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Researching the Senses as Knowledge

A Case Study of Learning to Hear Medically

Sarah Maslen

ABSTRACT Research in the growing field of sensory studies has begun to identify the sensory aspects of experience, particularly in our engagement with material culture. What is yet to receive much attention is how the senses are acquired and used by individuals and communities, and how they inform action. Adopting Barth's argument that cultural phenomena are most productively examined as different kinds of knowledge, this article argues that the senses can be examined as any other knowledge source. This article demonstrates the value of examining the senses as knowledge through an account of learning to hear medically. This example is taken from a broader ethnographic study of the aural practices and experiences of ninety-two musicians, doctors, adventurers,

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and Morse code operators. It argues that hearing is learned, specialized, and specific to the places we go, the people that surround us, and the things that we do. To seek out the sources and value of this taken-for-granted aspect of our experience, it argues that the senses can be analyzed in terms of their foundations, their acquisition, and practice.

KEYWORDS: hearing, knowledge, learning, occupations, medicine, health

Introduction

We rely on our senses to make judgments and perform roles, whether these are mundane aspects of life such as road crossing, or more specialized tasks such as orthopedic surgery. The last decade has seen an eruption of studies that have looked at the sensory aspects of practices as various as using an iPod (Bull 2007), building sand castles (Obrador-Pons 2009), preparing food (Sutton 2006), and cliff jumping (Laviolette 2009). Sensory difference has been located in terms of time (Corbin 1998; Schmidt 2000; Smith 2004; Sterne 2003a), place (Connell and Gibson 2003; Finnegan 2007; Forman 2000; Gibson and Davidson 2004), and peoples (Berger 1999; Bijsterveld 2001; Feld 1990; Ferzacca 2006; Hegarty 2007; Walser 1993), and has been shown to be subject to change as well as resistant to it (Bijsterveld 2004; Hegarty 2007). These studies have powerfully described often taken-for-granted sensory aspects of daily life. However, they have been less successful at translating their interests into "analytical reflection" (Vannini *et al*. 2012: 9). In other words, studies have yet to establish an approach that moves from describing the senses to understanding them.

This issue of achieving analytical reflection has been engaged with by anthropologist Fredrik Barth. He argued that in order to understand differences that are often discussed as "cultural," it is valuable to examine them in terms of how they are "constituted, produced, and used" (Barth 1995: 67). Central to Barth's argument was his framing of cultural phenomena as knowledge. The consequence of conceiving of culture as knowledge is that it is less abstract, and it emphasizes "people's engagement with their world, through action" (Barth 1995: 66). As a heuristic, it also facilitates an examination of phenomena in terms of their processes and practices.

Adopting Barth's framing of cultural phenomena, this article argues that the senses can be examined in terms of their contexts, acquisition processes, and applications, like any other knowledge source. The connection between the senses and knowledge is not entirely new, but at the same time, there is potential for us to take a more systematic approach in this direction in order that we might

understand how the senses are formed and come to act. To take a step towards this, this article begins by reviewing the literature from sensory studies that has examined the senses in the context of knowledge. This literature is found to be conceptually useful, but lacking in sustained analysis of the uses of sensory knowledge, and its acquisition. To illustrate the possibilities of a systematic approach to the senses as knowledge, the article builds on this foundation by analyzing the aural learning of medical doctors. This account captures how multiple knowledge types and learning modes combine to build specialized aural skills, and points to the important place of hearing in medical diagnosis. In doing so, it demonstrates the value of approaching the senses in terms of their knowledge processes and practices.

Theorizing the Senses as Knowledge

When we think about knowledge, theory and formal education can readily come to mind. This is in keeping with dominant definitions of knowledge, and is reflected in the theoretical, dialectical, and scientific knowledges that have been given most attention in the social sciences and humanities (Berger and Luckmann 1966; Knorr-Centina 1999; Kuhn 1962; Latour and Woolgar 1979; Mannheim 1936; Rouse 1987; Scheler 1980). However, these elements of knowledge do not capture knowing in its entirety. Increasingly, taken-for-granted knowledges are coming into focus that demonstrate how knowing is messy, located in space and time (Turnbull 2000), specific to small social groups (Knorr-Centina 1999; Wenger 1998), personal (Glaser 2001), and much of it can be less than conscious or difficult to put into words (Duguid 2005; Klein 1999; Polanyi 1966). This broadening of understanding of the scope of knowledge is more reflective of the diverse ways and contexts in which it is applied, and opens an opportunity for an analysis of areas of knowledge that have often escaped attention, including the senses.

