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Exploring the Role of Procedural Variations in Surgical Education

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EXPLORING THE ROLE OF PROCEDURAL VARIATIONS IN SURGICAL EDUCATION

(Thesis format: Integrated Article)

by

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Abstract

Variations in practice and procedure permeate clinical work. While clinical research routinely investigates the consequences of these variations for clinical outcomes, we have little understanding of their implications for education. The current policy environment in medical education makes developing a new understanding of the role of variations in medical education especially important. Current policy reforms in the assessment of learners draw on the notion of competence to suggest that medical education should focus on the performance of learners in the workplace. The current turn toward workplace-based assessment positions the observations of faculty into key functions in these assessment frameworks; therefore, knowing what shapes observations in workplace-based assessment is crucial. This dissertation uses grounded theory to explore how interaction between surgeons and senior surgical residents around procedural variations shapes teaching, learning, and assessment in the operating room. The findings of the research suggest that the culture of the surgical workplace leads surgeons to engage in complex social processes in interpreting and negotiating procedural variations. A surgical culture based on autonomy and individuality leads residents to tacitly seek out *thresholds of principle and preference* for each surgeon they work with. Surgeons endorse residents' tacit work as a means of learning to adapt to the ambiguity and complexity of surgical practice. The tacit *thresholding* work of residents may be so embedded in surgical culture that it plays an important role in determining how surgeons entrust residents intraoperatively. Workplace-based assessment could potentially utilize these intraoperative situated assessments made by surgeons. Emerging approaches to assessment suggest that attending to intuitive entrustment decisions made during everyday workflow may allow competency-based medical education to develop workplace-based assessments that make productive use of the subjectivity inherent to observations made by experts in the workplace.

Keywords

Surgical education, competence-based medical education, qualitative research, grounded theory, procedural variation, practice variation, workplace-based assessment, evidence-based medicine, situated learning, sociomaterial

Co-Authorship Statement

Put simply, the ideas in this work are the product of collaborative research. Any idea I put forward here was molded by hard won consensus. I collected the data, performed basic preliminary analysis, and wrote preliminary drafts of the manuscripts. All analysis and writing beyond that was conducted in concert with my co-supervisor Sayra Cristancho, doctoral committee member Chris Watling, collaborator Mike Ott, and supervisor Lorelei Lingard. Since almost my first day at the Centre for Education Research & Innovation, Sayra has been my mentor. Sayra put her confidence in me, and in turn gave me an opportunity to have confidence in myself. I will always be grateful to her for doing so. We worked together on a parallel project, though we never talked about it openly; I was working to learn the principles and preferences of a titan in our field, and Sayra was teaching me to learn. It was a once in a lifetime opportunity, and without Sayra I might have missed it. She guided me with a generosity I will always remember. Chris Watling set aside pressing concerns to patiently and iteratively shape the ideas at the core of the grounded theory. He contributed significantly to the character, structure, and nuance of the ideas themselves. Mike Ott brought the sober second thought to the theoretical work and pointed out to us what we could not see for ourselves. Finally, Lorelei Lingard curated the ideas in the dissertation. I knew I had done a good job when she would raise her eyebrows in surprise at a finding. She wasn't enthusiastic about every finding, and that selectivity was one of the greatest strengths of our research team. The stories we chose to tell, when I saw them initially, were each, I felt, of equal import. It was Lorelei who picked out the ones with theoretical import. This thesis, like much of the work emerging from the Centre for Education Research & Innovation, is a product of collaboration from the ground up. Without Lorelei, Thresholds of Principle and Preference may well have been just another property in a vague theory. She captained this ship with patience and grace.

Dedication

To Zale, Lynn, and David who find adventure amidst adversity.

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Over the course of these past months I have enjoyed documenting an idea that continues to surprise me, that I continue to learn from, each day I work on it. That said, to learn is to fail and to live without regret is to fail to learn. In that spirit, I extend earnest thanks…

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Chapter 1

This tale of another way of life is mainly concerned with education, with the process by which the baby, arrived cultureless upon the human scene, becomes a full-fledged adult member of his or her society. The strongest light will fall upon the ways in which Samoan education, in its broadest sense, differs from our own. And from this contrast we may be able to turn, made newly and vividly self-conscious and self-critical, to judge anew and perhaps fashion differently the education we give to our children.

- Margaret Mead*

1 Introduction

What now? You're a resident focused on an artery, red and gently pulsing. You are instructed to cut through the tissue beside it differently than the way you were told the last time you found yourself in this spot. So, what now?

Or what happens when you're the surgeon with your name on the top of the chart? When things go bad everybody will look to you. And it starts to look like the resident you've trusted to work on your patient is planning to take an approach you don't think is as good as it could be (even though you know one of your peers taught it to them in the first place). So, what now?

Broadly speaking, this dissertation explores these questions, and many others like them.

My doctoral program of research studied how residents learn to deal with the procedural variations of surgeons and how surgeons, in return, make sense of the residents' efforts. In the pages that follow I'll introduce what I mean by procedural variation, why it exists, and how it is relevant to surgical education. I'll describe some of the ways doing this research now coincides well with the current policy environment in medical education. And, finally, I'll introduce the more finely grained questions I will ask in each of the chapters that follow this introductory one.

* Coming of Age in Samoa, New York: Dell Publishing Company. 1928. p. 25

1.1 What is procedural variation?

For the purpose of this research, the term procedural variation means an intraoperative action that has the potential to be performed differently by different surgeons. Admittedly, I've used the term as a catch-all to capture procedural differences from the very small, like starting an incision with the cautery instead of the scalpel, to the very large, like using a laparoscopic approach rather than an open incision. But what may appear to be a catch-all, actually reflects the findings of clinical research in surgery: procedural variations are broadly-based and ubiquitous.[1] While efforts to reduce procedural variation in surgery can lead practices to converge temporarily, these changes have typically been time-limited and reversion to the status quo of variability appears common.[2,3] From the early days of modern clinical epidemiology,[4] where researchers in the mid-20th century showed that rates of tonsillectomy varied significantly by region,[5,6] to contemporary research into the varied outcomes of surgeons on the same procedure,[7] the notion that not every surgeon performs every procedure in exactly the same way has become an important area of study.[8]

1.2 Why does variation exist and why does it matter?

It bears asking, why don't surgeons use a standard, shared approach to procedures? The question is one clinical researchers themselves have been asking for some time, because variability presents a rhetorical problem for medical practices that define themselves based on the reproducibility and generalizability of evidence derived from clinical research. For almost thirty years, medicine has used 'evidence-based practice'[9] to define its underlying mission.[10,11] Translation of evidence from basic and clinical sciences into bedside practice has become the discourse guiding the way health professionals are taught.[12] That teaching focuses on helping doctors to identify high quality, generalizable evidence—usually in the form of randomized controlled trials—to guide the decisions they make during patient care. However, despite the push toward the use of unequivocal evidence, only 50% of clinical practices in internal medicine, for example, are actually based on evidence from randomized controlled trials.[13] Rather than an unambiguous translation from published evidence to bedside practice, in reality, competent medical practice is a mixture of solid evidence, grey evidence, observational evidence, and synthetic creativity.[9] In short, despite the dominance of evidence-based practice in public

discourses of medicine, the reality of clinical practice is much more ambiguous and complex.

