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Assembling a thermal rhythmanalysis: Energetic flows, heat stress and polyrhythmic interactions in the context of climate change

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A B S T R A C T

Rhythmanalysis, as developed by Lefebvre and Regulier, has provided theoretical and methodological inspiration for a growing diversity of work in geography. We focus on the energetic liveliness and agency of rhythm to engage with heat as an energetic form and heat stress as a threat to bodily health that is becoming intensified with climate change. We deploy the analytical vocabulary of rhythmanalysis to conceptualize and empirically trace how heterogeneous, polyrhythmic interactions play out in space and time as energetic-thermal flows are variously exchanged, accumulated and dispersed within and around human bodies. At the empirical site of an 'open-cut' mine in northern Australia, where labour is physically intense, intrinsically hazardous and thermally at the threshold of embodied capacities to function, we develop a distinctive interdisciplinary analysis of rhythms of the thermal environment; rhythmic patterns in the choreography of labour and production; and corporeal rhythms in working bodies. Combining thermal physiology, ethnography and environmental monitoring methods to reveal these interacting rhythms, we identify how polyrhythmic thermal entanglements produce and shape the management of heat stress, and their significance for movements between 'eurhythmic' and ' arrhythmic ' conditions. The case study pushes these terms to their limits, so we propose 'dysrhythmic' as a new adjective for the rhythmanalytic lexicon that enables greater analytical traction on the components of polyrhythmic assemblages. Beyond the specific problem of managing heat stress, we argue there is much insight to be gained from bringing rhythmanalysis into geographical engagements with the temporalities of adaptation in a changing global climate.

1. Introduction

On the flight to the mine, everyone is still. It's two weeks since this crew saw each other, but they hardly say a word. It's only a 50-min trip, but arms fold, sunglasses and hats cover eyes, and they sleep. The plane lands, and then in silent, mechanical sequence, the staggered rows stand, remove bags from overhead lockers, and process down the aisle. On the morning bus from camp to site, and the evening bus back, the same silent performance repeats.

This travel tai chi unfolds in dark, airconditioned cabins, a stark contrast to the mine site. Ejected into the blinding, searing sun, with hot winds, pulverized rock and pressurized steam constantly in motion, work is accompanied by a deafening orchestra of mammoth machinery, punctuated by the boom of blasted strata. Suddenly, these moments of stillness make sense. Workers are conserving energy for the 12-hour/14-day assault on the senses; making the most of the brief respite from the endless onslaught of the tropical sun, the incessant pumping-out of sweat and their bodies' leaden fatigue. These are the moments before battle. (Vignette drawn from fieldnotes.)

This paper is about how heat, rhythm and climate coalesce, and have consequence, in and for the thermal entanglements of the human body. As the vignette above indicates, we explore this empirically in relation to 'fly-in-fly-out' workers employed at an open-pit mine in northern Australia. To trace how heterogeneous, polyrhythmic interactions play out as energetic-thermal flows that are variously exchanged, accumulated and dispersed within and around labouring human bodies, we assemble a thermal rhythmanalysis. In so doing, we draw together three lines of theoretical engagement in geographical inquiry.

First, taking our cue from both physics and phenomenology, we are interested in heat as elemental to planetary and human life (Clark, 2015, Ong, 2012). Heat suffuses all material, social and corporeal geographies, it provides the conditions for livability, and in its movement and dynamism is an environment for, and a product of, bodily-performed practices (Oppermann and Walker, 2018). Geographers have engaged in various ways with heat. For example, as a sensory and cultural phenomenon (Hitchings, 2011, Vannini and Taggart, 2014, McHugh and Kitson, 2018, Cupples et al., 2007, Strengers and Maller, 2017), as modified and modulated through technology (Hitchings and Lee, 2008, Walker et al., 2014, Harrison and Popke, 2011) and as a

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threat to well-being, in both its presence and absence (Chard and Walker, 2016, Buzar, 2007, Maller and Strengers, 2011). While much of this work is in some way attuned to heat as an energetic form, it has rarely focused on the body itself as a site of thermodynamic interaction and consequence, or on the 'thermal interconnections' (Ong, 2012: 17) between embodiment and ways of doing and being (Jerstad, 2016). The broader 'material turn' in social theory, Barry (2015) argues, has also underplayed the 'energetic liveliness' of materials with scope for much more direct engagement with natural scientific accounts of thermodynamic relations. We are concerned with bringing those relations into play as significant and agentive within broader assemblages of heterogeneous material entities, including in bodies-at-work.

Second, we are interested in working with an ontology of rhythm and polyrhythmic interrelation as a way of tracing and articulating the 'energetic liveliness' of how heat flows and has consequence in space and time. By bringing together space, time, energy and matter in a single syntax, rhythm enables us to think through their inescapable imbrication. There have been various theorisations of rhythm across different disciplinary domains (Brighenti and Karrholm, 2018, Deleuze, 2003, Adam, 1990, Desain and Windsor, 2000, Rakoff, 2002, Henriques et al., 2014). In geography, rhythmanalysis, as developed by Lefebvre and Régulier,[1] has been particularly influential, worked with in relation to a growing diversity of geographical phenomena, cases and questions (Edensor and Holloway, 2008, Jones, 2011, Karrholm, 2009, Kullman and Palludan, 2011, Lager et al., 2016, Mulicek et al., 2016, Reid-Musson, 2017). For Crang (2001), Edensor (2010b) and others, rhythm provides a powerful way of thinking time and space together. Rhythms are spatiotemporal in constituting 'the multiplicity of flows that emanate from, pass through and centre upon place and contribute to its situated dynamics' (Edensor, 2010b: 3). Such flows can span the human and more-than-human and range across corporeal, social and cosmological domains (Lefebvre and Regulier, [1985] 2004).

Crucially for our argument, rhythms are not only spatiotemporal but also energetic. Indeed for Lefebvre they are 'that which [connect] space, time and the energies that unfold here and there, namely rhythms' (Lefebvre, [1992] 2004: 18). This conjunction has been little acknowledged (Walker, 2016), or has been interpreted abstractly as an indicator of social force and intent (Brighenti and Karrholm, 2018). We, however, follow our interest in 'energetic liveliness' through a material and thermodynamic understanding, engaging with energy as heat, and bodies physiologically as sites of thermal interaction and consequence that are shaped by rhythms. These rhythms are 'constituted by a myriad of materialities that are not restricted to the body', given that 'the body inhabits the world through … rhythmic exchanges' (Chen, 2017: 24), from the immediate (such as metabolizing food), to the cosmic (such as being warmed by the sun). Therefore, we ask: how might the analytical vocabulary of rhythmanalysis be turned to conceptualizing how heterogeneous, multi-scaled (temporally and spatially), polyrhythmic interactions play out, as thermo-energetic flows move within and around human bodies? Bodies that, in our empirical case, seek to manage the thermal load generated by such flows, while also being variously caught up in other rhythmic structures, such as the organisation of physical labour, market demand and production targets, or logics of safety and repair.

Third, we articulate heat through rhythm to contribute to thinking about the temporalities of adaptation to extreme heat, and by extension to climate change. Climate change is at its core about intensifications of energetic flows shifting the spatiotemporal patternings of climatic phenomenon, including thermal events of various forms and intensities. By exploring how heat is intensely present in the dynamic temporalities of an already-extreme empirical site in northern Australia, we bring to the fore how changing energetic-material rhythms (of extreme temperatures, for example) not only demand adaptation, but are also the stuff of adaptation per se: that is, where the ability to effectively manage thermal flows into and out of the body is the marker of whether adaptation has occurred successfully or not.

