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– ARTICLE –

'MUTANT FISH ONLY':
EPISTEMIC HYBRIDITY AND THE BOUNDARY WORK OF MEDICAL ILLUSTRATORS

Drew Danielle Belsky[1]

ABSTRACT

Drawing on two years of ethnographic research in North American graduate programs and professional gatherings for medical illustrators, my research builds on feminist studies of science and technology to understand how expertise and agency are negotiated in this female-dominated biomedical specialty. The disciplinary storytelling practices of medical illustrators navigate an insecure relationship to biomedical authority by reinscribing normative social hierarchies of gender, race, class, size and disability. When entering the profession, medical illustrators situate themselves as misfits and hybrids, straddling the border between rhetorically opposed territories of 'art' and 'science.' In the course of their graduate education, this tension is resolved by recasting this epistemic border-crossing as 'storytelling' and communication of scientific knowledge to those without it. This professional boundary work contains the potential disruption of epistemic hybridity by constructing their work as fundamentally subservient to biomedicine, limiting the potential to challenge conventions of representation and inclusion in the profession.

Keywords: medical illustration; professionalisation; diversity and inclusion; boundary work; borderland

INTRODUCTION

As night falls on a long charter bus ride between two graduate programs in medical illustration, a group of first-year medical illustration students discuss how they arrived in the program. With ample time to embroider upon their stories, each student traces their steps from high school, university and beyond. The stories vary enormously in specific content: struggling to finish high school and then discovering and tailoring an undergraduate degree in technical il-

lustration; a month spent preparing a last-minute portfolio while finishing an honours undergraduate science research project; an undergraduate degree in history while drawing cartoons for a student newspaper. They unfold at a leisurely pace, dwelling on specifics and feelings, doubling back to include additional details, leaving little out. The students' excitement at having an audience for their stories is evident; other students listen and occasionally chime in with their own experiences and feelings. I am drawn into the complexities and the intimacy of students getting to know each other by sharing their histories in the dark; I do not take any notes.

A year or so later, in 2018, another trip, another group of students. This time we are crowded awkwardly into seats on a suburban transit train, returning from an orientation-related social event. A few of the second-year students are discussing their process of finding this field. One asks whether others feel as though a part had always been missing, but here 'you get to be whole.' She is met with nods and a general sense of agreement. Another compares her experience to being a 'mutant fish in a pond of regular fish.' Coming to this program, she continues, is like being put into a pond that says, 'MUTANT FISH ONLY.'

Although medical illustrations have been produced throughout the world for centuries, in the twentieth century a distinct profession emerged in North America. The earliest training programs were founded in the early part of the century in Chicago and Baltimore, but during and after the Second World War, networks of mostly female medical illustrators developed additional training programs and formed a professional society: the Association of Medical Illustrators (AMI). There are currently four two-year masters-level graduate programs in medical illustration accredited by the Commission on Accreditation of Allied Health Education Programs (CAAHEP) in North America, via the AMI's Accreditation Review Committee for the Medical Illustrator. Graduate programs are typically affiliated with faculties of medicine and/or allied health sciences at large, research-intensive universities. Admission is extremely competitive, including reviews of transcripts, an art portfolio, and a personal interview. Each accepts between 16 and 20 students per year, with the exception of the oldest and most prestigious program, which admits only four to six students per year. I visited three of the four graduate programs and attended the AMI annual meeting in 2017 and 2019, as well as participating in professional gatherings and student exchanges. In addition to participant observation and informal conversations, I interviewed 28 students, faculty, and practitioners between December 2016 and April 2019.[2]

Over the course of my research and encounters with medical illustrators, I heard many describe their entry into the profession. Most stories follow a similar narrative arc: periods of searching or wandering, feeling out of place or incomplete, punctuated by a moment of discovery and connection. The first act usually includes an intense interest in either art or science or both, while also feeling that the typical career and life paths afforded by these interests do not 'fit.' Almost invariably, graduate students, faculty, and practicing medical illustrators position their background in relation to art and/or science. The binary of art and science is a key element of each story, regardless of the exact unfolding of events. As graduate students transition into professionals, this division between 'art' and 'science' is transmuted into an emphasis on communication, teaching, and 'storytelling.' The denouement of the narrative is the integration of the teller into the community of medical illustrators, frequently compared to a 'second family.' These stories emerge as relationships are forged both in graduate school and in professional life, and serve as a point of connection, enabling a sense of commonality despite a wide variety of individual trajectories and experiences. Although each narrative is unique, most include some version of these elements, which are mapped onto other versions in the retelling. Personal stories become touchstones that mark the tellers' belonging to the community and acceptance of its values and practices.

