THE ANIMAL BODY MULTIPLE: SCIENCE, RELIGION, AND THE INVENTION OF *HALAL* STUNNING

by En-Chieh Chao

Abstract. This article proposes a specific kind of ontological investigation in the field of science and religion. I argue that science and religion can create distinct practices that enact multiple realities, and thus they should be seen as more than different views of the same world. By analyzing the details of scientific experiments crucial for the invention of *halal* stunning, I demonstrate that religion and science are both permeable to the social, the biological, and to each other, and that seemingly incommensurable realities can co-occur in the body of an animal. Here, animals' modes of existence are interdependent with the technologies being used, and with the web of interactions that they are drawn into. In the process of inventing *halal* stunning, it is not so much about the same animal body that is thought about differently as it is about animals spanning across multiple, physiological, realities as they are recruited into different webs of interactions to create a new slaughter method.

Keywords: animal welfare; *halal*; ontological turn; religious slaughter; science and religion

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Among the readers and authors who care about the future of science and religion, I think it is helpful to advocate, in this field, a specific kind of ontological investigation that has been influential within the discipline of cultural anthropology. This is an ontological inquiry that questions the assumptions about what kinds of things can exist. Critically, this is done through an analysis of empirical practices that happen within and beyond human communities, and not primarily through a philosophical discussion. Niels H. Gregersen suggests that the field's object of research is the relations between science and religion in historical and contemporary contexts (Gregersen 2014, 420), and that the underlying guidance of this inquiry should be metaphysical realism: "the world exists regardless of the

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observer, and consists of a variety of mind-independent entities or objective relations (including also the observer's interpretation)" (Gregersen 2014, 423). While I agree that we should continue to ask *how* science and religion have been related to each other, I also think it is worthwhile suggesting that we ask *what* religion and science have been related to, in an ontological sense. Specifically, I am asking: does metaphysical realism mean that there is only one world—*the* world, and science and religion are merely different views of the same world?

Beyond the "One World, Many Worldviews" Ontology

This question has troubled the anthropology of religion for decades (Morris 2006). While cultural anthropologists pay close attention to both practices and views of different human communities, the question about just what kinds of being can exist was largely suspended rather than engaged. Even though cultural anthropologists are already among academic minorities who take seriously supernatural beings and transnatural forces, this hesitancy to challenge metaphysical realism remained so until recently. The so-called "ontological turn" over the last two decades within cultural anthropology and social studies of science (Mol 2002; de Castro 2004; Kohn 2013; Holbraad and Pedersen 2017) is one influential and ambitious move to tackle the question in order to escape an old restriction. What restriction? The restriction that has trained us social scientists to skillfully explain away "irrational beliefs" such as deities, gods, spirits, miracles, twins-as-birds, and so forth. We explain them away by symbolism, social or psychological functionalism, meaning, power relations, and subjectivity, because we assume that these "irrational beings" cannot coexist with a metaphysical realism that we, implicitly or explicitly, share with scientists.

In this vein, ontological anthropologists are arguing, each in their own way, that we should no longer avoid radical differences—shamanism, visions, jaguars that see themselves as humans, and forests that can "think" (de Castro 2004; Kohn 2013). All these "irrational things" have been so long buried by the ontological assumption that there is only one world and many cultures. Viviero de Castro mostly famously proposes that for indigenous people in the Amazonian basin, there is only one culture, but many natures (2004). With this multinaturalism, which defies the paradigm of "one world, multiple worldviews," de Castro invites us not to arrogantly think that "oh that's interesting, but *they* are *wrong*." Instead, we are urged to reflect upon our own ontological assumptions. Thus, ontological anthropologists insist that radical alterities should be appreciated more than ever before, and they should no longer be dismissed by the same ontological assumption where there is only one world, upon which cultural differences are built. Indeed, they contend that there is more than one world out there—and this multiplicity of realities does not merely happen

in the quantum world or in the hypothetical multiverse—but with us in everyday life. We are only beginning to grasp it.

The ontological turn departs from the old cultural relativism in some major ways. For example, when we say that "religion" as a category is a historical product of a specific political context in Western Europe (Asad 2003) that later acquired its discursive power in the modern world, or that the category of "religion" implies different things in different cultural milieus and historical contexts (Hefner 1985, 2009), we do not necessarily leave the old ontological assumption behind. For another instance, when we discover that scientists are never neutral and do make metaphysical assumptions (Burtt 1952), or that scientific truths are constructed by hiding things that do not fit (Knorr-Cetina 1981), we do not necessarily change our ontological stance. In fact, even when we fully realize that both "religion" and "science" are sociocultural and historical products that came to be seen as entities that can have some relations, we do not necessarily leave the ontological assumption behind. In fact, we may well hold onto the same ontological stance: one world, many worldviews (Mol 1999).