There are several antecedents to a rhythmic account of adaptation: in analyses of how extremes are already writing themselves into both social and corporeal formations as forms of 'weathering' (Hulme, 2017, Neimanis and Loewen Walker, 2014), and in a number of contributions to systemizing how time figures in understandings of climate resilience and transformation (Feola, 2015, Cooke et al., 2016), as well as to critiquing dominant temporal framings of change, impact and adaptation (Oppermann et al., 2018, Nobert and Pelling, 2017, Fincher et al., 2014, Brace and Geoghegan, 2011). Nobert et al. (2017), make particularly insightful contributions, drawing on Maldiney (2012) to open up a distinction between the 'explicated time' of pasts, present and futures and other periodised clock-time categories that dominate meteorological and climate sciences, and the 'implicated time' of durations and rhythms in the unfolding of everyday life. They argue that implicated time has been neglected in resilience thinking, calling for engagements with 'questions of time flow, rhythms and the temporal dynamics that are shaping differences and the arrhythmias of everyday life' (Nobert et al., 2017: 12). However, the temporalities of rhythm here remain largely conceived through human thought and action, not as also made through matter and energy per se. Yet the agencies of non-humans, or more-than-humans, also matter, including those of heat as thermodynamically doing work in the world, and in the human body, as we have argued elsewhere (Oppermann and Walker, 2018). Accordingly, in this paper, we consider how heat per se is productive of rhythm and vice-versa, and what this means for adaptation.

We bring these three conceptual engagements together through a case study examining the frequency and severity of heat stress at an open-pit mine and processing plant in northern Australia, undertaken as part of a multidisciplinary project. The site is in a region chronically exposed to extreme heat, with limited governmental intervention into the pervasive problem of heat stress (Oppermann et al., 2017). Based on similar work conducted by the research team elsewhere in the region (Carter et al., forthcoming), we expected to find high rates of chronic heat stress, and at least some reported incidents of heat exhaustion. As a result of climate change, maximum and minimum temperatures have already increased significantly, and are projected to worsen rapidly (Moise et al., 2015), furthering the need to understand heat management practices in order to identify useful strategies and barriers to adaptation to contemporary and future climate change.

Heat stress, heat exhaustion and heat stroke describe a continuum of significant threats to health. They result from excess thermal energy in the body and its secondary effects (Mitchell et al., 1976). Heat stress, which begins when the body stores heat resulting in a rising core body temperature, may precipitate heat exhaustion which manifests as a range of symptoms. These include fatigue, nausea, dizziness and irritability. If core temperature rises beyond 38°C for long periods of time, heat exhaustion or heat stroke may result. In extreme cases this causes loss of consciousness or heart failure, with a core temperature of 42°C considered life-threatening (Yarmolenko et al., 2011). Maintaining core temperature within such a narrow window requires bodies to thermoregulate through both involuntary, physiological processes and conscious, voluntary measures to cool down. Their combined effectiveness is such that rarely are weather conditions the sole reason for heat illness in healthy individuals, particularly as heat exhaustion or stroke, although with climate change we are pushing these boundaries (Sherwood and Huber, 2010). How (and how fast) the body gains and loses heat depends on a plethora of processes, including the body's ongoing material-energetic relationship with its thermal environment, and the heat that is produced by exertion and other internal bodily processes. As such, understanding why heat stress occurs (even at low

[1] Two jointly authored papers were published before Lefebvre's single authored text ´Éléments de rythmanalyse: introduction à la connaissance des rythmes'. The contribution of Catherine Régulier should not therefore be overlooked.

levels) requires us to identify not only general thermal conditions, but how these interact with other energetic- and spatio-temporalities to produce heat stress, or, indeed, to prevent or recover from it.

We begin in the next section by discussing our approach to building a polyrhythmic assemblage centred on the bodies of mine workers and the novel combination of ethnographic, physiological and environmental monitoring methods we deployed. We then develop our analysis by working through three sets of rhythms; rhythms in the spatio-temporal thermal (micro-)environment of the mine site, rhythms of the labour of different groups of workers, and physiological rhythms in workers' bodies and how heat stress manifests through these. We then go on to show that, through the combined agency of involuntary and deliberate bodily thermal regulation, this polyrhythmic assemblage is generally, but precariously, held in a stable 'eurhythmic' form, with instances of 'arrhythmic' heat stress routinely part of the narratives of workers' lives. We discuss how individual, chronic heat-stress can also enable the broader polyrhythmic assemblage of mine production to remain functional, terming such occurrences 'dysrhythmic'. Finally, we draw this analysis into a set of observations and conclusions about the problematic of heat stress, its immersive and situated grounding in the body and in place, yet simultaneous enmeshing in power relations and global circulations, and posit more expansive reflections on the potential for rhythmanalytic analysis of climate change and adaptation.

2. Working with rhythmanalysis

Rhythmanalysis as a methodology is generally described in quite open terms (Kullman and Palludan, 2011, Lee, 2017, Chen, 2017, Lyon, 2018), but has often been interpreted and deployed primarily as an intimate method, involving sensing rhythm with one's own body. However, statements in the original rhythmanalytic writings stress its interdisciplinary potential. For example, Lefebvre ([1992] 2004; 32) argues, the rhythmanalyst should work with data from 'psychology, sociology, ethnography, biology and even physics and mathematics', and elsewhere with Régulier, that:

> '*This analysis of rhythms in all their magnitude 'from particles to galaxies' has a transdisciplinary character. It gives itself the objective, amongst others, of separating as little as possible the scientific from the poetic*' (Lefebvre and Regulier, [1986] 2004: 94).

While the concept of rhythm can be 'grasped at the level of the sensory' (Chen, 2017), we see this as a starting point, an orientation for becoming attentive and open to various ways in which rhythms that are exterior to the body, less immediate, accessible or sensible, can be known and represented. Rhythm animates; there is 'nothing inert in the world, no **things**' (Lefebvre [1992] 2004: 26, emphasis as in original), positioning the 'rhythmanalytic project' as strikingly expansive. Rhythms are characterised as emerging from three domains – the cosmological, social and corporeal – covering 'an immense area: from the most natural … to the most sophisticated' (Lefebvre, [1992] 2004: 28). Cosmological rhythms are in the cyclical movements of the earth and the moon, giving pattern to day and night, tidal movements (Jones, 2011) and the structure of seasonal climatic fluxes. Social rhythms are made through social practices, institutional structures, timetables and schedules (Zerubavel, 1981), the norms of how things are done and organised. Corporeal rhythms are in the beating of the heart, the breathing of the lungs and in the chronobiology of organism functioning, forming an involved bundle of embodied rhythms. Through identifying rhythm at such widely varied spatial and temporal scopes and intensities, Lefebvre 'analytically scans rhythms across scale' (Reid-Musson, 2017: 4) in a way that directly accommodates our interest in moving between the cosmological flows of solar radiation to the intimate thermal physiology of the body.

Whilst these three broad domains of rhythm are separated out, Lefebvre and Régulier make clear their perpetual polyrhythmic interaction in the everyday. They, and others, also identifying other rhythms that are similarly entwined, for example in nature, ecologies and processes of material erosion and decay (Edensor, 2010b: 7). Polyrhythmias are characterised by constant interference or reciprocal action between ensembles of rhythms. For example, in how the cyclical rhythms of day and night structure the rhythms of waking and working, which can be disrupted when 'nocturnal activities multiply, overturning circadian rhythms' (Lefebvre and Regulier, [1985] 2004: 83). Polyrhythmias are therefore constantly unfolding, constituting what Chen (2017) refers to as polyrhythmic assemblages in which any one rhythm has a degree of integrity, but only within a constantly emergent, moving and interwoven whole (an open rather than a closed totality). On this basis, an assemblage that maintains itself in a more or less stable state is characterised by Lefebvre as 'eurhythmic' where 'rhythms unite with one another in the state of health, in normal … everydayness' (Lefebvre [1992] 2004: 25) such as in the homeostasis of a body. An assemblage that unravels when 'rhythms break apart, alter and bypass synchronization' (ibid: 78) is 'arrhythmic', becoming eurhythmic once more (perhaps in a different state) when it settles into a (new) pattern of rhythmic repetition and reciprocal reinforcement.

