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ORIGINAL PAPER

Anatomy Education and the Observational-Embodied Look

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Abstract Based on observations and interviews collected during a yearlong ethnography of two anatomy laboratory courses (an undergraduate and medical/dental course) at a large Midwestern university, this article argues that students learn anatomy through the formation of an observational-embodied look. All of the visual texts and material objects of the lab—from atlas illustrations, to photographs, to 3D models, to human bodies—are involved in this look that takes the form of anatomical demonstration and dissection. The student of anatomy, then, brings together observation (the act of looking), visual evidence (what one sees in the body), haptic experience (the act of touching), and anatomical-medical knowledge (what one labels the body) to identity as anatomy those objects on display. Through an interrogation of and reflection on the bodies of the course, the participants must learn to recognize and appreciate the descriptive and relational values of anatomical evidence, and in the process develop the habitus of anatomists. Drawing from the work of Maurice Merleau-Ponty, Pierre Bourdieu, and Herbert Dreyfus, the author seeks to both uncover how students learn anatomy as well as articulate a theory of embodied learning.

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In 1881, the American editor of *Anatomy, Descriptive and Surgical* (or *Gray's Anatomy*, as it is commonly known), William W. Keen, stood before the London International Medical Conference exhorting the use of human bodies in anatomy education. In this speech, which was later published in the 11th edition of the textbook, Keen argues the benefits of not the cadaveric specimen but the living one:

> What I wish, therefore, formally to urge upon teachers of anatomy is not that the living model should be used occasionally, but regularly; not as a rarity, but as a constant meanings of illustration—as much so as the cadaver or the skeleton (Keen 1887: 33).

Keen, he confesses, has used "this method for some seventeen or eighteen years" and finds that it both "throws an entirely new light on the practical application of anatomy" and "enlivens what is otherwise not seldom a dry subject" (33). This idea, Keen reminds his audience, does not originate with him; in fact, the famous anatomist Charles Bell, understanding the "value of living models," would often "introduce a powerful muscular fellow to his

class" (Keen 1887: 33). Keen even carefully suggests that female models might also be needed from time to time. These models should vary according to the anatomical topic being studied—for example, "a muscular athlete" for the muscles, a "leaner man" for the arteries and nerves (34). These living models were intended not to replace the cadaveric body but to provide a view of anatomy that dead, inert flesh could not. Keen's instructions are simple: after the lecturer has demonstrated a particular structure in the dissected body, he (unfortunately, often "he" in nineteenth century western medicine) turns the students' attention to the living model and demonstrates the structure "by the eye, by the touch, by the measurement from some fixed point, by line, or by percussion" (34). By emphasizing knowledge learning through touch, Keen inevitably highlights the role of the student's body in making sense of the model's. The goal of this method was not only to teach a body of knowledge but also to train the mind and the senses: "The eye of the student thus catches what the touch and the observation of the teacher have ascertained" (34). Thus, while praising the affordances of the living human body *as the more authentic specimen*, his pedagogical suggestion presupposes the affordances of the living human body *as the true perceptual technology* for making sense of the model and the anatomical knowledge instantiated by that model.

Keen's speech (as well as its published version in the 1887 edition of *Gray's Anatomy*) is remarkable for a number of reasons. Not only does it offer a view into the anatomy classroom of late nineteenth century America, it also does so in a way that seems, save for the prose style, particularly contemporary. During a period of medical history often lamented as the transition point when technologically mediated vision increasingly replaced the embodied learning and sensory evidence of the practitioner, Keen's argument is illustrative of the differences between practicing medicine and learning anatomy. Whereas medical technologies such as the X ray, the microscope, and others did offer a more mechanical and standardized tool for the diagnosis of medical ailments (Reiser 1993: 266–270), the body and the embodied knowledge communicated by the senses were still an important component to anatomical education. For Keen, as it is in the labs of today, to learn anatomy is to use the dead and the living, to move beyond the scopic in order to incorporate the haptic experience of touch.[1]

The anatomy laboratory, then, is a domain of vision, of looking, and seeking knowledge, but vision in anatomical learning (as in life) always operates as a part of other bodily systems and orientations. Clinical anatomical knowledge is embodied knowledge that one learns by interrogating and confirming both visual and haptic evidence. In a famous essay by the nineteenth century anatomist, Luther Holden, anatomy laboratory learning is described as a set of practices that involve the training of the entire body: "Our main object, therefore, is to induce in students the habit of looking at the living body with anatomical eyes, and with eyes, too, at their finger ends" (Holden 1887: 1025). Through the habitual examination of bodies, students developed "anatomical eyes" and "surgical fingers," perceptual tools which create in those participants a certain way of conceiving of the body. And this dispositional tendency is intimately linked to the bodily practices of the lab. Even today, according to a number of contemporary anatomy professionals, like Harold Ellis, the indispensable learning that students receive in the lab is not merely the wealth of anatomical information, provided by cadaveric specimen, but also the kinesthetic and the tactile experience afforded by the processes of dissection and demonstration. In fact, he views the development of "manual dexterity" as one of the aims of anatomy teaching (Ellis 2001: 149). Unlike Keen and Holden, however, most contemporary anatomists see dissection as the preeminent activity to foster this manual learning. Human dissection is, for Ellis, the only "educational modality in the preclinical" curriculum that teaches students "how to use their hands," not only how to hold cutting instruments but also "how to appreciate

[1] Keen would no doubt be disappointed, however, to learn what little use contemporary medical education makes of living models, though this might be changing. Schools in The Netherlands and Australia have used body painting as a way of connecting surface anatomy to internal anatomy (Op Den Akker et al. 2002; McMenamin 2008). In these programs, students paint anatomical structures onto the surfaces of other students' bodies. Also a school in the UK has begun to incorporate more voluntary surface anatomy sessions (again, in which students work with each other's bodies). Though these sessions are not without complications, 93% of the UK participants found them useful to their clinical education (Aggarwal et al. 2006).

tissues." (149). Hanna and Freeston also praise anatomical dissection over computerized modeling software; although students can learn anatomy from these simulations, these digital models lack the physical, three-dimensionality of the human body. The acquisition of manual dexterity and the appreciation of "tissue planes and the scale and depth of [anatomical] structures" are vital to laboratory anatomy, at least for medical and dental students (Hanna and Freeston 2002: 377). Their use of the phrase "appreciation of tissue" implies that one comes to a certain awareness, pleasure, or admiration for the complexity of the human body not just by studying it or cutting it, but also, and I would argue more importantly, by touching it with one's hands. The technique known as blunt dissection, for example, is the use of one's own hand, positioned as a flat surface, to explore the planes of the body. By sliding a gloved hand between, for example, the skin and the muscle beneath the skin, a student can both dissect that region and get a tactile, embodied awareness of depth, firmness, shape, and some texture. The hands, then, become a type of perceptual tool with which to understand, in this case, the cadavers and, by extension, the human body in general.

The haptic experience of touch, the development of manual dexterity, and the embodied experience of simultaneously working on and inhabiting a human body: all of these factors contribute to anatomical learning. As a training ground for future physicians, dentists, physical therapists, and other healthcare professionals, the anatomy lab with its focus on participant-led dissection and demonstration offers students the opportunity to assume the role of anatomists, in order to begin to understand the three-dimensionality of the body. And they do this by training not just their minds but also their bodies. In order to understand how this works, we must first understand the culture and the material practices of the lab. What activities are students, instructors, and TAs actually engaged in? How does the materiality of these practices exert a persuasive and ontological force? And how are these activities and these goals facilitated and constituted by the very human bodies of the lab? Drawing from a yearlong ethnography of two anatomy laboratory courses (an undergraduate and medical/dental course) at a large Midwestern, research-one university (University of Minnesota), I will argue that students learn anatomy and learn to materialize the discourses of anatomy on the body through their initiation into the bodily practices and embodied experiences of the lab.[2] In particular, I argue that students, TAs, and instructors use the various bodies of the lab (living and dead) as part of the formation of what I term an observational-embodied look. By way of this perceptual lens, the participants learn and teach anatomy through a dialectical process of hypothetic-confirmation, a dual process of self-assessment and self-persuasion that allows them to see the physical body as the anatomical body. All of the visual texts and material objects of the lab—from atlas illustrations, to photographs, to 3D models, to human bodies—are involved in this observational-embodied look that constitutes the learning (through physical demonstration and cadaveric dissections) of anatomical-medical knowledge. The student of anatomy brings together observation (the act of looking), visual evidence (what one sees in the body), haptic experience (the act of touching) and anatomical-medical knowledge (what one labels the body) to identity as anatomy those objects on display in the textbooks, in the lectures, and in the labs. This system of vision, then, implies more than merely viewing, touching, and knowing but instead constitutes a

