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Attunement and Multispecies Communication in Fermentation

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Abstract

Terada Honke is a natural sake brewery that utilizes practices like call-and-response and work song to coordinate its fermentation processes across human and microbial participants. I call attention to the concept of attunement, which is the ability to notice, apprehend, and connect with others in meaningful response. Drawing on ethnographic fieldwork, I explain why brewers must attune to the social, spatial, and temporal scales of life within the brewhouse, including the microbes who remain invisible to the brewers. I then analyze how the brewers practice attunement by attending to the relations between (inter-), within (intra-), and outside of (extra-) their bodies. These practices enable brewers to practice an embodied relationality that spans multiple scales and multiple species, or what others have called response-ability. I argue that this form of attunement could extend the idea of collective ethics to include microbial others and help rewrite the metaphysics of what it means to be human.

Keywords: fermentation, attunement, multispecies communication, embodied relationality, multiscalar ethics, human-microbe relationship, food and/as media

1. Introduction: Fermenting Foods Can Mediate Relations across Different Bodies

Food is a medium, connecting bodies in both literal and figurative ways. For instance, food can mediate a sense of identity for vegan, kosher, and locavore eaters through diet; or, practiced collectively, food can mediate the social bonds of a community group or a so-called national cuisine. Since we are obligate eaters, food mediates—and complicates—our relationships with other species because we use *their lives* to prolong our own. Modern endeavors to enhance the health benefits of food—including the overextraction of plants labeled superfoods, the booming industry of probiotics (foods so named because their bacterial profiles enhance our gut health), and the bioengineering practice of genetically fortifying crops with vitamins—epitomize this instrumentalization. At the same time, the latest microbiome research points to the fact that there are as many microbial cells in a human body as there are human ones (Sender, Fuchs, and Milo 2016). This means that the notion of *we* already encompasses multiple species. So, *how do we practice*

being humans, let alone healthy and sustainable ones, given that our ontological status is, and *has never been*, solely human?

To understand our foods (and our bodies) as being co-constituted with other species, I look to fermentation. As a mode of food preservation, fermentation has historically connected humans with seasonality and place, especially when the abundance of harvest necessitated community efforts to process ferments[1] for times of dearth. Across food cultures and for centuries, people have been practicing fermentation in concert with the plants, animals, and microorganisms that enable the transformation from food to ferment. Thus fermentation mediates the relationship we have with many different species (at the very least microbial), and these relationships span temporal, spatial, and social scales.

In thinking through fermentation, I follow the line of food philosophy put forth by Lisa Heldke (2012, 70) that sees food as not merely a substance but "loci of relations . . . that emphasizes the relational nature of food-and-us." And, in handling these loci, fermentation can be seen as a process that is contingent, emergent, and predicated on intimate relations between interconnected species. As both a food-making process and a health-sustaining practice, fermentation reminds us that our selves are comprised of and dependent upon other species like microbial life, who animate our bodies, our lands, and our collective well-being. In turn, our tangled relations mean we need a more robust figuration of what it means to be not-only-human.

Fermentation serves as a recurring encounter with microbial species, demanding the ethical decisions about how we get on with one another. Some species are considered expendable and useful, while others are not and are sterilized out of existence. How we continue to live and die well at the expense of other species confronts us with the philosophical question of how we valuate life. As Donna Haraway (2008, 295) cautions, "Because eating and killing cannot be hygienically separated does not mean that just any way of eating and killing is fine." Or, as Myra Hird (2009, 136) points out, we are always and already imbricated in a relational economy that traverses scales, spanning macroorganisms like cattle/beef to

[1] Within several disciplines (e.g., food studies, cultural anthropology, sociology), scholars use the term "ferments" to mean the outputs of fermentation. I (and other fermentation scholars) have consistently used this terminology as part of an unofficial lexicon when trying to point to "fermentation products" and "products of food fermentation." Given these two lineages, I prefer to keep this phrasing even though it may not be an officially acknowledged usage in the dictionary. I like to explain it as similar to the word "pickles," which we understand to be a category of transformed foods, transformed by way of pickling. So while we could be writing out "pickled foods" or "products of pickling, we also use "pickles" as the implied shorthand.

microorganisms like bacterial life. We are one of many organisms who participate in these transformational processes of composing, decomposing, and recomposing each other through food-based encounters. I see fermentation as a multispecies, transformational process, one that serves as a timely heuristic for thinking through the metaphysics of what microbes are, how we come to know them, and what an ethical life with them entails.

Because fermentation mediates the relations across human bodies, microbial bodies, and a shared environment, its hands-on praxis provides a way of engaging with the microbes that we cannot easily see or sense. I consider the material practices of fermentation to be an instance of interspecies communication, where assessing and following the progress of a ferment calls upon sense memory and embodied knowledge that helps one to cultivate a relational self (Hey 2019). This is partly because human involvement in fermentation is always indirect because humans can only encourage or discourage the work of microbial life, usually through tinkering with environmental parameters such as temperature, salinity, and oxygen availability to hope (and wait) for microbes to respond. In other words, human control in these processes is ever only aspirational, never absolute, framing fermentation as an ongoing conversation instead of one-way megaphone.

Thus it is the dynamic relationality that brings about fermentation instead of a human-driven recipe that one executes. I argue that these practices are predicated on a form of bodily attunement, which mobilizes a differential set of epistemological questions in microbial encounters. Instead of asking how we know if the good/bad microbes are present, attunement prioritizes a way of knowing that temporarily suspends the ontology of what a species *is* prior to them being affixed as "good" or "bad" for us humans. This refusal of presettled ontologies could, in turn, help us imagine a more nuanced kind of collective ethics, one that includes multiple species and, perhaps more importantly, does not reify anthropocentric categorizations of life in terms of human benefit.