How to analyse rhythms in these terms is not straightforward, as the expansiveness of the rhythmanalytic framework invites the finding of ever more rhythmic interrelations; 'Our rhythms insert us into a vast and infinitely complex world' (Lefebvre and Regulier, [1985] 2004: 91), making finding a place to begin or end difficult. Chen (2017: 51), who sees rhythmanalysis foremost as a heuristic method 'in which there are no set rules which affix how [it] may be exercised', suggests two alternative approaches. The first is to start from a specific rhythm and then map its associations with other sites of rhythmic production, building a polyrhythmic account. The second is to begin with a polyrhythmic assemblage, and disentangle it to identify how single rhythms interlock, syncopate or jar with others within the polyrhythmic whole. We take the second course, forming a polyrhythmic assemblage centred on the bodies of workers at the mine site, to identify how the clusters of rhythms within these bodies, the micro-environments they work in and their enacted practices of work and recuperation interact within the polyrhythmic whole.

As our phenomenon of interest is heat and heat stress, this rhythmic disaggregation pays particular attention to the patterning of flows and relations of thermal energy. How rhythms are energetically significant has not been integrated into accounts of rhythmanalysis despite, as noted earlier, being positioned by Lefebvre at the core of its ontology: 'Everywhere where there is interaction between a place, a time and an expenditure of energy there is rhythm' (Lefebvre [1992] 2004: 15). Taking material energy dynamics seriously plays directly into our concern for understanding human thermal interrelations and entanglements. In physics, heat is accounted for as 'energy in transit', a thermodynamic energetic exchange between materialities. As such, the dynamics of energy - as rates, patterns and intensities of physical flows and chemical and material change - are as important as the diverse 'things' that it relates.

Our attention to rhythm emerged from the case study research which followed 18 workers (all male) from four different work groups at the mine site, who were analysed as part of the 'pre-intervention' phase of the wider heat management study. The selected groups were considered to be most at risk of heat stress: the 'Drill and Blast' crew who worked on the surface of the open pit; 'Mechanical Maintenance', working in a roofed and partially-walled workshop or called out to repairs in the pit or elsewhere on site; and machine operators and maintenance mechanics, working in one of two groups, either 'Ore Preparation' or the 'Mill', both areas within the processing plant, which was largely open-air, or partly roofed. An important context for understanding heat stress is that the mine site is very remote, and the majority of employees, including 16 out of 18 in the case study, were 'Fly-in-Fly-out' (FIFO) workers (the detail of shift patterns is discussed in the next section), whose 'flight in' was described in the opening vignette (an amalgam of ethnographic notes and personal observations, by the first author).

The research deployed a multi- and interdisciplinary methodology combining thermal physiology (Brearley et al., 2015), sensory ethnography involving video and audio recorded observations and 'walkthroughs' along with semi-structured interviews (Pink, 2015, Pink and Morgan, 2013) and environmental monitoring. Extracts from the interviews are identified with a pseudonym and the work area of the employee. For the physiological analysis, each worker was monitored for one work shift (on one day) to quantify their heat stress symptoms. This included monitoring their heart rate and gastrointestinal (core) temperature. The monitoring equipment transmitted data from workers' bodies, later analysed at 30-second intervals, to paint a real-time picture of bodily responses to environmental conditions, exertion, and hydration levels. Interpretation of this data was also informed by a modified Environmental Symptoms Questionnaire (ESQ), which workers completed at the end of the day, identifying their own perception of thermal conditions, how heavy work tasks were and how hot they felt, as well as specific symptoms that are indicative of heat stress.

Weather conditions were identified from the weather station adjacent to the site, however, because the micro-environment could vary significantly (as a result of re-radiated heat from rock, concrete and metal surfaces or additional heat-sources), direct environmental monitoring was also undertaken with handheld equipment. This was also conducted in response to worker prompts about 'hot spots' during walkthroughs, and included thermal imaging (examples are included in the next section).

Most workers being monitored were also observed periodically (in person, utilizing written memos or video-recording), in order to understand the context in which they worked and the kinds of tasks performed. Finally, nearly all of the participants (16) were interviewed at the end of their monitoring day to ascertain their own account of the relationship between work, weather and heat stress that had unfolded for them over the last 12 hours, and their broader understanding and experience of this. Physiological symptoms and data on thermal conditions were used iteratively during interviews and walkthroughs, as prompts to get workers to describe the patterning of work and heat stress, including through their bodily sensations and responses to sensation, and the occurrence of any heat management activities.

2.1. Forming a polyrhythmic assemblage: outdoor mine work and heat

To assemble our polyrhythmic account drawing on this range of data, we first consider the rhythms of the thermal environment of the mine and then how these interrelate with the rhythms of labour patterns across different work groups and the temporal structures these operate within. We then bring the corporeal rhythms of the workers' bodies into play as the key site within which eurhythmic and arrhythmic effects and potentialities are of concern. Throughout this analysis we pay attention to how heat produces and results from, and flows through and between, rhythmic patterns.

2.2. Rhythms of the thermal environment

For outdoor workers, a pervasive source of heat is, simply, the sun. The location of the mine means that energy received into its material space through solar radiation and re-radiation is very high, at approximately 2264 kWh/m^2 per year (Fig. 1). This flow of energy is the main determinant of the thermal qualities of the mine site, but is always shaped by other rhythms, such as broad seasonal and daily repeating cycles, and the micro-geography of the heating and cooling of particular materials such as rock and machinery.

General ambient temperatures at the site oscillate across the year. The warmest temperatures occur during November/December, and coolest in July/August (Fig. 2). All of the workers interviewed who had spent more than six months in the region were aware of seasonal temperature variations, and many identified corresponding changes in their experience of thermal discomfort and heat stress. Diurnal rhythms were also experienced as broad variations in temperature between day and night, and from cooler mornings to warmer afternoons (Fig. 3). These thermal rhythms were also significant for other rhythms: of the 14 workers interviewed with experience of night shifts, 12 thought diurnal variations in temperature (and sometimes also humidity) significantly modulated how hot they felt while working, with cooler night-time temperatures enabling them to work faster or for longer periods.

While thermal rhythms in the general area of the mine were related to seasonal and daily variations in flows of solar energy from planetary cycling, these were encountered in more complex spatiotemporal patterns once absorbed and thermally re-radiated into the particular spaces where workers were conducting tasks. As solar radiation comes and goes, specific materialities respond with varying rapidity and intensity in their absorption and re-radiation of thermal energy, the latter having significant consequences for the changing thermal conditions of specific working spaces. As shown in the thermal image of Fig. 4, when measuring temperatures during the research period it was found that by mid-afternoon mine surface temperatures generally exceeded 60°C, with a maximum of 67°C, and air temperatures reached a high of 45°C (significantly higher than those reported in Fig. 3), heated both directly from solar radiation and by its re-radiation from the rock, which in some cases was itself chemically reactive, generating very hot temperatures. One worker described a pile of waste rock accordingly:

> "Mount Doom we used to call it. That was pretty bad. The ground itself was hot […] like a volcano pretty well. It would burn the bottom of the soles of your boots, it was so hot." – *Angus, Maintenance*