To highlight the difference of the ontological inquiry from the old cultural-socio-historical construction, at least four interrelated points are worth mentioning. First, much more and closer attention is paid to nonhuman things, including animals, plants, life in general, deities, gods, and nonlife things. Second, beings, things, and objects are crucial for cultural reproduction and reinvention. Humans are humans because of our relations with these beings/things/objects. Third, human-made artifacts, objects (including technologies) and animals do not merely "mean" something to us. That is, objects are not merely passive things to which humans attribute meanings. Instead, they actively *do* things that matter to us. Finally, nonhuman beings and the web of interactions that create their modes of existence can lead us to an understanding of multiple realities that do not reconcile with the "one world" ontology.

This radical approach, unsurprisingly, invites both avid endorsement and serious criticism. How exactly can we break from epistemological difference toward ontological alterity? What costs and benefits does the ontological turn bring us? There are many thoughtful reviews from different stances already (see Paleček and Risjord 2012; Bessire and Bond 2014). Here, my goal is not to contribute to this discussion, but to show another example that helps demonstrate the benefits of the ontological turn in the field of religion and science. I aim to question the assumption of the "one world, many worldviews" thesis by exploring a specific case. This case is about animals and the invention of "*halal* stunning" (which I shall explain soon), in which religion, science, and the animal body critically intersect and create a particular plurality of ontologies.

To be clear, my stance with the ontological turn is a self-consciously compromised one. Like many, I am still hesitant about—while looking

forward to—the human possibility of grasping radical alterity, and I am not ready to see all things as having equal agency. But I do think the ontological turn usefully forces us to rethink our analytical limits and to push forward the boundaries of better understanding our relations with "more-than-human" beings. Meanwhile, I suggest that we should not completely prioritize ontological inquiries over an analysis of social construction (see Paleček and Risjord 2013), because in some cases, such an analysis can effectively chart multiple ontologies. Consequently, I will show that in the case of the invention of "*halal* stunning," an ontological inquiry and an analysis of social construction can collaborate well enough to facilitate the discussion of a plurality of ontologies.

The "What" Question across Preexisting Body Boundaries

Now, I want to make it very clear about what I mean by ontology. By ontology, I mean a particular set of assumptions about what kinds of things can exist. As mentioned briefly above, this is largely an anthropological/social studies of science version of ontology, which does not necessarily overlap with the definitions of ontology in the tradition of philosophy. Accordingly, I am not talking about truths that transcend particular experiences of diverse human communities. Rather, it is the mundane, empirical things that happen within culturally specific contexts that concern me. What I critically rely on is Annmarie Mol's influential masterpiece, *The Body Multiple: Ontology in Medical Practice* (2002). As an anthropologist with full medical training, Mol did her fieldwork in a Dutch hospital to explore what atherosclerosis is. While pathology defines it as an abnormal thickness of the inner coating of the artery, clinical diagnosis defines it in terms of symptoms including pain while walking, weak pulse, and comparatively low blood pressure. As to the patients, their primary experience is pain while walking.

In medical textbooks, all these definitions would be taught as different aspects of a single disease, much like the "one world, multiple worldviews" thesis. However, as Mol reminds us, these different aspects do not always add up. For example, patients may have relatively severe thickening of the artery, yet feel no pain, and even appear to walk smoothly in a clinical test. Other times, patients have normal blood pressure, but still experience pain while walking. While pathologists observe the disease under the microscope, the surgeons face patients in the clinic. Here in the clinic, atherosclerosis is no longer a thickening of the vessel wall, but reported pain that occurs after a certain amount of exercise and bad pulsations. As the location shifts, "a sentence that tells what atherosclerosis is, is to be supplemented with another one that reveals *where* this is the case" (Mol 2002, 54).

The ultimate argument that Mol is making is that the ways that the disease is enacted are interdependent with the technologies being used. The disease is a different thing in a different setting. There is no one single unified object—the disease, and by implication, the body—out there. The object is each and every time different, depending on the technologies, human and nonhuman interactions, and some combinations of both that enact it. In sum, "different enactments of a disease entail different ontologies" (Mol 2002, 174).

Note again that Mol is rejecting the idea of a simple pluralism, in which there is one single object, and people can have different "views" about the same thing (Mol 1999). When the pathologists examine the disease, the disease is one thing, but not the same thing that patients experience or what the surgeon needs to deal with. The disease is multiple because it is enacted in different networks of technologies and interactions. It is a part of the larger web of interactions, and the characteristics of that web of interactions constitute its particular mode of existence.

As a different path from the ontological inquiry from radical alterity, Mol's approach reveals that a plurality of ontologies can happen to one patient in a modern hospital. In line with this ontological approach, the goal of this article is to show that some *halal* carcass-to-be, say, cattle, can be unconscious and conscious at the same time, depending on the technologies and knowledge being employed; meanwhile, a sheep can be dying and recovering at the same time, depending on the web of interactions between scientific experiments and religious requirement. Hence these animals, when brought into a network of scientific and Islamic practices, or what I call religious-scientific practices, generate a plurality of ontologies.

