrying out the simulated mission, planning and participating in exploration and reporting, sharing in chores, and contributing to hab life by cooking for and entertaining each other.

Figure 9. Group portrait of FMARS 2000 Rotation 2 Crew (Credit: William J. Clancey).

To recap, the Mars habitat examples illustrate how people make places into settings for carrying out activities; spatial layout of things and how they sit, stand, relax, etc. makes visible how they are conceiving social relations. Thus their *motives*, which are expressed in the activity (e.g., expressing “pride of place,” napping, concentrated reading), are in a triadic relation with *norms* and the *affordances of things and places* (e.g., the edge of the stateroom doors affords gripping with the hand).[2] This analytic, situated cognition perspective – relating conceptually coordinated, embodied behavior; social identity and practices; and the physical environment – is useful for design of buildings, furniture, work processes, and technology.

To round out the FMARS habitat example, particularly to illustrate technology design, we need to consider collaborative work. An important example is the activity of exploring a place remotely using a mobile robotic laboratory, such as the Mars Exploration Rovers (MERs). On Mars MER-like physical surrogates might be operated from habitats, orbiting space stations, or from Earth as they are today in NASA’s missions. Socio-technical studies of MER missions reveal an important aspect of spatial conception, namely people’s ability to imaginatively project themselves into the body of the rover, visualizing and simulating what they would do if they were standing there on Mars (Clancey 2012; **Figure 10**).

David Des Marais, an astrobiologist, described the MER scientists’ experience this way:

> The first few months of the mission, they had these huge charts on the wall, engineering drawings of the rover, with all of the dimensions. We’d have some geometric question, “Well can we see this; can we reach this? Is this rock going to be in shade or is it in the sun?” We’d go stand and stare at those charts, and over time we stopped doing it so much because we began to gain a sense of the body. That’s definitely projecting yourself into the rover. It’s just an amazing capability of the human mind – that you can sort of retool yourself. (Clancey 2012, p. 108)

Thus, the operation of the MER rover illustrates one of the central tenets of situated cognition, *embodiment* – in a nutshell, we are capable of tacitly (non-verbally) conceiving spatial relations that relate to how we have interacted and moved within our environment. Learned gestures and coordinated actions are coupled to concepts, ranging from simple actions like throwing something to hit a moving object to named motions, such as a “do–si–do” in a square dance. Thus, conceptualization appears to be a higher-order form of categorization (incorporating perception and motion patterns) for coordinating behavior (Clancey 1999).

Doing field science on Mars requires providing people with a means of *experiencing presence*, of being in that place. The technologies developed include MER’s stereo panorama camera, use of “virtual reality” displays and eyeglasses at JPL, life-size shared photographs, and even the proportions of the MER (e.g., the panoramic camera is 1.5 m high) and configuration of the

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[2] Affordances are dynamic relations among a physical place/thing and the intentions and behavioral capabilities of actors; they are not properties that reside in either the place/thing or the actor. Other examples: the upper bunk of the stateroom affords sleeping and being used as a standing desk; the table affords seating for six people at meals or four people using computers.

instruments (e.g., the RAT is on the end of the arm, and can be positioned on a rock like a hammer).

Figure 10. Mars Exploration Rover (MER) missions named Spirit and Opportunity, operated from Jet Propulsion Lab, Pasadena, California. Clockwise from upper-left: Schematic of MER instruments; MER science team informal discussion; pointing to a feature in the life-size panorama on the table; photograph taken on Mars of MER instrument deployment arm with sensors, microimager, and rock abrasion tool (RAT). (Credits: NASA/JPL; Chin Seah; NASA/JPL; William J. Clancey).

Crucially, the design of MER transforms the surface of Mars into a field science setting, a place where the scientists and engineers together can carry out an expedition, sensing, sampling, photographing, manipulating soil with the wheels, and in the case of the MER named "Opportunity," moving over dozens of kilometers over more than a decade. The scientists' spatial conception of their activity – the setting for their field science exploration – ranges from close-up photographs of grains of sand to wide vistas in craters and over the plains of Mars. But this conception includes as well nearby places they haven't seen and visual imagination prompted by photographs from orbit of routes they might yet or could have followed. By the very nature of exploration, a field science expedition necessarily includes seeking out and understanding "places we can go that we don't know much about." Indeed, for many years the

Mars Science Laboratory team was learning and hypothesizing about possible interesting and tractable routes within Gale Crater up the central mountain, which rises 5.5 km above the valley floor. Thus the setting for their exploration activity was constructed from the physical affordances, their interests, and the capabilities of the rover and its instruments.