The presence of such ambiguity may be even more profound in surgery.[14] The typical operating room is a complex system where time pressure, anatomical patient differences, and shifting team structures produce clinical judgements and procedural strategies with highly variable outcomes.[15] Some have gone as far as to suggest that, in surgery, the rate of use of evidence that comes from randomized-controlled trials is 24%, less than half of medicine.[14,16] A growing research literature has begun to explore these parts of surgical practice that as yet are not defined by unambiguous evidence.[17] Research on adaptive expertise,[18] purposeful slowing down,[19] and the reconciliation cycle,[20,21] have shown that intuitive judgment and procedural adaptation can be constitutive of safe surgical practice in a world where the evidence is highly incomplete.

1.3 What about beyond surgery?

Surgical variations may be importantly unique.[17,22] Medical interventions are conducted through a measurable medium. We assume the chemical composition of a drug prescribed to a patient to be the same in London, Ontario as it is in Toronto, Ontario as it is in London, United Kingdom. On the other hand, surgical interventions are conducted through subjective media—human minds and hands—"procedures are not pills, and a methods paragraph cannot describe a procedure with such specificity that clinically significant [procedural] variation cannot intrude".[23(p. 1349)] Research shows that neither a surgeon's choice of appropriate procedure nor the exact nature of the procedural steps can be assumed to be identical from surgeon to surgeon, let alone from hospital to hospital or country to country.[23-28]

All of these contingent factors aside, medicine struggles to deal with variation in much the same way as surgical education. Multi-million dollar interventions are frequently implemented to shape physicians' decision-making toward a common standard. From both within and outside of medicine, researchers work to develop point of care solutions, publicity campaigns, and continuing professional development modules to encourage physicians to reproducibly base their decisions on the same set of high quality clinical studies. But variation remains. Both medicine and surgery are confronted by the omnipresence of variation in a public and policy environment that discourages it. So why

am I studying variation in surgery first? The answer has to do with some of the finely grained differences in the way teaching, learning, and assessment happen in surgical education.

1.4 Could it affect education?

Surgical education is a strange beast. Residents work around the clock, often quite independently, to take care of the patients admitted to their service and to deal with new patient consultations. They receive guided instruction from faculty on how to deal with the pre-operative and post-operative management of patients. And they typically receive that instruction not in real time, but afterwards, before, and from afar. They are instructed by email, text, phone, and in person around what decisions to make about the patients of whichever surgeon they are working for.

Then they enter the operating room. Suddenly, every movement they make is observed. Every decision is watched closely. In medical education's context of largely unobserved work performed by learners, surgery presents a unique opportunity to study closely how faculty interact with, and form judgments about, learners on an everyday moment-to-moment basis.

Few researchers have taken advantage of this unique opportunity to study the role of procedural variations in surgical education. The rigor of research on the outcomes of procedural variations far outstrips the research on its educational implications. Not since Charles Bosk introduced the notion of 'quasi-normative errors' to medical education[29,30] has the notion of intersurgeon variation been rigorously approached in medical education.[31] This curious absence in the literature raises questions about the role of surgical and medical cultures in limiting such studies.[32] Why aren't we talking about—and studying—variation and its influence on education? The studies in this dissertation engage with these questions by looking at how surgical culture and the social processes of surgical education shape conversations around procedural variation in the operating room.

1.5 Why study procedural variation in education now?

Opportunities for studying procedural variation in surgery have multiplied. A new culture of research in medical education may have contributed to opening up lines of inquiry that were once perceived as too esoteric or too complex to study. Asking

practitioners 'what happens when you are forced to make decisions beyond the application of straightforward evidence?' has become a burgeoning area of inquiry. Information about surgical procedures has entered the public discourse through publically available information and videos online. Patients engage more often in critical conversations about surgery and surgeons than ever before. And the invention of technologies that make procedures more visible—such as laparoscopic, robotic, and remote technologies—offer researchers new glimpses of the decisions that surgeons and residents make in the heat of the procedural moment.

But all these contingencies aside, perhaps most importantly, medical education's current policy context has made asking these questions about procedural variation critically important. Competency-based medical education has become a global phenomenon.[33-35] Previously closed policy windows in assessment in medical education appear to have opened recently. Policy windows are periods where policy change can more fluidly occur.[36,37] Canadian postgraduate medical education policy-makers favor a hybrid, competency-based *and* time-based approach to training.[38-40] The Royal College of Physicians & Surgeons of Canada has been intending to implement such a workplace-based assessment framework focused on competent on-the-job performance in medical education since 1972.[41] The opportunity to finally realize that intent appears imminent with current shifts to ensure that assessment will be more "ground[ed]…in real clinical work".[39(p. 111)] Understanding the role of procedural variation may help to improve workplace based assessment in this midst of this window of potential reform.

1.6 Problem statement

In summary, this research tackles problems in two arenas. The first is in theories of teaching and learning in the surgical workplace. Little attention has been paid to the role of procedural variations of teachers, masters, or faculty in shaping the learning of learners, apprentices, or residents. How do learners deal with the cognitive dissonance of receiving opposing pieces of faculty advice intraoperatively? How do teachers make sense of learners' efforts to adapt? The second is in surgical education's emerging dilemma of workplace-based assessment. If medical education continues to move toward competency-based education and to formalize entrustment as part of the assessment

framework, then how might the social processes around procedural variations matter to such a framework?

1.7 Chapter overview

The chapters that follow this first introductory chapter will address these two theoretical and policy concerns.

Chapter 2 provides an in-depth examination of the theory of situated learning that served as a key sensitizing concept for this research and its implications for competency-based medical education. In performing the literature review that informed Chapter 2, I asked: are the epistemological concerns of situated learning and competency-based medical education related? Finding that they were related informed the subsequent empirical studies.

Before addressing those empirical studies, Chapter 3 provides a methodological examination of multiple perspectives on grounded theory. Chapter 3, in submission to *Qualitative Research*, asks what counts as grounded theory and explores whether it is possible to mix multiple methodological schools into a coherent program of research. The end of Chapter 3 includes a reflection on the particular grounded theory approach I selected for this doctoral research and some of its strengths and weaknesses.

Chapter 4 constitutes the first of the empirical studies included in this dissertation. The empirical paper in Chapter 4, published in the *Journal of Evaluation in Clinical Practice*, sets the foundation for the education research that was the main focus of the dissertation. I asked, in researching for Chapter 4, what social processes shape surgeons' interpretations of their procedural variations? When they make a procedural change, who do they tell? And why? It was in doing the research for Chapter 4 that the focus of this dissertation became clear, and so in Chapter 4 the reader will find a broadly descriptive study that asks many probing questions about the role of procedural variation in surgical practice.

Chapter 5 presents the second empirical study of the dissertation, and it is the cornerstone of this doctoral work. In Chapter 5, accepted for publication by *Academic Medicine*, I asked residents how they make sense of the intersurgeon procedural variations they encounter. Chapter 5 introduces the grounded theory of Thresholds of

Principle and Preference and it presents a theoretical framework for the social processes—what I called the four 'phases' of Thresholding—that are linked to residents' efforts to make sense of procedural variation in the workplace.