Before I go into the details of these religious-scientific practices, it is necessary to reconstruct a brief history in which "*halal* stunning" was invented. Long story short, halal stunning was born out of a dilemma caused by the simultaneous demands of animal welfare advocacy and Islamic tenets. While both the market and the state play significant roles in this process (Lever and Miele 2012; Fischer 2015), the focus of this article will be purposefully limited to the collaboration between religion and science in order to highlight the ontological plurality that a particular set of religious-scientific practices can bring about. While I will show the mutual impact that animal scientists and Islamic scholars have on one another during the process of inventing *halal* stunning, the ultimate argument is more than that. I wish to demonstrate that religion and science are more than different views of the same, preexisting world. In fact, I see them as innovative practices that create new existences with a plurality of ontologies. In this vein, I hope this investigation can help us rethink the restrictions of the "one world/thing, many views" ontology.

The Conception of *Halal* Stunning

To trace the origin of *halal* stunning, we should go back to—perhaps a bit surprisingly—New Zealand in the 1970s, when the meat industry was in a major economic transition (Fennessy 1983). After the British government declared that it would increase trade with other European countries while reducing its reliance on New Zealand in 1971, New Zealand needed a new market. To facilitate this transition, research was valued, and this was when the new automated equipment was developed (Richardson 1982; Petch 2001).

Soon after the second oil crisis, New Zealand started to make "lamb for oil" deals with Middle Eastern countries. October of 1979 was a breakthrough, when the Iranian government signed a contract to buy 200,000 tons of lamb over four years. The only problem to overcome was to ensure that the meat would be *halal* (Ahmad 2001). Meanwhile, the New Zealand government had just enacted a new law that required all animals to undergo preslaughter stunning. Consequently, state-sponsored scientists now had to determine just what sort of stunning could be both "*halal*" and "humane." This was an entirely new terrain for them. For one thing, stunning had already been used for pig slaughter for several years, but to apply it to sheep was uncommon. In fact, it was so rare that the veterinary scientists Blackmore and Newhook stated that there was probably only one company in the whole country that actually used routinized preslaughter stunning on sheep at that time (Blackmore and Newhook 1976).

Now, just what sorts of slaughter are "humane" and "*halal*"? We have to remember that in the 1970s, no one had even considered the idea of "*halal* stunning."[1] At least three questions need to be clarified:

1) What makes humane slaughter humane?
2) What makes *halal* slaughter *halal*?
3) What makes *halal* stunning humane and *halal*?

I will take the ontological approach outlined earlier in this paper to answer these questions. I will answer the "what" question, so that I can outline the network of *things*—animals, equipment, EEG (Electroencephalography) charts, microdialysis probes, and other technologies—that make different slaughter methods possible. By doing so, I will demonstrate that the birth of "*halal* stunning" was the result of negotiations between the discourse of humane slaughter, the scientific construction of "reversible stunning," and Muslim religious scholars' legal opinions (*fatwa*).

Meanwhile, I insist that animals are "enacted actors" (Law and Mol 2008) that are essential for the invention of *halal* stunning. It is animals of different kinds and ages and their respective tolerance of electricity with specific strengths and durations that cause a reversible seizure that enable

scientists and religious scholars to successfully claim the *halal*-ness of the stunning. In this process, I argue, the animal body is multiple because each body's characteristics are partially dependent upon the settings of scientific experiments that are designed in a way that is compatible with both Islamic tenets and the discourse of humane slaughter.

What Makes Humane Slaughter Humane?

Humans so far privilege the moment of death over the entire life course of a farm animal (including those "free-range" or "cage-free" ones), defining animal welfare and humaneness based primarily on this moment. Humaneness comes with the loss of consciousness of animals before death. Two major legal pioneers of humane slaughter are the 1933 Slaughter of Animals Act in the United Kingdom and the 1958 Humane Slaughter Act in the United States. The former promoted the application of mechanical stunning to replace the old method of striking animals with hammers to render them insensible before they were killed,[2] which did not apply to sheep, pig farms that lacked electricity, or religious slaughter (Beers 2006). The latter requires that large animals should be "rendered insensible to pain" before slaughter (Beers 2006, 160). The two acts, set apart by time and space, nevertheless share two common features. First, the core definition of humane slaughter hinges upon animals being rendered insensible. To be humane is to render animals insensible before their death. No measurement is required. Second, religious slaughter is allowed as long as animals are also rendered insensible due to brain anemia. No specific technologies and methods are required. Instead, a wide array of methods is allowed. In sum, after the passage of those two early laws, meat animals have two ways of dying that can make the slaughter humane. One is that they lose their consciousness before they die, and the other is that they lose their consciousness during the process of dying.