In short, technology of mobile robotic laboratories enables the activity of doing field science on Mars by facilitating, in the scientists' and engineers' imagination, the spatial conceptualization of being on the surface of Mars in the body of the rover – experiencing its capabilities and limitations for analyzing and traversing the unfolding terrain. Put another way, the process of exploring Mars is necessarily contextual and *the place becomes a setting, a stage for action,* by virtue of the conceptual embodiment that mental processes and the robotic laboratory's design enable. Further, the design of the rover, the software tools for planning and programming its actions, the layout of the rooms and even the floors of the JPL building itself (with ongoing missions in different locations on Mars sharing engineering facilities), and of course the roles, work practices, and schedules of the teams all fit together to constitute a *work system* that physically, intellectually, and socially organizes and makes this activity of exploring Mars possible.

4. The Felt and Aesthetic Experience of Places

We have considered how Mars expeditions occur in special places, both remote Mars analog locations on Earth and of course on Mars, referring particularly to the practice of scientific work. But we would be greatly remiss if we didn't mention the aesthetic, emotional motivations for exploration, which are arguably an essential personal motivation for being a scientist (Clancey 2012, chapter 9). Photographs from Devon Island and Mars reveal a great deal about our capability to project ourselves – conceiving of places spatially such that they are settings for activities – and the feelings that accompany this conception. **Figure 11** illustrates feelings and emotion with respect to identity; here we consider photographs that are themselves considered to be aesthetically pleasing, that is, what you experience when looking over a landscape (or seeing it as if you are physically there).

During HMP expeditions the group sometimes traveled by ATV late in the summer evening, when the sun was low on the horizon, to a hilltop overlooking Haughton Crater (**Figure 11**, left). Some people called this "a spirit place," as it evoked feelings of something sacred, transcending everyday settings, distant and foreign, yet visible and apparently reachable. This is an unlived-in world, a place revered by the Inuit, not partitioned, named, protected, or trammeled. It is a place quite unlike where we live and work; it opens for us like the curtains revealing an anticipated play, a yet unknown stage with not yet imagined actions, unpeopled by actors and artifacts, pristine, like land created before man, and abiding today alone.

The emotional aspect of perception is a relatively new topic in cognitive science. For example, Keltner and Haidt (2003) conducted experiments demonstrating that "awe is a very powerful trigger of prosocial behavior…." "[One is] Less focused on the self and more in tune with the present moment" (quoted by Mikulak 2015, p. 18). The very choice of Haughton Crater and its environs as an analog site was prompted by its awe-inspiring landscapes, photographs of which motivated others to join the expedition, and this effectively promoted collaborative research that transformed the place further into a setting for Mars mission simulations (Clancey 2014). Its relevance to comparative planetology (an extrinsic, systemic value) and the emotionally evocative feeling (an intrinsic, personal value) stimulate our imagination of being on Mars and confer an identity that "I am realizing the dream." As De Botton (2002, p. 183) says: "And insofar as we travel in search of beauty, works of art may in small ways start to influence where we would like to travel *to*."

The view of Meridiani Planum (**Figure 11**, right) reveals a different aspect of Mars, namely that it is not only an unvisited, unblemished world, but a place that nobody owns. Thus as a setting it has an idealized character; although a place we have traveled through and gotten to know, it still exists as if in a spatial ether, apart from the human body, indeed a place only for our spirit. Through the rovers we exist on Mars through a physical surrogate and conceptually in our scientific understanding, as the story of Mars; and in future imagined activities, as the story of humanity. Thus Mars is a place conceived scientifically, aesthetically, and emotionally, a setting par excellence, visually experienced like a vivid dream, known as if it is directly real to us, as if we have actually traveled through Meridiani Planum, Gusev and Gale craters, buoyed in awe with opportunity, spirit, and curiosity.