[2] My data are taken from a yearlong ethnography of the multimodal and embodied practices of the Program in Human Anatomy Education at the University of Minnesota, a larger project that specifically explores the visual and bodily practices of observation, presentation, and representation used to teach and learn anatomy. At the time of my fieldwork, this anatomy program housed two large-enrollment laboratory courses: (1) a dissection course for first-year medical and dental students, InMD 6150, and (2) an undergraduate lab, ANAT 3002. The medical and dental anatomy course, InMD 6150, was designed as an 8-week, intensive dissection lab (complimented by a conventional lecture) with the goals of teaching students cadaver-based gross anatomy as well as radiographic (X ray), histological (microscopy), and embryological anatomy. My data collection methods involved four components: (1) direct observation of actual laboratory sessions and the lab preparation meetings for both courses; (2) audio-recorded interviews with 15 medical and dental students, 4 undergraduate students, 15 TAs for the medical and dental course, 15 TAs for the undergraduate course, and 4 instructors; (3) collection of all teaching material from both courses, including both course websites; and (4) audio-recorded interviews with the 4 members of the anatomical bequest team who procure and prepare the bodies and work with donor families. My project was reviewed and approved by both the Program in Human Anatomy Education and the University of Minnesota's Internal Review Board. The names of participants used in this article are of course pseudonyms.

perceptual orientation that must integrate and juxtapose what is presented in the laboratory with the knowledge one is learning either inside or outside that space. Through an interrogation of and reflection on the bodies of the course, the participants must learn to recognize and appreciate what I will call the descriptive and relational values of anatomical evidence—in the process forming the habitus of anatomists.

The Observational-Embodied Look: Returning the Body to Medical Vision

My use of the term "observational" recalls the work of many scholars in science and technology studies who seek to understand how medicine became a largely scopic regime of visual investigation based on diagnostic technology that renders the body as a readable text. Ranging from the radiograph, the microscopic slide, the MRI image, and the CT and PET scan, these visual renderings, in a Latourian sense, transform the patient's symptoms and ailments into a visual inscription that carries an evidentiary and ontological force (Latour 1990; Dumit 2004). These visual inscriptions bear witness to the medicalized body by enacting it. My use of the word "embodied" is meant as both a contestation of the first term, "observational"—thus a wish to reposition vision as a bodily function—and an argument for the sensory, bodily knowledge that is required to read the anatomical body correctly. Like much of the work I draw from, I not only agree with but I find evidence for Donna Haraway's assertion that vision is always positioned and localized in *some body*. Vision is "the view from a body", and there is no such thing as a disembodied vision from *no where* (Haraway 1988/1999: 181). Her insistence on "the embodied nature of all vision" as an argument for "situated and embodied knowledge," I will illustrate, not only describes the anatomy laboratory but also finds in that educational space perhaps the best argument for understanding science as a situated and bodily activity.

The dominant reading of modern medicine as almost exclusively visual received its first best articulation in Michel Foucault's configuration of "the medical gaze" of eighteenth century French medicine. In his investigation into the perceptual and instrumental changes that marked Enlightenment medicine, Foucault theorizes the nature of medical observation, namely the look of the doctor or medical student onto the bodies of patients (and later cadavers) (Foucault 1963/1994: 108). This "perceptual act" of observation unified the "hospital [or clinical] domain" and the "teaching domain," in that the doctor's act of recognition (in, on, and through the body of the patient) was one with the medical student's "effort to know" (109, 110). Because the results of the often ambiguous observations had to be both worked out and made known, the use of spoken discourse, namely the interrogation of patients (and, Foucault implies, of other doctors), transformed the silence of the look into a more contemporary understanding of the medical exam. To practice medicine by way of this clinical look, then, was not to rule out other forms of sensory information. As Susan Lawrence has shown, medical training (at least in England) involved training all of the senses as well as translating that sensory evidence to others. For example, the doctor "translated the patient's account into symptoms with professional and lay meaning," while simultaneously translating "his own sensations into perceptions intelligible" to other medical professionals (Lawrence 1993: 155). Current medical professors had to instruct future medical professionals on how to both learn from sensory channels such as vision and touch as well as on how to communicate those findings in a legible and useful form.

Gradually, as Merriley Borell argues, "machine-based technologies" came to displace "the physician's senses" (Borell 1993: 245). As Stephen Reiser reminds us, however, this displacement was gradual and involved the collaboration of both technology and the doctor's sense: "The doctor became a detective, seeking physical evidence of particular disorders. [And] the patient's body became the field of investigation and the doctor's sense the media" (Reiser 1993: 263). In other words, these technologies augmented the physician's senses, enhancing his or her clinical judgments and, in Borell's words, "emphasizing investigation rather than reflection" (Borell 1993: 259). Sight, in Lisa Cartwright's view, became the dominate sensory model of investigation through medical imaging devices such as the X ray and the microscope, which dispersed the medical look across an array of disembodying technologies: "Perception becomes unhinged from the sensory body and is enacted across an increasingly complex battery of institutional techniques and instruments"

(Cartwright 1995: 82). Jose van Dijck echoes Cartwright's assertion when she agrees that medical technology, such as the X ray, "purportedly allowed the disconnection of diagnosis from an 'embodied' perception of symptoms" (van Dijck 2005: 84).

Twentieth and twenty-first century clinical medicine, then, operates by way of a visual logic of durable, standardized objectivity. To practice medicine and even dentistry, one must contend with visual inscriptions of symptoms, illnesses, and bodies—learning to create, to interpret, and to persuade by way of these visuals. To learn anatomy, the foundational language of medicine, however, one must learn to supplement visual evidence with haptic evidence, and one must learn to couple visual investigation with verbal interrogation and reflection. Of course, the cadavers cannot answer when questioned, and thus anatomy students, unlike doctors, cannot interrogate their "patients" in order to gain medical knowledge. The students in the lab, however, can and do interrogate each other as well as the other TAs, because objects in the laboratory are not always what they seem. And from these observations and interrogations, students learn to reflect on the embodied evidence on display, in a process that trains their judgment. This observational-embodied look involves both looking at and feeling objects and then figuring out what one is actually seeing and touching. Based on my yearlong observations and interviews with 57 participants, as well as my own first-hand, embodied experience of seeing and touching cadaveric bodies, I will explain this look by tracing its development in the students of the lab, specifically the way students move from, what one of the instructors terms, photographic anatomy toward evidence-based anatomy. The first stage of this development is largely a scopic endeavor:

> Their [the student's] brain takes a snap shot, right? And then when they [the students] are asked to, the brain has a snap shot of things they think they, they can associate with a name. And when they take the exam, they, they go through their snap shots, and they match it, and give it a name (An instructor of both the undergraduate course and the medical/dental course)

These "snapshots" of the structure produce what the instructor terms "photographic anatomists" or knowledge of what I call the descriptive value of the structures-in-question. By descriptive value, I mean the physical, and thus visible, description of any anatomical structure in relation to that structure's function. Throughout the semester, the instructor warns students not to stop at the level of photographic anatomy and provides a memorable explanation of why:

> Fieldnote excerpt from undergraduate course: [The instructor] reminds [the students] of a story he has mentioned once before: "last year we tagged a pancreas but everyone thought it was a penis. They saw something tagged sticking out and thought it was a penis." He repeats this again to remind them not to do this: "if something sticks out, it must be a penis." There is a bit of laughter at this. He then tells them not to be a "photographic anatomist" – they should not reason that "if it looks like the picture, it must be it," because then they are not really learning the feature, only what it looks like.

As this illustration of one student's humorous mistake makes plain, learning anatomy involves more than merely the visual memorization of how objects appear. The instructor's use of the term "snap shot" is worth nothing, in that it emphases the visual textuality of the body as a mental image, a picture of anatomy, that a student must take great pains to move beyond if he or she is to learn.

Moving beyond knowledge of appearances involves what the instructor of the course terms "evidence-based anatomy" and what I call the relational value of anatomy.[3] This stage of learning involves understanding the relationships between the structure and the function of that structure as well as its relationship with neighboring structures (that will serve as landmarks). Transitioning from the initial descriptive values to the more advanced relational values of observation entails a type of dialectical reasoning, or inner interrogation, in which a student draws conclusions and tests out those conclusions to deduce what a structure actually is. In the words of that same instructor,

[3] His use of that term "evidence-based" is adapted from the evidence-based medicine movement that seeks to standardize and protocolize medical procedures based on evidence taken from medical research and other verifiable practices, thus downplaying the more subjective "art" of medical practice and the errors of human decision-making (See Timmermans and Berg 2003).