Medical illustration is an embodied material-technical process that defines and enshrines bodily boundaries as both scientifically and socially salient. Like the creation of medical illustrations, forms of professionalisation, such as graduate education, are normalising practices. They establish the boundaries of professional belonging through a process of 'enculturation' (Subramaniam and Wyer 1998). Medical illustrators are fashioned as professionals both bureaucratically and socially throughout their graduate school experience. Graduate programs institutionalise professional norms by establishing a curriculum that reflects the core competencies and specific knowledge deemed necessary for credentialisation by the professional organisation and the larger legitimising structures with which it is affiliated. Curricula and faculty also actively define what constitutes professional expertise and comportment through the rhetorical shaping of the student's work and experiences, often reworking the ways in which graduate students make sense of their personal trajectories. This process situates the profession and individual practitioners within what Abbott (1988) calls 'the system of professions' in medicine by establishing the boundaries of their expertise and of professional belonging.

In this article, I analyse medical illustrators' self-fashioning through personal narratives of entry into the profession and the rhetorical re-framing of their

expertise through graduate education. Drawing on nearly two years of ethnographic research and interviews, my research builds on feminist studies of science and technology to make sense of how expertise and agency are negotiated in this female-dominated biomedical specialty. I argue that the disciplinary storytelling practices of medical illustrators navigate an insecure relationship to biomedical authority by reinscribing normative social hierarchies of gender, race, class, size, and disability. Narratives of coming to the profession situate medical illustrators as misfits and hybrids, straddling the border between rhetorically opposed domains of 'art' and 'science.' Although the hybridity of their knowledge practices entails the potential to rework epistemic categories and boundaries, this tension is resolved in the course of their graduate education by recasting their border-crossing as 'storytelling' and communication to those without scientific knowledge. This restructuring through graduate education is a form of professional boundary work that contains the potential disruption of epistemic hybridity by constructing their work as fundamentally subservient to established relations of power and privilege in biomedicine.

Although feminists have paid particular attention to the ways that racism and sexism are embedded in medical illustrations, much of this work fails to adequately account for the agency of image-makers in composing visual information (Cartwright 1998; Moore and Clarke 1995; 2001; Parker 2016; Treichler, Cartwright, and Penley 1998; Tuana 2004). Grounded in a feminist materialist approach to knowledge, I argue that the historical and disciplinary stories deployed as part of professional identity formation cannot be disentangled from the knowledge generated by these professions. In particular, I attend to how race, gender, and class have shaped the professionalisation of medical illustration, the way that disciplinary histories are told, and perceptions of the epistemic value of both their labour and their artifacts. In 'Situated Knowledges,' Donna Haraway asserts that '[b]oundaries are drawn by mapping practices; "objects" do not preexist as such' (1988, 595). She emphasises the performative aspects of knowledge production, a reflexivity that 'allows us to become answerable for what we learn how to see' (Haraway 1988, 583). Through her articulation of 'agential realism,' Karen Barad proposes that 'reality is sedimented out of the process of making the world intelligible through certain practices and not others' (2000, 236). Following Barad, I suggest that what is at stake for medical illustrators is not 'representations of an independent reality' but rather 'the real consequences, interventions, creative possibilities, and responsibilities' of those practices and of their own agentive roles in the making of scientific and medical knowledge (2000, 237). Drawing on Karin Knorr-Cetina's canonical analysis of 'epistemic cultures,' I approach medical illustration as part of the 'arrangements and mechanisms' that 'make up how we know what we know'

about bodies in a medicalised western context (2009, 2). I evaluate historical and contemporary materials for what Michelle Murphy has called 'regularities' – defined as 'the pattern of arrangement that is repeated, congealed, and constitutive of a scientific discipline or epistemological tradition' – in order to develop an understanding of how medical illustration is materialised in tandem with its biomedical objects and material practices (2006, 13).

MUTANT FISH

Prior to their decision to pursue the field, most medical illustrators describe not fitting into traditional programs of study or social groups, and a sense that they had to choose or that something would always be missing. They articulate this sense of wandering, contradiction, or incompleteness through a sharp divide between the scientific and the artistic, two 'sides' that seemed incommensurable. When I asked about his background, Eric, a junior faculty member, described a particularly zigzagging path:

> So, I started a general degree, then decided I wanted to be in the sciences. Near the end of my science degree, I actually dropped out of my science degree because I found that all I was doing was making art. So I thought, I'm changing directions and this is my path. I am an artist. And I did a fine arts degree. And when I was completing the fine arts degree, I thought, this isn't quite what I want to do either. […] But all to say I just knew this wasn't quite – this wasn't the right fit. And frankly, I was missing dealing with some aspects of science and having that being more a part of my life.