My argument here is one of relationality, moving away from an object-oriented approach to food as *things to use* to instead focus on the dynamic processes of co-constitution. I contend that fermentation is one way to practice human and more-than-human entanglements in an ethical manner, tending to the differences and needs of each species without defining the entire relationship by them. By focusing on relationality, this paper examines the embodied practices and the philosophical approaches of being-with others whose needs and lifeways may be invisible to us.

2. Framework: An Approach Informed by Feminist Thought

To unpack the multispecies and embodied relationality in fermentation practices, I call upon feminist thought along two trajectories: (1) the corporeality of

feminist new materialism, which animates the agentic capacity of various bodies, and (2) the ethico-onto-epistemologies of feminist technoscience, which grounds my analyses in practices, not just principles, so as not to hide it behind abstractions. Combined, these approaches connect the ethical actions (the *why* and *for whom* questions) with their philosophical impetus (the *what* and *how* questions). So, while sake fermentation—the basis of this analysis—may not be of feminist concern per se, I situate my argument within a greater repositioning and critique of dominant ideas about what a body can do, how differential bodies relate, and how they do so across species and scale.

A new materialist framework grounds ideas in real practices by foregrounding the corporeality of one's body while also recognizing the discursive powers that affect lived experiences, differentially. My ideas about embodied epistemologies are particularly informed by feminist accounts of the body, which prioritize fleshy understandings (and differences) of bodies and embodiment. These perspectives lament the postmodern tendency to solely focus on language and discourse because it has "foreclose[d] attention to lived, material bodies and evolving corporeal practices" (Alaimo and Hekman 2008, 3). Feminist new materialism argues that material objects and their discourse cannot be separated, and, by prioritizing this indivisibility, new materialists "shift the focus from ethical principles to ethical practices" (Alaimo and Hekman 2008, 7). This foregrounding of practices is intentional here, for I ask how food practices (and fermentation practices) help us enact a more ethical way of being and living with others. I do not mean only microbes; I mean other humans as well.

Seeing bodies as active participants in processes of subject/knowledge formation works against the dualistic thought that the mind (or self) operates separately from the corpus; rather, they are integrated—incorporated—into a living whole. It is crucial here to take the body as a collection of forces in dynamic interplay, "as a transformer and a relay point for the flow of energies" (Braidotti 2002, 21). The benefit of employing an "embodied subjectivity" is seeing bodies as being connected and entangled in more than just descriptive ways; it is to imagine "new conceptions of corporeality . . . which see human materiality *in continuity with* organic and inorganic matter" (Grosz 1994, 22; emphasis added). This emphasis on continuity complicates binaries like mind/body and human/nonhuman because to view the body as unbound, porous, and unruly is to disrupt the neat, either-or separation of dualisms.[2] Instead of mind or body, embodiment allows knowledge to emerge as mind-and-body.

[2] Binaries themselves are never innocent as they are often organized vertically to favor a hierarchical structure (e.g., mind over body, objective over subjective, self

Donna Haraway (1999, 193) highlights the need to be critical of the affordances granted to each unique view, arguing that one's "positioning implies responsibility for our enabling practices. It follows that politics and ethics ground struggles . . . over knowledge projects.". The fact that knowledge is situated—in a body, in a physical place, in a particular social location—demands attention to difference and to how those differences come to matter. As we participate, emerge from, affect, and are affected by these differences, knowledge production must remain committed to an "ethico-onto-epistem-ology—an appreciation of the intertwining of ethics, knowing, and being" (Barad 2007, 185). What is to be done with knowledge, and done well, cannot be divorced from how that knowledge came to be. As such, how we come to know microbes is itself a messy question that is tied to what microbes even *are* and what we humans are to do about them. Cleanly isolating any one of their ontologies or epistemologies risks a skewed sense of ethics, and we already see this in microbial representations along helpful/harmful or friendly/unfriendly lines.

Whereas an object-oriented (and positivist) understanding of fermentation sees distinct units of foods, humans, and microbes that *inter-act* to produce a ferment, I consider fermentation to be an ongoing *intra*-active differentiation wherein the microbes on foods, on hands, in the environment, and the humans who handle them, matter in dynamic relationality, always and already making and remaking each other. So foods, microbes, and humans cannot be separated. Microbes move and move through us, as do foods, and we humans move through their worlds as sometimes agents, other times bystanders. There is no cause and effect, only phenomena that perpetually emerge, at least until analysis makes an agential cut to provisionally carve out the agencies at play with "human," "microbe," "food," and "ferment" in relation to one another.

To ground these relations in specific terms, this article draws on data generated during ethnographic fieldwork conducted at Terada Honke (TH), one of two natural sake breweries out of the approximately 900 in Japan.[3] "Natural," here, means that laboratory-optimized microbes are not added to the fermentation process; instead, the brewery relies on the work of endogenous bacteria and yeasts that have inhabited the open-air brewhouse since the brewery's inception in the 1670s. Over the course of two winters, I engaged with and practiced as an apprentice brewer, working alongside my interlocutors while I conducted fieldwork. I looked to TH not for its singularity but for the richness and "fine detail" (Barad 2007, 91) that

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over other). Seeing binaries only as either-or categorizations limits the interlocking ways of understanding the complexity or severity of phenomena.

[3] This emphasis on natural processes, combined with TH's ethos of "working from the microbes' perspective," served as the rationale for choosing this site.

allowed me to analyze the differences that came to matter, particularly around how brewers came to know microbial life and work with it in sake fermentation. While there are cautions against tokenizing or exoticizing what is done "over there," accounting for my corporeal affordances as an able-bodied researcher and my social location as a mixed race *hafu* (the accepted term in Japan to indicate mixed blood) framed this knowledge as being socially situated (from my view) and situated in (my) bodies as lived experience.

Due to their commitment to natural brewing, the success of the brewery relies on the relational practices of humans with microbes, who remain largely invisible to the brewers. Microbes are varied and ubiquitous, so the practices that work in one scenario may not in others. As such, brewers need to attune to microbial life with the unaided eye, calling upon other senses and the perceptions of other brewers to ascertain the fermentation processes in progress. So, in addition to interviewing brewers and corroborating my own perceptions, I had to prioritize embodied and immersive approaches in order to engage with microbes on a firsthand basis.