Chapter 6, submitted to the *Journal of Surgical Education*, turns on the findings of the previous chapter to ask, if residents have developed social processes to address procedural variations, then how do surgeons interpret residents' efforts? Do surgeons believe that residents' work to find thresholds is a useful aspect of surgical education?

Chapter 7, submitted to *Medical Education*, follows up findings of the research in Chapters 5 & 6—that both surgeons and residents acknowledge thresholds of principle and preference—by exploring the role of thresholds in assessment. In this study, I asked how the social processes around thresholds shape surgeons' judgments about residents and how trust develops between residents and surgeons in workplace-based learning.

Chapter 8 concludes the dissertation with a discussion of the implications of these findings for medical education and for education theory. First, I discuss how the assessments of learners by faculty are so imbued with variations that turning to situated assessment may help to find new sources of information about learners' performance. Second, I discuss the way turning to close examinations of the material of surgery, and the way surgeons and residents negotiate those materials in practice, can inform education theory's understanding of workplace-based learning. The theory of situated learning that constitutes the original sensitizing concept for this research tells us meaningful things about the way learners integrate into communities. Bringing the lens of sociomaterial theoretical approaches and turning to close examination of the materials of learning can bring us closer to understanding the mechanisms of the complex social processes that shape so much of the learning that occurs beyond the classroom. The final words of this dissertation discuss how the findings derived from this theoretical research may be used to inform the day-to-day practices of clinical educators.

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Chapter 2

The issue of censorship has received little attention in examination research. In the past few decades there has been a trend to replace the old and somewhat negative terms of examination, grading, *and* censoring *by the modern concept* evaluation. *As indicated by the word root, the issue of values remains.*

- Steiner Kvale*

2 Theory: Competency-Based Medical Education and Situated Learning

Methodological writings in grounded theory present some discrepant instructions. Earlier grounded theorists suggested that researchers seeking to develop a grounded theory should approach their data collection with as few preconceived ideas as possible. As grounded theory developed, methodologists became more attuned to the necessity of performing a literature review thanks to contingencies of academic life like the securing of grants. The move toward literature review in advance of grounded theory development correlated with a turn toward epistemologically constructivist notions that no researcher is ever beyond theory or preconceived knowledge. Being more transparent, therefore, about what theories the researcher brings to the research has come into favor. A term borrowed from symbolic interactionism, 'sensitizing concept,' has been used by grounded theorists to describe how it is that a researcher can attempt to both bring previous theory into their analysis while also being open to new, unexpected, or challenging findings.

The chapter that follows describes two of the sensitizing concepts that I brought along with me throughout the research process: situated learning and competence-based medical education. Situated learning is a highly cited theory of learning in medical education. Sociocultural theorists of learning, especially, use situated learning to describe how learning is a social experience. Competency-based medical education is a second

* "Examinations reexamined: Certification of students or certification of knowledge." In: Lave J, Chaiklin S. Understanding Practice: Perspectives on activity and context. New York: Cambridge University Press; 1996. p. 221

contemporary idea in medical education. Pressure has mounted on academic programs to become more accountable to regulatory bodies and to the public for evidencing how learners are performing not only with adequate medical knowledge but with the professional and social behaviors that patients deserve and demand. In this chapter, I explore how these two sensitizing concepts are related and postulate about how they may combine to inform medical education. The chapter is exploratory, experimental, and works with ideas developed early in the doctoral process. It earned its way into this dissertation by way of picking out a faint signal amidst much of the noise about these two contentious concepts in medical education. Ultimately, the ideas in here came to significantly inform the findings in the studies themselves.

2.1 Introduction

Situated learning emerged from social anthropological work on apprenticeship-based learning in the developing world.[1] It has since become one of the most widely cited learning theories in medical education research. It continues to be used to interpret professional identity formation,[2] development of procedural skills,[3-6] the hidden curriculum,[7,8] clinical exposure for medical students,[9] entrustment,[10] and assessment.[11,12]

In Canada, competency-based education arose during a period of dissatisfaction with medical practices. Through the latter half of the 20th century patients increasingly exerted their autonomy in making medical decisions and in designing the health care system.[13,14] In Ontario, in the 1980s, traditional paternal perspectives came to a head with a failed doctors' strike over billing practices and a drop in public support for the status quo.[14] The result was the undertaking of an early form of participatory action research between physician and patient groups to develop a theoretical framework of what a physician should be and how learners should be assessed in their efforts to become those physicians.[15]

The chapter explores the inextricability of situated learning and competence-based medical education. These two ideas share significant practical concerns. They also share epistemological perspectives. However, when medical education deploys these ideas in scholarship and policy-making, the practical concerns come to overshadow the epistemological foundations from which they arose. In this chapter, I use a conversation

about assessment to bring the application of these two ideas in medical education around the postmodern turn.

2.2 CBME and situated learning share practical concerns

Situated learning and competency-based medical education (CBME) both focus on learning that occurs in the workplace. This workplace focus leads away from an emphasis on abstract knowledge and toward a focus on how knowledge is socially constructed. Consequently, both situated learning and CBME emphasize the importance of context.

2.2.1 *Competency-based medical education*

Competency-based medical education (CBME) attempts to make medical education institutions, programs, and participants more explicitly responsible for demonstrating how learners perform across the professional behaviors and attitudes expected of physicians by patients. This new policy focus on workplace performance takes assessment from tests of clinical knowledge toward the expectation that learners document their learning and progress explicitly in a portfolio of "periodic milestone-based reports"[16(p. 8)] that consist of records of workplace-based assessment such as "encounter cards, mini-Clinical Evaluation Exercises, multi-source feedback, [and] logbooks".[17(p. 102)] Examinations of abstract knowledge are de-emphasized: currently regulatory "resources are heavily concentrated on the annual production and psychometric evaluation of centralized, terminal examinations. Although not without value, these examinations…focus primarily on the lower levels of Miller's pyramid…Positioned at the end of training, they are of no formative value…[and] may actually have a negative impact on exposure to and attainment of higher order competencies in the final year of training".[17(p. 110)] In response, CBME takes a longitudinal approach to assessment policy by also de-emphasizing the role of "single subjective measures, often removed from the workplace (e.g, in-Training Evaluation Report, Final in-Training Evaluation Report, global rating scales, [and] oral exams)"[17(p. 102, brackets in original)] in addition to final summative exams. CBME turns, instead, toward socially embedded knowledges.

Competency-based medical education posits that assessment is improved when it no longer assumes that knowledge acquired in the workplace can be abstracted from its

context. In a purely objectivist assessment paradigm, "there is one 'truth'…and everything that deviates from this truth is error or bias." [18(p. 56)] Now, discourses of competency-based education note that "[i]f we want to assess complex skills that are also mostly work-embedded or work-related, we have to rely on professional judgment"[19(p. 217)] to construct "meaningful" systems of assessment rather than the objectivity oriented "psychometric approach [which] tends to ignore the role of the assessment context".[20(p. 241)] As competency-based medical education makes the turn toward social context in the role of assessment, looking to sociocultural learning theory may help to clarify how teaching and learning function in the workplace.