The following discussion draws together the existing sensory scholarship that has taken steps towards conceptualizing the senses as knowledge. This review aims to provide a foundation for future research within this conceptual trajectory.

Grand Narratives and Their Discontents

Early conceptualizations of the senses as knowledge have positioned this relationship at a societal scale, and have tended to focus on the primacy of vision. Seeing has been considered the dominant mode of knowledge acquisition in post-Enlightenment Western societies responsible for the progress of science and "object-centred thinking" (see Jay 1993: 21–147; Pacey 1999: 39–57). Vision has given the capacity to think and develop ideas, and to "observe" truth (particularly aided by technologies such as the telescope, microscope, and camera). The work of Foucault is an example of scholarship that has stressed the visual in the modern world. Foucault emphasized

a relationship between visibility, power, and knowledge that was observed to extend from modern prisons to the "surveillance" of daily life (Foucault 1977). As he contended in *Madness and Civilization* 'madness no longer exists except as *seen*' (Foucault 1967: 237).

The apparent dominance of vision has been attributed to an assumed shift from orality/aurality to literacy in processes of Western knowledge acquisition (Schmidt 2003: 41). Perhaps the greatest observer of such a shift from oral to written cultures, Ong (1982: 96) claimed that literacy "gives thought different contours from those of orally sustained thought," and facilitated the more complex, critical, and reflective ways of thinking that enabled the progress of Western civilizations. He argued: "Without writing the mind cannot even generate concepts such as 'history' or 'analysis' … [it] is an absolute necessity for the analytically sequential, linear organization of thought" (Ong 1979: 2). Ong's argument provides an example of a connection between the senses and knowledge at a macro level: vision enables analytical and rational thought and, by inference, oral/aural knowledge traditions lack these attributes.

McLuhan's work on communication technologies such as the alphabet and print media made a similar connection between thinking styles, knowledge, and sensory modes. For McLuhan (1962), these technologies affect cognition and social organization, specifically through the change in perceptual input. He argued that the development of print technology contributed to key ideological shifts in the modern Western world, including the rise of individualism, democracy, and capitalism. Similarly, Anderson (1983: 77) argued that literacy and print media were primary technical means by which national identity could be maintained, because they "mapped different realms." In other words, the acquisition of new visual technologies was accompanied by visual knowledge which enabled a national identity.

These scholars have drawn attention to the capacity for the senses to mediate thought and action, that is, that the senses are a foundational knowledge. However, they have also been criticized for taking a selective view of the senses and knowledge in modern Western culture, and this critique has been the focus of scholarly attention. Their "visualism" or "occularcentrism" prompted a significant body of work which challenged the underlying assumption of a hierarchy of the senses. Many recent edited collections have taken this hierarchy as their starting point, and have sought to highlight the position of other senses in social life in response (see Bull and Back 2003; Classen 2005; Drobnick 2006; Erlmann 2004; Smith 2004). Given the emphasis on visual tools for knowledge creation such as the telescope and microscope, Schafer (2003: 35) critically wrote: "It is almost as if the great achievements of Western philosophy and science were produced in a huge anechoic chamber." Gouk (2004: 87) was critical of what she termed "simple, linear models" that suggested an all-encompassing and final shift away from

hearing towards knowledge through the visual, on the grounds that it was an inadequate model for understanding both early modern European thought as well as appreciating knowledge comparatively and cross-culturally.