Like Eric, many students and faculty expressed a sense of separation between the artistic and the scientific, contrasting them even as they expressed the convergence of their own interests and aptitudes. Although this division is not always a source of tension, the assumption that such a division exists underpins the narrative arc and the respondent's trajectory. Parallel statements joined by a coordinating conjunction are common: 'I always liked drawing, but I was always interested in biological science,' explained one faculty member (Brian). A student explained, 'I was working in a research lab and I've always done art, but I didn't really think that there was a field that could combine the two' (Una). These descriptions repeatedly frame science and art as seemingly irreconcilable bifurcating paths between which they felt they must choose.

The rhetorical demarcation of art and science as distinct and even opposing epistemic practices has a long history upon which the discursive boundary-

drawing of medical illustrators is built. Despite ample evidence of the co-production of scientific knowledge and representational practices, tensions between the two are a perennial concern (Kemp 2010; Lynch 1991; Smith 2006; Wise 2006). Indeed, Lorraine Daston and Peter Galison (2007) argue that the evolution of 'objectivity' as an epistemic value can be traced through disputes over what constitutes proper practices of visual representation in science. They argue that the forms and usage of images in science reflect anxieties about both the role of human actors and the ability of representations to reflect a reliable and ontologically stable version of nature. As the substantial literature of scientific representation in Science and Technology Studies (STS) and related fields attests, the contours of these anxieties have changed over time, and are also contingent on the precise nature of representations in question (Burri and Dumit 2007; Coopmans et al. 2014; Frow 2012; Vertesi 2007). Although graphs of experimental data, molecular models – more recently COVID-19 modelling – and anatomical illustrations each elicit different concerns, the epistemic character of images and image-making remains a core anxiety. Given this long history, it is perhaps not surprising that tensions around representation and valid scientific knowledge lie at the core of medical illustrators' occupational insecurity and professional self-fashioning.

The early stages of medical illustrators' professional narratives not only recapitulate broader social assumptions about the place of art and science in society, but they also illustrate the ways in which educational and career structures organise around and reinforce these divisions. Practitioners often describe having come to science or art late as a result of having dismissed one in favor of the other at some earlier point in life. For many, art was something to be done 'on the side,' while science was seen as a more serious and difficult but more economically stable pursuit. This was especially true of those who began in science careers or pre-medical studies. Several confessed that they or their families had not considered art an acceptable or sensible career path. Faculty member Freja joked that 'making my living as a painter' really meant painting while 'doing other things to make a living.' Although many were supported and encouraged by family members, others encountered resistance to their change in focus. For example, Julie, an early career faculty practitioner, described being introduced to the field by her mother, a lecturer in biology, at a young age: 'I think she was like, oh man, I hope she doesn't think, "I'm a fine artist!" you know, because of the financial issues with that.' A graduate student who left a lucrative engineering position to attend intensive drawing classes and prepare applications described navigating a good deal of family tension over his choice. Although he attributed much of the friction to cultural expectations of his Asian-American family, other students commiserated. Pursuing medical illustration not only

requires explanation but also justification, especially when giving up a more easily understood and economically secure STEM career.

Those who began as artists, illustrators, or graphic designers before (re)discovering an interest in biological sciences often described having been deterred from sciences and math early on in school. Rachel, a graduate student, explained that she had 'kind of just closed my mind off to, like, science and math.' She attributed this attitude to the prevailing climate that 'if you're talented enough at the art that you do, don't worry about the academics.' Similarly, Freja summed up her reasons for at first dismissing a scientific career:

> At a certain point in your life it's like, oh, you're an artsy-type; oh, you're the science-type. And there's this kind of division that happens, or at least when I was in high school. […] And that kind of sense that you couldn't somehow bridge those camps was very, you know, it was really deeply engrained.

On the other hand, some took advantage of this unequal footing when navigating educational trajectories. Brian, another mid-career faculty member, described his attempts to organise his undergraduate education around his interest in medical illustration:

> Like a lot of schools, if you're a science major you can't take fine art courses, but if you're a fine arts major you have to take some science courses for your general liberal requirements. Okay, fine, so I enrolled in the fine art program and then for the outside courses I took a lot of biological science and anthropology.

These narratives recapitulate not only the incommensurability of science and art but also conventional hierarchies of knowledge that situate scientific careers and subjects as more necessary, difficult, and economically valuable, while arts and humanities are institutionalised as facultative and even opposed to 'academics.'

Most students and practitioners I spoke with repeatedly identified the fields of art and science as distinct, even opposite, and thus incompatible domains, until medical illustration offered a place for both at once. Their feelings of division and wandering between disciplines are reconciled through the discovery of 'a field that could combine the two' (Una). In a short biography commemorating her forty years as head of the oldest training program, Ranice Crosby responded to her biographer's question of 'how a young person can determine

if he or she is inclined toward a career in medical art': 'Do you sit on the fence, trying to be comfortable and satisfied? Are you afraid to fall in the science or art pasture and never see over the fence again? You've got it!' (Cody 1993, 17). Medical illustration emerges as the resolution of division, a third way, or as Crosby puts it, 'a place to sit happily "in the middle of the fence" and not be accused of fault or indecision' (Cody 1993, 17). Crosby, like many others, positions the field in the borderland of two seemingly irreconcilable worlds.