> I think maybe in your identification that is always your first step. Then, once you move from that step to the next step, which is evidence-based, you ask yourself. "Okay this looks like it." And then you look at all the information around and say "does all the peripheral information convince me that it is this?"

This second stage, which is the recognition of the relational value of the structure-in-question, is based on an analysis of the visual and the haptic evidence on display. His use of the work "convince" is telling and typical of the participants I interviewed. From TAs to students to instructors, all of them used rhetorical language, such as "persuade," "convince," and "argue," to describe how students move beyond the visual memorization of anatomy and toward a confirmation of their knowledge of anatomy. In order to retrace this process—this movement from descriptive values to relational values—and with it the difference between visualizing anatomy and knowing it, I will retrace the study habits and pedagogical practices in which the students engage.

Visualizing Anatomy: The Descriptive Value

Due in large part to the abundance and variety of representations students encounter in the lab (and will in the future as healthcare professionals), understanding the descriptive value of structures, being able to visualize their location and physical appearance, is the first step in learning anatomy. After all, the images and objects offer up schematized, idealized, or exaggerated representations, which influence how students visually conceive of the anatomical body and how they engage with photographic anatomy. The visuals of the course exert a persuasive and ontological force, in that they are used in the labs to teach and learn anatomical knowledge, to inscribe this knowledge on the physical body in a sense that mutually articulates (and enacts) both simultaneously. And the more naturalistic (photograph-like) images afford a view of the anatomical body that is idealized, compartmentalized, and scientifically aesthetically beautiful. These very characteristics that make the images of *Netter's Atlas of Anatomy*, for example, significant also make it problematic as a primary learning tool. Students, struggling with the limitations of *Netter* illustrations, have described them as "cluttered" with too many labels, "disorienting" in that so many structures are missing or reflected (or pulled back and away), and even "deceiving" because "you expect something in one location and it is someplace else." (This language is taken from my interviews of students enrolled in the medical/dental course.)

Students easily and understandably come to focus their attention too heavily on mental visualizations of anatomy, because nearly everything in the lab seems oriented toward that end. Even studying the terms can lead students to overemphasize physical description because of the way the names for structures are embedded with visual clues, such as (as one student pointed out) "glottis for tongue" or "cranium for head." In previewing the *Netter* plates and beginning to learn the anatomical terms, students begin to work with the descriptive values of the structures-in-question. For most of the students (and even the TAs who reflected back on their time in the course), this is the primary use they make of the verbal-based texts. Though all of the students I interviewed (in both courses) admitted to buying the more conventional (word-dominant) textbooks, only one student confessed to reading the chapters on a regular basis. Most of the students only turned to the textbook when they were confused by the visual image offered in *Netter* or, as one student in the medical/dental course explained, "I get what they are saying, but I cannot visualize it in my head." The verbal descriptions in the textbooks, then, were also used in order to visualize the look or the function of a particular structure.

None of this is meant to suggest that visualizing anatomy, and understanding the descriptive value, is unnecessary to the course. After all, this photographic sense can aid in studying and in dissecting. Stephan Hirschauer finds that an image from an anatomical atlas offers "a normative picture" that "document[s] products of dissecting labor" by granting an "idealized account of what has been done" (Hirschauer 1991: 311, 310). In the case of medical students, the image offers a guide to what should be done. The *Netter* plates, then, though at times cluttered, deceiving, and idealized, do help students in the medical/dental course understand where and what to cut:

> I try to look over my *Netter* in order to get a picture, a visual, visual picture. Because I find

> that if I don't have any idea what it is supposed to look like when I go in there, you know, you tend to kind of ruin things. And if you know where to look for things, you know different relationships to keep an eye out for them. Because it seems like if you can preserve them, you will get and see a lot more important things. (Carlotta, medical student)

In the interview excerpt above, studying with *Netter* and working with the descriptive value it affords, guides this student's dissections, helping her become more adept at creating a visual-material text that can be used by her and any other student in the lab. For the students in the undergraduate course, these visualization practices help them make the most of their laboratory sessions. Through prestudy with these texts, they learn to "recognize anatomy" (as one student put in) in the body of the cadaver.

An overreliance on *Netter* and any of the non-human visuals, however, can become a problem only when students fail to grasp the importance of learning a particular structure's landmarks, relationships with other structures, and crucial non-visual properties. One TA in the undergraduate course explains what she finds to be a major problem of how students learn in the first several weeks of the course, namely the tendency to memorize the look of structures:

> Because you memorize the landmarks around it, I mean, you memorize it based on the landmarks and not because it looks a certain way. Because if you memorize that a muscle is looking a certain way that may change anatomically, the variations you may have from cadaver to cadaver may be different. So it is more important that you know the landmarks that surround it. (Kate, TA in the undergraduate course)

Her understanding of how one learns anatomy is rooted in the necessity for moving beyond a focus on the memorization of physical description, because of both the natural anatomical variation and, perhaps more importantly, the need to understand neighboring landmarks. This is not to mention the fact that a reliance on the descriptive value of a structure can be further complicated when that structure-in-question has been removed. If a student can only recognize a structure-in-question by its appearance, he or she might confusingly tag a similar looking structure if that structure-in-question is not there. Several of the TAs (in both courses) stated time and again that the trick to learning anatomy was to learn systematically, to come to grips with how the structures work together—namely evidence-based anatomy and the relational values it reveals.

Knowing Anatomy: The Relational Value

Understanding the relational values of anatomy, then, involves the incorporation of visual evidence into both more advanced anatomical knowledge (an understanding of anatomical relationships) as well as haptic evidence (touch, texture, depth, scale, movement, and other kinesthetic qualities). An awareness of the complex relational values of anatomy not only makes one a good anatomist (as one of the instructors suggests above) but constitutes what could be called authentic or at least more reliable anatomical knowledge. One of the dental students offers an explanation of the layers and components to learning anatomy:

> [1] They [student's who understand anatomy] look at the whole puzzle and then, kind of, can flow through it. That's a good way to put it, kind of look at it like it's a puzzle. Some people take each piece and then try to find it or some people, like, group pieces together and then lock it into the puzzle.
>
> [2] And like people who can, I think, say okay, I know this muscle is the stylohyoid because it goes through the stylohyoid, and it's near the hyoid. So I know where that is. And I think others just memorize it as stylohyoid, as a blank name, and they know exactly where it is. But they don't understand the relationship and why it's called what it is. (Larry, dental student)

By way of a jigsaw puzzle metaphor, Larry articulates anatomy learning as a slow visually oriented process of bringing together various components that will eventually be made to fit into a coherent visual image. Yet, like any puzzle, the connections are already predetermined, and one must understand where things connect. To do this, one follows the evidence on display, which, though visual in the case of a jigsaw puzzle, is not always visual in the lab. (Though, arguably, one uses touch to assemble a

jigsaw puzzle as well, particularly in judging with one's hands which pieces fit where.) In the section I have marked as [2], Larry then continues with an example of this puzzle-completion process. Because he understands the names for the structures and where they are located in the body in relation to landmarks, he is able to fit the pieces together. The relationships are crucial here; they give the visualization of the structure its coherence.