While the work of Ong and McLuhan has been critically received, Classen's cross-cultural work on the connection between the senses and thought has escaped such criticism. Echoing Ong and McLuhan, Classen (1993: 136) argued "sensory models are conceptual models," and "the way a society senses is the way it understands." Looking at this relationship across time and culture, she argued that the dominant sense in a community – including a sense of thermal dynamics, smell, and color – influenced their worldview (Classen 1993: 121–38). That is, she held a similar interest in the connection between sensory modes and knowledge. However, while she argued there was a relationship between the senses and thought, in her cross-cultural focus and inclusion of non-visual senses she also addressed any "natural" hierarchy of the senses. Rather than one sense being best, sensory orders related only to time and culture. With these concerns over a sensory hierarchy addressed, the concept of sensory models acting as a foundational knowledge emerged as useful.

While arguments particularly about visual dominance have been critiqued, the more basic relationship between sensing and knowing is worthy of enduring interest. These grand narratives position the senses as foundational knowledges that structure or facilitate thought. However, their discursive foci have opened them up to criticism, and inhibited their capacity to provide a framework from which to analyze the constitution, production, and use of these sensory knowledges. To build on this foundation, we can examine sensory knowledges in terms of their principles, learning practices, and uses. This approach adds to our understanding of the senses as foundational knowledges by observing them in action. The present research has sought to contribute to this end.

The Senses as Self-knowledge

While some work that has emerged recently in sensory studies has been more concerned with challenging sensory hierarchies, the use of the senses in everyday life has also attracted interest, and has contributed to an empirically based knowledge/senses nexus. For example, an awareness of this relationship simmered beneath the surface of Tilley's study of gardening, which suggested that the sensory qualities of material artifacts become so significant to our lives that they "actively mediate how we think and how we act" (Tilley 2006: 312). In this case, the relationship between the senses and knowledge was not a central argument. Tilley demonstrated some of the significance of the senses in gardening, but he did not explore the relationship between the senses, knowledge, and practice. However, a limited number of studies have been more direct in their

conceptualization of the senses as knowledge at this micro social scale, preferring the idea of the senses as a form of self-knowledge.

One study that has been more direct in its consideration of the senses as self-knowledge was Hockey's autoethnography of long-distance running. Hockey brought together what he termed the "corporeal skills, knowledge and experiences" of runners negotiating their training routes on a daily basis (Hockey 2006: 184). Running was conceived as an application of a dynamic self-knowledge that was intimately tied to the senses in a particular place and time. He wrote:

> How distance runners see a hill as it approaches them, what the ground feels like as they ascend it, how their cadence changes as they engage with it, what the odor of their own sweat means to them as they labor up it and what their lungs tell them at the top of it – these cognitive and corporeal ways of knowing unfold as the route does itself. (Hockey 2006: 198)

This reflection demonstrates the role of the senses in an athlete's performance feedback during a run. Their cerebral and physical knowledge is dynamic, multisensory, and responsive. Hockey reflected that during the research process he became aware of a substantial stock of knowledge that may not be shared by a non-runner, indicative that this sensory knowledge was both tacit and specific to this epistemic community.

Like Hockey, DeNora argued that people had a remarkable self-knowledge when it came to their music and how they used it. For DeNora, music is a "technology of the self" used in self-regulation, self-modulation, and self-identity. In her research, respondents exhibited strong practical musical knowledge in terms of what they "needed" musically at any given time, regardless of musical training, whether that was to enhance or maintain a preferred physical state like excitement or relaxation, or to promote concentration, evoke memory, regulate emotion, or validate identity. One participant, for example, described using different combinations of music to gently wake up before switching music to get going in the morning (DeNora 1999: 35). Another described needing to be "careful" with music in minor keys because it could make her sad (DeNora 1999: 36). A similar idea was presented in Bull's studies of personal audio technologies. One iPod user expressed: "I always plan what I will listen to and it reflects what I want to hear or feel at that time" (Bull 2007: 30).