Modulating the ethnography with multispecies and multisensory considerations demanded that I employ a "multisensory approach—grappling with unfamiliar sensoriums, with different kinds of touch, smell, taste, and vision" to apprehend, notice, and meaningfully engage with more-than-human others (Kirksey and Helmreich 2010, 565). As a result, these approaches enabled me to mobilize the embodied, immersive, and participatory practices of sensory ethnography (Pink 2009; Stoller 1997), downplay the role of human agency by practicing the art of noticing more-than-human beings in multispecies ethnography (Tsing 2015), and prioritize the building of trust and relations over data collection and knowledge extraction in feminist ethnographies (Skeggs 2001). These modulations were important to consider because fermentation is dynamic and ever changing without necessarily featuring (or even serving) a human figure, thereby requiring tools that consider humans not as exceptional but as members of multispecies communities (Rose et al. 2012, 3). Ultimately, my approach to this research values dynamism over static snapshots, multiplicity over singular truths, and interdependency over isolatable variables.

3. Invisibility: Why the Brewers Need to Sense Changes on Social, Spatial, Temporal Scales

Sake is a fermented rice beverage made entirely of rice. Like many ferments, sake is made with a starter culture called a *shubo* that jumpstarts the process of transforming rice into alcohol, but these processes can take weeks to start (a point to which I will return momentarily). Sake is actually the result of a triplicate fermentation process happening simultaneously: rice is fermented into these shubo starters (made possible by yeast and bacteria), rice is fermented into a malt-like substance called *koji* (using a mold, *Aspergillus oryzae*), and, finally, more rice is combined with the shubo

and koji to ferment into sake over months. As a layered and incremental process, sake fermentation confounds the causal one-to-one relationship of ingredient to product.

When preparing the shubo starters, TH uses song to keep the time and mashing rhythm consistent from batch to batch, year to year. Huddling over barrels, the brewers mash rice with wooden poles to the tune of a call-and-response work song with lyrics that give thanks to the rice harvest, the gods for providing abundant blessings, and the well water that springs up in fervor. The song is a gathering, an invitation to come together through rhythm, concord, and the collective well-wishing for good sake. As such, it is more than a procedure to get to the next step; rather, it is in performing the song that brewers create a sense of connection to microbes, to each other, and to place, all through the iterative tasks of fermentation. This song—as well as other practices at the brewery—help the brewers practice attunement: the ability to notice, apprehend, and engage in meaningful response.

This process of cultivating shubo, as part of the Kimoto method, used to be commonplace until modern brewing practices considered the method to be too inconsistent, unpredictable, and time-consuming, thus ushering in an era that normalized the use of purified and lab-optimized vials containing known microbial strains with known trajectories. Notably, TH did not hold onto the traditional practice of song but reverted to it in the 1980s under the direction of Keisuke Terada, as part of a greater overhaul of what he considered to be a problematic business ethos. Terada felt the industrialized and efficient brewing process to be too removed from the historical context and uses of sake, which were considered to be acutely local, crucial to social ties, even medicinal.[4] For him, brewing could only happen through working with others, requiring a shift out of a self-centered, top-down positionality to instead recognize and give thanks to all of the forces—social, microbial, environmental, cosmic—that made human life and work possible (Terada 2007). He believed that fermentation was not a human triumph over microbes but a service in reverse; fermentation happens when humans enable microbes to do it. To reemphasize and reinsert the human in fermentation processes, TH did away with machines and vials that proffered ease and consistency to instead take up a work ethic that relied on manual labor and the attuned bodies of brewers.

Since then, the brewers continue to practice coordination on several scales. First, in doing tasks by hand and breaking them up into increments that are manageable for the human body to handle, the brewers have to coordinate their work across many different hands. At the time of my ethnography, eight brewers would

[4] The nod to medicinal uses of ferments is neither new nor unique to sake. In Japanese, the epithet for sake evokes its “one hundred [medicinal] uses” as if to call upon it like a panacea.

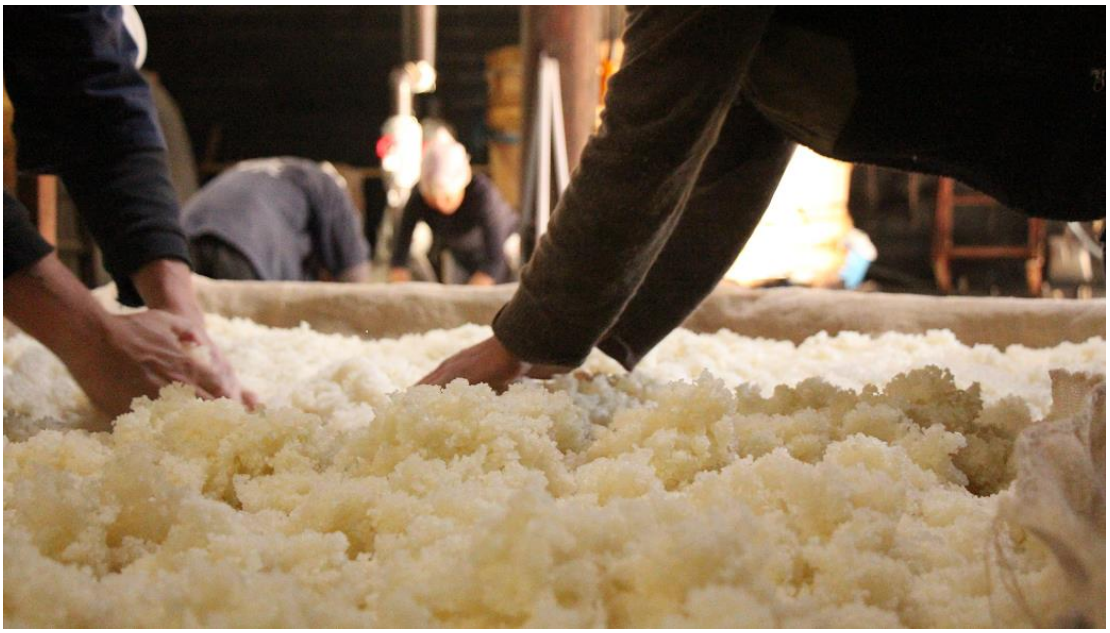

Figure 1. Brewers' hands flipping steamed rice to help it cool uniformly. Photograph by Maya Hey, 2019.