And though there is a need for repetition and memorization in order to learn the names and the landmarks, students, TAs, and instructors, all explain learning as a process of either appreciating the three-dimensionality of the anatomical body or working to three-dimensionalize any physical body in order to understand it in "reality" and not just in "theory." This discussion from a medical student, Ramona, illustrates how relational values and three-dimensionality (two components of Larry's puzzle) are not always transparent:

> [1] Up until the first test, I was studying so hard that I felt the material just wasn't sinking in, until I realized that I kind of needed to come at it from two different directions. So name the nerves and all the branches and what they do, and then go back and name the muscles and what nerves, you know, innervated them. So that's kind of how I have been preparing ever since then. (Ramona, a medical student)

In this first section, Ramona, through her own self-assessment of her performance, comes to doubt the way she has been studying because of the doubts she has about anatomical knowledge and the anatomical body, namely that the information isn't "sinking in." Though she does not link her understanding of the anatomical body directly to touch, she does use embodied figurative language to describe what it is not doing, namely "sinking in." The three-dimensional metaphor is striking, of course, but more than that, there is her awareness of the need to "come at it from two different directions" (a spatial metaphor). For her, those directions are the incorporation of knowledge about two sets of related structures, ones that work together in the body: the nerves and the muscles they innervate. The ability to see the body in three-dimensions helps Ramona at least to learn anatomy by learning how structures work together. This awareness is complicated, however, by the visual objects of the course:

> [2] I am just trying to picture everything as a whole, how everything fits together. The biggest problem is just picturing everything in 3D and having the body there is definitely a lot of help, even though it is usually supine, in a supine position, or in the pronate position. So you still almost visualize it in just two planes. (Ramona)

Here, she directly expresses the importance of three-dimensional relationships but then complicates that by pointing out the limits of even the cadaveric body, especially the way cadavers, as inert flesh that lacks motility, cannot easily be moved or manipulated outside of the supine position in which they rest. (Here, Keen's argument for the living model makes even more sense.) The three-dimensionality, then, is there, but participants have to visually (and physically) work to conceptualize it. In other words, even when participants acknowledge the significance of what I am terming relational values, they still have to some to grips with the limitations of the visual-material texts in order to get at those values. In what remains, I will argue that learning and knowing evidence-based anatomy and the relational value of the anatomical body are only possible if one learns to physically interact with the various bodies in the lab, interrogating those bodies and their own in order to convince themselves that they do, in fact, know what they think they see. In the process, participants develop a particular habitus, one enacted by the learning processes that an observational-embodied look, in part, make possible.

Habitus Formation and Embodied Learning

Embodied observation, which students learn through purposeful action in this particular context, not only facilitates learning but also contributes to the development of what Pierre Bourdieu has termed habitus. Beyond the dichotomies of strict objectivist thought and complete subjectivism, Bourdieu's concept of habitus offers a way of explaining how social practices, ones that seem so second nature they often go unnoticed, mark a person as a member of a certain group (Bourdieu 1977: 73). Bourdieu first defines

habitus in the following way: "[the] systems of durable, transposable *dispositions*, structured structures predisposed to function as structuring structures" (Bourdieu 1977: 72, emphasis in original). In essence, one's habitus consists of "the thoughts, perceptions, and actions" that one develops as a part of his or her socialization into a particular group (Bourdieu 1980: 55). These actions, according to David Swartz, can be expressed in "language, nonverbal communication, tastes, values, perceptions, and modes of reasoning," not to mention (as Bourdieu makes plain) actual corporeal mannerisms, deportment, and motor function (also termed bodily *hexis*) (Swartz 1997: 108; Bourdieu 1977: 94). By "systems of durable, transposable dispositions," Bourdieu is referring to the way the habitus manifests itself in social behavior and supposedly personal dispositions that are transferred to a number of social situations yet are developed as part of one's inculcation into a group.

According to David Swartz, the term disposition conveys two important components of habitus: "structure and propensity" (Swartz 1997: 103). First, habitus, as something that one often develops from early socialization, sets "structural limits for action," according to Swartz (103). Second, because habitus is what Bourdieu terms a "mode of generation," it is also understood as an inventive quality that generates one's thoughts, perceptions, and actions, yet it does so "as a system of cognitive and motivating structures" (Bourdieu 1977: 78; Bourdieu 1980: 53). This, according to Swartz, is what Bourdieu means by "structured structures" and "structuring structures," namely that habitus works by way of, in Swartz's words, "deeply internalized master dispositions that generate action" (Swartz 1997: 101). One's habitus, then, is what not only structures one's thoughts and behavior, but, as such, also generates the social world for a particular human subject by "imposing different definitions of the impossible, the possible, and the probable," and by doing so in a way that is often concealed by and from the person involved in the habitus (Bourdieu 1977: 78). Rather than manifesting as an "obedience to rules," habitus, and the actions it constitutes, works nearly invisibly as a kind of logic or commonsense or shared perception that one develops through one's membership into a particular group. The habitus, then, is part of Bourdieu's wish to overcome the universalizing logical of structuralism, by attempting to understand how people are caught between determinism and complete freewill (Bourdieu 1977: 73).

The constraints and criticism of Bourdieu's concept are perhaps obvious. First, habitus is a potentially totalizing concept that leaves little room for social transformation. Michel de Certeau has criticized Bourdieu's concept as being so totalizing and all consuming that it becomes almost dogmatic and tautological. Specifically, he argues, habitus is a concept used to describe practices by concealing how practices actually work (de Certeau 1988: 58–59). Second, habitus seems to remove or at least downplay individual choice, because of the way these dispositions seem to reproduce themselves across an entire group of people. For example, does one dissect a body out of a choice to learn medicine (founded in a personal belief that the cadaver is the best resource), or does one dissect a body because of the cultural and disciplinary logic (founded in the past and recapitulated in the present) that espouses dissection as beneficial, or does one dissect because they must in order to pass the class and become a dentist (founded in adherence to a rule-bound system)? Some have argued that Bourdieu's theory gives us no real way to answer these questions, because it does not always allow one to parse out the complexity of motives or the multiplicity of actions. I would disagree with both of these critical positions. Though "all-pervasive," habitus, I argue, has "a degree of plasticity" that does not foreclose human agency but instead seeks to understand the perimeters that restrict human agency by seeking to explain what actually forms a particular individual's responses to the world (Hoy 1999: 14). As a conceptual category, habitus seeks to elucidate why certain groups and certain people think and act as they (seem) to do, by explaining "how our perception of possibilities are narrowed down to a range within which we comport ourselves with enough play to feel as if we are choosing freely and meaningfully" (Hoy 1999: 14).[4]

I find habitus to be a useful concept for anatomy education for two reasons. First, habitus is a theory of

[4] Bourdieu was not, after all, interested in intentionality and was, in fact, skeptical of any attempt to trace out causality, in part because he thought participants could not be the best judge of their actions (Bourdieu 1977: 18–19); therefore, any sort of individualist approach said very little about the social and could not be used as a sociological model but instead intimated a psychological model.

practice that involves the body, perhaps even puts the body at the center of social practices. One's habitus is a product of the internalization of social structures, formations, and practices that one subsequently externalizes (or re-plays) in the form of bodily activities, such as thoughts, perceptions, gestures, language, movements, etc. And one of the ways to understand the workings of the habitus and to see the effects of the habitus in its process of perpetuation is to understand or at least be attentive to the bodily affects of the habitus, specifically bodily *hexis* (gestures, deportment, etc.). The practices of the lab are embodied practices, internalizations that are externalized through particular gestures, movements, and activities as well as thoughts, perceptions, and appreciations. Second, I agree with Hoy that habitus "adds the social dimension" to Maurice Merleau-Ponty's "theory of embodiment." (Hoy 1999: 10). Though one might easily object to the quasi-spiritualism of Merleau-Ponty's discourse (not to mention that of the entire phenomenological project), one can benefit a great deal from connecting his work to that of Bourdieu's, specifically in the way that the former can be viewed as predicting key arguments of the later. Particularly, Merleau-Ponty's discussion of habit and tool or instrument use can be considered as an inspiration for and usefully supplement to Bourdieu's habitus. Though not imposing instinctual actions on the human being, the body, for Merleau-Ponty, does "give to our life the form of generality" and "develops our personal acts into stable dispositional tendencies" (Merleau-Ponty 1945/2005: 169). These "dispositional tendencies" are either played out in or experienced by way of (he is never clear which) habit and habitual actions; the human body, through which we experience these dispositions and habits, is "our anchorage in a world" (Merleau-Ponty 1945/2005: 167). He even goes so far as to say that it is the body, and not perhaps the conscious mind (or consciousness), which "'understands' in the acquisition of habit," "understands" in this case being "the harmony between intention and performance" (Merleau-Ponty 1945/2005: 167). In other words, these practices of habit formation, these dispositional tendencies, navigate (like habitus) the middle ground between conscious intention and lived-through enactment.

For Merleau-Ponty, the body becomes our anchorage in the world of meaning making through the creation of perceptual tools, born out of these dispositions, which we use to experience that world. Often because "the meaning aimed at" cannot "be achieved by the body's natural means," the body must then "build itself an instrument" and "project thereby around itself a cultural world" (Merleau-Ponty 1945/2005: 169). Though the ambiguity of the phrase "build itself an instrument" does not spell out whether the body makes an instrument *for itself* or an instrument *of itself*, Merleau-Ponty, I would argue, means to keep both in play. Our relationship with tools and instruments is always an embodied relationship of incorporation that creates the cultural world around us. Herbert Dreyfus has sought to explicate and even add to Merleau-Ponty's notions of skill acquisition, specifically "how one's relation to the world is transformed as one acquires a skill" (Dreyfus 2005: 130). To do this, to conceptualize a working model for how the body facilitates learning, Dreyfus argues "skills are acquired by dealing repeatedly with situations that then gradually come to show up as requiring more and more selective responses" (Dreyfus 2005: 132). In other words, as a student repeatedly encounters tasks in a social setting that gradually require more and more skill, successful students learn to master the tasks and move onto more complex tasks, eventually without a need for conscious thought. The tasks and the skills used become second nature to the participant as she acquires the skills needed to move onto the more complex tasks. Though Dreyfus' point is an obvious assumption that foregrounds a number of educational theories (particularly those of Vygotsky), his contribution to ideas of learning is his insistence (at times inadvertently) of the role of the body and the ways in which the body as a perceptual tool is the foundation of all learning.