The metal surfaces of equipment and engines could also reach very high temperatures of up to 80°C. The vehicles and fixed plant machines are so enormous that mechanics have to climb both under and inside them, creating extremely hot micro-climates to work in. Together, these different heat sources create a complex thermal terrain that intensified already hot weather conditions, as this observational memo (of video taken by first author) and associated thermal imaging in Fig. 5 demonstrate:

> *…we cross the baking-hot concrete to the next multi-storey metal structure. Climb 4 flights of stairs to the open, top level. Here's the hydrocyclone, says my guide. It looks like a machinic octopus, sucking up heated slurry from a vortex below. Steam rises constantly among its legs. The thermal imaging camera reads the steam as 70°C, and the cooler parts of the metal at about 50 °C. The sun beats down on us from above…*

With such intense thermal 'signals' coming from their environment, workers were closely attuned to the rhythmic spatio-temporality of thermal conditions across the site. They used this knowledge to develop tactics to decrease exposure or manage exertion levels. For example, one participant on 'clean up duty', hosing down the processing plant, described his spatio-temporal progress as "chasing the shade", using the changing angles of the sun in relation to built structures to work out the coolest routes through the micro-geography of the site. Nearly all workers used their breaks to move to an indoor air-conditioned space. Other tactics included collectively scheduling more exposed or exertional work early in the morning, to take advantage of how specific spaces took time to heat up during the day. For example, in describing the regular replacement of components of the 'vibrating screen', a key part of ore processing, a worker explained:

> "when we hop inside the vibrating screen [it's] all right in the morning, because the sun's [on the] side, but when it comes over [head], [you are] inside a metal object radiating heat, and it's a confined-space job, [so] you're in there just sweating and sweating." – *George, Ore Preparation*

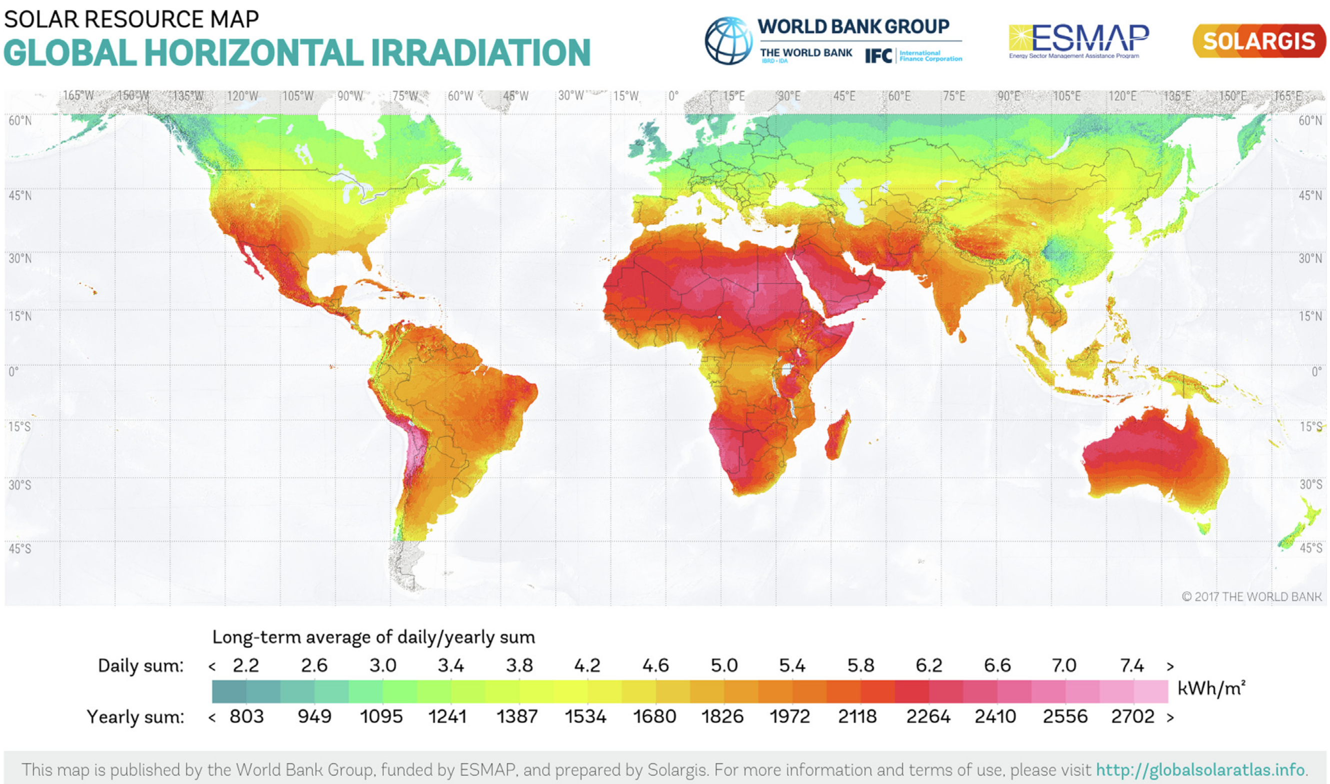

Fig. 1. Patterning of cosmic radiation: [The World Bank [CC BY 4.0 https://creativecommons.org/licenses/by/4.0. Source: https://upload.wikimedia.org/wikipedia/commons/1/1e/Global_Map_of_Global_Horizontal_Radiation.png].

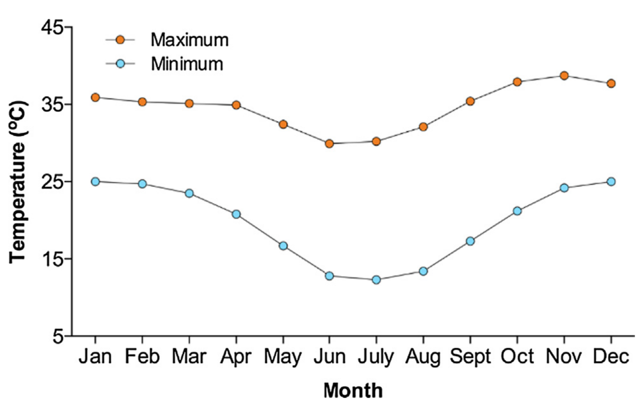

Fig. 2. Annual rhythms: Historical (1969–2018) mean maximum (orange) and minimum (blue) temperature for the monitoring station adjacent to the mine site. Data from Australian Bureau of Meteorology. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Fig. 6 shows a thermal image of this equipment and the temperature of the metal surface receiving direct radiation from the sun, as well as cooler areas that only receive indirect heat. George went on to describe actively using these patches during short hydration breaks: "[I'll drink] in the shade in the screen. It's actually cooler on the side." In another example, a worker recounts making judgements about periodically moving away from particular heat sources:

> "on the float floors, with the heat coming up from all the hoppers and the steam rising […] we're working on top of that. That just adds to the heat, and it just knocks you for six. […] I'd have to walk away every now and again to cool off because it gets to the point where you feel lethargic […] the heat itself makes you feel dizzy and […] sometimes it just gets too much." – *Tyler, Mill*

In coming and going in broad cycles and in more precise moments and spaces of accumulation and diffusion, the spatiotemporal patterning of thermal energy emerges as distinctly agentive. It influences the thermal load on workers' bodies, but workers also actively interact with these heat rhythms to try and responsively and pre-emptively shape what work is done, where and when. We examine these interactions further in the next section.

2.3. Rhythms of work and production

While rhythms in the thermal environment could sometimes be adaptively articulated with rhythms of labour, the overall choreography of work rhythms was primarily determined by the requirements of production. The mine and processing plant run non-stop, turning over 5 million tonnes of ore per year into concentrate for shipment. Every work-group has its role in ensuring this system operates as seamlessly as possible. Blue (2019) alerts us to how work practices are often rhythmically institutionalised in how they are sequenced and interconnected. At the mine site, this had energetic, and specifically thermal implications: the rhythmic interdependence of different areas of production meant they are significantly constrained in their ability to respond to heat exposure, with the pace, frequency and intensity of work practices tightly configured by sets of interconnected institutional, regulatory and production-oriented arrangements.