This issue of the relationship between the senses and knowledge again becomes a question of how they are established and come to act. In other words, how can we observe and understand sensory knowledge in its practices and processes. Macpherson spoke to this point in her study of a blind walking group. She argued that: "While we may all have objectively *relatively* similar bodies our actual sense of embodiment and sensation depends on how our body is put to

use, our body's past, and its future" (Macpherson 2009: 185). This argument resonated with the account by Hull, in which he observed that his own blindness changed the way he thought, and equally, that the resulting lack of knowledge prevented him from performing certain tasks. For example, he described how he could theoretically cross the road as well as a sighted person, but in practice he lacked knowledges like whether the lights had changed color or whether the road was clear of traffic (Hull 2001). These observations point to sensory influences such as context, experience, and *knowledge*, as well as physical ability. However, the focus of both articles was the "qualitatively different" sensory experiences people may have, and the issues this raised for discussion of the senses (Macpherson 2009: 184). This is no doubt a worthy subject of research. However, it is also important to discuss the development and application of the senses to move past description and understand them further.

Studies have carried out this task with varying degrees of success. Hahn's (2007) ethnography of the Tachibana school of *nihon buyo* explored the teaching and learning of this dance form, and its relationship to embodiment and cultural knowledge. Learning, according to Hahn, was multisensory and included visual, touch/kinesthetic, and aural/oral aspects. In writing up the research, Hahn focused on the cultural history of the dance form and its broader social aspects. The study was rich in description; however, it did not deeply address the underlying learning practices. Berger (1999) similarly explored music perception as learnt, but like Hahn, paid more attention to describing meaning-making than assessing it. Both of these studies had a goal of examining the senses in terms of how they are constituted and used, but focused more on description than analysis of their practice.

These studies conceptualize the senses as acquired, personal, and applied in the everyday, and illustrate some of the contexts in which sensory knowledge is used. They make a significant contribution conceptually, but have not included sustained analysis of the uses of sensory knowledge, or its acquisition. It is this type of analysis that Barth suggested we focus on in order to understand aspects of our experience and our differences that are often discussed as "cultural." Such an approach has, to date, not been applied to sensory studies. My research takes a step towards filling this gap. The rest of this article illustrates the possibilities of such a conceptual and empirical approach, by analyzing the process of learning to hear medically.

The Research

The findings reported here are drawn from an ethnographic study on the sensory practices of four occupational communities including doctors, musicians, adventurers, and Morse code operators. The focus of the project was primarily hearing within these communities. While scholars of the senses have argued for a multisensory

approach (Classen 1993; Edwards *et al*. 2006; Howes 2003), the reasoning behind this decision was a need to look more specifically at a particular knowledge, its acquisition, and application in order to obtain the necessary depth. At the same time, as will be evident in the following analysis, non-aural forms of sensory knowledge were also discussed in the research, and I include these where relevant.

A multiple case study design was used because it facilitated a detailed and intensive analysis of specific cases, while remaining comparative in nature. The comparative element of the project assumed that dynamics of social phenomena are better understood if they are examined in relation to two or more "meaningfully contrasting cases or situations" (Bryman 2001: 52). A comparative approach was particularly valuable for this research, because the sensory aspects of experience can often be taken for granted, or not easily put into words.

Semi-structured interviews were a primary data source, including a total of ninety-two participants across the four cases. Interviews focused on participants' lives, including their learning experiences and uses of hearing. Interview questions acted as a guide, or else a fallback if the conversation floundered or moved off topic, with the participant's narrative otherwise driving the discussion (Flick 2002: 86). Research questions included: To what extent is hearing specialized? What learning practices are used in the constitution of an individual's hearing? What is the involvement of communities in the development and maintenance of aural knowledge? And how is hearing used by experts in substantively different fields? Interviews lasted between 30 and 240 minutes, and were recorded and later transcribed with the consent of participants. The interviews were then thematically analyzed (Layder 1998).

The doctors who are the focus of this article came from a broad range of specializations and localities. Participants came from one major city and three regional centers across Australia and New Zealand, and included general practitioners, surgeons, anesthetists, and physicians from various specialties. Recruitment relied on informal networks, as it was a challenge to contact interested doctors, given issues of professionalism and time constraints. A total of fifteen doctors were included in this case. Ethics approval was obtained for this research.