He begins by grounding his discussion of skillful coping in Merleau-Ponty's notion of "the intentional arc," which is a type of "feedback loop between the learner and the perceptual world" (Dreyfus 2005: 132). Merleau-Ponty offers this description:

> Let us say rather… that the life of consciousness—cognitive life, the life of desire or perceptual life—is subtended by an 'intentional arc' which projects round about us our past, our future, our human setting, our physical, ideological and moral situation, or rather which

> results in our being situated in all these respects (Merleau-Ponty 1945/2004: 157).

The intentional arc is "a dialectical or circular relation of milieu and action," a recursive space involving the learner and the social world in which the learner is engaged (Dreyfus 2005: 132). In learning, one's "past experience is projected back into the perceptual world of the learner and shows up as affordances or solicitations to further actions" (Dreyfus 2005: 132). Returning to the lab, when anatomy students are engaged in dissection or demonstration, they are inculcated in an intentional arc of activity and meaning making. If repeatedly exposed to these activities and if successful at skillfully coping with the perceptual tools within that arc (including their own body), then students not only learn, but they also internalize certain skills, tasks, movements, and perceptions as second nature. At this point, hopefully, the connection between habitus and skillful coping should be clear. As one becomes an expert or develops a certain habitus, "the world's solicitations to act" in specific contexts and under specific constraints replace conscious models and representations of what to do and what not to do (Dreyfus 2005: 132).

To learn, according to this embodied model, is not a simple process, because a participant is faced with a host of objects, choices, and perceptual tools that constitute the intentional arc. Through the habitual repetition of certain situations, the subsequent development of skills, and the formation of habitus to interpret the situation, the learner seeks to achieve "a maximum grip" on the situation (Dreyfus 2005: 137): "According to Merleau-Ponty, finite, involved, embodied coping beings are constantly 'motivated' to move so as to achieve the best possible grip on the world" (Dreyfus 137). The bodily metaphor is, of course, an intentional one and stems from Merleau-Ponty's concept of the body as the foundation of perception. The body, then, is not merely inert matter or a container for the mind; the body is the way we come to grips with the world. Thus, the body—and embodied learning or embodied coping—is the means through which we understand the intentional arc, or the social setting in which we are engaged. To return to a previous illustration: when a TA teaches students how to give a prosection demonstration, that TA teaches students to make sense of an array of complex objects (the cadaver, their own bodied, the books, the instruments), all of which constitute the intentional arc of learning. In order to be successful, students must achieve a maximum grip on the objects, tools, and resources around them. And to do this, they must make choices and use certain resources while ignoring others. And they must receive feedback (positive or negative) from that intentional arc (comments from the TA or an internal feeling of correctness, for example).

Learning anatomy is an embodied process not simply because they use one body to learn another, but also because they use their own bodies and their developing habitus to make sense of (to come to grips with) the subject matter, the tools, the texts, and their perceptions. In a physical sense, this intentional arc of the anatomy lab is established through the social setting and the work of the TAs, who aid (and who can perhaps hinder) the skilled coping of students. The TAs not only teach anatomy, model techniques, set up the lab space, but also exhibit a more advanced (or deeper) habitus, in that their experiences within the lab as students and teachers encourages them to understand themselves as anatomists. This process of self-persuasion, or habitus formation, can be witnessed in four common embodied activities, all of which involve the observational-embodied look: (1) performing dissections; (2) teaching prosections; (3) studying in groups; and (4) clinical correlation sections.

Doing Dissections: Digging Through the Body

To dissect a body, one literally has to excavate layer by layer the various outer structures in order to arrive at the inner ones. The language that participants deploy to describe the process mirrors this kind of archaeological work; TAs, students, and instructors describe it as "digging," as "sifting through," as "diving down," and as "uncovering." As I mentioned, the participants first learn this process of excavation on the two-dimensional texts (usually the naturalistic displays like *Netter* images), thus relating one visual text with another:

> I take *Netter*, and I just dig through *Netter*. I go over and over and over. I have a photo atlas too that is actually pictures. I go through that too. And I just see what it all looks like; I try and get it all as memorized as possible. So that I can get

> to where I can just look at the structure and identify it. I do that before I do it on the bodies (Lynn, a medical student)

Again, her language is telling: Lynn digs through the images before she digs through the cadaveric specimen. This hands-on process of direct and embodied observation, looking and touching, constitutes a type of tacit, immersed, and indirect learning, one that happens by way of the process and not perhaps by way of any deliberate studying. For example, one TA in the medical dental course (Jonathon) recounts the advice he gives to students: "So yes, that is what I would say for a future student; to just dissect and not worry about the learning until you come back in [the lab for independent study]." The environment of the lab, during the dissection sessions, he admits, can be loud and not the best place for studying; therefore, he encourages students to just "dig away and focus on that."

Students also understand performing dissections as a form of implicit learning-by-doing. One medical student, Barry, was very interested in the prosection method used by the medical school at University of Michigan, which entailed filling the labs with already prosected bodies so that students could just focus on studying and not dissecting:

> And so you can get the really standardized thing, but you don't get, you don't get any of the experience of digging through lots of fat to find particular structures that you know you need to see. Yet I think, like I say, there is a lot of variability. I don't know. Well. I think arguments could be made both ways. (Barry, medical student)

Here, this act of "digging through" is what constitutes the learning and causes him to rethink his previous criticism of the University of Minnesota's dissection model of learning. Barry's ideas mirror those of other students who explained how well they understood either a certain structure or one particular day's dissection if they were the one to find most of the structures themselves (Lab partners trade duties when it comes to dissection, because not everyone can cut at the same time).

Here are the words of a dental student, Marianna, who explains the relationship between their dissections (as processes) and the already prosected bodies (as models):

> Doing something myself, you know, actually helps me to remember it much better. But as far as wanting to know what structure is where, I will go to the pro-section, you know, just to make sure that what I am looking at on my body is what I actually think it is. So I use the pro-section as a major reference. (Marianna, dental student)

Again, dissection is a process of active learning, but the prosection also offers an opportunity for learning, one that on the surface seems to be a strictly visual process of looking and figuring out, but, as Marianna continues, this is not the case:

> And I think that's what a lot of people do. Because I have noticed that when we have pro-section, people always come over and look down at it, tinkering inside it, and then go back to their tables. And then they say, well, we need to cut here, and that kind of stuff. So yeah, it helps them both in identifying the structures and in the dissection process. (Marianna, a dental student)

The prosections—the cadaveric bodies dissected by the TAs and not the students—also involve haptic evidence. The students' "tinkering inside" the prosected model helps them realize depth, positioning, and spatial arrangements, which they then use to guide the dissection of their cadaver. And though there is obvious anatomical variation, the knowledge gained from one body can help students understand and learn from another—if one understands, again, the relational values. The goal of having prosected models is, after all, to provide a typical example of what the other dissections should look like once that lab session is finished. Making sense of a prosection requires both photographic and evidence-based considerations.

Teaching Prosections: Demonstrating Bodies and Knowledge

More than just visual-material models, the prosections, in particular the demonstrations students give to one another, serve a central function in the observational-embodied look, in that these demonstrations, these brief lectures, are organized specifically to help

students move beyond merely looking. Teaching with and from a prosected cadaver is not an uncomplicated process, particularly in the way that students must assume teaching roles with objects they might not fully understand. Take, for example, the not uncommon scenario provided by the medical student, Mitch:

> I get the most out of it when I do the pro-section demonstrations to people. We show up; it is a very cleanly dissected. All of the fat and the garbage is out of the way. And they teach us step-by-step what comes out of this opening, what goes where, and that kind of stuff, which is helpful. Otherwise, it is just four idiots who don't know anymore than the other one. It's like the blind leading the blind. (Mitch, medical student)

Though his comment might seem a bit course, Mitch is giving voice to a common complaint, namely that dissection can be a frustrating even distressing process. After all, students are required to explore often-fatty regions of the body without the proper knowledge of what they are in fact searching to find. This is acerbated when students are then instructed to guide each other through the body and through the process of dissection. Though he was the only participant to describe it as "the blind leading the blind," he does point out what can happen if a group of students set to give the demonstration is not prepared. For example, without previewing that lab session's material, those four students might be receiving their first and only introduction to those structures during that 15-min or 20-min practice demonstration with the TAs.