The discovery of medical illustration as a career not only offers a resolution to these epistemic tensions but also sparks an ardent and enduring commitment. Many practitioners described a pivotal moment of connection with the visual culture of science, which shifted their focus away from a more traditional career, with a flush of excitement:

> I was still interested in going into medicine, loved art, went to a nursing career seminar because my guidance counsellor knew I was interested in life sciences [and] health profession[s], and there was a brochure, like a book, that had all of the different health professions that you could go into. Just like a typical book you'd get from a guidance counsellor. And there was this picture of a woman sitting at a drawing table, much like the one you see right there, with a skull and this eyeball in the background and all these pictures, and I – being a visual person – I didn't read the article, I just kept looking at the picture and thinking, what is that? And then I read about it, and it was like this epiphany. Like [a] life-altering [laughs] utopian choice that I'd never even thought of, and I immediately went to the library and looked up everything I could about the field. And the more I learned, the more I – this was like a calling. (Karen)

Like Karen, a mid-career faculty member, students and practitioners usually described this 'a-ha moment' (Genesis) in a heightened affective register, peppered with exclamations, gestures, and emphatic repetition. Feelings of relief, excitement, and passionate drive accompany the discovery and subsequent decision to pursue medical illustration as a career. For some, this meant applying 'the next day' (Diana), while others single-mindedly dedicated months or years to completing the requisite science coursework, developing a portfolio (as required by all four accredited graduate programs), and applying, sometimes multiple times. The turning point is experienced as a coming together of oppositional extremes, as though the order of things that the speaker had previously accepted had been utterly upended and replaced with an entirely new vision of the world.

Sociologist Thomas Gieryn introduced the concept of 'boundary work' in 1983, defining it as a rhetorical practice (enacted primarily by scientists) involving the 'attribution of selected characteristics to the institution of science (i.e., to its practitioners, methods, stock of knowledge, values and work organisation) for purposes of constructing a social boundary that distinguishes some intellectual activities as "non-science"' (Gieryn 1983, 782). Through this work, Gieryn argues, scientists establish and maintain their own credibility and authority to make statements about the world by describing and differentiating their work from other kinds of knowledge. This differentiation takes three basic forms: protecting their own autonomy and authority from incursions by political or corporate interests, expanding their 'ontological domain' as a reliable source of knowledge, or rejecting the legitimacy of other knowledge claims, groups, or practices as unscientific (Gieryn 1999, 15–17). Subsequent work in science and technology studies and related disciplines have examined and developed these ideas further, including expanding the framework to encompass internal boundary work within and between scientific disciplines (Amsterdamska 2005; Burri 2008).

What remains constant throughout the scholarship on boundary work is the 'cultural space of science [as] a vessel of authority' (Gieryn 1999, 15). The precise shape and contents of the vessel may be in dispute, but not its existence or importance as a location of authority. Gieryn argues that 'the epistemic authority of "science" as a cultural space is chronically reproduced [and sustained] through repeated and endless edging and filling of its boundaries' (1999, 14). Like the reiteration and anxious repetition of racial and sexual categories, the boundaries separating science and non-science must be endlessly re-drawn precisely because they 'can never really, in discourse, be proved' and can only be made to matter through the boundary-drawing process itself (Bhabha 1994, 14). The repetition of supposedly obvious boundaries is both a discursive marker of categorical anxieties and the instrument of their durability.

In the case of medical illustrators, professional boundary work involves a rhetorical move that first inscribes a boundary between art and science, then constructs professional expertise as the ability to move across that boundary while remaining within the legitimate domain of science. In the course of graduate education, faculty model professional boundary work and professional values for future medical illustrators, transmuting the art/science binary formula into a concern for 'communicating effectively.' Like students, faculty explanations of medical illustrators' expertise also hinge on aligning certain abilities with 'art'

and others with 'science,' but they reorient this relationship to privilege science as the position of knowledge in need of transmission, reducing art to a set of technical skills or tools deployed in achieving that purpose.