Learning to Hear Medically

Medical hearing aided by a stethoscope (termed auscultation) is a recognizable form of medical aural knowledge. Indeed, the stethoscope as an aural technology is an enduring symbol of medical practice (Sterne 2003b). The heart is most associated with the stethoscope, with a standard "check-up" including auscultation to investigate for abnormal heart sounds, pathologies such as pericarditis, and more basically, a patient's heart rate. The lungs are also a common subject of auscultation (is the patient "working" to

breathe, are they "noisy," "rattly," or "wheezy"). In addition to this medical hearing, doctors also hear other bodily sounds unaided by a stethoscope and "listen" to patients in consultation.[1] In interview, doctors consistently stressed this breadth of their aural knowledge: their ears are constantly engaged, taking in the soundscape of the human body. Particularly in a surgical context, hearing is also used to monitor the soundscape of the work environment and its technologies. The medical case offers a clear example of hearing as knowledge, because many of these sounds are outside of most people's aural experience. This emphasizes the extent to which aural knowledge is acquired and specialized. The following analyzes the learning practices involved in the acquisition of this medical hearing.

Medical training has an extensive formal component, requiring completion of a four- to six-year undergraduate program and many more years of less formal learning and examinations for professional practice. However, the doctors that I spoke with were consistently of the opinion that while the formal elements of learning were essential, medicine was ultimately an apprenticeship, with practical and perceptual knowledge being learnt through mentoring and experience – particularly during "rounds" – from an undergraduate level onwards. Learning was seen as continuous and more web-like than linear. Doctors moved through a mix of formal and informal learning and picked things up, weaving their way through an immense body of knowledge, networks, and experience that culminated in a medical expertise that necessarily included specialized sensory knowledges including hearing.

Roughly two knowledges emerged as particularly critical for informing medical hearing. The first was the biomedical, which was defined by its strong focus on the underlying biological processes of health and disease. The second was termed clinical, and referred to the practical capacity to perceive these biomedical indicators in patients, sometimes with the aid of tools such as a stethoscope. However, while these knowledges could perhaps be crudely distinguished, a key finding of this research was that they were ultimately interdependent. In other words, learning to hear medically requires a complex mix of theory, experience, and, as I will show, creative attempts to describe and share an aural knowledge that is difficult to put into words.

Learning the body in biomedical terms primarily took place during the formalized aspects of medical training and was largely theoretical; however, as the following examples capture, this theoretical knowledge was intertwined with clinical indicators. During undergraduate degrees in medicine and surgery, a training doctor continued their education in science, with a focus particularly on the systems and organs of the body. During this phase of education, students were first taught the internal workings of a healthy human body. This type of knowledge was captured in the following description of a deceptively complex heartbeat:

> The first heart sound is generated by the mitral and tricuspid valves closing. During systole, where the heart contracts and expels blood from the left and right ventricles, that [sound] is associated with the closing of the mitral and tricuspid valves, which stop blood flowing into the ventricles at the same time from the atria. As they close that causes "lub," and blood is expelled from the heart, and then at the end of systole or the contraction of the ventricles, the aortic and pulmonary valves close, and that gives the "dub."

This description was shared in the context of a doctor teaching me about how to hear the heart. It was deemed the first thing I needed to learn in order to understand hearts, their sounds, and how health and pathology were perceived through hearing. In this example of a beating heart, there is a connection between a biomedical understanding of the systems and organs of the body and their clinical indicators. Valves open and close, the heart muscle contracts, blood is pumped, and this process causes perceptible sounds.

The function of other body parts was also expressed in theoretical and clinical terms. A description of arthritis began with a biomedical understanding that joints could wear away the layer of cartilage that allowed for frictionless movement. With the absence of this layer, the joint "creaks" and "grates." As an orthopedic surgeon explained: "That is basically the auditory manifestation of the fact that the joint has lost its lining layer of cartilage. As soon as I hear or feel that, I know that the person has a problem." Similarly, the condition of pleural effusion was framed in terms of a physiological understanding that, like the heart, the lungs were encased by a membrane. In cases of pathology, water built up between these layers and if a doctor "percussed" the chest cavity the sound would be "dull" in the presence of fluid (see Table 1 for further examples).[2]