Another complication of the prosection teaching is the language the students use in teaching each other:

> Like, some groups do an awesome job, and other groups just kind of fly through it and just want the next group to come over. So it really helps when some groups go slow, and show you the arteries and everything, where they branch off of, and not just pointing at the artery saying, "this is an artery," or something like that. (Amelia, a dental student)

Amelia is explaining a type of "this-is-that" discourse used by the unsure or uninterested demonstrator. Throughout the medical and dental course, the students and the TAs disparaged these reductive verbal descriptions because of their dependence on visual logic and descriptive values. Knowing only that "this" is "that" in one particular body does not help students understand how to find "this" in another body, because they are solely reliant on finding a structure that resembles "that."

Instead, students, TAs, and instructors alike encouraged students (and each other) to, as one instructor put it, "teach the body, not point at it." One dental student, Marianna, knows exactly how she wants to be taught:

> I want a relationship, and I want compartments. Like I want, "here is this artery, and you can find three branches in the anterior compartment and three branches in the posterior compartment." I don't want them to just go through and point and name what each thing is because that doesn't help learn. (Marianna)

What she wants to understand is what I call relational values; she wants to know "compartments" and "relationships" as well as how structures work together. For example, comprehending and recognizing the branches of arteries tell one a great deal about location and relationships, where those arteries "run" and where they carry blood. In effect, the descriptions that are deemed more helpful are ones that narrativize the body: "We say the structure, and we go from there, do a little story about it. And for us, I think that really helps" (Amelia). These narratives often involve ascribing a kind of bodily or kinesthetic agency to the structures-in-question. For example, nerves, veins, and arteries "run" and "dive." Muscles at times "pull" instead of contract. And some structures were even described as "hiding" behind other structures. All of these narrative descriptions, in a sense, represent the work these structures are believed to perform in the body, work that is interconnected and cannot be determined by "this-is-that" discourse.

Learning to illustrate and to narrate the relational values of the body is important, because students perform prosection talks throughout the semester, both during the official labs and during unofficial study periods. Understanding the relational complexity of anatomical knowledge and the anatomical body and being able to communicate that information in a way that does not erode the interconnectedness of structures and systems: both of these will aid students in teaching themselves and each other. These perceptual

and rhetorical capacities, if you will, (to view the body in a certain way and then to communicate that understanding) also allow students to assess both their comprehension (by comparing what they know to the demonstrations) and their skill at dissecting (by comparing what they are told about the prosection model with their own cadaveric specimen).

Studying in Groups: Interrogating the Body Together

Similarly, the third set of embodied practices that help (or can help) to facilitate this observational-embodied look is the small group-study sessions that students independently engage in during the open labs. These working groups, some of which are more formal arrangements deliberately created by students who want a level of consistency, offer the opportunity for a more overtly self-persuasive, dialectical, and interrogational meaning making. In both classes, though perhaps more in the medical/dental course, students often study together, by either working with another student who happens to be in the room or by working with their friends who are also enrolled in the course. These groups of two to five students return to the lab sometimes after the official lab session. While there, students, using their identification lists and laboratory notes, will perform as many demonstrations as they can. Moving from cadaver to cadaver, using the other visual-material objects of the room, students will teach each other what they know about the anatomy of each visual text, quizzing each other as they go:

> So one person will point at something, and one person will identify what that structure is. So it is a similar type of feel to the test because you have to come up with a name off the top of your head, rather than looking at the word on a list and then find it. (Randy, dental student)

As Randy states, these study sessions involve learning anatomy by mimicking the knowledge necessary for the exam, which, for the medical/dental course, provides tagged structures that students must correctly recognize and name. Learning the terms and learning how the structures are related, usually through those narrative accounts of what structures do (how they behave in the body, even), becomes a part of the interrogation process. Encouraging students to share with each other all they know about the structure-in-question.

Most of the students and TAs described this group learning as a dialogic or dialectical process in which participants work together to recognize and learn anatomy. These very intense, yet relaxed group sessions are praised by students and TAs because they allow students a chance to learn from both the cadaveric specimen and each other:

> So if you are someone who needs that dialogue, and to talk about things, and to bounce ideas off other people, I think that is really effective for some people. (Stacy, medical student)

As Stacy mentions, students work together to come up with answers (confirmations of anatomical structures) that they might not understand on their own. During a typical session, a group of students will walk up to a cadaver and, either using their notes or working completely from memory, one student will often play a TA role and begin asking other students to identify and discuss whichever structures this TA-like student is pointing out. Students often take turns responding to this surrogate TA's questions. If there are points of confusion, disagreement, or complete misunderstanding, usually the students will all work together, offering clues, explanations, and study suggestions to whoever in the group needs the assistance. These moments of confusion often encourage everyone in the group to help out, not just that student playing the TA. Usually, the team does not move onto the next set of structures until everyone in the group has understood. The actual interaction of these sessions involve not just the question and answer format of the "this-is-that" discourse but more importantly the narrativizing of the anatomical body, as students often require each other to back up their conclusions with some kind of evidence. In working out the meaning of difficult structures, students, for example, are required to offer up evidence based on relational values, because they are often understood as more convincing than the descriptive values that all present can see (and perhaps disagree with). During one student session I observed in the undergraduate course, three students were debating what turned out to be an artery and not a vein. In order to prove her point, a very confident student asked her more skeptical companion to

"reach in and touch it," to confirm her argument through feeling the structure.

This dialectical activity also mimics the ways TAs and instructors quiz students during the regular laboratory sessions. These exchanges, referred to by some as "pimping" the students, involve questioning students about both the descriptive and relational values of anatomy in order to, as one undergraduate students put it, "kind of get your brain working a little bit more and kind of help you out as far as determining relationships." The sexual and coercive implications of the term "pimping" are as revealing as they are troubling. Though clearly the labs are not a space of blatant and illegal sexual trafficking, the term does, in a sense, intimate how one body is used for another. In the traditional use of the term, a pimp (usually a man) forces a prostitute (usually a woman) into a brutal sexual economy in which the prostitute is pimped for the economic well-being (and cultural capital) of the pimp. One body (the prostitute's) benefits and serves the purposes of another body (the pimp's) by serving the needs of other bodies (the john's). In labs, however, students are pimped by forcing them to explain, in a stand and deliver fashion, what they know about the anatomical body, which is usually the cadaveric body on display in front of them. One should not assume that the docile body of the cadaver is the stand-in for the prostitute. Instead, I would argue (in an analogy that admittedly I might be stretching far beyond the point of usefulness) the body that serves others is both the cadaver's and the student's. In other words, in this formation, the cadaver is used to serve the needs of the students and the TAs; but, more interestingly, the student and the student's knowledge of the body is used to serve the purposes of anyone standing around. The body that does the work is both the cadaveric body and the student's embodied knowledge. These friendly interrogation sessions often happen in small groups, thus allowing the pimped student to offer up this gift of the anatomical body to any other body present.

Applying Clinical Correlations: Incorporating the Body

This bodily analogy implied by the term pimping, as a description for the rapid-fire quizzing of students, also suggests the way in which the students and all other participants use their bodies for the benefit of others. I am specifically referring to the way students come to incorporate anatomical knowledge by either projecting it onto the living bodies of the lab or performing it in order to teach themselves and others. These uses of gesture and physical demonstration illustrate a more advanced, evidence-based anatomical knowledge.

> I think, obviously, they use the cadavers, and we use a lot of our own, you know, our own body to point at things, because sometimes it is hard to, it is hard to kind of sometimes conceptually see things, because you can move an arm while the cadaver can't move its arm for you or for itself. And so we use a lot of our own, I guess, body parts to point to. (Constance, dental student)

According to Constance's formation, which William Keen would no doubt applaud, the cadaver and the living human afford the student of anatomy an illustration of some structure or process (in my words, they can be made to display the anatomical body). But the limitations of the cadaveric body often force students to work with the living: to move, to turn, to manipulate each other's bodies in order to explain more advanced concepts such as motion, origin, and insertion. Again, as Constance explains, "if you know the muscles, if you know its action, then you know its origin and insertion," and so "using the body is best for muscles." These clinical insights can be hard to ascertain from the static cadaver.