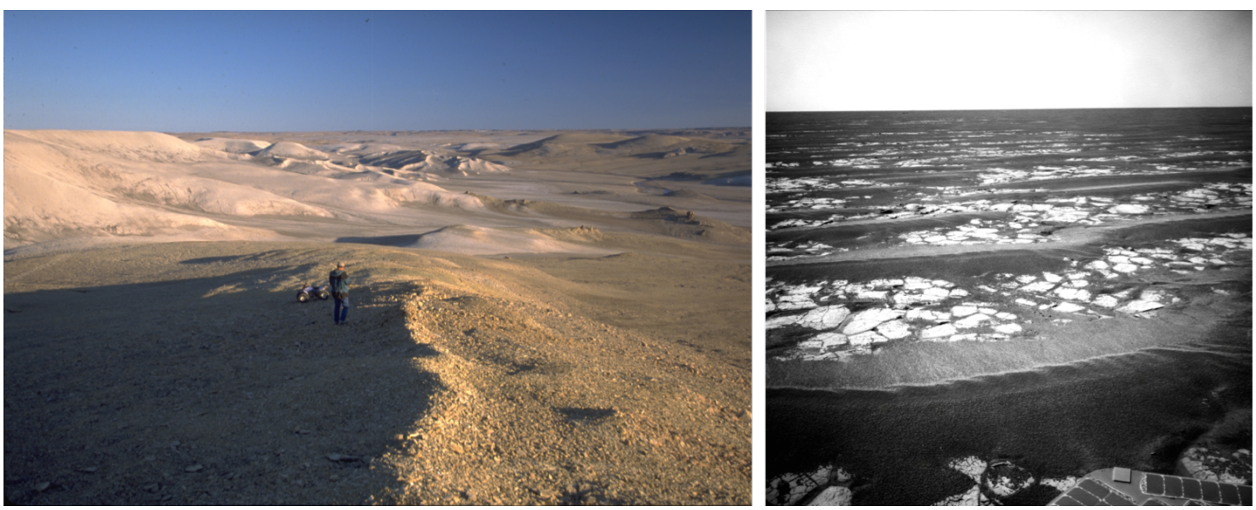

Figure 11. The Hills, "A Spirit Place" (Credit: NASA Haughton–Mars Project, William J. Clancey) and Meridiani Planum viewed from Opportunity Mars Exploration Rover (Credit: NASA/JPL) .

Two related photographs from the Arctic and Mars reveal how spatial conceptions are affordances for activities, that is, the perception of the place is coupled to a conception of and primes possible movements, transforming it into a setting, a place where an activity could be carried out. Exploring the crater in 1998 by ATV, we came upon a ravine (**Figure 12**, left) and paused.

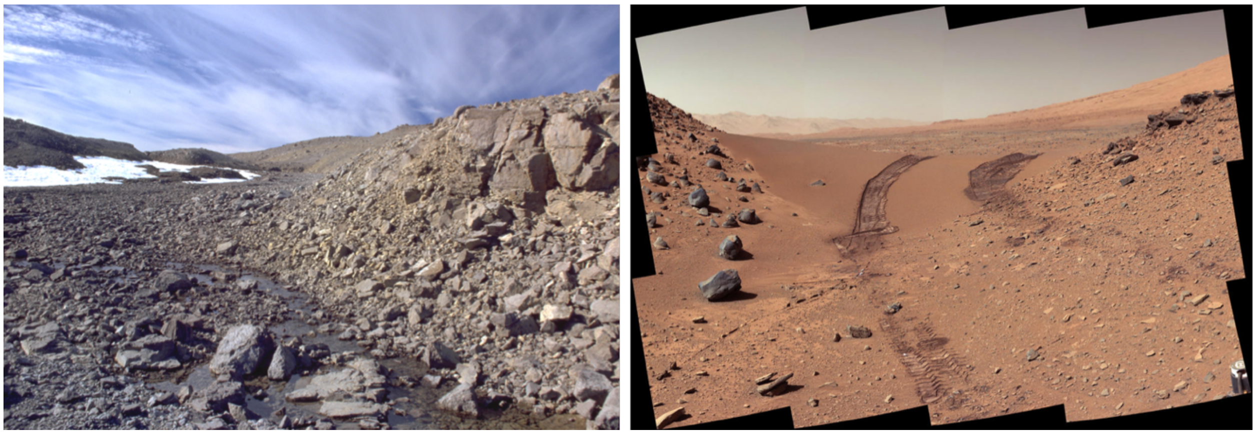

Figure 12. "The Ravine," Haughton Crater, Devon Island (Credit: NASA Haughton–Mars Project, William J. Clancey); Crater tracks of Curiosity, Mars Science Laboratory (Credit: NASA/JPL).

The ravine's perspective suggested turning off our planned route, to drive up the rubble, perhaps to gain a better view of the hills above and what lay beyond. Places are thus "seen through activities," conceived as possibilities for action that satisfies needs – for passage, shelter, reconnaissance, storage, cultivation, etc. As expressed by Fox (2000, p. 42), "When defining our relation to landscape spatially, the temporal side of the equation has to be taken into account...." The ravine beckoned for exploration, it physically afforded an ATV path, and its receding perspective urged me bodily forward. Already engaged in our simulated Mars "traversal" on an afternoon away from base camp, I felt a strong desire to go and be *up there*. But our small group turned away, continuing forward, so this place has always seemed like someone met in a crowd whom I would have liked to know. It was more mysterious knowing that almost certainly no human being had ever tread there – it was not even yet a "road less taken." Viewed askance, it looks and feels like Mars on Earth. It is one of uncountable places in the solar system that nobody knows, yet we know exist and might become a setting for our exploring, "a place for being," or in the case of Mars, a setting for a future civilization.

Another photograph taken in Gale Crater on Mars (**Figure 12**, right), looks back on the tracks of the Curiosity rover through some small hills through which it passed.[3] Examining this image, notice how we move into a place with our eyes, conceiving where we can go, what we might touch: "Our attention…engages in motion over the landscape" (Dewey, 2014). This tacit conception lends aesthetic value, pleasing-ness to the view.