process 600 to 1200 kilograms of rice on a daily basis—washing, soaking, and transferring the rice by hand in 10- to 30-kilogram increments. At the same time, the brewers needed to ensure that each pail of rice was processed in a similar manner so that the cumulative effect would amount to the same degree of processing, whether in the first pail or the last. To attune to each other, the brewers synch up through vocal call-and-response and other rituals (like the song) that create a rhythmic workflow (a point I will elaborate in the next section). Attuning here means apprehending between humans, listening and participating in exchanges on a social scale.

On a spatial scale, the brewers need to practice a kind of attunement with the more-than-human brewing environment, because this ambient space is where endogenous microbes thrive. Following the natural-fermentation philosophy of letting it happen (versus direct inoculation), TH believes that the role of the human brewer is not to ferment per se but to set up conditions *for microbes* to do the fermenting. Given their invisibility, microbes are everywhere and nowhere at the same time, so their activity must be ascertained by other means. Brewers must rely on their sense of smell, sense of touch, and other sense memories to match indications of microbial presence (e.g., air bubbles) with brewing expertise to continue creating hospitable, livable conditions for the microbes to thrive. Attuning here is between brewers and the greater surroundings, of which microbes are a part. It asks the brewers to extend the scope of attunement beyond the human socius to listen for more-than-human socialities.

This spatial coordination with microbes is most apparent in the brewing expertise used in starting the starters. These shubo starters take more than a month to propagate, and they can only be prepared during in the "kanjikomi" cold season to best enable ambient microbes. Consistent with other matrilineal monikers (e.g., vinegar mother, pasta madre), the term shubo literally translates to "sake mothers" (酒母).[5] They are comprised of a teeming variety of microbial species, some that metabolize rice starches into volatile acids (for aroma), others that convert starches into amino acids (for flavor), and still others (like yeasts) that produce alcohol.

Notably, it is the biodiversity and biochemical complexity of the shubo that ensures its survival, and brewers must create conditions to invite successive microbial populations in a deliberate sequence for the entire starter to thrive. First, they must create conditions for nitrate-reducing bacteria who enable lactic acid bacteria to join the starter; then, these lactic acid bacteria create acidic conditions for yeast to flourish, and the combined acidic environment helps ward off opportunistic molds.[6] Each of these species thrive at different temperatures, and brewers must therefore attune to the spatial temperatures over different time scales—both throughout the day's temperature fluctuations and over the course of weeks and months. Thus, it is not just a question of whether microbes are there or not (they are), but it is the brewers' *perpetual return* to the shubo that helps them ascertain which species joined. This process asks brewers to practice a temporal and longitudinal attunement because fermentation continues whether or not it is desired by the brewery's schedule.

The brewers need to sense changes on social, spatial, and temporal scales in order to work in concert with invisible lifeforms. Unsurprisingly, the brewers name this invisibility too, referring to microbes as "what the eyes cannot see." But it is *because of this invisibility*, not in spite of it, that the brewers see their tasks as ways of engaging with the invisible. For instance, one of the brewers who leads the work song considers the lyrics as a way for him to interface with microbes, apprehend their "messages" (his term), and "play with the world that the eyes cannot see." In this

[5] It is worth noting that another name for shubo is "moto," which translates to "the source" of sake. This emphasis points to the origin of flavor and the uniqueness of each brewery's fermentation practices.

[6] This phenomenon of "warding off" opportunistic microbes was famously demonstrated by Elie Metchnikoff, who could not find a willing test subject to infect themselves with cholera so ingested the bacteria himself. Metchnikoff was not infected because his intestines were already colonized by intestinal flora due to his Balkan diet of fermented dairy. (To test his initial theory, he had his lab assistant also ingest cholera, and it nearly killed him.) This was the beginning of thinking about probiotics in a prophylactic way.

sense, the brewers perform their tasks for an unseen audience, which is further compounded by an unforeseeable future. Whereas positivist analyses (like identifying species by DNA-based sampling) can predetermine the profile of which microbes are present, the brewers at TH commit to an indeterminate milieu of microbes because the by-product of doing so produces an attuned body and, as I will explain in the next section, multiple scales of relationality.

4. Practicing Attunement: How Brewers Relate to Each Other and to the Shared Space

Brewers must attune to many things to successfully brew sake. These include the tangible ingredients like rice and water, as well as others that are invisible to the human eye like microbial life. (Other invisible forces like electromagnetic frequencies from lightbulbs or soundwaves are also thought to affect fermentation). But more than on the graspable and invisible entities, brewing is predicated on the relationships that make up the bustling, multispecies conviviality within the brewhouse. These relations color the interdependencies of a multispecies ecology from which fermentation emerges.

To handle these ingredients, the brewers must tune in to their senses: their physical senses, their sense of self, and their sense of having to connect to the intangible and attune to the invisible. It is not enough to rely on quantitative observation; rather, the brewers immerse, participate with, and attune their bodies to sensory information. The key is in noticing: attunement is the ability to notice, listen, and respond to the space and all of the inhabitants within it, human and more-than-human. Attunement allows the human body to sense these forces and connect with them without knowing them in advance or even controlling them. These relations highlight to whom or what we can respond and inform the ethical potential of thinking beyond the individual.