These clinical correlations, as they are termed, which reconnect anatomical knowledge (as a discourse system of ideas) to the lived experiences of the human body, link structures to functions in a way that introduces students to "the whole puzzle" of anatomy. All of the participants I interviewed found these correlations not only illustrative and interesting, but also motivating, stimulating these future healthcare professionals to really learn anatomy and not just memorize it for the exam. These correlations participate in that same process of interrogation and persuasion in that students encounter the importance of tracing visual and embodied evidence. Take, for example, Stacy's account of her own personal connection to these correlations:

> And it also just makes it more interesting. It is kind of like another one of those "ok, people, if we cut this then you're going to have this." And then you're like, oh, right. Like if you sprain your ankle—like I have played soccer, and I had played for 18 years. And I have sprained my ankle a hundred times, and it wasn't until we had our clinical correlate when she was like, "yeah, when you have a first-degree sprain, your anterior talofibular ligament is like this." And then I'm like, "oh." And that was on the practical [exam], and I was like, "okay, that's the one I keep spraining." (Stacy, medical student)

Here we see one student learn anatomy by personalizing the process, physically incorporating the anatomical body, even understanding her own body in anatomical terms. What was once a sprained ankle is now caused by a knowable mechanism, one that can assist her future clinical practice not to mention shape her relationship to her own body. Though one might read as hegemonic this embodying of anatomical knowledge by reading it into and onto the physical body, understanding the physiological basis of the human organism can be personally empowering and productive, particularly for these students who will some day put this knowledge into action.

The physical and literal application of these clinical correlations, for the medical students at least, actually begins during their formal medical education. Several times throughout the medical/dental gross anatomy course, the medical students are required to participate in clinical correlation sessions, ones organized by the instructors, which seek to connect the world of the lab with the world of medical practice. During these sessions, medical students meet in small group in (tiny) examination rooms where they work with either TAs or instructors to make explicit the relational value of anatomy for clinical practice. Usually, by actually touching and palpating the body, students learn both how certain structures work in the body and how these workings make up what we understand to be the human organism. Take for example this passage from a medical student who found these sessions both illuminating and entertaining:

> Like I had not totally understood the nerves yet, and in the clinical correlates they taught us different [physical] exams, you know, where to check, sensory innervations on the hand and stuff like that. If you couldn't feel this part of your hand, then it meant there was a problem with a certain nerve or something. So actually, it helped me put together where things were running because of the clinical correlations. We actually went into one of the little exam rooms and, you know, did stuff on each other. And, you know, that was really cool. (Jennifer, medical student)

By doing "stuff on each other," Jennifer was able to get a better understanding of one system of structures that can be conceptually challenging, specifically understanding how nerves innervate muscles and how that innervation makes motor function possible. By admitting that she was able to "put together where things were running," Jennifer not only narrativizes the body but also expresses the importance of understanding how structures work with other structures, which she was only able to fully understand by touching the body of others and moving her own.

Though dental students (during my year of observation) did not participate in these clinical correlation sessions, exposure to clinical applications of anatomical knowledge happens throughout the course, but they require a more advanced stage of learning. Part of being in the labs and taking the course is to be immersed in the discourses of anatomy, to inscribe that anatomy onto the body, to encode that anatomy onto the visuals of the lab, and to incorporate those inscriptions into their conceptualizations of the body. But in order to do this, students must know anatomy; they must have the knowledge of the system (so to speak) that is necessary to recognize that system in the body. These moments of clinical connection, of understanding the relational values of the body that allow the body to function, are both a result of the process of skilled coping and encourage the development of habitus. Take for example, the very brief donor medical histories that are printed out on each cadaver tank in the medical/dental course. These one-page lists of pathologies and ailments, which correspond to the cadaver in the tank, offer students (and TAs) clues to what they might find (or not find) in the body. For example, if a donor had her gall bladder removed, this donor history will help those dissectors make sense of why that particular structure is absent in their cadaver. This is an obvious example of how

students make use of these histories, but this is perhaps the least significant way. For example, when I asked one student whether or not he and his "body buddy" team ever look at those histories, this was his response:

> And as far as the initial learning of the anatomy, you would be kind of like "what is this" [mimics noticing and reading the sheet]. But then you would figure it out, and then it would become really, really interesting, particularly after you had learned the basic anatomy. And then you see variations based on procedures that have been done or things that have gone wrong. It is just like, "oh, wow, now I understand everything even more," what they did when they did a coronary bypass, or a gallbladder was removed, or this person was a smoker, what that looks like. (Randy, dental student)

He exemplifies what both students and TAs in the medical/dental course expressed—that the donor histories are interesting and useful but only "after you had learned the basic anatomy." And "then you see" relationships in the body and clinical implications and applications—both of which represent the advanced anatomical knowledge that I term the relational values rooted in evidence-based anatomy that one learns by seeing and then moving beyond that into a form of embodied knowledge that in communicated through touch, motion, and manual manipulation. The use of these donor histories and other forms of clinical correlations is inevitably a form of embodied evidence that is persuasive to students in that it motivates them to learn anatomy and, some have even mentioned, take better care of their own bodies.

Anatomization; or the Habitus of Anatomy Education

This observational-embodied look constitutes much more than the educational methods of the anatomy laboratory. Through this incorporation of the anatomical body as and into all other bodies of the lab, the cadaveric body becomes science, or is rendered as science, through a process of anatomization—a process involving the development of a particular habitus. And this begins in the way participants (students and TA) come to focus on the practices themselves and not the objects:

> But then again, we started working, and they became more about finding the anatomy than it was about the person, herself. So, you know, it's definitely keeping the purpose of what you're doing in mind rather than focusing on what you're doing to someone that used to be living. I mean, so, yeah, it's definitely more of an object to work with than a human for me. (Samuel, medical student)

For Samuel, then, this focus on doing, a preoccupation with practice, allows ones to perceive of the body as an object of those practices. In other words, the body becomes an object subsumed by the practices acted out upon it. The body becomes a collection of structures that one must dissect and/or find, with the emphasis placed on the processes of rendering (dissecting, identifying, and demonstrating) that give the "object" (the body) it's meaning and coherent. This focus on practice does not, however, mean that students lose sight of the reality and the humanity of the object. As another medical student, Louis, describes it, "I didn't forget that it was a real person, but it [dissection] became more of just something that I'm doing, rather than something I'm doing to someone."

This focus on practice and the anatomization of the body entail an articulation of the body as anatomical matter, specifically tissue, which becomes an instructional object. In recounting his move from initial anxiety to adaptation, one dental student, Roy, describes the process in this way: "And then you realize that it is just tissue, and it is just a learning tool. And I haven't really thought about it much since then." Here, the body is valuable as a scientific specimen of anatomy knowledge and anatomical structures. This anatomization of the body does not strip the humanity from the body but instead only adjusts the focus (perhaps) from the personhood (or former personhood) of the body to the anatomical value of the body: "I was always fully aware that it is just a bunch of matter that made up the human body, and it was here for our learning as all" (Erin, TA for the undergraduate course). For Erin, and many others, the cadaveric body becomes a tool for understanding the component parts that "made up" (or constitute) the human. Though the personhood of the

body is downplayed, the human relevance of the body is not. This anatomization does, however, reduce the body to its component parts:

> You just really start to see things in pieces rather than just, you know, this person, as a whole. And, and you are just so focused on the structures and everything else, you are not paying attention to the body as a whole. (Samuel, a medical student)

This rendering of the body as the body-in-parts is, I argue, a consequence of both the anatomization of the body (or the perception of the body as an object of science) and the observational-embodied look that perpetuates that anatomization in the first place. In other words, viewing the body as science encourages participants to focus on the anatomical structures of the body, which inevitably increase one's focus on the body as a collection of complex structures with descriptive and relational values. Yet, for many of the students and the TA who act as dissectors, the practices of dissecting the body, of transforming it into a corporeal object of anatomical knowledge, also encourage one both to view the body as science and to hyper-focus on the body-in-parts.