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[3] The image has been white-balanced to show what the Martian surface materials would look like if under the sunlight of Earth's sky.

Conceiving is a reconstructive process of remembering (Bartlett 1932/1977; Clancey 1997). Thus, “what I am seeing here” is seen through past places, perhaps how we *felt*, how we were oriented in activities when in places physically like this, and what activity the place affords. Visual perception (including in the imagination) is not necessarily accompanied by speech, but a felt experience, an *apprehension*, constructed from how categories of multiple dimensions – visual, verbal, auditory, olfactory, kinesthetic – were related in prior constructions. Emotion organizes and reinforces conceptualization (and remembering) – thus conceptualizing is bound to *attitude*, a personal stance towards that aspect of the experienced world (Bartlett 1932/1977). Therefore, conceptualization of activity–settings is always accompanied by some feeling/attitude, such as a sense of security (protective or threatening), movement (past, present, or future), or awe (including wonder, mysterious feeling, and admiration of beauty).

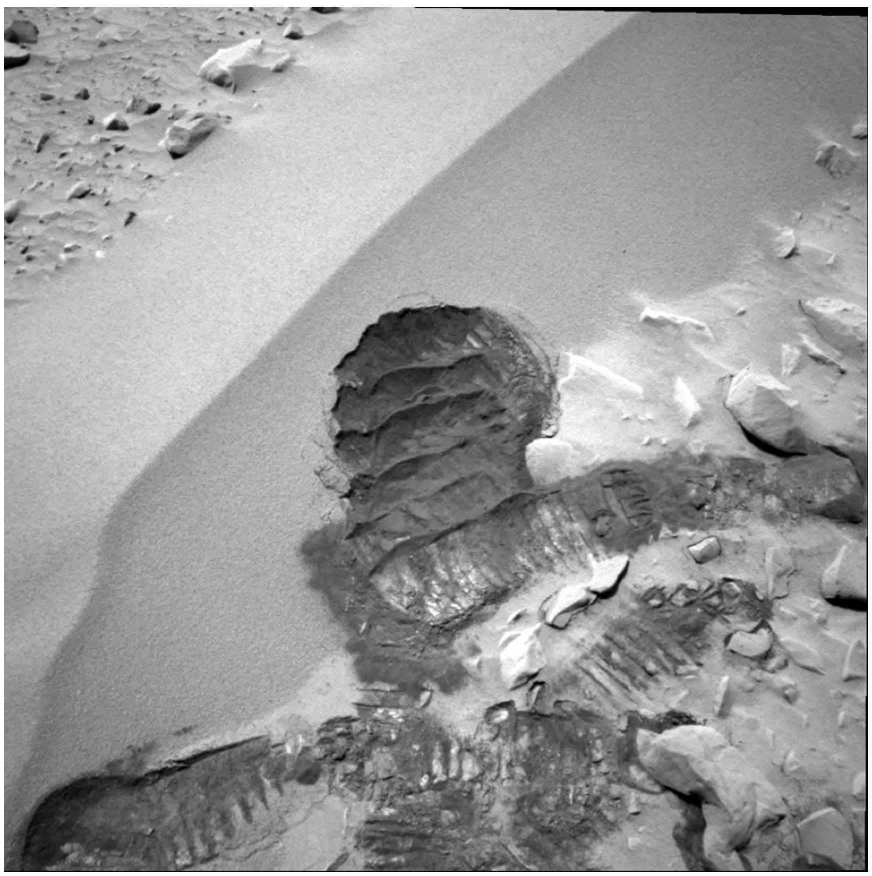

Figure 13. “The Footprint on Mars” — wheel tracks of the Spirit Mars Exploration Rover (Credit: NASA/JPL).

By virtue of being reconstructive from embodied experience, visual perception and conceptualizing a place are also *self-referential* in the sense of relating to our bodies and our actions. **Figure 13** provides a striking example. Some viewers see footprints here, quite reminiscent of the iconic boot prints of Apollo astronauts; in fact, they are MER’s tire tread marks, created by deliberate attempts to "excavate" the soil by removing the top layer of sand and dust. As an apprehension, a non-discursive conception, the sight of the boot prints concomitantly projects ourselves into the image, it places us on Mars. We conceive this place as a "trampling around" activity–setting. These "boot prints" mark this place behind the Columbia Hills, tens of millions of kilometers away, as a place where people have been. The photograph symbolizes what we feel in exploring Mars through the rovers; in the words of MER scientist, Jim Rice:

> I put myself out there in the scene, the rover, with two boots on the ground, trying to figure out where to go and what to do, and how to make that what we're observing with the instruments. Day in day out, it was always the perspective of being on the surface and trying to draw on your own field experience in places that might be similar. (Clancey 2012, p. 100)

Conceptualization is inherently value-laden and hence self-referential: What does this place, thing, event, idea, etc. mean to me? We encounter a place in a manner that fits our ways of knowing within a purposeful activity and conceive it accordingly. Scientists structure their inquiry, particularly in observing, recording, and organizing data, so that it may be accommodated by established schemas of scientific models and social order. For example, data collection during the Mars Phoenix mission was adjusted to create tables and comparative analyses urged by scientific journal editors. Consequently, Mars as a place was seen-through the schemas and constraints imposed by the activity of scientific publication. What was interesting to photograph, shovel, sample, and measure near the Phoenix lander became ordered by the layout of tables and graphs. My own photographs from Haughton-Mars Expeditions and FMARS were sometimes taken because of a striking perspective or lighting, but also generally just attempting to "map" with images where people were and what they were doing.