2.2.2 *Situated learning*

Situated learning is a social learning theory popularized by Jean Lave and Etienne Wenger in their seminal book, *Situated Learning: Legitimate peripheral participation*, published in 1991. The central claim in situated learning is that knowledge is not *only* abstract, symbolic, acquired, transferred, or inert as it is understood to be in the 'disembodied'[21] representations of learning such as information processing theory and the stimulus-mediation-response model.[22] Lave and Wenger describe a situated theory of learning that assumes a critical position against 'cognitive,' 'intellectualist,' or 'conventional' theories of learning.[23] For Lave and Wenger, previous theories that pose knowledge to be a static, acquirable object can lead to potentially oppressive consequences. In a situated approach to learning, learning cannot simply be a process of transmission of knowledge from master to apprentice because each member of a community comes from their own peripheral position. Situated learning "provides access to a nexus of relations not otherwise percieved as connected"[1(p. 36)] by flattening the hierarchy and positioning each member of the community as engaged in a process of knowledge negotiation rather than knowledge transfer. As scholarship in situated learning has continued, Lave's work has attempted to destabilize modern notions of abstract technical knowledge that marginalized ways of knowing that she observed during anthropological study in other parts of the world.[24,25] Consequently, situated learning posits that privileging modern ways of knowing overvalues the knowing subject and devalues the deeply social way learning occurs in apprenticeship.

A potentially resolvable conceptual and terminological antagonism underlies conversations across situated metaphors of sharing learning and acquisitive metaphors of individual learning.[26,27] In the past, these two different metaphors have resulted in conflicting units of analysis and tension over the use of the term 'context'. For Lave & Wenger, any general knowledge is always "gained in specific circumstances…[and] brought into play in specific circumstances".[1(p. 32-33)] When a learner is learning a new skill they are not simply acquiring the requisite knowledge, skills, and attitudes: they are *also* learning to perform that skill in the social structure of their specific workplace.[27] The substantive learning the trainee has done is considered tethered to the situation. If the learner wants to apply those skills in a new situation, a similar discursively-mediated learning process will have to take place. To do this learning, subjects construct knowledge through social action in the form of *legitimate peripheral participation* and in social structures in the form of *communities of practice*. Legitimate peripheral participation describes how persons involved in training situations are socially positioned and how their learning is actualized. Communities of practice are socially and discursively constructed groups that share practices and constitute the *context* of learning.

2.3 CBME and situated learning share epistemological concerns

Epistemology is a term used to describe theories about the nature of knowing. What we believe about what can be known shapes what we believe can be done with that knowledge. The beliefs about what can be known held by CBME and situated learning, that is, their epistemological foundations, are based in potentially postmodern concerns.

2.3.1 *What is postmodernity?*

Postmodernity is a complex and rarely tackled topic in medical education. The last fifty years of medical education research have been vastly different from the first fifty years.[28] The most recent period has been named both medical education's second wave[28] and its postmodern era.[29-31] Defining modernity helps to clarify some of the ambiguities of postmodernity. Modernist thinking assumes that, by identifying and controlling variables, experimentally designed scientific study can uncover truths about human thought and behavior.[32] The first wave of medical education research was largely based in behaviorism.[28] It was characterized by attempts to experiment and control, to dig down

and isolate the kinds of thoughts that doctors have, both good and bad. This research made the assumption that, if researchers could objectively identify why and where doctors made mistakes, then educators could develop targeted interventions to train, to *condition*, them to no longer make those mistakes. This approach to the scientific study of human thinking operates according to a modernist logic.

Logical positivism, as a key facet of modernist thinking,[30] claims that theories about the world can be proven true by attending only to facts without interpretation.[33] Originally, logical positivism was a response to supposedly scientific work dedicated to solving moral and metaphysical problems, like *proving* the existence of a 'human spirit,' for example.[34,35] By the 20th century, however, the discourse of objective truth in logical positivism and its 'Scientific Method' of hypothesis verification had become a tool used to silence scientists whose work or epistemological position precluded the very idea of objective truth.[36]

Work in the philosophy of science and in the basic sciences began to destabilize logical positivism's assumptions about the possibility of unequivocal proof. In the philosophy of science, the work of Karl Popper and Thomas Kuhn marked waypoints in the process of understanding how inextricably human factors are embedded in the work of science.[37,38] In physics, for example, the twinned ideas of inherent error—that any measurement of anything carried a modicum of bias or interpretation—and the observer effect—that making an observation changes the nature of the observed phenomenon—permanently altered the relationship between scientists in the natural sciences and their notion of truth.[34,35,39]

Philosophers of science began to collate these emerging ideas into a postpositivist understanding of science and knowledge. Postpositivist science rejects the idea that a theory can be *verified* to be true. Rather than verifying the truth of a theory, Karl Popper led the way toward the use of the null hypothesis and the primacy of *falsification.*[37] Despite powers of modern knowledge generation, insisting on falsifiability means that science is limited to only ever inferring the validity of a theory by running out of ways to reject it. Postpositivism, therefore, is characterized as an approach to science that accepts the inescapability of interpretation. The measurements, the phenomenon itself, and even the research questions are subject to forces beyond our control and understanding.

Postpositivist science is a postmodern science. It is a science that comes after positivism, modernism, and the primacy of verifiability. It is fundamentally an interpretive science. Most importantly, it is science that is made *reflexively aware* of the limited degree of its powers to objectively understand the world.[40,41]

The postmodern era of science is a product of the decline of modernity and the logical positivism that defined it amongst philosophers of science and scientists themselves.[30] The work of postpositivist philosophers such as Popper gave way to the postmodern ideas that arose in the second half of the 20th century. Medical education has adapted to these changes in scientific thought. My argument is that the second wave of medical education research shares in two of the major epistemological positions of postmodernity.[42] Using the framework of Crotty,[35] I will name these epistemological positions 'constructionism' and 'subjectivism.' Constructionism posits that, while the world is real, how we make meaning out of it is interpretive and our knowledge socially constructed. Subjectivism posits that there is no single reality and that meaning is not only interpretative but is also not necessarily tethered to any object, neither a natural one nor a constructed one. Subjectivism takes constructionist notions of knowledge even further down the postmodern epistemological continuum. To that end, subjectivism and constructionism are each necessary but singularly insufficient to define postmodernity.[43] Relative to previous conceptions of science, subjectivism made room alongside constructionist research for scientific work drawing on subjectivist theoretical perspectives such as critical theory, feminism, and postcolonialism,[35,42] and together these epistemological perspectives have come to shape what today is called postmodernity.