'I kind of feel like we're artists that think like scientists,' posited one program director, George. He explained that thinking 'like scientists' meant thinking 'analytically,' having 'really keen observational skills,' and a concern for accuracy and 'getting things right.' Although attributes like creativity and problem-solving ability were sometimes described as artistic traits, George explained, '[i]t's not a fine art kind of creativity.' Indeed, at one point he even deftly reclassed observational skills as something that 'scientists have.' George referred to the science/art dichotomy repeatedly, not only to make sense of his own trajectory into medical illustration but also to situate the history of the profession: 'I've seen that shift in the profession where it was, like, we're artists, you know, and we do science. And now it's sort of like we're both scientists and artists, if not more science.' For him, this shift was reflective of the increasing volume and complexity of scientific and technical knowledge required, alongside economic pressures to produce and adapt ever more quickly. However, regardless of changes in technology or scientific knowledge,

> it'll still have the communication problem, something you need to educate someone on, and you have to analyse it and figure out how to do that and how to do it the best way. I don't see that changing, how could it? We wouldn't be doing the same thing anymore. It wouldn't be our profession anymore. (George)

Although his description suggests a synthetic aspect to their work, he identified communication as the through line connecting disparate and evolving material practices. For George, 'teaching and problem-solving' is 'the foundation' of the profession.

The border-crossing experiences and knowledges of medical illustrators are transmuted through this third element: communication. In an interview, the head of one graduate department, Lisa, hastily sketched a Venn diagram with three overlapping circles. She explained,

> When students come in, I think that they think that it's science and art. Part way through the program, we help them realise it's science, art, and communication, and my belief is that the most effective medical illustrator has science and art, but a solid, solid foundation of communication and that's what – that the science has to be accurate,

> but it's not the beauty of the art or the power of the art, it's the art in service of communication, I think. (Lisa)

It was not her first time using this explanation, and indeed her colleague Karen referred approvingly to having seen her present it in a recruitment session. Karen echoed Lisa's 'three parts,' emphasising the need for both 'good rendering skills,' scientific training, and communication skills:

> It's like, if you can't communicate putting all those things together, your illustrations are not going to teach anything. An illustration is a piece of artwork that teaches, and if it's not teaching anything, then it's just a piece of art. Yeah. You have to be able to tell a really good story. (Karen)

Like most practitioners I spoke with, Karen's description explicitly distances their work from 'art' by stressing its purposiveness and prioritising functional goals of teaching and storytelling over aesthetic flourishes. This repeated emphasis on purposiveness and instrumentality establishes a field that is neither art nor science, but rather a mediator between those with knowledge and those without. The end goal is to 'tell a really good story' about science.

The vocabulary of storytelling is pervasive in the field: 'the storytelling really is where the magic happens,' laughed Julie, a faculty practitioner. Although one might expect the idea of story in medical illustration to refer to the temporal unfolding of a natural process or clinical encounter, the discourse of storytelling extends beyond narrative functions. For medical illustrators, 'storytelling' encompasses decisions about elements or details to include or omit, providing context such as spatial relationships and scale, and managing affective responses through aesthetic choices. The language of story and storytelling becomes a shorthand to describe the plotting and management of a viewer's experience. The audience's attention must always be focused on the *right* things, collectively understood as 'the story.'

The discourse of storytelling and communication enables medical illustrators to elide the generative and potentially disruptive epistemic possibilities of scientific representational practices by positioning their work as merely documentary. The labour of medical illustrating not only encompasses substantial research, conceptual ability, decision-making, and rendering skill, but also inventive and speculative work. The material exigencies of representational forms necessitate both synthesis of available information and close attention to detail, which in turn enable medical illustrators to identify gaps and dis-

crepancies. In this telling, the medical illustrator must be able to imagine and manipulate objects in space and time in plausible ways and to make complex inferences from incomplete information. Although it is possible to minimise gaps in knowledge through various aesthetic choices, the need to make that choice consciously opens up possibilities for addressing those gaps and generating new questions. However, the shorthand of storytelling repackages these generative practices as the ability 'to create an image that tells the story *that the specialist wants*' said Paul, a senior faculty member (emphasis mine). This construction situates medical illustration as purely documentary and medical illustrators as fundamentally subordinate to the researchers and physicians with and for whom they work.

When graduate faculty and working professionals emphasise communication or storytelling as the key elements of professional expertise, this influences how students understand the work and what they are meant to be learning. Students are enjoined to 'show the story of it…' and to include or omit details depending on whether they are 'part of our story' (fieldnotes). As they progress through the program, students quickly adopt a similar language, which in turn structures their personal narratives and professional values. Although some students I spoke with earlier in their graduate work mentioned storytelling and communication, they had difficulty articulating themselves and acknowledged that certain concepts that they believed to be important were 'still kind of fuzzy' (Wes). By their second year, students had developed a more robust vocabulary to describe and situate their own expertise, often in very similar terms to their programme directors. Xenia, a second-year student, links the shift toward thinking about her work in terms of communication and problem-solving directly to her coursework and conversations with faculty:

> We talked about it and before that I had just been like, oh, a medical illustrator is somebody who understands science and somebody who draws. And it's not just that, visual problem solving is what we're really good at. How do you come up with a solution that will fit your audience? How will you integrate all of this information into something that communicates effectively? So, it's not just, like, a pretty picture plus science, because anybody can draw a pretty picture of a heart or a pretty picture of bones or nerves if they use good references. But trying to communicate what those things do? That's something that not everybody can do if they just are good at art or they're just good at science. So, communication, effective communication, is the biggest thing, I think. (Xenia)

Unlike incoming students who struggled to put their thoughts into words, she proudly declared, 'That's my spiel about medical illustration.' Over the course of their graduate education, students reconfigure the science/art dichotomy by learning to construct their expertise as 'communication' and 'storytelling.' As they progress through the programme, they model this 'spiel' in conversations and critiques, both honing and reinforcing its explanatory force. The transition to professional is thus the transition from 'good at art & science' to 'storyteller.'