4.1. Radio Calisthenics and Other Spatial Choreographies

Every morning, the staff gather outdoors at the center of the brewery grounds in preparation for what are called “radio exercises.” Like other countries with quasi-nationalized exercise regimens, Japan in the 1920s had instituted a calisthenics program with a warm-up routine guided by radio broadcasters. Recorded onto a cassette tape, the broadcaster’s voice instructs each movement over a three-minute piano accompaniment, counting out the duration of each step. Under a single, impressive camphor tree, the staff move in unison with each inhale, each stretch, and each bounce, doing so with the agility and familiarity that comes with repeated practice. It is what starts the workday and what aligns the entire company to the same beat. The staff arrange themselves conscientiously so as not to bump or whack nearby colleagues with their swinging arms and twisting torsos.

The sheer proximity of people requires a kind of spatial acuity while bending and stretching. This spatial acuity is an extension of proprioception, or the sense of self in space. Proprioception is a neurokinesthetic phenomenon of how individuals perceive their bodies, or parts of their bodies, in relation to a given space. It is the sense of self-orientation we use to duck our heads enough to clear a stoop, or to place a cup down on a table without too much force. Unlike other senses that rely on a singular sense organ (e.g., sight for eyes), proprioception relies on a distribution of information from diverse "communicators." Surfaces like the skin compile and disperse information to make sense of a place—the whoosh of a whirlwind by the door, the heat of nearby steam, the solid footing of gravity. In this sense, thinking about proprioception enables one to listen with the entire body, with cues always coming from more than one source.

Figure 2. Brewery staff begin each work day with calisthenic exercises. Photograph by Sayuri Oki, 2019. Used with photographer's permission.

4.2. Call-and-Response in Song and in Other Timed Tasks

Later in the day, the brewers rely on vocal call-and-response to guide other tasks in need of timed coordination. For example, when taking the rice out of the giant steaming basket, the brewer responsible for digging must call out "*Yo!*" before sending off a pail of steamed rice, because the residual bellows of steam obscure the brewers' vision inside the brewhouse. The brewers receiving the rice must call out

"*Sa!*" to inform the digger to cue up the next batch. The timing is critical here because the just-steamed rice loses heat with each passing moment: too slow and the brewers risk allowing the first pails of rice cool too much and inviting microbes at an undesirable temperature.

When cooling the rice, the brewers must sense the temperature of the rice with their hands, being careful to turn over hotspots that hold onto heat so that the rice releases heat uniformly. In this sense, the brewers listen with their hands *and* listen with their ears, in order to know where their bodies can sense heat. Ultimately the effect of this effort is that the contents of the entire steaming basket (often amounting to a metric ton of rice) cools evenly even though it is dug up in units of 10 kilograms at a time. A rhythmic call-and-response ensures consistency in embodied terms, in that an individual brewer *responds* to what is seen, sensed, and heard with a meaningful *call,* be that a verbal cue (*Sa!*) or an action (flipping rice). These coordinated tasks require that each being be attuned to one another as well as to their individual selves.

Figure 3. Steam lingers around the digger's torso as he quickly portions rice into pails. Photograph by Maya Hey, 2019.

When the brewers prepare the shubo starters with song, their coordinated movements echo the ease that comes from regularity. The structure of the work song is one of call-and-response as well, but in a lyrical manner, with the brewers mashing rice to the beat of the song. The main singer enumerates the tasks and gratitude involved in the making of sake ("*We wash more rice for tomorrow's preparations*" and "*With thanks to the Kozaki shrine / the water wells up and becomes sake*") and the remaining brewers chime in with agreement ("*Oh yes! Yes!*"). The song's 15 verses span 25 minutes in its entirety, and the song's duration is fully incorporated into the corps of brewers, whose bodies *know* the pace of the song. Depending on the ambient temperatures, the head brewer may call for fewer verses to modulate how much the brewers mash the rice.

4.3. Listening for (Microbial) Cues outside of One's Body

When preparing the shubo, what starts out as distinct granules of steamed rice looks like porridge by the end of the song, opening up the starches for bacteria to enter and take up the substrate. In this sense, the song is also a multispecies call-and-response, wherein bacteria (and later, yeasts) join. While the song is lyrically set up as a call-and-response, the brewers also see the months-long process of cultivating a shubo starter as a form of microbial call-and-response. Specifically, they see their song as the call to which the bubbling up of yeasts (which evokes fermentation's Latin root word, *fervere,* to boil) is seen as a microbial response. When the yeasts respond earlier than anticipated, the brewers explain that that batch was particularly lively. When the yeasts do *not* respond (in the form of bubbles), the brewers attempt different calls, usually in the form of warming up the immediate environment—and all of this is determined from the long durée of continually engaging in microbial epistemics.

Brewers train their bodies to notice microbial responses, which might be in the form of a bubble, heat release, volatile aromas, or changes in viscosity. Importantly, the brewers do not convert microbial cues into human abstractions (e.g., numbers) to then decode and rationalize. They instead engage with their bodies and adopt what they call "working from the microbe's perspective," where brewers train their bodies to apprehend microbial responses. In other words, the brewers see their work not as being some steward to microbial life, overseeing their work from above. The relationship is almost reversed, where brewers deliberately place the onus upon themselves to communicate in "calls" that are meaningful to microbial life.

Thus, brewers insert themselves into a multispecies and multiscalar call-and-response, even though they do not consider their tasks as such. At the same time, the tasks are not a surefire protocol for the brewers to execute; as a call-and-response, the brewers' cues are only partially scripted *to account for microbial responses along the way*. To the brewers, microbes are considered ontologically present but with a

Figure 4. Changes in the shubo starter, like in viscosity or texture, are seen as a microbial cue to which brewers respond. Photograph by Maya Hey, 2019.

tacit understanding that human bodies/things (like down feathers) can affect the fermentation process. Proactively thinking about what goes into fermentation positions the brewers within a microbial call-and-response such that their attuned practices are themselves calls to which they must apprehend microbes' responses.