Where biomedical knowledge was easily found in textbooks and lecture theaters, clinical sources were more diverse and creative. Such learning practices respond to the lack of metalanguage with which to describe sound, a challenge that has endured from the nineteenth-century practice of medicine into the present (Sterne 2003b: 211–12). In the previous example of the function of a heart, the description used the onomatopoeic signifiers of "lub" and "dub" to represent the sounds that occurred when a normal, healthy heart pumped blood. As well as forming part of the theoretical description, these signifiers were a lexicon that was used and made meaningful during rounds. As students' attention was directed to the "lub" and "dub," the heart came to be known in these terms. While a similar onomatopoeic language was used to describe other sounds of the heart, to further explain abnormality and make these sounds perceptible, teachers drew on common metaphors to promote understanding. For example, the third heart sound, "lub-di-dub," which can be present in both weak and strong hearts, was metaphorically

Table 1 Understanding clinical examination through aural signifiers and theory

Condition	*Theoretical knowledge*	*Description of aural signifier*	*Role of aural signifier in diagnosis*	*Knowledge source (aural)*
Arthritis	"The joint has lost its lining layer of cartilage that allows for free, frictionless movement"; cartilage is not displayed on X-rays	"Creaks" and "grates"; "It sounds like wheels that need oil"	Arthritis not shown on X-ray; diagnosis dependent on feel and sound	Experience; "picked it up"
Orthopedic surgical context (implants)	"Bone is a cylinder in most cases. When you drill from one side to the next, you will go through bone, and then reach a hollow area in the middle before you reach the outer area. If you're drilling not a diameter but a tangent, then instead of plunging into the middle, you will continuously go into the hard bone"	Pitch changes when drill reaches the outer layer of bone; when metal implants reach bone the sound "bottoms out" and becomes "dull"	Indicates the surgeon has reached the other side of the bone and needs to pull the drill or saw back to prevent damaging soft tissue; Lack of sound indicates the bone is being penetrated in wrong direction	Surgical mentor directed attention; "listen for the drill … listen, listen, listen … hear that change?"
Pulmonary edema	Pulmonary edema is where there is fluid in the air cells of the lungs. This means that when air is taken into the lungs, the air cells pop open	"Crackles" or "pops"; sound can be replicated by wetting your index finger and thumb with a bit of saliva, placing them next to your ear, and pulling them apart	Fluid generates a sound that can be heard with a stethoscope for a diagnosis	Learnt during rounds
Normal heart sound	"The first heart sound is generated by the mitral and tricuspid valves closing. During systole, where the heart contracts and expels blood from the left and right ventricles, that [sound] is associated with the closing of what are called the mitral and tricuspid valves, which stop blood flowing into the ventricles at the same time from the atria. As they close that causes 'lub,' and blood is expelled from the heart, and then at the end of what is called systole or the contraction of the ventricles the aortic and pulmonary valves then close, and that gives the 'dub'"	"Lub-dub"; "boom-boom"	Used as a screening tool to distinguish between normal and abnormal; hearing normal heart sounds indicate no further investigation is required	Learnt during rounds; heard in a simulated environment; correlating heard sounds with cardiograph; heard on medical dramas