The ideal of constant operation, 24 hours per day, 7 days per week, creates a particular patterning to labour at the site. The Enterprise Bargaining Agreement (EBA), a collective industrial agreement for the mine-site's operation, seeks to enable constant operation at a remote site through a distinct rhythm of a 2-week-on/2-week-off schedule for workers. This allows for the 'fly-in fly-out' (FIFO) routine of moving workers to and from the mine, which is contingent not only on particular labour-relations at the site, but also embedded in the restructuring of the patterns of mining labour across Australia (Peetz and Murray, 2011) and the increased availability of air travel. The temporal

Monitoring Day	Ambient Temp. (°C)
1 – first half	30.4
2 – first half	30.2
3 – first half	31.7
4 – first half	30.9
Overall Mean	31.5
1 – second half	39.1
2 – second half	37.7
3 – second half	39.3
4 – second half	38.6
Overall Mean	38.9

Fig. 3. Diurnal rhythms: Mean environmental conditions during first and second halves of work shifts (corresponding to morning and afternoon) for 4 monitoring days. Data from Australian Bureau of Meteorology.

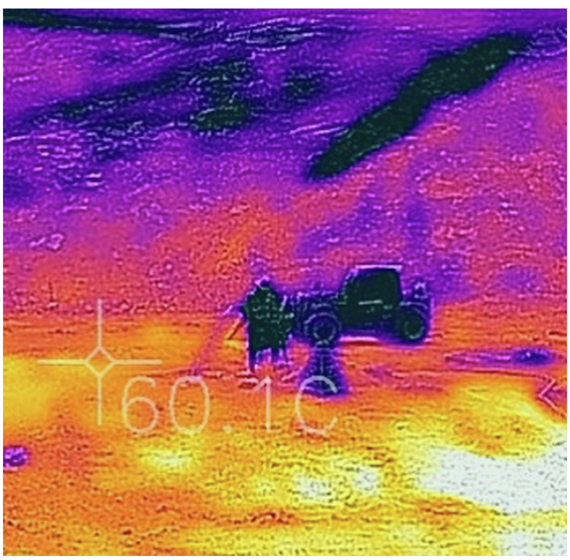

Fig. 4. Thermal imaging of surface temperatures in the pit, mid-afternoon: locally measured air temperature was 44.9 °C and ground surface temperature was at least 60 °C. Image shows a worker temperature testing a drilled hole, in front of a small vehicle.

structure has significant effects on heat exposure and exertion: the 24 h cycle is split into two shifts, with workers working 12-hour shifts for 14 days in a row. On this model, shifts (and hence exposure) are long, and there is little time for workers to recover between shifts; they have less than 12 h to rehydrate, cool down, eat (twice), sleep, and engage in social or leisure activity to break up the monotony.

The two-week FIFO model (and high salaries) also allow for workers' homes to be geographically distant, and in a cooler climatic zone. As such, the rhythm of constant relocation for a period of two weeks can cut into the temporality of physiological acclimatization to hot temperatures, as well as their physical fitness if this is not actively maintained during periods away from work. As one long-term employee noted, returning to work was more physiologically challenging for staff living in cooler climates, who on arrival felt sensorially and physically impacted when exiting the aircraft:

> "Because we're two and two [week] rosters, we've got a lot more people coming up from inter-state from a two-week break, so getting off the plane […] is more of an issue than it used to be." – *Benjamin, Ore preparation*

Fig. 5. Hydrocyclone. The bright fuzzy yellow patches show the steam escaping around the tubes drawing hot slurry from the vortex below. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Another noted the particular rhythm of his own acclimatisation:

> "Probably the first couple of days, it'd be maybe two, three times I'll get dizzy. […] But after that, I do notice that my body's starting to acclimatise and then I'll start getting back to normal." – *Jarred, Mill*

Rhythms within 'roster' patterns were also significant for how work was interpolated with rhythms in the thermal environment. Some work groups alternated between a week of day shifts and a week of night shifts, coincidently providing a significant reduction in heat exposure. However, safety regulations prevented other groups from operating this way. For example, regulations determining that explosives could only be laid out and detonated in daylight meant the Drill and Blast crew were confined to daylight operation, despite the fact that their work location, literally a blast zone, meant they were exposed to direct solar radiation and high levels of re-radiated heat (demonstrated in Fig. 4).

Within the cycle of daylight-working, this crew's activity was also structured by particular scheduling practices and interrelations between different work groups. 'Blasts' – when explosives were detonated - were planned and scheduled for particular times of day, partly for

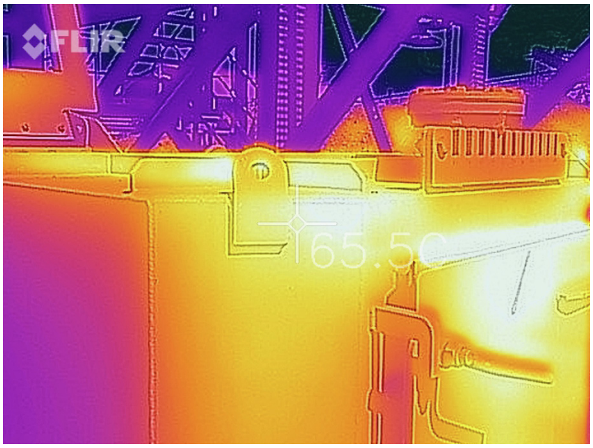

Fig. 6. Vibrating screen unit, demonstrating thermal gradients in relation to angle of the sun, and the cooler (left-hand) 'side' relative to the front wall with the entry hatch.

safety reasons, and partly to allow the rhythmic interaction between different tasks and work crews in the pit: geologists would identify the next area to be blasted; the Drill and Blast crews would drill holes, fill them with liquid explosives and blast them; blasted rock would be removed by the miners in excavators and dump trucks, taken to the ore processing plant; the ore would be crushed, passed through to the mill, refined, dried and bagged for transport; driven to a port, loaded, and finally shipped. The constant awareness of the strongly interdependent rhythms of this process and that any 'down-time' prevented high-value product getting to market, meant that avoiding disruption to other work groups' patterns was a key mobiliser of the pace at which work was done. As such, the Blast crew worked at high intensity in the morning because of limitations both in daylight hours and pressure to avoid delaying removing the rock with knock-on effects for the rest of the process. As a result, different temporalities (clock time, solar time, task time) were woven together in the accommodations, concessions and linkages between multiple rhythms across and within different work areas. How this played out could have serious implications for both production and heat stress, as this quote indicates:

> "If you've got a machine that just broke down, it's been running 10 hours non-stop. It's flaming hot. Getting in the back of it, ambient temperature plus the machine temperature can easily be over 50°Celsius. You can literally feel the blood pulsing. It sounds like water, just like sh, sh, sh, in your ears, and it can go on for hours. You get out of there, and you're just drenched from head to toes." - *James, Maintenance*

This also demonstrates that different kinds of exposure and the length of exertion are key sources of heat stress risk. A way of understanding heat stress is through quantifying it as the sum of an individual's core body temperature over a period of time. Fig. 7 demonstrates differences in measured total heat stress between work groups engaged in the case study over the course of a shift. Given the variation in exertion as a result of changes to work tasks, thermal loads could vary widely within and across work groups, day-to-day and week-to-week. However, in this instance, it was those working in the Mill who show the highest thermal load, despite the fact that this is also the area with relatively more shade from roofed structures or sheds.