The discourse of storytelling enables medical illustrators to resolve the tensions between art and science by recasting their expertise as mediation. However, this move also serves to reinforce the binaries and borders at the heart of their epistemic conflict. In 1993, Bruno Latour suggested that the tidy distinctions and dualities (most particularly of 'nature' and 'society') that post-modern intellectuals of the late twentieth century had eagerly sought to dismantle never really existed in the first place. Instead, he argues, these two poles are established and maintained through the practices of 'translation' and 'purification.'

> The first set of practices, by 'translation,' creates mixtures between entirely new types of beings, hybrids of nature and culture. The second, by 'purification,' creates two entirely distinct ontological zones: that of human beings on the one hand; that of nonhumans on the other. (Latour 1993, 10–11)

Practices of translation between poles create hybrids, whose existence (and necessity) is dependent on their purification into distinct and totally separate realms. Indeed, Latour argues, 'the second has made the first possible: the more we forbid ourselves to conceive of hybrids, the more possible their interbreeding becomes' (1993, 12). This 'modern paradox' enables the proliferation of fantastical polymorphic nature-culture hybrids whose existence depends upon the very binaries that fail to contain or explain them. The constant repetition and purification of binary categories makes hybridity and mediation possible precisely by ensuring that they are kept separate.

The separation into binaries is as inherent to western technoscientific modernity as the hybrid techno-cultural formations, knowledge, and networks of human/non-human forms it produces. Gloria Anzaldúa's foundational work *Borderlands* explores life along literal and metaphorical borders as not only a clash of cultures but of forms of knowledge: '[the] coming together of two self-consistent but habitually incompatible frames of reference' (2012, 100). She proposes that the 'new *mestiza* copes by developing a tolerance for contradictions, a tolerance for ambiguity' (Anzaldúa 2012, 101). For Anzaldúa, this

ambiguity is resolved through the formation of a *mestiza* consciousness which allows her to 'break down the subject-object duality that keeps her a prisoner' (2012, 102). In their everyday practice, medical illustrators cultivate a hybrid identity in order to navigate the contradictions and ambiguities of scientific and representational knowledges. However, as Paula M. L. Moya (1996) points out, although the generative, boundary-crossing potential of hybrids is formed at the nexus of friction – physical and social locations where cuts and borders have been imposed – this position is not inherently liberatory. Indeed, Moya suggests that although hybrid cultural identities enable 'a critical perspective,' these embodied and often painful realities are not inherently 'transgressive' simply by virtue of their indeterminacy within established cultural categories (1996, 128). In the case of medical illustrators, the potential for such a critical perspective – whether born out of epistemological borderlands or embodied experiences of difference – is kept in check through the process of enculturation into the dominant category.

As is clear in the case of medical illustration, hybridity is not inherently disruptive to existing borders. Indeed, those who exist along the borders can be effectively recruited to patrol them. Throughout their graduate education, the epistemic uncertainties and contradictions of medical illustrators' early experiences are smoothed into a coherent narrative that reiterates binary distinctions and positions professional medical illustrators as mediators firmly allied with scientific values. By articulating science and art as incommensurable ways of knowing between which they are uniquely able to move, the personal narratives of medical illustrators enact Latour's (1993) 'purification' of modern categories, where science is construed as a reflection of non-human nature and art as human(-made) culture. At the same time, the rhetoric of communication and storytelling positions medical illustration as 'translation,' constructing themselves and their profession as hybrid figures uniquely capable of travelling between the two poles.

In both graduate education and promotional literature, it is accepted as given that a story needs to be told and that medical illustrators should tell it. However, focus on the craft of 'telling the story' as a question of navigating and manipulating an audience often obscures whose story is being told, and why. Banu Subramaniam has explored the persistent undercurrents of colonial classification practices and eugenic thinking in evolutionary biology, and how 'these complex histories are entirely erased within disciplinary histories' (2014, 67). Similarly, the training of professional medical illustrators overlooks its foundations in both unequal gender relations and colonial classification of human difference.[3] Although their work is often explicitly constructed to achieve

specific outcomes (such as encouraging certain behaviours in particular populations or commercial adoption of medical products), the social, political, or economic investment of the storyteller in the story being told is surprisingly rarely acknowledged. Staunch emphasis on meeting narrative goals skirts the inherent partiality of telling a particular version of the 'story.'