More generally, how graphics are used during these missions reveals different ways that people can relate to Mars and the scientific work (**Figure 14**). We can categorize graphics in terms of purposes and activities – what are these people doing or expressing? We find a range of motives from "pure" artistic expression to scientific inquiry–but *personal feeling and aesthetics (what looks good) are important for all purposes*. These images show how Mars as a place can be conceived *practically* for depicting or planning a route (top-left photograph: creating a synthetic, third-person view by superimposing the rover in a photograph taken further down the hill; also bottom-right: superimposing a route on a photograph taken from orbit); *scientifically*, by analyzing chemical structure (top center); *artistically*, by deliberately creating and selecting pleasing photographs (notably Bell's coffee-table book and the commanding view from the Columbia Hills).

In summary, aesthetically pleasing images (interesting, intriguing, evocative, and/or awe-inspiring) have these qualities because *they convey information through feelings coupled with multiple categorical relations* – including relating perception and action (e.g., rover tracks), relative scale (the two left-most photographs), color (particularly the choice of artificial color in the spectral analysis), and 3-D perspective (the orbital view). The emotional quality of being pleasing accompanies a non-discursive, meaningful way of knowing a place. The initial experience is feeling value (Damasio 1994, 1999), which tacitly primes attention to study the image. Looking at the spectral analysis or the view from the Columbia Hills, we experience its significance and may express our appreciation of its value. Situated cognition theory suggests that what constitutes information, what is significant, arises within an ongoing, mentally organized conception of activities and our concomitant identities. In short, who we are, what we are doing now, what interests us, how we see the world, how we feel about it and what we claim to perceive, how we interpret our perceptions, and the possible actions are all coupled, mutually dependent and emerging as a whole within our mentality. Our sequential actions of looking, describing, manipulating – our inquiry – consequentially enables further ways of knowing and interpreting the place, which we will represent by additional images, descriptions, models, and artistry.