2.3.2 *How is situated learning postmodern?*

Situated learning makes use of constructionist and subjectivist epistemological perspectives. But, even before looking that closely, the very notion that situated learning is a 'theory' is a postmodern notion. What counts as a learning theory is contested space. For those leaning towards modernist concerns, a theory is a testable hypothesis that *explains how a phenomenon works.*[44,45] For others, a theory can be a framework for *interpreting possible meanings* at play in a situation.[46-48] Accordingly, theories of learning used in medical education research can range from cognitive psychological theories—such as cognitive load[49]—to sociocognitive theories—such as distributed cognition[50,51]—

to sociocultural learning theories—such as situated learning. According to Sfard,[26] at the cognitive end of this spectrum, knowledge is represented using an 'acquisition metaphor' and at the social end knowledge is represented using a 'participation metaphor.' Sfard argues that these metaphorical representations convey different assumptions about what knowledge fundamentally is and what can possibly be known. That is, they hold different epistemological positions. Situated learning regards knowledge within the 'participation metaphor,' and thus positions situated learning as epistemologically postmodern.

Situated learning theory makes use of postmodern epistemological positions that are widely taken up in education research.[18(p. 140 & 153-155)] Kincheloe, for example, defines postmodernity as such: it concerns "the failure of reason, the tyranny of grand narratives [such as the notion of scientific progress], the limitations of sciences, and the reposition of relationships between dominant and subordinate groups".[52(p. 55)] Situated learning is concerned with these same concepts. Subjectivist elements of situated learning are concerned with flattening hierarchy and resisting traditional conceptualizations of knowledge. Constructionist elements of situated learning are concerned with the limitations of scientific objectivity, the constitutive nature of interpretation in knowledge development, and reconceptualizing the social structures that shape learning.

2.3.3 *How is CBME postmodern?*

I wish to argue that competency-based medical education has the potential to be a second-wave product of medical education based on a postmodern epistemological position drawing on both constructionism and subjectivism. Competency-based medical education assumes that while we may not be able to glean stable objective truth about the 'goodness' of a doctor, what we can do is observe a phenomenon, measure it, and interpret that data with the understanding that what we believe to be true about it is shaped by our social constructs. Medical education has explicitly taken on constructionism as a valid epistemological position, positing that "judgements of real life performance in a social context will *inevitably* involve 'subjective' interpretation of 'objective' information".[20(p. 250, emphasis added)] Outcome-based assessments used in competency-based medical education are an example of such a second-wave movement in medical education. In outcomes-based assessment, learners are assessed in actual clinical practice rather than the testing of *abstract* knowledge outside the clinical

environment. Outcomes-based assessment is predicated on the assumption that a person observing, interpreting, and judging the clinical work of another is a socially constructed but acceptably representative measure of performance[53]; while, objective-based assessment, through multiple choice tests for example, is a modernist attempt to measure the amount of abstract knowledge an individual owns.[54]

CBME also approaches some problems from a subjectivist epistemology. Research methods that draw on subjectivist epistemologies such as critical discourse analysis, situational analysis, and participatory action research are postmodern forms of knowledge production. They are concerned with the idea of deconstructing the notion of a rational or objective person. They aim to bring silenced perspectives into official conversation. They assume that discounted realities, theories that are believed to be untrue or irrelevant, are discounted not because they are objectively false but because they challenge the discourses of those in power.[55] This kind of rethinking of professional values in CBME is based on the subjectivist epistemological position that there is no objectively researchable 'good' doctor; instead, there is only the subjective understandings of what people want their doctor to be. The "relative absence" [17(p. 111)] of documentation of competence and the increasing "need for programs to demonstrate how their graduates are meeting broader societal needs" [17(p. 13)] are leading toward a need to more clearly justify the target of assessment. The perceived responsibility to "ensure the competence of qualifying specialist physicians"[17(p. 112)] is closely tied to a comprehensive assessment of the learners' "meaningful demonstration of competent performance *on each of the required components*". [17 (p. 113, emphasis added)] Canadian CBME policies attempt to expand postgraduate medical education's "disproportionate focus on the Medical Expert Role"[17 (p. 110)] by identifying 847 unique "competency milestones" [56(p. 8-9)] "to articulate a comprehensive definition of the competencies needed for all domains of medical practice and thus provide a comprehensive foundation for medical education".[56(p. 3)] Insisting on comprehensiveness and assessment beyond the medical expert role sets the CBME framework up as a potentially epistemologically postmodern one.

2.4 Medical education emphasizes the practical over the epistemological

Both situated learning and CBME are highly cited ideas in medical education. Questions, though, have begun to arise about the degree to which the implementation of CBME matches with its epistemological roots.[15,57] Similarly, while yet unrecognized in the literature, the way situated learning is employed in medical education loses track of the postmodern ideas at the theory's core.

2.4.1 *Focus on competencies*

Competency-based education, in its initial positioning, held postmodern concerns about overcoming entrenched notions of the paternally-defined professional focused entirely on technical knowledge.[18(p. 56)] Some argue that medicine is enmeshed in a "long, stuttering and uneven transition from a doctor-centric to a system-centric approach to healthcare".[58(p. 104)] Some argue that central manifestation of this change for medical education is the push toward patient-centric competency-based assessment.[58] However, competency-based medical education's focus on comprehensiveness has the tendency to lead to "long lists of learning objectives or reductionist tasks".[17(p. 103)] The current policies invoke a "more holistic" [17(p. 116)] attempt to "integrate multiple components such as knowledge skills, values, and attitudes"[17(p. 100)] while simultaneously creating a framework that can guide "objective" assessment of "concrete, observable learner behaviors or well-defined components of a learner's knowledge base".[59(p. 4)] Thus CBME assessment policies walk a fine balance between attempting to convey the dangers of too closely itemizing medical work and the development of assessment policies that are, for instance, "sufficiently robust as to fail a resident who behaves unprofessionally, regardless of his/her medical expertise".[17(p. 63)]

My argument about postmodernity in CBME relies on a separation between '*competencies*-based assessment' and '*competency*-based assessment.' In this formulation, competencies-based assessment refers to an objectivist theoretical framework developed solely by experts through "functional analysis of the occupational roles, translations of these roles into outcomes, and assessment…on the basis of demonstrated performance".[60(p. 693)(ex. 61,62)] Competency-based assessment, by contrast, refers to a subjectivist theoretical framework developed using a bottom-up approach to

identifying what society wishes from their physicians.[13-15] On one hand, CBME privileges multiple social voices and attempts to create a theoretical assessment framework that prioritizes subjective interpretations of the role of the physician over professional-centric, scientific, or objective framings. On the other hand, modernist understandings of validity have led to attempts to 'atomize' competencies.[15] These top-down attempts lead to long lists of learning objectives in the form of sub-competencies, key competencies, enabling competencies, and milestones.[54,63,64] Postmodern education researchers using subjectivist epistemological perspectives have claimed that, once atomized, competencies-based vocational education can work to become an oppressive instrumentalization of knowledge.[65(p. 114)] Medical education runs the same risk. Without attending to the postmodern subjectivist approach to knowing in which competency-based education was created, the competencies risk becoming a rhetorical trump card used to reproduce dominant values.[15,66]

2.4.2 *Participation as acquisition*

Situated learning's uptake in medical education faces a similar tension between theory and implementation. In the workplace, clinical teachers[67] and students[68] recognize that knowledge is socially shaped and learning constitutively occurs within a context. But the dominant interpretation of situated learning in the research literature and in policy tells a different story.[69,70] Medical education research takes the 'culturist', or 'cognitive plus,'[71] stance on context in situated learning.[(e.g. 50,72,73)] Medical education research, being dominated by individually acquisitive theories of learning, generally posits that context is important insofar as it influences the individual learner's process of acquiring knowledge.[31,74,75] For example, according to Karen Mann, situated learning posits that as learners "become more skilled, they move more centrally in the community".[73(p. 64)] Similarly, according to Durning & Artino, the tenets of situated learning hold that learners are peripheral because they are not true members of the community and they are initially taught by near-peers rather than masters.[50] While medical education has taken up situated learning theory, it has done so through a cognitive lens: learners work toward the centre and context is only important insofar as it determines the acquisition of knowledge.