The development of compulsory preslaughter stunning only took place in the late 1970s. It was an era when notions of hygiene, epidemic prevention (such as rabies campaigns), and animal welfare were intertwined with the rise of global environmentalism (Callicott 1993). After the Europe Convention for the Protection of Animals for Slaughter held by the World Organization for Animal Health in 1979, the idea of humane slaughter achieved unprecedented legitimacy, making the techniques of preslaughter stunning the new standard.

The promotion of preslaughter stunning, however, did not immediately set up a precise guide on the operation. In 1980, the globally renowned scientist and animal rights activist Temple Grandin argued that the proper technique for applying stunning was still largely understudied. In Germany, there was already knowledge about the ampere, voltage, and duration for effectively stunning pigs, and about the right timing to bleed the animals

lest they woke up again. However, the knowledge about sheep and cattle in this regard was completely lacking. Grandin commented,

> Specific data on voltage, amperage and application times for sheep and calves is sparse. Not only was amperage data not cited in a majority of the papers, but the EEG or the grand mal seizure was not used as the criterion for effective stunning. (1980, 251)

In other words, before 1980, the main point of so-called preslaughter stunning was to render cattle and sheep insensible, and it never included a set of precise numbers to define a standard for "humane" stunning. The application of stunning itself was already assumed to be "humane." To rectify this shortcoming, Grandin insists that scientists should be able to sort out which kinds of stunning technique should be applied to which animal, defined by precise numbers and standardized by the appearance of grand seizure on an EEG, so that "humaneness" can be assured. At this point in the early 1980s, numbers started to figure more sharply in the application of stunning. More experiments ensued.

What Makes *Halal* Slaughter *Halal?*

While scientists were searching for the right boundaries to cause the grand mal seizure on different meat species, whether stunning could cause death was not initially considered important. As long as the unconsciousness remained, the humaneness remained. All scientists needed to know were more detailed numbers for each species. However, the same could not be said for *halal* slaughter, because rendering the animal a carcass before the moment of ritual slaughter is a major taboo for *halal* dietary regulations.

To begin with, the word *halal* in Arabic means "permissible" or "legal," as opposed to the concept of *haram*, meaning "forbidden" or "illegal." According to Islamic law, between *halal* and *haram*, there are three other categories (recommended but not obligatory, neutral, and not recommended) and the doubtful category, but due to the limits of this article, I will mostly focus on *halal* and *haram*.

The basic categories of *haram* things include: (1) pork and its derivatives; (2) animals slaughtered not in the name of God; (3) animals that die themselves or are abused, injured, or killed by other animals; (4) blood; (5) alcohol; (6) animals that live in water but also walk on land; (7) fierce predatory animals; (8) predatory birds with sharp claws; (9) harmful animals (snakes, rats, scorpions, and so on); (10) beneficial animals (bees, spiders, and so on); (11) disgusting animals (flies, flees, and so on). I argue that each item listed above is not a self-evident, preexisting thing, but actually is the outcome of different networks of negotiations that need new definitions in new situations. However, here I can only focus on the third category and demonstrate how the living animal body or carcass

is multiple because the animal body/carcass is enacted differently by a religious-scientific network of technologies and knowledge.

It must be noted that animal welfare in slaughtering is not foreign to Islam, but it rests on very different premises. For example, Islamic notions of animal welfare do not privilege the loss of consciousness prior to death. The foundation of this point can be found in Al-Qur'an 2:172 and 5:3 and several *hadith* verses.[3] Living and healthy animals need to go through the proper ritual slaughter process to become legitimate food. In the process, humans must lessen the pain of animals. It is forbidden to harm the body of the animal before the moment of ritual slaughter. Traditionally, the way to lessen pain is to use an extremely sharp knife aimed perfectly at the spot on the throat that can cut the carotid artery, jugular vein, trachea, and esophagus all at once in one slice (Regenstein, Chaudry, and Regenstein 2003, 121–22). From this perspective, preslaughter stunning that hurts the animal or causes death is *haram*. Such stunning violates the "no harm" principle and is suspected to potentially violate the "carcass taboo."

From this outline, *halal* slaughter is potentially incompatible with preslaughter stunning, unless there is a kind of stunning that does not harm the animal. This, then, leads to another question: *what* is harm?

As I will show in this article, eventually animal scientists discovered a kind of stunning that does not constitute "harm" and successfully won the approval of many Muslim religious scholars. This "no-harm" stunning is also called "reversible stunning" or "*halal* stunning." Its foundation is scientific experiments, its motivation came from the transnational meat market, and its legitimacy was drawn from *fatwa*.[4]

What Makes *Halal* Stunning *Halal* and Humane?

Now back to New Zealand. Compared to the situation in 1976 mentioned earlier, things in 1982 had improved significantly. Most commercial lamb had gone through preslaughter stunning. This fast transformation was undoubtedly the achievement of the Meat Industry Research Institute of New Zealand (MIRINZ), an institute sponsored equally by the state and the meat industry.