5. Theorizing the Inter-, Intra-, and Extra-relational Connections with Humans and Microbes

The preceding examples demonstrate attunement in action, for each individual must tune into their own bodies as well as those of others in order to respond meaningfully in sake-making practices. In attuning to spatial practices, the brewers' choreographies during singing and calisthenics provide a collective sense of movement in unison, allowing the brewers to move together as one body*, inter-relationally.* In the timed practices, the call-and-response moments of singing and cooling the rice provide an opportunity to use one's ears, hands, and full body to listen for other members' cues to act. Here, the brewers must process sensory information within one's body *intra-relationally* in order to cycle through the decoding and

encoding that drives the call-and-response. These communication pathways extend beyond human beings*, extra-relationally*, and include more-than-human participants in a microbial call-and-response.

As well, the different kinds of attunement seem to be mutually compounding: intra-relationality begets interpersonal relationships of camaraderie, heightened awareness towards extra-relational surroundings make veteran brewers acutely aware of their bodily senses, and coordinating movement between brewers enables the continuity of the entire brewing operation.

5.1. Inter-relationality: Connections between Beings

The brewhouse contains a collection of individual brewing bodies, with their different corporeal affordances, embodying know-how independently *and interdependently*. By participating in group work like the mashing song and the rice cooling, the brewers learn these practices to complete the tasks in relation to others. Unloading the steaming basket to cool the rice is not merely the work of *I cool the rice,* because it is defined in terms of the temporal, spatial, and social connections between brewers. Thus, the work of "I" is always accompanied by the work of peers: I call "Sa!" *when* a colleague delivers a new pail of steamed rice, I flip the rice *where* a colleague has not yet done so, and I listen for the next cue from afar, if and when a colleague is ready for the next step. Each body apprehends the "call" from other brewing bodies in order to produce a "response," which then becomes the next "call" for others to respond to. Each response is thus another call that seeks a response, and this self-perpetuating nature of call-and-response drives the co-labor and collaboration within the entire brewery. The back-and-forth co-respondence becomes inscribed onto brewers' bodies in the form of embodied knowledge and eventually develops into technical expertise with iterative practice.

The work song for preparing the shubo strengthens the group dynamic of the brewers through the lyrical structure of call-and-response. Like other historical instances of work songs, the rhythm drives the movement with an embodied sense of purpose, as there would be too much discord and deviation without it. Particularly in agricultural societies, the work songs of field work extended this purpose to collective groups (whereas hunting societies celebrated the *individual* hunter or the sole shaman whose ceremonial songs blessed the hunter before an expedition). Indeed, the shift to a group ritual with field-based work songs combined the efficacy of ritualizing movement with giving thanks to divine powers (Gioia 2006, 40–41). This collectivizing work amplified the human penchant for social bonding.[7]

[7] In the North American context, it is important to cite the African and Black heritage of work songs, where both person and song were brought to the New World on the premise of slavery and plantation work. (This later informed entire music genres such

The work song for mashing is thus performed both for the brewers' accord as well as for a latent microbial audience. As with the songs of goat herders and shepherds, the work song is both invitational and declarative, helping the nonhuman species to locate the human. Here, Cynthia Willett's ideas on interspecies ethics can help us to think of engagement between brewer and microbe as that of a call-and-response, one that functions as a basic expression of a desire to connect. In particular, Willet mobilizes the idea of affect attunement to theorize preconscious, intersubjective, and nonmimetic connectivity through species: "Attunement across sensory modalities constitutes the basis for a call-and response exchange at a level that may be preverbal, nonrational, and mysterious and yet vital for the ethicality of biosocial bonds" (Willett 2014, 91). This is most evident in interspecies play, whose improvisational structure provides opportunity to meta-communicate on a relational scale (i.e., communicating *this is not an attack, this is affection*).[8]

Crucially, acts of play and improvisation require reciprocity, for playing at the expense of others is no longer play. I am reminded of the brewer (mentioned in Section 3) who considers his work as "play with the world that the eyes cannot see," and I see the greater ethos of TH to be one of making spaces hospitable for all beings to enjoy each other's company along the way. The daughter of Keisuke Terada, Satomi, speaks of microbes as part of a greater relationscape at TH and describes very lively shubo starters as proof (to her) that microbes participate in brewing moments: "They're listening, having fun with us." Satomi sees the welling up of shubo starters as a kind of response to the work song that the brewers perform. Whether microbes are listening or not is beside the point (for we would not be able to confirm or deny it in any case); these brewers express a positioning and a desire to connect with microbes.

5.2. Intra- and Extra-relationality: Connections within and amidst Beings

Attunement mobilizes a kind of communication that asks for participation beyond language and mimesis; rather, the exchange works because responses are

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as blues, R&B, and even rock 'n' roll.) While there is (rather egregious) speculation on whether the work songs of oppressed laborers were performed as a defiant or a commiserating gesture, the feeling of the song is secondary to the fact that the song is "as much about 'being' and 'doing' as about feeling" (Gioia 2006, 57). I do not mean to detract from the emotional weight of dealing with exploitation or to even justify the song's efficacy as a tool, but I do mean to call attention to the fact that field work, as group work, was carried by way of song.

[8] See the work of Katie King (2015) on this matter, who builds on the research of Gregory Bateson (1987, 185) and play's ability to meta-communicate about relationality.

mediated through the embodied senses. Or, as Willett notes, the relational quality of interspecies attunement might be conveyed in the form of vitality affects (a term coined by Daniel Stern), which includes experiences, like cooing or crescendo, whose intensities may be nonverbal but are felt (Willett 2014, 90). Further, these intensities can convey a relational quality between communicators. In this sense, the exchanges between brewers and microbes remain incommensurate but nevertheless connect the communicators through the senses. That is, one's senses become active agents in the sense-making process of attunement instead of being a passive receptor that notes incoming stimuli.