As a form of professional boundary work, repeated classification of medical illustrators' knowledge and skills in terms of science, art, and storytelling situates a small and difficult to categorise field of practice within the broader system of medical and scientific professions. The 'modern paradox' separates scientific knowledge from craft practice precisely because the skilful work of rendering is necessary to construct scientific facts as both knowable and self-evident. In order to maintain credibility within a field that has long been suspicious of representational practices (and women), medical illustrators position themselves modestly, as what one faculty member self-reflexively called 'transparent vessels' that merely translate and repackage knowledge generated elsewhere. Although this restructuring situates medical illustrators as experts, it ensures that they are not perceived as a threat to scientific hierarchies of knowledge by rendering their material and craft knowledge as subservient to the transmission of scientific knowledge.

FAMILY

Prior to pursuing medical illustration, personal origin stories often focus on division, incompleteness, and not fitting into established categories. Integration into the profession elicits expressions of belonging and kinship. Upon graduation, one student posted giddily on Instagram that, 'more than anything, I got a second family.' Indeed, the 2017 annual meeting of the Association of Medical Illustrators (AMI) was peppered with expressions of familial attachment and support. One long-time member even referred to the meeting as 'a family reunion… these people are my extended family.' Another member, presenting a lifetime achievement award, described the AMI as 'a calling, a family, a labour of love.' Several laughingly explained that medical illustrators often pair up romantically as well, legitimating their metaphorical kinship. As an ethnographer interloper, I knew that some degree of integration had been achieved when a faculty member assured me that my presence in their department would be missed: '[It's] like you're one of the family.' For graduate students, this incorporation into the professional family marks the conclusion of a process through which they transition from wandering disciplinary misfit to member of a new cohesive professional community. This rhetorical and emotional shift from misfit outsider to privileged insider – from 'mutant

fish' to family member – is one of the most profound markers of successful professionalisation as a medical illustrator.

However, not all families get on well. As Janet Carsten points out, 'hierarchies and exclusions … are part of what kinship enables' (2013, 250). Jeanette Edwards and Marilyn Strathern (2000) have addressed the prevalence of the family metaphor in constructing ideas of community in Euro-American cultures, marked by an emphasis on positive aspects of social connectedness and affective alignment while eliding the tensions and antipathies that can also characterise 'family.' They point out that ideas of belonging are not value-free, 'as though there were something productive and generative about making connections as such' (Edwards and Strathern 2000, 152). Academic analysis tends to follow these discursive habits, drawing uncritical connections between kinship and positive affect in a 'sentimentalized view of sociality as sociability and of kinship ("family") as community' (Edwards and Strathern 2000, 152). What is left out of benign accounts is that belonging and inclusion also imply both possessiveness and exclusion, establishing relatability (or lack thereof) as a product of 'the characteristics one owns and the people claimed as one's own' (Edwards and Strathern 2000, 153). Ideas of family and community (and the discursive slippage between the two) are embedded forms of social boundary-making, the same processes that permit the exclusion of those who do not fit in.

Emphasis on this 'big happy family' obscures the hierarchies and exclusions enacted both within the profession and in the products of medical illustration. Following a controversial presentation on 'Normativity and Diversity in Healthcare Images' by three early career practitioners at their annual meeting in 2016, the members and leadership of the AMI were forced to confront these frictions and the contemporary legacies of the field's colonial past. The presenters pointed out that, although the field has historically been female-dominated, the professional organisation remains overwhelmingly white, and men hold a disproportionate number of positions of power and leadership. Furthermore, despite decades of criticism, biomedical images continue to normalise a thin white male body as the standard from which all others deviate (Parker 2016).[4] Since 2016, the AMI has made efforts to address these separate yet interconnected issues. The organisation has begun to address the lack of diversity – most often construed as racial diversity – in both their membership and the images they produce through a variety of diversity initiatives, including a dedicated committee and conference slot, an official statement, and active recruitment among underrepresented demographics. Individual medical illustrators have also devoted considerable effort to bring these issues to the fore and to challenge representational norms in their own work. However, practitioners' at-

tempts to expand the range of bodies in their work are often limited by social and economic pressures to deliver uncontroversial products quickly or risk their own livelihoods.