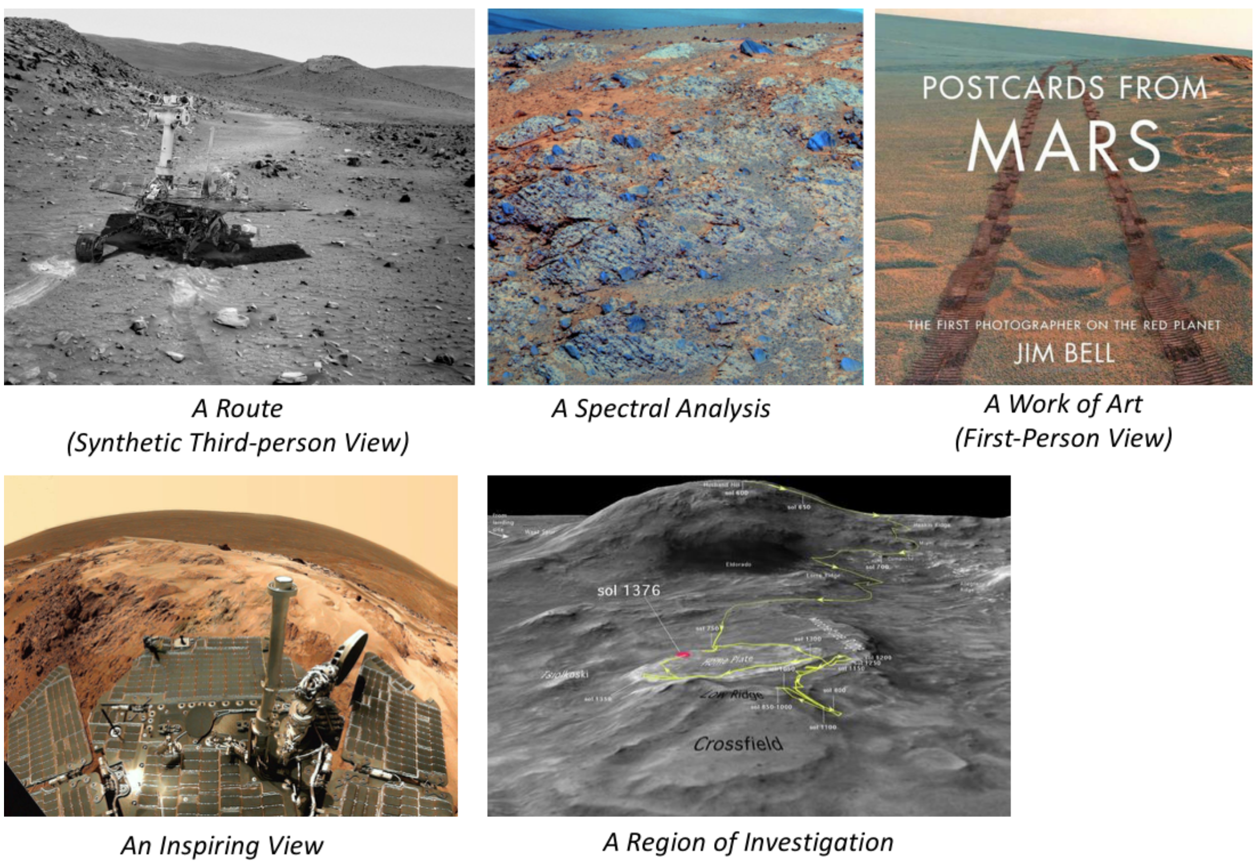

Figure 14. Visual artifacts reveal the different dimensions by which we conceive of a place, creating a setting – what are we seeing the place as, what activity does it afford? (Credits: NASA/JPL and Jim Bell).

5. Historical Precedents and Theories Relating Setting, Identity, and Felt Experience

Socio-technical studies of work settings have been informed by earlier research in proxemics and urban design; both provide data, methods, and application opportunities for situated cognition analyses. Past and present studies have a common methodological orientation, termed "design for activities" or "design for interaction," which considers physical needs in the environment (shelter, shade, seating, etc.) and the practical needs of social interactions (e.g., conversation, chance meeting, eating together). *Proxemics* is defined broadly in the context of animal behavior (ethology) as the study of nonverbal communication, such how distance and orientation when standing near someone reflects a cultural attitude of intimacy (or not). In *urban design* sociologists and architects incorporated humanist, activity-oriented perspectives in public settings, such as rail station waiting rooms (Hall 1966) and city plazas (Whyte 1980) to encourage improvised sitting and clustering. Hall characterized these "reaction bubbles" as "interrelated observations and theories of man's use of space as a specialized elaboration of culture" (p. 129, p. 1). Hall believed that the value in studying proxemics is that it enables evaluating not only the way people interact with others in daily life, but guides design of "the organization of space in [their] houses and buildings, and ultimately the layout of [their] towns." This claim is reflected by Lynch's (1955, 1960/2001) study of Boston, in which he promoted

> […] consideration of the city as a complete landscape that is seen, felt, and heard as a complicated sensuous environment that encompasses us throughout much of our life. What is the effect on us of all that we sense while we loiter or bustle through the city streets and squares? What can we do to make this flow of stimuli more satisfying, more inspiring, more humane? (Lynch, 1955, archival page "K.L. 3-8-55 1955 March 8"; Valdez, 2011)

In sociotechnical studies of the 1990s, anthropologists – who had realized long ago that layout, settings, and interactions with a physical environment were integral to behavior, ritual, and culture more generally – recorded and described how activities in workplaces were socially ordered (e.g., Jordan & Henderson 1995), interpreting proxemics as manifesting relationships (e.g., a feeling of discord, parsimony, or threat).

Alexander et al.'s (1977) notion of a design "pattern language," which has been influential in a wide range of disciplines including computer programming, is particularly relevant in understanding settings. He emphasizes that patterns in successful urban designs and homes are organic, they emerge naturally through and during activities. We can design objects, architecture, and processes, but uses, values, adaptations, and practices will develop through experience over time. As we see in the HMP base camp, the structure and functions of settings, like the behaviors that occur there, are dynamic. Meanings and functions are reinforced through interaction but also prone to improvised or reflective modification as new perceptions and conceptions develop, often prompted or constrained by changing contexts (physical and social). A simple example in the FMARS habitat is how the upper deck table has been positioned. Originally it was oriented lengthwise, perpendicular to the wall in front of the large portal; by 2001 it was parallel to the wall, allowing one to turn around from the table to the workbench behind.

Alexander's theory provides a way of understanding aesthetic, pleasing designs as having multiple levels of patterned organization:

> In short, no pattern is an isolated entity. Each pattern can exist in the world, only to the extent that it is supported by other patterns: the larger patterns in which it is embedded, the patterns of the same size that surround it, and the smaller patterns which are embedded in it. This is a fundamental view of the world. It says that when you build a thing you cannot merely build that thing in isolation, but must also repair the world around it, and within it, so that the larger world at that one place becomes more coherent, and more whole; and the thing which you make takes its place in the web of nature as you make it. (Alexander et al. 1977, p. xiii)

For example, Wurster's pattern language for home architecture (Treib 1995/1999) included a backbone serving as a corridor connecting private spaces with public living and dining rooms in between, typically created by expanding the corridor towards the back of the house. Further, rooms were designed and oriented to the environment such that the outdoors became an extension of inside; it is experienced and lived in as one setting with nested parts.