For producing *halal* meat, MIRINZ systematically distinguished two kinds of electrical stunning, head-only and head-to-back. The head-to-back stunning would cause cardiac arrest and death in animals, which would constitute a violation of the carcass taboo (Grandin 1985; Gregory 2005). Consequently, although this method was easier and more efficient for humans to slaughter, it was not used in the production of *halal* meat. Instead, the head-only stunning was used, which would only cause temporary loss of consciousness and no cardiac arrest. In 1983, head-only stunning was recognized by the Muslim immigrant association in New Zealand and

Iran as *halal* (Ahmad 2001). In the following years, Iran topped the list of importers of New Zealand lamb.

With the advent of head-only stunning, now the obstacle that MIRINZ scientists needed to overcome was not from religious scholars, but from fellow scientists. Two veterinary scientists from Massey University, Blackmore and Newhook, were especially concerned that the so-called "head-only *halal* stunning" was not humane enough. Their reasoning was that it took different durations of time to recover from unconsciousness among different kinds of animal. In general, cattle were more likely than sheep to remain conscious and to wake up before they bled to death. If cattle were stunned with head-only stunning, they were not sufficiently stunned, and they would feel extreme pain when they woke up. In order to prove that "head-only" stunning was not sufficiently "humane," Blackmore and Newhook did an important three-part experiment.

In these three experiments, what makes humane slaughter is determined by EEG readings. When the EEG is below 10 μV or above 35 μV, it means that the animal loses consciousness and thus is insensible to pain. The publications of the three-part experiment were where Newhook and Blackmore (1982a, 222) started to systematically use the term "reversible" to describe "insensibility." Here, "reversible insensibility" was not associated with "*halal*," as it later became, but was instead used as a weapon to protest *halal* stunning. Indeed, Blackmore and Newhook insisted that the insensibility could be *reversed* because the head-only stunning did not stun the animal enough and the animal, especially cattle, might regain consciousness before it died, which then constituted inhumane torture (Newhook and Blackmore 1982b, 1982c). Therefore, they concluded, head-only stunning should be avoided as much as possible and be replaced by head-to-back stunning (Newhook and Blackmore 1982a, 231).

After these three experiments were published in *Meat Science*, the leading journal of scientific meat research, MIRINZ was forced to face a dilemma: on one hand, Islamic religious scholars only approved head-only stunning as *halal*, but on the other hand, scientists like Newhook and Blackmore considered head-only stunning to be inhumane. Interestingly, it was under this circumstance that MIRINZ learned some new crucial information. Precisely because there were thresholds for "reversible insensibility" that allowed different species of animals to lose and later regain consciousness, those thresholds were indicative of precise boundaries of a kind of stunning that does not cause permanent harm. This would persuade even more Muslim groups to accept electrical stunning and help the country sell their lamb to Muslim markets throughout the world. Now, the key to the dilemma was just how MIRINZ could prove that there was a kind of head-only stunning that was both (1) humane, meaning that the animal remained insensible all the way through the slaughtering process after being

stunned; and (2) *halal*, meaning that the animal could regain consciousness if not slaughtered after being stunned.

This double requirement led MIRINZ to conduct a series of related experiments in 1986 in order to respond to both religious scholars and animal scientists. One of the experiments was to conduct stunning with 400 V 2.5 A-50 Hz on 12 cattle. The result showed that there was no significant difference in the speed of reaching insensibility between head-only and head-to-back stunning. So, if the latter was humane, the former should also be humane (Devine et al. 1986, 210).

In another relevant experiment made by MIRINZ (Devine et al. 1987), one group was head-only stunned and allowed to recover, the other was head-only stunned and slaughtered (Devine et al. 1987, 107). The result showed that if calves were bled rapidly after they were head-only stunned, they would lose their consciousness irreversibly. On the contrary, if they were not slaughtered, they would regain their consciousness (Devine et al. 1987, 107–8).

The problem was, however, that calves were not cattle. Cattle were much stronger. Even if one was head-only stunned and immediately cut on its throat, if its brain still retained enough blood, it could still maintain some level of consciousness. This, then, fell back to the accusation of inhumane slaughter (Petch 2001, 322). At the time, MIRINZ could not entirely resolve this problem of cattle. What they could do was simply to prove that sheep would lose consciousness between 8 and 22 seconds if directly slaughtered without stunning (for cattle it took 79 seconds), and those slaughtered after head-only stunning needed to wait 50 seconds to lose consciousness. Surprisingly, those with head-to-back stunning even had to wait 52 seconds (Devine et al. 1986). This came a little surprising, because it was assumed that the whole-body stunning should more quickly cause insensibility and irreversible death. This strange phenomenon gave MIRINZ inspiration. For unstunned normal animals, EEG criteria could judge insensibility, but not so much for stunned animals. Electrical stunning *changed* animals' physical states by causing a prolonged increase in the poststun EEG amplitude. Hence for stunned animals, the EEG could not be the sole standard of judging insensibility (Devine et al. 1986, 267) and could not alone be a reliable index of humane stunning.