Legitimate peripheral participation is intended to describe the mechanism of the social construction of knowledge. Lave and Wenger write that it is *through* legitimate

peripheral participation that abstractable "cognitive processes (and thus learning)"[1(p. 34, brackets in original)] are constructed and become *practisable*. Legitimate peripheral participation's constitutive nature is what distinguishes situated learning as, to use Sfard's term, a 'participation-oriented' social theory where learning is tethered to its situation.[26] Indeed, there is no possible antonym for legitimate peripheral participation: there is no illegitimate participation.[1(p. 35)] All participants in the situation must be considered. There is no centre. All persons are peripheral and all contribute from their own peripherality.[1(p. 35)] Participation can be more 'full' but it cannot be more 'central'.[1(p. 36)] The concept, therefore, is analytical not normative. Its purpose is to expose the constitutive and legitimately social mechanism of the learning process and to start a discussion about how historical discourses and control over resources can lead to alienation of learners from full participation.[1(p. 36 & 42)] As in medical education's use of the theory, when situated learning is stripped of its postmodern knowledge claim by diluting the notion of context and focusing on a centre of participation, legitimate peripheral participation is lost as the mechanism of learning and the acquisition metaphor for learning comes to dominate.[26]

2.5 Reconciling this tension requires new conversations

Conceptual tools exist for reconciling the tensions between epistemology and practice in situated learning and CBME. First, rethinking the idea of context may allow medical education research to resolve some of its disciplinary conflicts. Second, emerging approaches to assessment may offer some recourse to considering how to make use of the postmodern notions at the core of situated learning and CBME.

2.5.1 *Rethinking 'context'*

CBME emphasizes the importance of context in assessment. Yet implementing assessment policies that are coherent with emerging postmodern approaches to assessment has proven challenging. Resolving a miscommunication over the use of the word 'context' may help to reconcile this tension. On one hand, cognitive theories of learning argue that context is a physical, environmental factor. On the other hand, recent work in situated knowing has gone so far as to suggest that context does not even exist, that it is a false separation.[76] This gap means that when situated learning theorists discuss the importance of context, cognitive learning theorists—quite reasonably using the cognitive definition of the word context—believe that the situated learning theorist is

asserting that all learning is dependent on who is present at the moment of learning and on the physical characteristics of the environment.[77] In response, the cognitive theorist rightly asks: 'What if you're learning on your own? What if you're so deeply absorbed by a practical problem the people around you disappear and you are thinking only about facts and material entities?' This cognitive interpretation of context is at play in contemporary approaches to assessment in medical education.

But situated theorists mean something different by 'context.' Situated theorists collapse the 'contextual categories' of cognitive theorists.[22] In this formulation, deeply learned 'concepts' are inextricable from 'context,' which situated theorists understand to include historical and cultural elements. When situated theorists say social process or context "subsumes the learning of knowledgable skills",[1(p. 29)] they mean that all the things that have happened to you, all the things that you've said and read and heard and practiced, all the things about your specific job, all the things you hope to accomplish someday, all those to whom you'll be telling what you've learned, and, most of all, all of the ways you and your coworkers in the relevant situation (whether you're physically there or not) make meaning, have a profound and embodied but *ultimately unknowable* effect on how and why and what you learn. This is what situated theorists mean by context, and, not coincidentally, it is a central tenet of postmodernity.

Medical education largely ignores situated learning's postmodern knowledge claim about the embodied nature of knowing. If left intact, situated learning posits that knowledge is shared between multiple individuals and inherently shaped by their sociocultural context. Once that postmodern knowledge claim has been diluted, the theory becomes a simple signpost used by individually acquisitive theories to demarcate that the physical and institutional environment of learning is important in a limited way.

2.5.2 *Constructionism and subjectivism in assessment*

Situated learning and competence-based medical education share similar principles in the field of assessment: "Performance-based assessments are…predicated on sociocultural theories of learning [citing situated learning] in which learning is understood as a process of participation in activities situated in appropriate social and cultural contexts".[78(p. 149)] Unfortunately, though, instead of thinking about how postmodern notions of social construction and subjectivity can contribute to assessing

medical learners, medical education largely reverts to modernist attempts to objectively measure knowledge as a proxy for the 'goodness' of a physician.

Canadian CBME policy research suggests that "the challenge remains to find a complimentary assessment framework that integrates the diverse values implicit in CanMEDS, while at the same time motivating the authentic assessment of competence, supporting decisions regarding promotion of certification and capturing the essence of competent clinical practice".[16 (p. 108)] Recently, a literature on assessment has begun to emerge that describes a 'constructivist' approach to assessment.[20,29,79,80] In the interest of efficiency, I will not address the complicated and contentious difference between constructionist and constructivist epistemologies,[81] but I will say that I believe this new approach carries significant elements of both and will hereafter refer to this approach as a *constructionist* approach to assessment. This constructionist approach, in short, says that the "concept of a true score has been challenged".[20(p. 251)] It is characterized by a turn away from positivist notions such as objective testing, construct validity, and generalizability and a turn toward real life clinical work, expert judgment, broad sampling, reliability, and defensibility.[19,79,82] Rather than researching and implementing assessment that declares itself to be true,[83] intuitive and subjective qualitative evidence is being used[84-87] to develop authentic assessment consensuses that originate from postmodern constructionist and subjectivist epistemological positions.[29,58,88] 'Authentic assessment' is a student-centered approach to assessment conducted in real world settings.[89] CBME embraces the notion that a single, decontextualized multiple choice test are insufficient to authentically assess trainees' abilities to practice in the clinical context.[90] Global rating scales,[91] learning portfolios,[92] ITERs,[93], and multi-source feedback each bring assessment off of the test answer sheet or communication checklist. These methods assess learners not on abstract knowledge acquisition but on intuitive and holistic frameworks for understanding 'outcomes,' workplace performance, or trustworthiness.[64] Lastly, literature on these methods often points to the difficulties medical education has encountered in attempting to 'atomize' the roles of physicians and establish the objective validity of those roles.[79,94-98]