A situated cognition perspective relates well to this idea of "deeply rooted patterns" in what Alexander calls "timeless ways of building." Relationships that Alexander finds in design of alcoves and roads relate perception, emotion, and activity in a manner that is also inherently social (e.g., a setting designed for privacy, itself a social relation, may also enable "watching life"). Patterns are not rationally inferred or necessarily articulated, but embodied in how we relate to and configure furniture with respect to windows in a room or arcades in a garden. To demonstrate this duality, in the quoted excerpt above we can substitute "activity" or "practice" for pattern, "automated tool" for thing, "setting" for world, and "human experience" for nature:

> In short, no activity is an isolated entity. Each activity can exist in a setting, only to the extent that it is supported by other activities: the larger practices in which it is embedded, the activities of a similar nature that surround it, and the smaller actions which are embedded in it. This is a fundamental view of the world. It says that when you build a tool you cannot merely build that tool in isolation, but must also repair the setting and practices around it, and within it, so that the larger world at that one place becomes more coherent, and more whole; and the tool which you make takes its place in the web of human experience as you make it.

This substitution is another way of showing that settings, activities, and identities are conceptually coupled: The visible physical *patterning of things* we create and configure (e.g., the base camp, the work tent) and the *patterning of our behavior* in the world (e.g., practices in the work tent; sitting on the ATVs) both reflect and shape the *patterning in our understanding* of the social world as perceptual and linguistic categories and conceptions of settings, activities, roles and values. This dynamic is summarized well by social scientists engaged in "design ethnography":

> The main virtue of ethnography is its ability to make visible the "real world" sociality of a setting. As a mode of social research it is concerned to produce detailed descriptions of the "workaday" activities of social actors within specific contexts. It is a naturalistic method relying upon material drawn from the first-hand experience of a fieldworker in some setting. It seeks to present a portrait of life as seen and understood by those who live and work within the domain concerned. It is this objective which is the rationale behind the method's insistence on the direct involvement of the researcher in the setting under investigation. The intention of ethnography is to see activities as social actions embedded within a socially organised domain and accomplished in and through the day-to-day activities of participants. (Hughes et al. 1994, p. 430; quoted by Rönkkö, 2010)

6. Conclusions about Places, Situations, and Activities

In this section I reflect on the editors' original topic summary for this book, explaining how I interpret the various themes and questions.

Socio-technical studies are typically interdisciplinary collaborations that "bring together contributions on the *spatiotemporal contingency of human life* from different fields of research."[4] Notably in today's work system design teams, a cognitive psychologist might be carving up practices according to "tasks"; a human factors psychologist emphasizing "workload" and fatigue; a social anthropologist categorizing settings, activities, impasses, and circumstantial interactions; a sociologist analyzing conversational patterns; and a computer scientist mapping workflow, data structures, and communication media. In this manner, the practical, functional, epistemological, emotional, social, and physical "facets" and motifs of life are reified in descriptions and designs.

To recapitulate basic terminology: A *situation* for an actor is conceptual, a mental construct. In contrast, in socio-technical studies, *places* are names given by a community of practice to a physical environment (both natural and built) as a means of structuring their knowledge and activities. Examples include Haughton Crater, "the lower deck of the hab," and "the work tent." Places in a cultural parlance provide a shared frame of reference for describing the world and activities; consequently, many cultures may share the same distinctions, such as the map of the world (though disagreeing about some boundaries). *Settings* for actors in a culture are conceptually both more abstract (e.g., "a stage," "a retail store," "an expedition camp") and elaborated insofar as they always entail certain activities and not others. Thus in our understanding, our "mental models" of the world and our practices, settings are conceptually tied to norms and identities.

In practice, a particular activity may always occur in a particular place, such that culturally the name of the place, the activity, and its meaning as a setting blend. For example, for over 15 years

[4] From "Rationale – Situatedness and Place." Cf. also the Preface of this volume.

the Haughton Mars Project organization set up a permanent camp with buildings and rigid tents, such that "the HMP base camp" designated a specific place on Devon Island. This prescribed area became the setting for "the HMP expedition," an annual summer activity.