The Birth of *Halal* Stunning

While MIRINZ scientists were grappling with fellow scientists, they won wider approval from the religious side. In 1986, the World League of Muslim Association and the World Health Organization held a convention to verify that the proper application of head-only stunning would not cause permanent harm or death to the animal. Both scientists and Islamic scholars attended the convention at the Berlin Institute of Veterinary Medicine

between June 30 and July 3, where experiments were conducted on a 35 kg adult sheep and an 18 kg lamb. The two animals were stunned by electricity of 30 V and 1.25 A for three seconds. The animals displayed seizures, and then recovered (WHO-ROEM 1997, 18). The convention also played a video sent from MIRINZ, in which adult cattle of less than 450 kg were stunned and recovered. The meeting also reviewed other experiments conducted at the University of Edinburgh. Finally, the convention issued its *fatwa*:

> Comprehensive studies in developed countries, especially New Zealand, have shown that, when applied to the head only, electrical stunning of animals does not cause death, since it is a reversible and recoverable state. If not slaughtered, the animal so stunned would make a full recovery. (WHO-ROEM 1997, 18)

Here, The League of the Muslim World and WHO decided to see the "reversible" state as the evidence of the *harmlessness* of the "reversible stunning." Because such reversible stunning neither harms the animal nor causes death, it is *halal*. The premise of this religious ruling does not rely on religious interpretation of "what is harm" alone, but instead is rigorously based on the results of scientific experiments.

From then on, MIRINZ endeavored to find the range of different stunning intensities in which different species can fully recover from seizure. If the electricity was too strong and hurt the animal, it would fail to meet the *halal* requirement, but if it was too weak to induce the seizure, it would violate the animal welfare standard. Later, MIRINZ discovered that sheep would not have seizures if stunned with 1 A for less than 0.2 seconds (Cook et al. 1995). Following the standards of unconsciousness marked by seizure, MIRINZ repeatedly experimented to determine the right intensities and durations, so that the animals could enter the state of seizure but later resume breathing (Devine et al. 1986).

The features of different species are complicated, and the reversible stunning does not necessarily guarantee that the slaughter is *halal*. Sheep can lose their consciousness in as little as eight seconds after stunning. For cattle, however, it could take as long as 60 seconds or more (Newhook and Blackmore 1982a, 1982b). In fact, the cattle's brain could still have enough blood to maintain consciousness even if stunned and slaughtered (Petch 2001, 322). In order to solve this problem, MIRINZ and Blackmore jointly created a new experiment in 1993. All the animals were stunned and later recovered three days prior to the experiment. The experiment applied an electrical head-only stun of 400 V and 1.5 A to nine cattle and six sheep, and then slaughtered them within 10 seconds. This way, stunning and bleeding would hasten the speed of brain death, and no animal would retain any consciousness. This time, the proof of insensibility was no longer dependent on the EEG. Rather, the proof was from a microdialysis probe

Table 1. The parameters of *halal* stunning by species

	Head-only electrical stunning				
	Sheep	Lambs	Calves	Cattle	Deer♣
Min. amps♠	1.0	0.7	0.9	1.1	1.0
Range	1.0–1.5	0.7–0.9	0.9–1.5	1.1–2.5	1.0–2.0
Time (seconds)	1.0	0.8	1.0	1.0	1.0
Range	1.0–4.0	0.8–1.5	1.0–4.0	1.1–4.0	1.0–1.3

Source: Gilbert 1993, 5.
♠: humane minimal amps. ♣: female only.

that measured the density of gamma-aminobutyric acid or GABA in the somatosensory cortex (Cook et al. 1996, 256). The stunning was finally both humane and *halal*.

Numerous related experiments were conducted that led to the 1996 victory. Indeed, as early as 1993, MIRINZ had discovered a possible, also the most reliable at the time, range of "*halal* stunning" (Table 1). This was arguably the first systematically drawn boundary of "*halal* stunning." Senior leader of MIRINZ Gilbert praises the system as accepted as "humane to the animal, safe for the workers, virtuous and *halal* by Muslims worldwide" (1993, 2).

The Animal Body Multiple

In my earlier work (Chao 2018), I thought that the invention of *halal* stunning is a great example of how "natural and social orders are produced together" (Jasanoff 2004, 2). After all, we now know the range of tolerance of electrical stunning of different species that is strong enough to cause seizure but not strong enough to cause death, and this knowledge is simultaneously biological and cultural. The technology is scientific and Islamic at the same time. Certainly, the work of sociohistorical construction has been crucial. Without the specific question posed by the Iranian government, there would be no desire to deal with the *halal* question in the first place. Similarly, without the openness of the application of Islamic law that stresses flexibility in new eras, further acceptance of new technology by Islamic legal authorities would be impossible. The result is a coproduction of natural and religious orders.