Here, I return to the materiality of the body and to it as a sense-making entity. As feminist new materialists note, the body is not "merely a passive transmitter of messages" but instead participates in the ongoing and vital processes (of gendering or racializing, for instance) that connect the material and the discursive (Coole 2005, 128). In attunement, the body participates in call-and-response also through its production and reception of sensorial cues. It is through its corpo-reality that a body creates sensory information that is meaningful: "Its very materiality plays an active role in the workings of power" (Barad 2003, 809). Beyond a degree of self-awareness, attuning bodies can *create* knowledge with and through embodiment.

Sense-making with the body enables brewers to attune to the sensory cues that microbes make, but registering the microbial calls as *information worth attuning to* underwrites the extra-relational connections amidst the brewers and microbes in an environment. Brewers frequently and confidently spoke of the endogenous microbes who live inside the brewhouse, and their repeated enunciations made it seem as though microbial invisibility was circumstance instead of a limitation of the human eye. Importantly, brewers make note of microbial presence not as *mono* (or things) but as *koto*, which Shiho Satsuka (2015, 81) translates to mean "events" and "about-ness" of a thing. One particular refrain I heard from the brewers was *Kin wa tsune ni iru*, or "Microbes are always present." They use the verb "iru," which is used to describe the presence of an alive being, instead of "aru," which is the verb for objects to exist. Their use of the alive version of *to be present* (iru) might suggest that the brewers consider microbes to be inseparable phenomena from their own brewerly existence, not a microbial object that is separate from them. Microbes inform the brewers' sense of self (as *a* brewer) and their sense of group work (as *brewers*) that animates the brewing environment.

These layered forms of embodied relationality help brewers cultivate response-ability, wherein rendering their bodies capable of response to microbial life enables them to practice a kind of *multispecies and collectivized ethic.* The brewers' tasks are not completed alone but always in concert with multiple scales of life, relying on attuning their bodies to the inter-, intra-, and extra-relational connections

between beings, within a being, and amidst other beings, respectively. In this sense, attunement provides a mechanism for working with—not on—microbial life.

Working with microbial invisibility calls upon the brewers to practice *an array of epistemologies* to ascertain which microbes come to matter in brewing. First, proprioception enables a spatial epistemology because the sense of self in space informs both an embodied and an emplaced way of knowing. Second, the sensory modalities like touch and smell allow for an embodied epistemology to participate in the happenings of more-than-human sociality. Third, the recurring encounters of fermentation give brewers the opportunity to engage with microbes on a more-than-human temporal scale.

The metaphysics of engaging with a fermenting body involves multiple ways of knowing, on social, spatial, and temporal scales; in turn, these epistemologies grant brewers a way of "knowing" microbes *before* they become affixed in the ontological categories of good/bad, helpful/harmful, friendly/unfriendly.[9] The relationality does not precede the encounter; that is, it is only through encounter that microbes become what they are: an unruly force in fermentation to which brewers attempt to cultivate the ability to respond. Thus, response-ability is an ethical stance committed to ontological indeterminacy that then gets enacted and actualized through bodily attunement.

6. Attunement as a Way to Participate in Multispecies Communications

Attunement helps the brewers practice a form of response-ability such that sensing the multisensorial and multiscalar cues of microbial call-and-response keeps the brewers' bodies receptive to other forms of communication and response. To heed and respond is an inter-subjective process. We come into being through responses with others, in what Haraway calls a game of "response and respect" where the term *respicere* evokes the etymology of looking back (i.e., re-spect) with regard (Haraway 2008, 19). Attentiveness is the mechanism for response and respect. To use Anna Tsing's (2015, 22) turn of phrase, the arts of noticing call upon the "patterns" and "rhythms" of multispecies assemblages "to notice the divergent, layered, and conjoined projects that make up worlds." Taken further, this kind of noticing of others (including other species) leads to an expanded understanding of who we ought to include in multispecies ethics: "The cultivation of skills for both paying attention to others and *meaningfully responding* . . . is concerned with the politics and ethics of how we might come to know others" (van Dooren, Kirksey, and Münster 2016, 6; emphasis added). Our responsibility (or, response-ability) in multispecies worlds is

[9] See also the work of Astrid Schrader (2010) and Jacob Metcalf (2008) on this point of not overdetermining the ontology of microbial and companion species, respectively.

both an interpellation and a mandate: we depend on multispecies worlds but may not know how best to respond in them.

Communicating with multispecies others requires us to go beyond making sense *of them* to making sense *with them*. To do so, one must find ways to participate in the calls and responses already underway and make contact: "To claim not to be able to communicate with and to know one another and other critters, however imperfectly, is a denial of mortal entanglements (the open) for which we are responsible and in which we respond" (Haraway 2008, 226). If we are to excuse ourselves on the basis of incomprehensibility, our absolution would be a call unto itself. It would be a call of disengagement, an unwillingness, a forfeit, a giving into the trouble and still expecting some outside force to reconcile the differences for us. Since the human-microbe relationship is an entanglement that we cannot opt out of, their incomprehensibility does not absolve us from how (we ought) to participate in embodied and emplaced ways. We will need to find ways to insert ourselves in the ongoing calls-and-responses already underway.

In particular, microbial life has been difficult to imagine as an entity worth attuning to, or if so, it is often within the context of a microbiome craze and a healthist attention to optimizing individual health projects (Hey 2020). This stems from a larger philosophical irreconcilability wherein microbes are disregarded because they are not "big like us" (Hird 2009, 21) or have remained invisible to the unaided eye until 'discovered' in the context of disease and decay (Latour 1988). Even in the contemporary context of probiotic 'care' for microbial thriving, "the most generous acts of interspecies care expressed in rewilding remain premised on securing the health of the human body" (Lorimer 2017, 38). The goal for living and working with microbial life is not to leverage their alterity as a pathos-centric argument that one ought to care about microbial wellbeing (see Willett, 2014, 9). Beyond the fact that microbes may not have the affective pull of a panda or baby seal, their invisibility keeps them out of sight and out of the human imaginary when we do not have a say in our imbricated corporeality. Microbes comprise the very means of our staying alive and in ongoing encounters with every eating event. Fermentation acutely makes these multiplicitous ecologies noticeable and noteworthy.