Illustrating that places can be known universally but settings are cultural distinctions, the HMP was required by the Inuit to move from its original river site to an area outside the crater in 2000. The Nunavut Territory owns this land and the Inuit people made known that Haughton Crater was sacred. The boundaries of the place marked on the map were universally agreed, but the native and scientist communities had completely different understandings of its significance as a setting for activities. The Nunavut council on neighboring Ellesmere Island decided that the HMP expedition and Mars Society would have only limited access to the crater. Thus the crater as a setting for activities is a direct expression of identity, in which the scientific and native "tribes" seek to express "who we are" and "what we do" in the same place, construing it as a setting in very different ways. Strikingly both social groups feel the "spirituality" of the place and desire to leave it undeveloped and pristine, which provided common ground for a compromise. (A similar story is playing out today with astronomers on Mauna Loa volcano in Hawaii.)

Of course, cultures regulate their own activities within settings, too. HMP camp was structured like a tiny village so different activities occurred in their own setting – the mess tent for cooking and eating, the greenhouse, the location for placing personal tents, etc. However, the community may also view these as places where different activities are negotiable and open, such that the meaning of the place as a setting is adapted and interpreted over time through practice (e.g., the mess tent is reconceived and reconfigured as a setting for after-dinner lectures; the Inuit allowed scientific work within Haughton Crater if the scientist is accompanied by a member of their community).

In summary, actors' knowledge of "what happens in a place" is essentially how they know the place as a setting, for being "who we are." In some respect activities can be easily articulated (e.g., "expedition members sit and work at their laptop computers in the work tent"); in other respects, purposes may be tacit, not reflected upon, or individually improvised (e.g., you can use your work area to store personal things you need during the day, such as your tooth brush and a towel).

I have also stressed that in my interpretation (Clancey 1997) *situatedness* refers to the capability to conceptually organize behavior that relates feelings, perception, and understanding of the self as a social actor: What am I doing now? (WIDN) Who am I being now? (WIBN) How should I be behaving now? How well am I doing now? This ongoing, multidimensional categorizing capability, falling under the rubric *higher-order consciousness* (see Clancey 1993), is a neuropsychological process (its mechanism) and pervasively social in orientation and meaning (its content). Thus the "situatedness of human life" is not a claim about a *place*, because "being situated" is an ongoing conceptual-interactive accomplishment, a coordination of understanding and behavior dynamically, in real time. Part of this *conceptual coordination* involves continuously reconceiving "the situation" to simultaneously fit and construct one's identity, in all the respects listed above – WIDN, WIBN, etc.

In summary, my understanding of "the situation" (or more completely, "my situation as a social actor, here, now") means much more than being in a physical place, which of course existence trivially entails. Similarly, saying cognition is *embodied*, is not the trivial claim of "being in a body," but that activity is conceptually coordinated with respect to perceptual-motor experience, manifest particularly in body-oriented metaphors (Lakoff & Johnson 1980). Putting this together, the MER scientists are able to do field science because they are conceptually embodied in the rover, and they coordinate the rover's actions through a broad and particular understanding of the field science activity through which they conceive "the situation we are in now" – all without being in the place where the investigation is occurring, on Mars.

Thus, my *understanding of the setting* in which I carry out my activity (here, now) transcends my objective designation of the place. The MER scientists conceive of Meridiani Planum and Gusev Crater, named places appearing on maps of Mars, as complicated, finely structured settings (e.g., an ancient streambed; outcroppings marking a geological disconformity) for applying their roving laboratory instruments, in the activity of surveying and probing the story of water and possible life on Mars. They know the place and hence who they are ("what I am doing now") by how they can move through it and analyze its chemical and atomic nature. Thus places on Mars where they work, are conceptually transformed by their images and tentative interpretations into settings for field science. These practices and competence makes them Mars explorers.

Simultaneously, for the scientists working in person together in Pasadena, California during the first months of each expedition, being at JPL in the privileged science meeting rooms (restricted to members of the team), conferred and reinforced an identity of participating on an historic mission, the first overland expedition on another planet. Even visiting the workplace, building 264, is awe inspiring, for it has been the setting for the Viking missions (the first landings on Mars), the Voyager missions (the first spacecraft to fly by the outer planets), the more recent New Horizon mission to Pluto, and many more planetary explorations. Thus, the meaning of the place, how and why it is valued, may develop such that it becomes sacred within the culture, which is to say the activities that occur there have an intrinsic, transcendent purpose for the community such that the name of the place evokes its social meaning as a hallowed setting.[5] JPL/264 has this meaning for planetary scientists. Symbolic analogs for Mars, like FMARS, where being on Mars can be imagined and practiced, have become pilgrimage settings for members of the Mars Society and other believers in the vision. The mystique of the planet Mars itself increasingly captures the public's imagination: it is aesthetically alluring, scientifically interesting, and a place where we can rove, explore, and someday might live. As we make Mars a setting for these activities, it makes us artists, scientists, and potential settlers. We conceive of

[5] For a related description of expeditions as liminal experiences see Clancey (2012, Chapter 9), particularly the references to Martin Rudwick's analysis.

the place in these ways and sometimes all at once, creating and realizing new identities for ourselves and the people who follow.

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