Third heart sound	Third heart sound can be normal or a sign of pathology, particularly heart failure. The third heart sound is the product of turbulent blood flow. These heart sounds are commonly referred to as "murmurs." A third heart sound is due to a regurgitant valve, which causes turbulence	"Ten-ne-see"; "lub-di-dub"; "boom-bo-boom"; described as either weak or strong "like the spinnaker on a yacht," in cases where the extra heart sound is due to a particularly powerful and athletic heart	Used as a screening tool to distinguish between normal and abnormal; in context of patient history, indicates where further tests are required	Learnt during rounds; heard in a simulated environment; correlating heard sounds with cardiograph
Fourth heart sound	Fourth heart sound relates to blood flow and is always an indicator of pathology. Pathology is indicated by the placement of the murmur. In the case of aortic stenosis, blood flow is obstructed through a stenosed or blocked valve, which causes turbulence. In the case of hypertension, the heart is thickened so the blood makes a noise as it hits against rigid muscle	"Ken-tuc-ky"; "bo-boom-boom"; "like a hose directly hitting against a bucket … it makes a "ding" noise as it hits the wall"	Hearing a fourth heart sound is always an indicator of pathology, and as such requires an echocardiogram and further tests	Learnt during rounds; heard in a simulated environment; correlating heard sounds with cardiograph
Pericarditis	The two layers of the membrane that encases the heart become inflamed and do not pass smoothly over each other when the heart beats	"Grates" or "scratches"; described as a "rub" sound imitated by rubbing hands together, as if to get warm	Inflamed membranes generate a sound that can be heard with a stethoscope	Learnt during rounds
Pleural effusion	Like the heart, the lungs are encased in a membrane. Water can build up between these layers (particularly in aged people)	Lungs compared to a water tank that you can "tap" to establish the water level, below the water level sounds "dull," and above sounds "resonant" or "hollow"; "hollow, hollow, hollow, bomp"	Diagnosis can be achieved by "percussing" the lung (the left hand is placed on the chest wall, and the ring hand taps with the middle finger in a "hammer-like fashion, just like you would with a water tank"; technique used in general practice and hospitals in lieu of technology-based tests	Learnt during rounds

described as "like the spinnaker on a yacht" in cases where the extra heart sound was due to a particularly powerful and athletic heart. Similarly, the fourth heart sound was expressed as "like a hose directly hitting against a bucket" in the sense of the timbre of the fluid. The use of such metaphors works to make lessons memorable, but also, as Lakoff and Johnson (1980) argued, to structure understanding.

Clinical knowledge of the body is therefore not only limited to words, but also asks students to imagine and make sounds to facilitate experience and direct attention. Normal lung sounds, I was told more than once, sound "a bit like what you would expect them to sound like." It was suggested I may have heard normal lung sounds on a medical drama or would just know if I could imagine what air passing through something would sound like. Less was left to chance with pathologies of the lungs. Mentors helped students to produce the sounds and demonstrate them in order to direct attention before many examples were pointed out in a hospital context. Pulmonary edema, for example, is a condition where there is fluid in the air cells of the lungs. The presence of this fluid means that when air moves through, air cells pop open. Through a stethoscope, a doctor could hear "crackles" or "pops," a sound that can be replicated by wetting your index finger and thumb with a bit of saliva, placing them next to your ear, and pulling them apart. The acquisition of aural knowledge required at least some experience, a challenge that was in part creatively negotiated in the medical context.

Much clinical sensory learning was on the wards. An anesthetist described a particularly memorable experience, were he was introduced to a "seagull murmur" during rounds:

> They would tell you what you were supposed to be hearing. They would say: "This patient has what you would call a 'seagull' murmur – it is high pitched and sounds exactly like a seagull flying along in a high wind – see if you can pick it". And sure enough, after some time, you could believe that it did possibly sound like a seagull.

This same directed process of meaning making was pointed to by another anesthetist, who stated: "It is very difficult to explain to somebody what something sounds like, you just have to experience it for yourself, then when you are told what it is, you can put it in the memory bank, so next time you hear it, at least you will consider it as a possibility." In both of these examples, training doctors came to experience sounds in the context of their stated metaphors and meanings. The reality that this learning relies on particular metaphors and shared experiences means that this way of communicating and building sensory experience is necessarily specific to places, peoples, and times. The last phrase of the first anesthetist's description is perhaps the most telling. Learning to understand the body's

sounds took time, signifiers aided it, and these came to be akin to the sound that was perceived. In other words, aural learning was not only a matter of describing sounds in a certain way, rather with repetition and guidance, it was almost as if the heart sound and the seagull were perceived and understood as all but identical.

This combination of biomedical and clinical knowledge made the medical body aurally perceptible, an approach that extended to learning practice for the other senses. A surgeon described that where normal tissue was soft, malignancies were hard. While this surgeon knew this theoretically, making these distinctions in an operating theater was dependent on feel, and in his experience, cutting through breast cancer could be best equated with "cutting an unripe pear." In similar terms, he described the stools of someone with cholera as visually "like rice water." Critically, without these frames of reference, which made conditions "tangible" and allowed them to be "pictured", the theoretical knowledge remained meaningless. As Sterne (2003b: 213) put it: "hearing the rattle, seeing the lesion" renders "medical knowledge more true and more present through immediate perception," it transforms "abstract knowledge into a very specific kind of practical knowledge."