This anatomization of the body—this rendering the body as science—is an unavoidable consequence of interacting with the cadavers in this particular biomedical space of the anatomy lab because of the very purpose of these cadaveric bodies: namely to learn and teach anatomical-medical knowledge by way of the authentic anatomy provided by the human body. In the anatomy lab, the cadaveric body is infused with what Catherine Waldby terms "biovalue," or "a surplus value of vitality and instrumental knowledge which can be placed at the disposal of the human subject" (Waldby 2000: 19). In other words, biovalue is produced whenever human material, what she terms "marginal forms of vitality" ("foetal [tissues], the cadaverous and extracted tissues, as well as the bodies and the body parts of the socially marginal") are "transformed into technologies to aid in the intensification of vitality for other human beings" (Waldby 2000: 19). Biovalue can be found whenever the human body as bodily matter—organs, tissue, and the whole cadaver—is "instrumentalized" in ways that make that human material "useful for human objects" in "science, industry, medicine, agriculture, and other arenas of technical culture" (Waldby 2000: 33). Waldby originally introduced this concept in relation to biotechnologically rich environments where the human body is translated into informatic code (as in the Visible Human Project) or extracted in the form of viable human tissue for biomedical research or donation (and circulated in what she and Robert Mitchell term "tissue economies") (Waldby 2000; Waldby and Mitchell 2006). The biovalue of stem cells or human blood is not only dependent upon its instrumentalization (being made into a useful technology) but also upon its physical separation from what is usually taken to be the living human body. By separating these tissues from the body and "setting up certain kinds of hierarchies" among them, biotechnology seeks to "change their productivity along specific lines" (Waldby 2000: 19; Waldby 2002: 310). And this separation from the body and enactment of biovalue usually involves those bodies "at the margins of life or death" ("nearly dead or not-quite-alive") (Waldby and Squier 2003: 28). Though Waldby identifies this process as taking place at "the level of the cellular or molecular fragment" and *not* "at the level of the body as macro-anatomical system," I would argue that the cadaveric body of the gross laboratory is no less invested with biovalue through its instrumentalization and perceptual separation from the typical body of living personhood (310). In the technologically less advanced anatomy lab, biovalue is expressed in the cadaveric body as participants (students and TAs in particular) come to recognize the descriptive and relational values of the anatomical body, a formation of concepts imposed on and enacted by way of the former living humans in the lab. The cadaver becomes the object of anatomy and the primarily text on which this anatomy is written. Through the development of a particular habitus, the living participants' bodies become tools used to read the anatomical body (of knowledge). To learn anatomy is to adopt an observational-embodied look that incorporates vision and touch, one that requires a physical interaction with the cadavers. Or as James, one TA in the undergraduate course, discussed, "you need to touch things [like nerves, arteries, and veins], feel it, to know it." This haptic experience, which occurs when one "makes of the body a tool" (in Merleau-Ponty's words), is caught up in the processes that invest the cadaveric body with biovalue. The living bodies in the lab, then,

operate as a type of corporeal biotechnology that, through a particular type of embodied, observational engagement (one that is both physical and perceptual), transforms the cadaveric body by anatomizing it—literally cutting into it and at the same time rendering it as anatomy.

One of the course instructors provides a more detailed and perhaps even beautiful account of this complex (and not unproblematic) movement toward anatomization:

> [1] You're so wrapped up in identifying muscles that it's no longer–, I mean, you still appreciate that it is human, I mean, you still have the respect. But you're mindset is, you know, "I have to learn this muscle. I have to learn this intestine." And so the—I think it is a concentration on the learning to overcome your, to overcome your inhibitions about a dead body.
>
> [2] But I mean, it could go—well it all goes from the students being afraid to get close enough to even touch, and they are hesitant to look. But two or three weeks later, you know, they are up to their elbows moving organs around. So, so, it's, it's an odd phenomena, but it's just, ah, it's kind of a switch that goes off, you know. Before you know it, you are just fully stuck into learning.

First, in section [1], this instructor describes how the participants' focus on the objectives of the course and the practices of the lab encourage them to hone in on the specific structures and not the overall bodies themselves. Though, as he argues, this focus on structure does not preclude a respect for the personhood of the cadaver, particularly a respect for the gift of cadaveric donation that made this anatomy experience possible in the first place. Second, once students make this transition, they become, in his words, "fully stuck into learning." This very kinesthetic and embodied metaphor describes the way that students literally and figuratively push themselves bodily into the content of the course (anatomical knowledge) and the actual learning tool of the course (the human cadaver). And the "switch that goes off" perhaps represents the effects of certain dispositional tendencies and the role the observational-embodied look plays in the development of those tendencies. For the participants in the gross lab, clinical distance, I argue, then is more than merely forgetting the personhood of the cadaver or even removing themselves emotionally from the task but instead involves a complex perceptional shift, and the development of habitus, that allows them to simultaneously view the body as both person and specimen as well as both engage with and disengage from the emotional content of dissecting and demonstrating this human body.

Conclusion

In this article, I have sought to illustrate the habitus of anatomical education, a perceptual lens through which a student, TA, or instructor of anatomy comes to understand the human body as always the anatomical body, projecting anatomical discourse onto the body. Specifically, I have recast this concept as part of a way of seeing, an observational-embodied look, a term I use to describe the ways in which acts of looking imply not only viewing with the eyes but touching with the hands. The hands, in a sense, come to see as much as the eyes. Again, to quote Luther Holden, one object of anatomy laboratory education is "to induce in students the habit of looking at the living body with anatomical eyes, and with eyes, too, at their finger ends" (1025). Through their ever-growing awareness of both the descriptive and relational values of anatomy (how structures do or should look and how structures relate to and work with other structures), students learn to incorporate anatomical knowledge as an embodied knowledge. And participants in the lab learn these values through an interrogation of and reflection on the visual-material texts of the course—the images, the objects, and the bodies. As a way of bringing together my articulation of embodied learning as well as how participants in the anatomy lab engage in these practices, I will end with a visual illustration (Fig. 1).

This student, who I will call Ted, writes down notes from the whiteboards during one of the open lab periods. After I took this photograph, for which he granted me permission, I asked him how things were going that day. "Slim pickings," he told me, pointing to the board. He went on to explain that there was not that much "that grabs me" today. At my long pause, he clarified that none of the information on the board

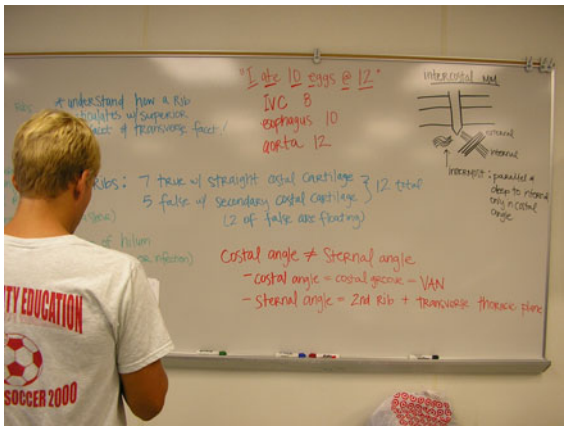

Fig. 1 A dental student copying information from a white board

really warranted copying, because he already either knew the information or had it in another form that would be more helpful to him. When I asked him what he was writing then, he turned the notebook so that I could see it. On the page was a drawing not transcribed from the board but created by him from some of the information on the board. He explained that "this will help me get it, teach it to myself later." I nodded and paused. Taking this as a cue to further explain, he told me if he could draw it, if he could "make it go" where it needs to, then he would know that he "really knew it." Here, an observational-embodied look involves taking down anatomical words from the board, rendering them as an interrelated set of images, using those images to review the structures-in-question, and, as a result, learning to see the human body as the anatomical body.

According to my argument, the student, the board, and everything in that room constitute what I, inspired by Merleau-Ponty, Pierre Bourdieu, and Herbert Dreyfus, term the intentional arc, the social and perceptual world in which this student's body is immersed. The intentional arc of the anatomy lab is constituted by an array of texts that students must interact with and use as tools, in order to make meaning out of anatomy. This is exemplified here by one student's act of using the information on the whiteboards. But rather than merely copying it as it is, he transforms it into a visual display that allows him to understand both the descriptive and relational values. And why this act of drawing and why not just copy the verbal descriptions? Because he perceives a particular affordance in his social environment (his intentional arc), one offered by both the whiteboard and the information on it. This drawing, this visual-material instantiation of anatomical discourse, will become a tool, a text, and a perceptual instrument he will use to make sense of the body. I call it a perceptual tool because of the way it and the bodily practices that lead to its creation will shape his perceptions. This drawing, after all, is a representation of the anatomical body, a body that due to his socialization in the labs is merging more and more with the physical body of lived-through experience. This view of the body as always anatomical and his use of these visual texts to reach a maximum grip of the content, the concepts, and the social practices of the course form in this student certain dispositional tendencies that will shape how he understands the body and the world around him. And it is through all of this that he will learn anatomy.

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