Mill work required generally less consistent physical exertion than for the Drill and Blast crew, but had periods of high intensity, particularly when machine parts needed to be replaced or repaired. The temporal patterning of these work tasks was entrained to the wear and tear on machinery arising though its rhythmic interactions with the materiality of rock, water and chemicals and the energetic rhythms of crushing, grinding, heating and pumping. In turn, these rhythms

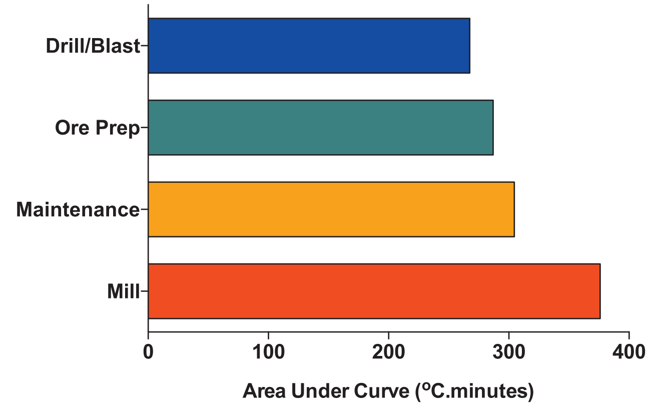

Fig. 7. Total heat stress 'time' as thermal load over the course of a day shift.

interacted with broader economic and logistical rhythms: such as shipment schedules for parts being transported nationally or internationally, meaning that replacement tasks could be delayed or compressed in time. During the days of observation, a lot of repair work was undertaken in the mill area, in part because a delayed shipment of replacement parts arrived, prompting high intensity work to get the equipment installed with minimum disruption to operations and output of metal concentrate.

The ore being mined and processed contained metals with toxic properties, creating a potentially hazardous working environment in which risk-management strategies added significantly to the complexity of managing heat. For example, within the Mill group, 'baggers', were responsible for loading the final product, a bulk concentrate, for transport. This was widely considered to be the hottest job, as it required workers to wear extra 'Personal Protective Equipment' (PPE) of coveralls and full face-masks, in addition to the gloves, hard hat and cotton full shirt and trousers worn by all workers. As a result, 'baggers' retained additional body heat while working in a hot, largely enclosed shed that also retained and re-radiated heat from the external environment, as demonstrated in the thermal images in Figs. 8 and 9.

Compounding the higher thermal input, hydration and cooling were also much more complicated for baggers. Simply having a drink involved the process of exiting the shed, removing the hard hat, removing the cap part of the full-body coverall, removing the face mask/respirator, removing gloves, retrieving a water bottle from a cleaner spot,

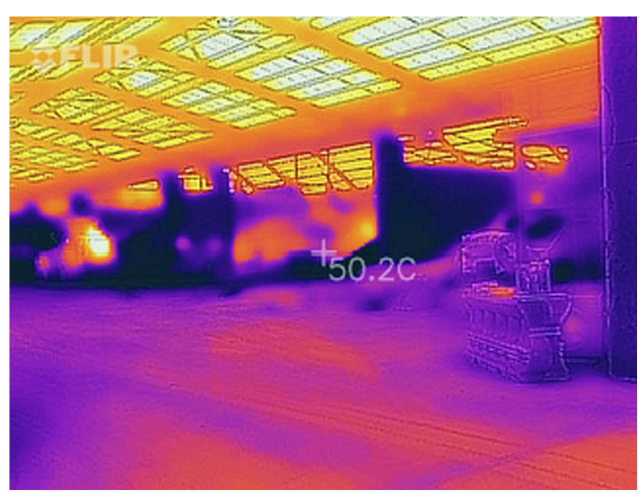

Fig. 8. Concentrate bagging shed. Significance of radiant heat from un-insulated corrugated iron roof visible in thermal gradient. The dark areas are walls retaining the concentrate (in granular form). 50.2 °C of the selected area is the surface temperature of the concentrate. The roof is hotter, as demonstrated in the next image.

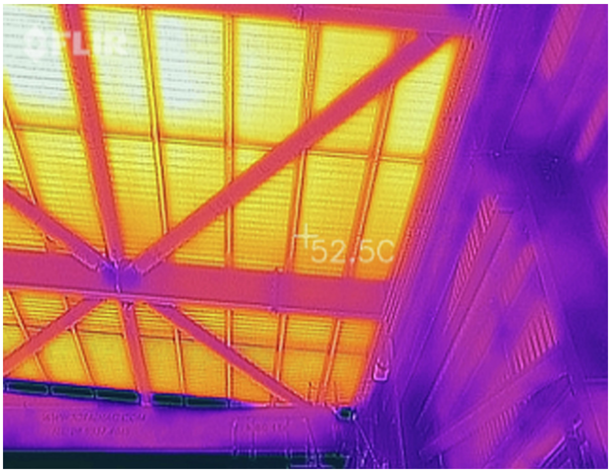

Fig. 9. Roof of one of the mill sheds, at 52.5 °C.

having a drink, and then donning the PPE again in reverse order to re-enter the shed. The requirement to avoid ingesting the metals being extracted meant that, across the processing plant, keeping water bottles clean and wanting to drink frequently entailed a temporal trade-off. Observations and interviews showed that each worker had a different strategy and rhythm for dealing with this – some drinking less frequently, and keeping water bottles further away and cleaner, others wearing CamelBaks (water bladders in small backpacks) to enable more frequent hydration, capping the mouthpieces and periodically wiping them with alcohol wipes in an attempt to keep them clean. These patterns of trying to reduce contamination were essential to the health of workers but disrupted the rhythm of more frequent hydration they might otherwise adopt in an effort to prevent heat stress. As one mill worker noted, "sometimes you tend to let it go a little bit long before you rehydrate again."

2.4. Rhythms in labouring bodies

So far, we have worked through how thermal rhythms in the environment of the mine site are produced and experienced, and how these combine with various rhythms of work to have consequences for patterns of heat exposure, metabolic heat generation and the ability to access cool spaces or hydrate to improve heat-loss. As we have seen, this polyrhythmic assemblage is visible in the sum of these effects on the bodies of workers as heat stress, measurable in part through their core temperature – or 'thermal load'. Furthermore, keeping thermal load in a safe range also becomes a rhythm in itself, routinely part of their working lives.

The dynamics of thermal load brings us to the bundle of rhythms that constitute the ongoing functioning of human physiology and their involvement in bodily thermal regulation. The corporeal system has its own embodied rhythms of storing, creating, using and dispelling energy, including as heat (Jablonski, 2013, Mitchell et al., 1976). To manage thermal load, these are governed by involuntary chemical and physical processes – such as sweating and vasodilation of blood vessels in the skin - as well as by voluntary, 'behavioural' responses, such as sitting in front of a fan, hydrating, or reducing physical work rate. These processes also often have their own rhythmic interrelationships, such as between sweat rate, thirst and hydration rate. Thermal regulation then is how the bundle of embodied voluntary and involuntary rhythms is sustained in a (thermally) eurhythmic condition. These rhythms are 'different, but in tune' (Lefebvre, [1992] 2004: 25), in an equilibrium condition where the body's core temperature remains within a safe range.