Subjectivist epistemology is less apparent in assessment research despite the broad movement toward constructionist assessment methods in medical education. As in

constructionism, subjectivist knowledge claims about assessment in medical education problematize the notions of objectivity that come with abstract assessment of knowledge acquisition. However, subjectivist approaches use a different starting point. Rather than focusing on the impossibility of positivist, verificational science and the inescapability of socially-mediated interpretation as in constructionism, subjectivist approaches focus on the relationship between power and assessment. For example, important research within CBME points out that, while public dissatisfaction with the paternalism of medicine was an impetus for moving toward CBME in Canada, current attempts to scale back the power of medical culture to determine the nature of assessment have been taken over by professional interests.[15] Rather than moving toward holistic assessment of learners' responsibility to attend to public expectations, CBME largely eschews postmodern perspectives on knowledge by using the notion of objective assessment of competencies as a means of retaining the status quo.[57] The emergence of constructionist assessment tools as described above may provide a new opportunity to attend to these subjectivist epistemological concerns and move CBME around the postmodern turn by focusing on renewed interest in public accountability.[99]

2.6 Conclusions

Abiding by contradictions is embedded within the logic of postmodernity. The pursuit of objectivity and openness to subjectivity are contradictory but necessary elements of assessment in medical education. Situated learning is but one theoretical approach to interpreting the constructionist and subjectivist elements of assessment from a postmodern view. Competency-based assessment is conceived with postmodern principles of situated learning but, as of yet, medical education does not draw on similar principles in its implementation. My goal is not to argue that there are incompatible objectivist and postmodern assessment researchers, nor, even, is my goal to argue that there are individual studies that fall into each of these camps. Rather, my goal is to situate emerging notions in assessment within their epistemological context to demonstrate some of the potentially postmodern facets of medical education.

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Chapter 3

In creating an atlas such as this, it is important to achieve a happy medium between complexity and simplification. If the pictures are too complex, they may be difficult and confusing to read; if over simplified, they may not be adequately definitive or may even be misleading. I have therefore striven for a middle course of realism without the clutter of confusing minutiae. I hope that the students and members of the medical and allied professions will find the illustrations readily understandable, yet instructive and useful.

- Frank Netter*

3 Methodology: Four Schools of Grounded Theory Research

This chapter explores what it means to do grounded theory research. The paper itself is rather technical and requires some previous knowledge of grounded theory to be understood. It has been submitted to *Qualitative Research*,[1] a journals whose authors routinely investigate complex methodological concerns. The paper discusses how four schools of grounded theory research are different and how they share core similarities. A section after this methodological paper explores how the empirical research in the dissertation made use of these core similarities in the schools of grounded theory research and some of the challenges I encountered in the research process.

3.1 Introduction

This paper is built around two linked arguments about grounded theory. Grounded theory is a form of social psychological research[2-4] that grew out of and distinguished itself against the 'rich description'[5] found in ethnographic research.[6] It was developed and used primarily by sociologists in the 1960s and 1970s to study substantive areas of work—such as palliative care [7]—to generate sociological theory about modes of social interaction and the thinking that underlie them.[8] Since the 1970s, grounded theory has been taken up by multiple disciplines including education, anthropology, health professions research, and many others.[9] The uptake of grounded theory has been marked

* 'Preface to the First Edition.' Netter's Atlas of Human Anatomy. Philadelphia: Saunders. 2014.

by a coalescence of methods of data analysis and theory production into what I am calling four 'schools.' Both of my arguments revolve around these four schools.

The first argument addresses the *notion of theory* in the four schools of grounded theory research. The claim that there are different approaches to conducting grounded theory research is not a new one.[10-12] It became increasingly clear in the early 1990s that agreement about how grounded theory is done would be unlikely when the founders of grounded theory launched a caustic scholarly debate.[13] Since these debates about grounded theory began, what it means to do research that is 'grounded' in the data from naturalistic settings has continued to be much discussed and debated.[14] Yet, what 'a theory' is, how a reader interacts with it, and what its purpose is, has escaped close scholarly analysis. My first argument will focus on problematizing how grounded theorists understand what counts as a grounded theory and how it should be created.

The second argument focuses on two methodological concerns in grounded theory. I've chosen these two concerns because I believe they are 'core categories.' Differences in these two categories have significant downstream effects on both methodology and on the produced theory.

The first methodological concern is the role of description in grounded theory. Early grounded theorists privileged abstract theory that, at what they perceived to be the lowest level, used analysis of a substantive area like a specific health care profession as a tableau for abstract theory, or, at the highest level, that collated multiple substantive areas together to discover abstract categories of behaviour and thinking that transcended location, culture, and time.[8] Where description ends and theory begins continues to be the dispute at the core of methodological writing on grounded theory.[13]

The second concern pertains to the role of accounting for exceptions to a theory within that theory. Early grounded theorists defined themselves against ethnographers who produced "researched description… [instead of] sociological theory"[8(p. 30-31)] primarily because ethnographers "rarely present an analysis of an exception or a negative instance".[8(p. 138)] 'Exceptions' here means presenting examples of discrepant cases to a category as well as the finely grained differences between the concepts within a theory, which grounded theorists called properties or dimensions. In their efforts achieve the

ideal of abstract theory, early grounded theorists produced monographs that presented abstracted and "carefully documented"[15(p. 133)] representations of human behavior and thinking by taking minute and exacting account of exceptions to the theory as they went. It appears they believed accounting for the factors that influenced those they observed to behave in ways that escaped smooth inclusion in their theory would allow the theory to remain abstract and to pass the test of time.

The first and second arguments depend on one another. Calling the notion of theory into question risks veering into solipsism. Yet a tangible outcome like constructing a single definition of the term theory is not the goal of this paper. Instead, I intend to show how different understandings of what the *research product* should look like are inextricable from understandings of how the *research process* should be designed. That said, causal arguments about whether the product or the process are the primary contributor to the variance that I'm describing promise a conceptual clarity that may not be possible, or perhaps is merely not possible at present, to deliver. In this paper I will point out fundamental differences between the ways the seminal grounded theorists understand what a theory is and I will point to linked methodological differences. Exploring causal arguments for these differences would require deep examination of ontological stances at the heart of grounded theory research and, perhaps, qualitative research approaches in general. And while that work is valuable, it is beyond the scope of this paper. What follows is instead a primarily a technical paper about the process of grounded theory research and its products.

3.2 Four schools of theory on grounded theory

Each of the originators of the four schools of grounded theory have different understandings of the notion of theory. For Glaser and Strauss a theory is a product. While for Strauss and Charmaz, theory is a process. In the original conception, a research product is a theory if it "explains or predicts something".[8 (p. 31)] But, if the question is extended to ask what it means to explain or predict, what form the explanation or prediction takes, or how a reader interacts with it, the simplicity of this early statement begins to fall away. In each of the four schools, a theory is different. For Glaser a theory is abstract, for Strauss it captures complexity, for Charmaz it is about theorizing an argument about the world, and for Clarke it is about theorizing comparisons. The citations

in Table 1 below have been chosen to introduce this basic premise of difference. The stark division between theory as a noun in the first two cases and theorizing as a verb in the second two is deliberate and grounded in the literature. Both Charmaz and Clarke take care to explicitly identify their methodological preference not for theory, writ large, but for the process of theorizing. This division imposed by Charmaz and Clarke is just one example of the lack of consensus over what a theory is, how it is made, and what its purpose is.