At the time, however, I was hesitant to explore the whole process as a site for an ontological inquiry. Admittedly, I saw the whole thing largely from the social construction, even when I partially utilized actor-network theory. As time goes by, however, the more I dwell on the various issues about the development of scientific *halal* certification—questions such as "What is a pig?" "Does the presence of porcine derivatives necessarily equal

the presence of pork?" "Is the molecular version of pig's DNA the same thing as the pollution of pork mentioned in Al-Quran?"—the more I think this has much to do with the ontological question.

During what happened in Berlin in 1986, scientists and religious scholars were not the only key actors. The cattle from the video sent from New Zealand and the sheep in Berlin were equally important. Without their recovery from seizure, there would be no proof of "reversible" harm and no "*halal* stunning" to begin with. Undoubtedly, these animals are what Law and Mol call the "enacted actors" (2008). They are enacted into a specific kind of being, whose features are interdependent with their responses to the condition given by the experiments designed for a very specific goal. It is not just that we have consequently known more about these animals and also make a new *halal* boundary redrawn. Indeed, what happened was that humans led these animals into different modes of existence by recruiting them into different webs of interaction.

Note that in the 1986 experiment, MIRINZ switched their technology to determine the conscious status of cattle. A strong animal after *halal* stunning and slaughter was conscious according to EEG; yet, when scientists measured the density of GABA in the somatosensory cortex, it had already lost its consciousness. The question is neither about individual variations among cattle—I will address that point soon—nor about the technical accuracy that should be accomplished in the future. The fact was that stunning *changed* the animal body. So the question is instead: can an animal be conscious and unconscious at the same time?

Note that EEG is still one of the most commonly used tools to determine the unconscious state of human patients during an anaesthetized surgery. We may also admit that there is so much we do not know about what consciousness is. That is a dauntingly huge ontological question. For now, the question is a much more limited one: conscious or unconscious, which one is true? The answer: they can be both true, because the animal is multiple, and sometimes different versions of it do not add up. Much like the different versions of atherosclerosis that Mol describes, here the animal body is not single, but multiple. Whether it is insensible or not depends on the technology that enacts it. The animal is only part of larger networks of technologies that modify its body. During the experiments, each time the animal body is manipulated and readjusted according to the designated goal and the physiological responses of each animal. In a word, it is not so much about different views of the same animal as it is to *do* different things with the animal and let the human-animal-machine network *do* the job to prove the unconscious state of the animal.

Not only that. The sheep in the video and in the lab is also multiple, as it is simultaneously dying and recovering during the slaughter with

halal stunning. In fact, it must be dying and recovering simultaneously, because that is the hallmark that makes the stunning "reversible." Now in the 1986 experiments with MIRINZ, the same sheep A was stunned and recovered and then slaughtered. But in the actual production line of *halal* lamb, when sheep B undergoes the same process it will not recover. It will directly die. But scientific experiments have proved that it *could* recover. The death of sheep A hence contains a testable process of regaining life, proved by science and approved by religion. We just need to repeat the history of now-deceased sheep A with the body of sheep B, except that the recovering part will always remain in the zone of the imagined, one that is however scientifically proved. As long as the age and weight of sheep A and B are similar, we assume that the same thing would hold true, even if the two states of recovering and dying may not actually add up if we do test each commercial animal before we kill them. So, although we do not know for sure if sheep B is fully unconscious and can recover if the cut is not done, we assume it must be so. We are basically reproducing the category of sheep, cattle, and other animals without knowing much about each individual animal.[5]

There is more. From the very beginning, animal welfare activists, religious scholars, and meat scientists have wanted different things. It is not about different views of the same thing to begin with. It is not the same, unchanged, stable animal that is thought about differently. It is that the three groups of humans want the animal to *do* different things for them. Animal welfare activists want the animal to stay insensible before death and remain so during the process of dying. Muslim scholars want the animal to have the potentiality of recovering if the cut is not done. Meat scientists want both.

The animal body spans across multiple realities because it is recruited into different webs of interactions. Here, my focus is not so much to align the different views we humans attribute to different kinds of slaughter methods as to outline the material creation of new existences of the animal body that makes a new slaughter method possible. With *halal* stunning, the animal is enacted into a "*halal*, humane carcass" by a whole range of material rubrics: electric currents of certain intensity, neurotransmitters' density, and hypothetical recovery. The animal's characteristics are dependent on the characteristics of the meticulously orchestrated environment, and when the environment changes, the animal body responds and changes accordingly within its physiological capacities.

Religious-Scientific Practices with a Plurality of Ontologies

Through specific stunning techniques, EEG readings, and the microdialysis probe, scientists and religious scholars worked together and constructed a

set of religious practices that was previously unheard of: *halal* stunning. The question facing the meat scientists was obvious; it does not matter what views they hold about *halal* meats and animal welfare. The most pressing question was *what* to do. The actions that helped them to reach their goal must come from *what* the animals can show.