We can no longer afford to bracket "the human" as a standalone unit of philosophical analysis, for "to be human" is to be multiple, and our coevolution demonstrates the ongoing call-and-response involving multiple scales of life. Recall that the mitochondria of our cells were once bacteria (Margulis 1998). The proteins enabling nutrient transfer in mammalian placentas were once viruses (Lowe 2017, 94). We humans are living proof of mergers that prevailed, and we will need to anticipate future ones. We would do well to heed the advice of Katherine Hayles (1999, 285) who, in theorizing the posthuman, invites us to imagine "opening up new ways of thinking about what being human means." Rather than think of the human as an

exceptional and bound being, it may be best to think of our bodies as porous (beyond fluids, as past feminist thinkers have argued) and include our engagements with microbial life as a millennia-long improvisation of trying to get on with one another. Darwin got it wrong: trying to outlive the other and survive has only imposed the constraints of a mythological antagonism.[10]

Given that our bodies have never been solely human, we would do well to reimagine our responsibility as being extended beyond the borders of our gut lining and skin. Building on the findings of microbiome research, Heldke (2018, 248; emphasis added) argues that the relational self is actually a collective self, defined by "the way in which the individual is constituted *through* relationships with humans and other macrolevel creatures." This nested and co-constituted way of thinking of the self complicates what it means to be a human individual and an unbound, multispecies self. We have always been co-constituted, coevolving on a biotemporal scale, but the metaphysics have yet to catch up on any commitment to co-responsibility.[11]

We will continue encountering microbial life whether we want to or not because our lives are tangled in mundane acts of eating, cooking, and cleaning, or in more specialized encounters of fermenting, farming, and immunizing. We cannot ask microbes to stop killing us and expect them to do anything of the sort, no more than we can apprehend their saying the same to us. And yet, this happens all of the time. We will need to rewrite what is meant by multispecies communication, response-ability, and the metaphysics of both. What are we saying, and how do we know those messages are received?

Attunement asks us to reconfigure and transform how we think and act within these invisible relationscapes. Instead of trying to reconcile the scalar difference of individual versus collective ethics, we would do well to imagine the differential vulnerabilities within a collective that place higher risks upon certain individuals—whether that is at a human scale, a microbial scale, or an environmental scale. As Shotwell (2016, 111) concedes, there is an ultimate contradiction with moral formation on an individual level that cannot be scalable to a collective because of the presumed substitutability between scalable phenomena. Congruent with concerns about our health, safety, and sustainability as issues that affect us all, and some more

[10] That said, I do not want to swing the pendulum to the other extreme either. We are not guaranteed a mutualistic relationship either. Like Lisa Heldke's (2018) elaboration on parasitism at the end of her article "It's Chomping All the Way Down," I argue that we would benefit from fleshing out the politics of use and do away with the rosy outlook of symbiosis.

[11] A notable exception would be the work of Lisa Heldke, who coined the term "co-responsible option" in 1992.

disproportionately, I echo Shotwell's (2016, 132) call "to work collectively towards a more collective and relational form of ethics adequate to the global and systemic crises we face." It matters how we practice being human in the face of ongoing disasters, and these are not only feminist concerns.

7. Final Thoughts

Food mediates relations because its hands-on material practices ask us to engage our bodies in different ways. I have described fermentation practices that connect humans and microbes, and I have elaborated on how our bodies come to know them. But the same could be said for other food practices. In eating practices, food mediates how we nourish our co-constitutive bodies, and our bodies come to know food through ingestion. In agricultural practices, food mediates how we cultivate the land, and our bodies come to know food through participating in economic and ecological systems. In cooking practices, food mediates how we develop biosocial bonds, and our bodies come to know food through gatherings and rituals. As such, the practices of food are interepistemic ones, in which how we come to know our foods (in taste), our bodies (in health), and our place in society (in positionality) makes up who we are, as individuals and as collectivities.

I have elaborated on attunement as one form of epistemic knowing because it asks the human brewers to engage on multiple scales: (1) attuning on a social scale of humans, (2) on a spatial scale of humans and microbes, and (3) on a temporal scale of microbes. This multiscalar approach to knowing demands an attention to the precise configuration and modes of connectivity, and it is this specificity that prevents unitary claims about who "we" are or how we "ought" to be. Specificity also pushes against the erasure of the relativistic notion that "anything goes." In cultivating an awareness for oneself and an attentiveness towards others, I have proposed ways to theorize *and practice* living with one another while holding onto our differences.

Fermentation mediates relations across human and microbial bodies such that it is emergent and participatory. Sake brewing is a deeply embodied activity and greater than the sum of its individual parts, and the success of the brewery is predicated on brewers who attune their bodies to more-than-human cues in a microbial call-and-response. By thinking of food-making in this way, bodies emerge as an active carrier and performer of food-knowledge. Crucial to fermentation is the concept of attunement, a way of simultaneously tuning to one's physical senses, the social periphery, and the more-than-human entities that collectively transform foods. It is a corporeal phenomenon as much as it is a philosophical approach to working with others we may not easily see or sense. As an embodied epistemology, attunement means listening with multiple senses. It means comparing and compiling one's sensory stimuli (in an instance of intra-relationality), tuning into each other (inter-relationality), and tuning to the ambient environment (extra-relationality). I

have argued that attunement may be one way to imagine and approach cultivating a collective ethic that includes multispecies others. Thinking about food-making as an attuned, response-able venture can help us reimagine collective ethics across species and across multiple scales of life.

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