As Sara Ahmed, Chandra Talpade Mohanty, Banu Subramaniam, and others have deftly explored, 'diversity and inclusion' initiatives often serve to obscure the structural exclusions and colonial histories at the heart of institutional and economic structures (Ahmed 2012). Such projects often defuse the threat of disruption to fundamental structures by recasting difference as 'benign variation' and historically-produced social inequalities as deficits to be overcome in order to fit in (Mohanty 2003, 193). Ahmed asserts that, in order for diversity initiatives to be put into place, they must be made commensurable with the existing institution and with the larger ideological space within which it functions: 'the story of diversity thus becomes the story of diversity's inclusion into the terms of an institution' (2012, 9). As Subramaniam pointedly asks, 'What does it mean to recruit a group into an enterprise that simultaneously teaches them about their own biological inferiority?' (2014, 221–22). A diversity predicated upon incorporation into the normative professional body fortifies the very structures that have excluded them by constructing the standards and norms of culturally dominant groups as 'normal and neutral' (Beagan 2000, 1262). In other words, the process of enculturation into the AMI 'family' may in fact undermine diversity and inclusion efforts by excluding those people and practices who do not evince sufficient family resemblance or adhere to family values.

CONCLUSION

Professionals and disciplines are made through boundary-drawing practices through which the criteria for belonging and right acting are made clear. These boundaries must be endlessly re-drawn precisely because they are only ever provisional and contingent, mobilised, and operationalised in discourse and in practice, but never truly fixed in place. The rhetorical construction of epistemic categories and professional values enables medical illustrators to situate themselves as experts without troubling the foundations of what constitutes legitimate scientific knowledge, the total separation of humans and non-humans, and of 'moderns' and their colonial 'others.' Through this double act of purification and translation, they reassert allegiance to the power and authority of science and medicine and secure access to the social and economic privileges that it confers. The process of professionalisation turns epistemic misfits into the standard-bearers of the scientific story, domesticating and containing the disruptive potential of 'mutant fish.'

As a predominantly white and historically feminised paramedical profession, medical illustrators' narratives navigate a precarious relationship to biomedical authority by re-inscribing modern categories and hierarchies of knowledge. Although personal origin stories begin by acknowledging the insufficiency of modern categories, the process of professionalisation contains and defuses the potential of this hybridity to disrupt those categories and the colonial hierarchies that structure them. Disciplinary narratives not only cement the disciplinary culture, they establish 'the terms of [the] institution' by demonstrating acceptable forms and paths to belonging. They frame analyses of changing circumstances and establish the kinds of stories that can be told (and the kinds of images that can be made) in the future. The boundary work of professionalisation repositions medical illustrators not as dangerous border-crossing hybrids but as mediators and 'storytellers' whose work re-inscribes (often literally) hierarchies of knowledge.

The position of medical illustrators at the borders of scientific and craft knowledges presents possibilities for intervening in the hierarchies and exclusions of biomedical knowledge, but, as Anzaldúa makes clear, the contradictions of incompatible cultures will not be resolved by constructing a third option in order to navigate between them. Both individual and collective efforts to diversify the profession and its products must also address the mechanics by which hybrid identities are de-politicised in the service of policing and maintaining boundaries. Medical illustrators' hybrid knowledge practices enable careful attention to how, why, and where boundaries are drawn, and to the material and social conditions through which particular forms of embodied difference are made meaningful. Only by cultivating a 'critical perspective' from the borderlands of medical knowledge can medical illustrators shift the terms of the institutions and values upon which the field is built (Moya 1996, 128). Perhaps by rejecting binaries and the hierarchies they enable, illustrators might build something altogether different in the space of 'untethered possibility' between them (Pinkvoss in Anzaldúa 2012).

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feedback provided by the editors and reviewers.

NOTES

1 Science & Technology Studies, York University, Toronto, Canada
Email:?

2 To preserve anonymity in a very small field, names, dates, and some personal details have been changed or omitted where not directly relevant. All of the faculty identified as white. Although some students I spoke with identified as Black or Asian, few explicitly situated this background in relation to their entry into the field or their identities as medical illustrators. While it is likely that my own whiteness inhibited interlocutors of colour from speaking entirely candidly about their experiences, it is noteworthy that even when prompted, respondents rarely made clear connections between medical illustration and their experiences of race, gender, or disability.

3 While it is well beyond the scope of this article to do so, the evolution of anatomical and medical illustration as a standardising and normative practice can be traced through colonial practices of anthropometry, collecting, and classification, as well as anatomical dissection. (See, for example, Cober 2015; O'Sullivan and Jones 2015; Pugliese 2005; Sappol 2003; Schiebinger 2004; Wallis 1995; Warner 2014).

4 The persistence of the Euro-American white male body as an anatomical norm, particularly through mainstream anatomy textbooks, is well-documented (Alexanderson, Wingren, and Rosdahl 1998; Giacomini, Rozée-Koker, and Pepitone-Arreola-Rockwell 1986; Lawrence and Bendixen 1992; Mendelsohn et al. 1994; Moore and Clarke 1995; Parker 2016). Although early studies focused primarily on gender, more recent work has examined additional axes including race, age, size, and visible disability, linking the lack of sufficient visual representation of global majority populations and diverse body types to disparities in medical research and treatment.

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