An example of the limits of knowledge without experience was given by one doctor, who recalled that despite five years of medical training, he was unable to identify a jaundiced patient when it was first encountered. While he knew that jaundice was an indicator of pancreatic cancer and knew its presentation was a yellowing of skin tone, he had not yet learnt to perceive yellow. He continued: you can learn about certain pathologies and their indicators formally, but it is "on the wards that you start to acquire an understanding of what a 'flushed face' means, or whether someone is 'blue.'" Again, this finding is in keeping with the argument that: "No metaphor can ever be comprehended or even adequately represented independently of its experiential basis" (Lakoff and Johnson 1980: 19). Metaphors such as rice water, pear cutting, spinnakers, and seagulls may be useful conceptually, but without experience of what these mean in practice, they are only a first step for the acquisition of sensory, including aural, knowledge.

This last example of misunderstanding without experience is not meant to indicate superiority of experiential learning in the medical community, but rather the interdependence of knowledges and learning methods. Biomedical knowledge and clinical signifiers were discussed together because they were mutually dependent and equally valuable for building aural knowledge. A neurologist explained: "Knowing simplistically what generates the sound gives you a bit of a feel for why a sound happens." Equally, however, without learning the signifiers and experiencing what they mean, theoretical knowledge was useless. This interdependence of knowledges challenges claims that different kinds of knowledge operate independently "like radio stations operating at different frequencies

… unable to listen in on each other" (Vervoorn 1998: 255). It also challenges arguments that some knowledges are more valuable, or more worthy of the term (as opposed to "skills" or "know-how"). And specifically in terms of our appreciation of sensory knowledge, it captures the necessarily complex, creative, and time-intensive learning practices that are relied on in the development of specialized hearing.

Conclusions

There is only a limited literature that has approached the senses as knowledge, with the majority largely descriptive. Grand narratives have drawn a connection between the senses and thought, and at a more micro social scale, it has been argued that the senses are a self-knowledge that guide action. This article argued that we extend this work by looking at the senses in terms of how they are developed and used, and has given an example of the type of data and analysis that contributes to this end.

The case of learning to hear medically captures how multiple knowledge types and learning modes can be combined to build specialized hearing. It also points to the important place of an aural knowledge among other ways of medical knowing. In the case of hearing, formal education plays a direct role in a doctor's learning through structuring understanding and directing attention. Experience in the broadest sense is also vital to make sounds perceivable. This multimodal approach to learning and the interaction of knowledges indicates that, in practice, "formal" and "informal" are not discrete, but can combine in response to available learning opportunities, and the learner's needs (LaBelle 1982: 162–4).

Equally, it is important to stress that this sensory knowledge was not an optional add-on. Without it, a theoretical knowledge of health and pathology could not be put into practice. Knowing biomedically that arthritis is where a joint has lost its lining layer of cartilage is not the same as being able to clinically hear the "creaks" and "grates". But as an orthopedic surgeon explained: "As soon as I hear or feel that, I know that the person has a problem." This analysis highlights the learning practices through which this specialized hearing is acquired, and also points to its importance.

While research on the senses is proceeding, it remains a nascent field. At this stage, there is significant scope to consider how the field can be theoretically situated, and possible directions for empirical research. Following Barth, one approach is to consider the senses as an active and dynamic knowledge. Such an approach focuses on practices of sensory learning within community contexts. However, regardless of the heuristic used, it is not enough to describe sensory aspects of culture: our study of the senses must take account of not only context, but also the processes at work, and the relationships between people and their worlds.

Notes

1. Listening here refers to patients' words. This term was used by the doctors themselves for this type of medical hearing, as well as other "active" types of hearing such as auscultation.
2. In both of these cases, diagnosis was supported by both hearing and touch. This multisensory approach to diagnosis is beyond the scope of the present discussion.

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