However, the combination of externally absorbed and internally generated (metabolic) thermal load has the capacity to push thermal regulation to its limits; to destabilise this equilibrium into a potentially arrhythmic condition in which 'rhythms fail to synchronise into a healthy state' (ibid: 25). Dehydration as a result of heavy sweating is one example of this, but at its furthest extreme such arrhythmia results in heat stroke and death. In relation to heat stress, Fig. 10 shows in precise temporal detail one example of how the rhythms of bodily exertion, reflected by heart rate, were closely followed by changes in core temperature. For this worker, the spike in the data between 12:45 and 13:45 corresponds to the commencement of a strenuous task in the vibrating screen unit during a hot part of the day. This is completed at 13:45 and the worker rests, allowing for relatively rapid cooling of his core temperature. While completing the task, the worker's core temperature passes the 38.5 °C threshold for healthy, heat acclimatized workers (International Organisation for Standardisation, 2004) for more than an hour. This type of exceedance is commonly observed in the monitoring of the core temperature of outdoor workers' in northern

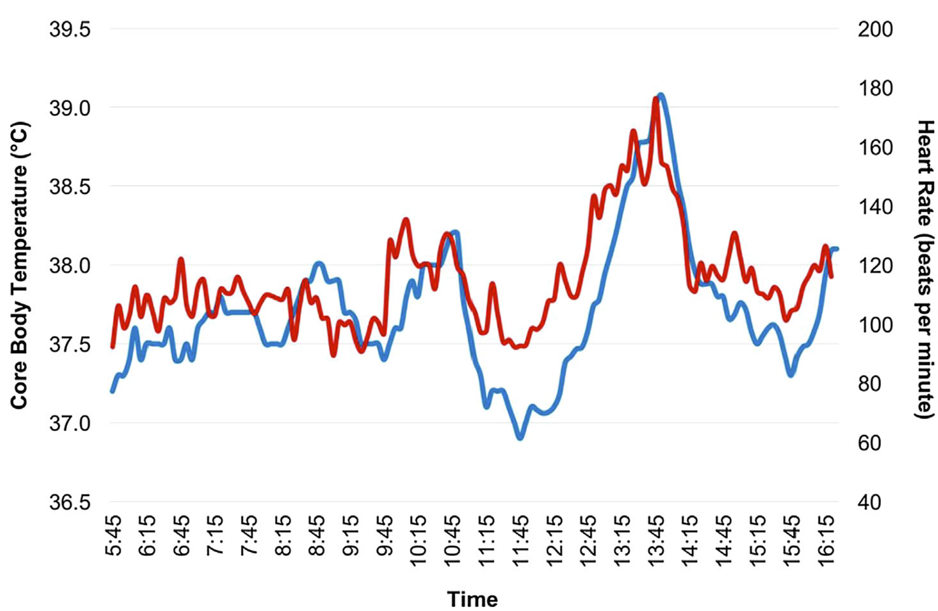

Fig. 10. An example of measured heart rate (red) and core temperature (blue) across the work shift. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Australia (Brearley et al., 2016). In this case, the worker did not suffer any adverse effects and by ceasing work and cooling down he was able to rapidly restore a safe core temperature. He was also afforded additional 'space' for his core temperature to rise by 'pre-cooling' through an air-conditioned lunch break from 11am to 11.45. This shows how important tactics of pre-emptive and responsive spatiotemporal scheduling can be to control thermal load throughout the day.

However, the complexity of keeping these bodily rhythms in harmony with work and environmental rhythms means that a eurhythmic state was not always achieved. Talking about the same task, another worker recounted:

> "one instance when I was working on the vibrating screen deck. […] I was under quite a bit of pressure to get the job done. And I was under the assumption that I would have a relief come up [any moment, so I kept pushing on, but they didn't arrive], and I'd actually gotten pretty bad […] I was stumbling left and right." – *Tyler, Mill*

Other instances of more or less serious consequences of intense periods of heat exposure and/or exertion were recounted in workers' interviews. These included first- and second-hand accounts of physical and mental effects, including people becoming irritable, irrational, confused or losing consciousness, for example:

> "He's getting red, or starts to make some silly answers or silly decisions." – *Will, Ore Prep*
>
> "[On one occasion] both my arms cramping during work […] I was still cramping up throughout that whole night […] I've seen people the same as me. Feeling dizzy or sick." – *Isaac, Drill and Blast*
>
> "We've only had one mate of ours get real [bad and] had to get put on a drip for heat stress. Other than that, there hasn't been any real major incidents – I mean, definitely, people have the headache effect." - *Liam, Mill*

Such examples demonstrate that successful thermal regulation is an inherently precarious achievement. It takes constant, fine physiological and social attunement to maintain both bodies and production in a eurhythmic state in such a harsh environment while doing labour-intensive work. Part of ensuring eurhythmia is the ability to identify and prevent or ameliorate arrhythmic developments. These can be set off by the thermal implications of a variety of rhythms: work-shift patterns, real-time production pressures, interconnections between sequences of work tasks and the material complexities of toxic materials and apparently simple actions such as taking a drink. In the next section we consider further the notions of eurhythmia and arrhythmia, and articulate the case study with the lines of theoretical engagement outlined in the opening of the paper.

3. Dysrhythmia, agency and adaptation

While eurhythmia and arrhythmia are deployed across a range of rhythmanalytic research and writing (Lyon, 2018), they have also been recognised as having limited analytical or evaluative traction in unpacking polyrhythmic interactions (Blue, 2019; Edensor, 2013; McCormack, 2013). For our purposes, these terms have usefully captured the rhythmic constitution of the movement between conditions of thermal balance and imbalance, in part because they are terms perhaps most readily applied to the bundle of rhythms of the body, or of living organisms more generally (as noted earlier, Lefebvre repeatedly used such examples). They are also useful in thinking about the system of the mine site as a whole. However, this raises questions about how to use notions of eurhythmia and arrhythmia at different but connected scales (the body to the mine site), or in other words, how to unpack the interrelations between polyrhythmic assemblages.

If, for example, we conceive of the mine site's operation as a polyrhythmic assemblage, then its eurhythmic condition, aligned to the ends of profit and accumulation, could be interpreted as its continual, efficient operation with minimum 'down time'. As part of this ongoing operation, as we have found, there may well be instances of (thermally generated) arrhythmia within the bodies of workers (heat stress or heat illness). This may or may not impede the apparent eurhythmia of the production of the site as a whole. While workers' labour is essential to the mine's functioning, heat stressed workers do not always interrupt work rhythms. In fact, on the contrary, chronic heat stress seems relatively wide spread. The only occasions where heat stress might interrupt the site's operation, is when heat illness results in the cessation of work in a work area (possibly with knock-on effects to the wider production system), through a heat illness induced mistake (Hancock and Vasmatzidis, 2003), or, as one of the quotes indicated, the rare occasions where a staff member is given medical attention, possibly requiring further members of the crew or emergency response staff to assist them in getting to the clinic.

Adding the term dysrhythmic may be useful in finding a way to account for moments that intimate arrhythmic potential but do not (on their own, at least) fully destabilise whole assemblages. In medicine, dysrhythmia can be used to mean an 'abnormality' or a kind of chaotic element in a functioning system. We also find it productive to foreground the meaning of the prefix 'dys' as in 'bad' to indicate that there can be (by some metric) 'bad' rhythms that might be negative for specific, contained polyrhythmic assemblages (for example, of workers' bodies) but which are nonetheless enrolled in maintaining a more extensive polyrhythmic assemblage (such as a work group, or an overall business). Indeed eurhythmic assemblages as entities may well rely on and obscure dysrhythmic elements. In contrast to arrhythmic elements, they are pathological but within certain bounds, such that their pathological nature can in fact be in service to, rather than disruptive of, the eurhythmia of the wider assemblage. In this case study as well as in related research in the region (Oppermann et al., 2018), we have observed how workers internalise and normalise chronic heat stress to enable a workplace to continue functioning. In energetic terms, this kind of dysrhythmia can absorb certain energies (thermal) while still maintaining the expenditure of others (exertional) in order to keep the polyrhythmic assemblage operating to complete work tasks and achieve production targets.