The story does not end here. More and more experiments have been deployed to better comprehend the ramifications of applying *halal* stunning. For example, many suspect that stunning hinders the efficiency of bleeding (Lever and Miele 2012, 529), which has led to more experiments and debates. At the same time, the demand for humane slaughter has also pushed scientists to respond to more questions in detail, such as the error rates of stunning and the rates of animals requiring a second stunning, as well as the stress that animals experience under different slaughtering methods (Zivotofsky and Strous 2012; Nakyinsige et al. 2013).

This is a clear example of mutual support between religion and science, in which science helps redraw the boundaries of *halal*ness to facilitate the meat trade,[6] and religion helps guide scientific experiments, which result in new knowledge about different species. More specifically, the invention of *halal* stunning demonstrates that scientific experiments do not simply seek to find a fixed reality, and that Islamic law is not a closed system. In fact, religion and science are both permeable to the social, the biological, and to each other.

Equally important, the process involves a plurality of ontologies. The seemingly incommensurable realities that co-occur in the body of animals—the cattle are both conscious and unconscious, and the sheep is simultaneously dying and recovering—are not always incommensurable. They are both *real*, depending on the web of interactions that enact the animal. The animal body and carcass-to-be is drawn into different networks, defined by animal welfare theories or the system of *halal* stunning. In each set, the animal body is not the same thing, but a different part of a larger human-animal system that is designed to *prove* certain things. In the system jointly engineered by religion and science, the animal is now playing the role of the receiver of certain kinds of electricity that is strong enough to make it unconscious but weak enough to let it recover. The animal would never have to experience that situation were it not for the specific demand made here, and its body does not stay the same. It ventures into unknown territories. How the animal reacts constitutes what it is, and what the animal is comes from these newly arranged devices.

By analyzing the details of scientific experiments crucial for the invention of *halal* stunning, I have demonstrated in this article that seemingly incommensurable realities can co-occur in the body of an animal. Here, animals' modes of existence are interdependent with the technologies being used, and with the web of interactions that they are drawn into. The invention of *halal* stunning is not merely about the same animal body that is

thought about differently, but also about animals spanning across multiple, physiological, and religious realities as they are recruited into different webs of interactions. When the response of the animal body is characteristic of the environment that is designed for specific human purposes, the world surrounding the animal body is neither single nor stable, but multiple and mutable. As the animal body is enacted by those multiple worlds, it is also multiple. In sum, in the process of inventing *halal* stunning, science and religion create specific practices that enact multiple realities. As such, they should be seen as more than different views of the same world.

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Notes

1. Things would be very different several decades later, when many religious scholars had already determined that stunning and *halal* slaughter are not necessarily incompatible (Bonne and Verbeke, 2008), while some still reject the "*halal* stunning." To make things even more complicated, in recent years, some brands in Europe claim that the "authentic" *halal* meat should not go through preslaughter stunning (Lever and Miele 2012).
2. See https://www.hsa.org.uk/about/history-of-the-hsa.
3. "Verily, Allah has prescribed *ihsan (*excellence) in everything. So if you have to kill, then kill in the best manner. If you slaughter, then slaughter in the best manner. Let one of you sharpen his knife so his animal feels no pain." http://dailyhadith.abuaminaelias.com. Retrieved on August 8, 2019.
4. In the modern context, the fact that Al-Qur'an and *Hadith* could not possibly cover all the matters of new technology and products, the need for new religious legal opinions, or fatwas, is increasing. It is not surprising, then, that a great number of *fatwas* across the globe have been issued regarding topics such as immunization, contraceptives, antibiotics, genetically modified organism (GMOs), abortion, organ transplantation, and so forth. In a word, religious scholars in different countries of different eras would consider these new topics and engage in debates, later issuing new *fatwas* regarding them (Atighetchi, 2007; Brockopp and Eich, 2008; Fadel, 2012; Have, 2013; Ghaly, 2013). Nevertheless, in Islam, there are multiple schools of law, factions, and communities. Different groups and individual Muslim scholars often hold different opinions about the same matter, and this has been a hallmark of Islamic law. Thus, flexibility, contestability, and creativity are all characteristic of Islamic law, and its content is often renewed in each era, as some scholars believe that this is also commanded by Al-Qur'an (Hallaq 1984; Zubaida 2015).
5. The reproduction of the animal categories is political because it affects how we continue to treat animals in certain ways. Humane slaughter values the moment of death a great deal. When Mol mentions that statistical and pathophysiological ways (which only knows individuals and not groups of people) of handling anemia do not entirely overlap, she specifically points out that the disease enacted in treatment does help reproduce the four categories of people: children, men, women, and pregnant women (Mol 1999, 81–82).

6. New Zealand has been the world's largest *halal* lamb exporting country (Farouk, 2013) and most *halal* meat in the United Kingdom is produced with *halal* stunning (FSA, 2015).

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