Considering how to respond to dysrhythmic elements raises important questions of power and agency. Remembering the connection in the introduction to new materialist thinking and the notion of 'energetic liveliness' (Barry, 2015) we approach agency within the thermal polyrhythmia we have characterised, as distributed across human and non-human elements and associated rhythms. Seasonal and diurnal cycles of solar radiation, day-to-day weather formations, and localised thermodynamic exchanges between materialities (air, rock, metal) at the mine site are all examples of 'vital' rhythms that exceed the human (whilst recognising of course the human input into rhythms of 'global heating'). Even within labouring bodies-at-work we can understand thermodynamic relations and involuntary thermal regulation as working independently, in 'automated' ways. Whilst much of the thermal-energetic polyrhythmic interactions we have worked through are therefore exterior to the social, the rhythmic patterning of work, labour and production is not. In the context of the thermal and temporal 'cost' implicit in all rhythms, 'capacities to act', by changing rhythms and their articulation, play a key role in the production of eurhythmia, or arrhythmia, and the character of these states, such as whether they are tolerant of dysrhythmia or not. As such, how much play or flexibility there is within polyrhythmic assemblages is a question of how power to form and reform ongoing polyrhythmic interactions is distributed and located (Chen, 2017: 49). As individuals and groups, workers to some degree engage in a distributed, more-than-human 'orchestration' of the assemblage of rhythms, but they are typically manoeuvring, negotiating, collaborating and coping, rather than 'writing the score'. As Lefebvre and Regulier ([1985] 2004: 82) note:

> 'The everyday is simultaneously the site of, the theatre for, and what is at stake in, a conflict between the great indestructible rhythms

and the processes imposed by the socio-economic organisation of production, consumption, circulation and habitat'.

There are clear linkages here to enabling adaptive capacity, and to designating adaptation options as 'successful' or 'maladaptive'. In the operation of a mine site, literally and metaphorically 'grounded' in localized rhythms and yet also thoroughly enmeshed in the circulation of global resources and capital, we can also see, through the manifestation of thermal load and heat stress, an example of the mundane yet intensive ways in which the 'rhythms of capitalism pervade the everyday … setting down the beats through which work and leisure proceed' (Edensor, 2010a: 13). We were not able more precisely to investigate within this research project how work patterns and the rules and norms of work practices were negotiated, monitored or disciplined, but such questions are critical in order to more fully establish how capacities to act to manage heat stress, by intervening to limit dysrhythmia or cascades into arrhythmic conditions, are enabled and distributed.

In the opening of the paper we framed energetic-thermal flow, rhythm and the case study within the context of debates over the temporalities of adaptation to climate change. Arrhythmia, dysrhythmia and the distribution of agency have a much wider relevance in this context. The global climate system can be conceptualised as a polyrhythmic assemblage par excellence, teetering on the brink of a cascade into a profoundly arrhythmic state (Steffen et al., 2018). Global climate change is in itself rhythmically structured: as a comparison between repeating patterns of variation in meteorological measures and abstractions that have shifted from how they 'used to be', and projected to continue to be rhythmically dynamic (in terms of changing cycles, durations and intensities) and – more terrifyingly - arrhythmic (in terms of 'runaway' climate change) in the future.

How these shifting climatic and weather-rhythms entangle with the emergent polyrhythmic every-day in all its situated complexity, recasts the core question of climate change and adaption in rhythmanalytic terms, capable of analysing contingency and moments where radically different temporal, spatial and energetic flows come together in the 'implicated time' that is lived, enacted and emerges, from moment to moment. It matters then, to pay attention not only to the micro-manoeuvres available in the management of micro-temporalities and micro-spatialities of adaptation (Nobert and Pelling, 2017, Nobert et al., 2017), but how these are necessitated by, and come together as micro-energetic patterns or rhythms, that work to keep polyrhythmic assemblages in a harmonic, eurhythmic condition, whilst also, as we have argued, attending to any dysrhythmic elements that are normalised or otherwise obscured from view.

For our interest in developing a rhythmic understanding of heat stress the implications of climate change clearly have very direct relevance. At the mine site and in northern Australia more broadly, the additional thermal through-put has the potential to fundamentally destabilise the finely-tuned, highly contingent, and inherently fragile weaving of multiple rhythms that keeps more extreme health impacts in check. The micro-manoeuvres that constantly adapt to emergent thermal conditions and thermal polyrhythmia more broadly are evidently already present. In this sense, energetic rhythms are not only demanding this responsiveness, but are themselves the stuff of adaptation – where the ability to effectively manage thermal flows while still completing 'core business' is the marker of whether everyday adaptation is successful. In this setting, and in many others around the world where heat extremes are expected to become more prevalent, the ways in which rhythms - including the dysrhythmic – are managed, come together and interact in thermal polyrhythmia will be crucial to whether arrhythmic or eurhythmic assemblages emerge, or are maintained.

4. Conclusion

In this paper we have deployed the analytical vocabulary of rhythmanalysis to conceptualize and empirically trace how heterogeneous, polyrhythmic interactions play out as energetic-thermal flows which are variously exchanged, accumulated and dispersed within and around human bodies. Engaging the thermodynamics of heat flow with rhythms of planetary cycles, environments and materialities, the rhythms of labour, scheduling and organisation, and the metabolic and thermoregulatory rhythms of bodies-at-work, has involved following Lefebvre's injunction to seek out and interrelate diverse rhythmic forms 'from corpuscles to galaxies' (Lefebvre, [1992] 2004: 51), drawing together diverse knowledges. In so doing we have provided a novel application of rhythmanalysis, bringing the energetic liveliness of rhythms into view by focusing on thermal flows and furthermore using rhythm to demonstrate not only their spatial, temporal and energetic contingency but also their agency. We have also proposed dysrhythmic as a new adjective for the rhythmanalytic lexicon. Eurhythmia and arrhythmia, we have argued, can have dysrhythmic elements within them, problematic or 'bad' in their own right, but able to contribute to either state.

In developing this rhythmanalytical account, we have sought to contribute to geographical engagement with heat as a pervasive and immersive phenomenon that intermingles social and natural domains. By engaging empirically with a setting and a region in which thermal flows are intensely present and significant (Oppermann and Walker, 2018), and utilising a rhythmanalytical approach to the case study, we have drawn out the spatiotemporal complexities and agentive effects of heat, tracing thermal energies as shaped by, and in interaction with, a variety of other rhythms, as workers attempt to manage the thermal load on their bodies. Their working lives are physically intense, intrinsically hazardous and thermally at the threshold of bodily capacities to function. Yet workers also demonstrate a high awareness of this, with heat management practices attuned to these rhythms and their potential for rearticulation. That their management of heat load emerges as an inherently contingent and precarious achievement is a critical insight and concern, not only for current health and well-being but also for those working outdoors in a rapidly warming climate. We have argued that a key question in the analysis of polyrhythmic assemblages is not only whether outdoor workplaces are in – or moving towards – a eurhythmic or arrhythmic state, but the role of dysrhythmic rhythms in propelling shifts between states or enabling them to stabilise. This is perhaps easiest to miss when dysrhythmic elements contribute to a eurhythmic state, raising ethical questions for workplace practices and adaptation more broadly. Finally, beyond the specific energetic problem of the management of heat stress, this seems to indicate there is much to be gained from rhythm-ising geographical engagements with adaptation in a changing climate. We would agree with Chen (2017: 169) that there is 'no conclusive formulation of rhythmanalysis as a research method', opening up opportunities to analyse the deep complexity, multiplicity and ongoing emergence of climatic entanglements through a range of epistemic and heuristic approaches. Looking within (as well as beyond) the reach of the geographical imagination, and its many knowledge-making practices, there is still much innovative work that a rhythmanalysis which seeks to 'receive data from all the sciences' (Lefebvre, [1992] 2004: 32) can do.

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