Table 1. Important positions on the nature and purpose of theory in grounded theory

Glaser (2007)[16]	"In the case of qualitative data, the explicit goal is description. The clear issue articulated in much of the literature regarding qualitative data analysis methodology is the accuracy, truth, trustworthiness or objectivity of the data…[while] [t]he conceptual nature of classic GT renders it abstract of time, place, and people".(p. 1-2)
Strauss (1987)	Grounded theory "is designed especially for *generating and testing theory*" (emphasis in original, p. xi) and privileging "higher-level"(p. 242) formal theories which "capture a great deal of the variation"(p. 8) that characterize social phenomena such socialization rather than substantive theories pertaining to an "empirical area of enquiry such as…professional education".(p. 242)
Charmaz (2006)	"Theories present *arguments* about the world and the relationships within it."(p. 128 emphasis added) "My preference for theorizing—and it is for theorizing not for theory—is unabashedly interpretive. Theorizing is a *practice*. It entails…constructing abstract understandings about the world and the relationships and within it…The fundamental contribution of grounded theory methods resides in offering a guide to interpretive theoretical practice not in providing a blueprint for theoretical products".(p.128, emphasis in original)
Clarke (2005)	"[A] strategy for pulling grounded theory around the postmodern turn is asserting the analytic sufficiency of sensitizing concepts, analytics, and *theorizing* for solid grounded theory research. This replaces the pursuit of substantive or formal theory advocated in traditional grounded theory…More modest and partial but serious, useful and hopefully provocative… The possibility of analytic extension of theorizing… is accomplished through the use of comparisons rather than theoretical formalization and claims of transcendence".(p. 28-29, emphasis in original)

This lack of consensus will be explored in detail below by analyzing the four 'schools: Glaserian, Straussian, Charmazian, and Clarkeian.[17] The choice to use the term

schools as a means of comparison is deliberate. For some, there are two 'versions',[18,19] 'strands',[19] 'approaches',[11] or 'models'[13] of grounded theory, that of Strauss and that of Glaser. I have chosen to not use any of those terms. Those terms are too linked to the notion that there are two categories of grounded theory. However, I believe that there are finer distinctions to be made. I have also not chosen to use the categories created thus far by those who see the finer distinctions. There is a precedent in the literature for finer categorizations such as traditional, alternative, and postmodern grounded theory which acknowledge the fine distinction between more than two categories of grounded theory.[14,20] But the language used to describe the categories problematizes often older versions of the methodology by implying a sense of progress. The symbolic interactionist interpretation of social change is not that progress toward a sort of social ideal is occurring, is not that grounded theory is getting inherently better over time, but rather that social change is simply constant and without a singular guiding logic.[21] For this reason, the argument I lay out below both uses non-normative labels for the schools but also comes fundamentally embedded with the notion that the methodological changes in grounded theory in the half century since its inception are not fundamental refinements of the tool but are rather socially-situated adjustments to contemporary and changing ontological stances assumed in scientific discourses.[22]

I have also chosen to not use the names given to the categories of grounded theory by the founders of the schools themselves. 'Formal,' 'traditional,' and 'classic' are adjectives used by Glaser to distinguish Glaserian grounded theory from other approaches.[23] Charmaz uses 'constructivist' to distinguish Charmazian grounded theory.[2] And Clarke uses 'situational analysis' to distinguish Clarkeian grounded theory.[20] Following partially in the footsteps of Morse,[12] I have chosen to opt out of using these proprietary names. Doing so furthers the fundamental position of this paper: grounded theory is not simply a style or a method of qualitative data analysis. While it is now known to be "used to label any research endeavor that involved coding, any form of qualitative data analysis, and any kind of theory construction",[24(p. 168)] in the research that uses the methodological strategies of the four schools there is a unique underlying thrust to the analysis of data and the products it is intended to create. Using the names of their founders to identify the schools allows me to more actively demonstrate that, while the

four schools have different interpretations of the purpose and conduct of the work, not only are they held together by coherent social concerns through symbolic interactionism and pragmatism but that those four interpretations are bound, just as persons from whose names they are drawn, to the specific concerns of their time and place.

3.2.1 *Glaserian*

Theory, according to Glaser, is not expressly descriptive. It is not "empirical description" [25(p. 14)], "voluminous description",[4(p. 92)] or "immaculate description".[4(p. 3)] Situated descriptions of substantive areas, he argues do not "build and contribute on more general levels of the scientific enterprise, such as to a theory of becoming…[instead] pure description is situation specific".[25(p. 15)] For Glaser, the purpose of theory is to do what description cannot do and to transcend person, place, and time. It is, in short, to produce what is known in sociology as 'formal theory.' Formal theory is "theory developed for a formal or conceptual area of sociological inquiry".[4(p. 144)] This oft-repeated definition in the grounded theory literature uses the term 'formal' circularly in both the term and its explication. Only by attending to suggested examples of formal theory can the form and character of formal theory become clear. Glaser draws a distinction between substantive theory and formal theory to make his definition of the purpose of grounded theory:

> "We defined substantive theory as theory about a substantive area of inquiry—such as pain management, science careers, patient care and professional education. It is theory that fits the substantive area's main problems and works in predicting outcomes in the area…In contrast, a formal theory is a theory developed or discovered for a conceptual area of inquiry—such as status passage, social stratification, formal organization, or stigma".[25(p. 99)]

Glaser pursues sociological theory at the highest levels of abstraction. *Discovery*, for Glaser, was a manual for how to create theories that persist at the highest levels of both academia and popular culture. "Good ideas are one good test of the theory. They last, people cannot resist using them. They cannot forget them: for example who can forget 'looking glass self,' 'generalized other,' and 'anticipatory socialization.' The highest laurels of sociology go to the producers of good ideas. Good ideas contribute the most to the science of sociology. Findings are soon forgotten, but not ideas".[4(p. 8)] Some scholars have suggested that the legacy of grounded theory is its failure to create useful

ideas like stigma at the level of abstraction it purports to seek.[24] Yet Glaser's conception of the purpose of theory continues to be to create ideas at this level of abstraction. A grounded theorist's work is to continually "transcend preceding theories" by "integrat[ing] them into a broader theory" with a "process of greater scope and higher conceptual level".[4(p. 15)] His mission—and, he implies, the mission of the social sciences in general—should be to create, brick-by-brick, a complete structural representation of human interaction using abstract theory.

Grounded theory, Glaser writes, "provides a bridge to seeing the same problems and processes in other areas".[25(p. 15)] While the work of grounded theory may be specific—"generating concepts and their relationships that explain, account for and interpret the variation in behavior in substantive area (sic) understudy (sic)",[25(p. 19)] its true purpose is general. The yield of a grounded theory is "just hypotheses!"[25(p. 16)] about how people in a situation behave to process problems they encounter. But those hypotheses should be general and abstract enough to transcend the context in which they were discovered. They should, therefore, be represented as permanent characteristics of human social life.

3.2.2 *Straussian*

The complexity of a theory trumps its level of abstraction according to Strauss. This focus on complexity had downstream effects on what he portrayed to be the appropriate scope of a grounded theory, its descriptiveness, and its espoused epistemological standpoint.

Strauss introduces the term complexity to the methodological literature on grounded theory in 1987.[21] While it may seem innocuous, introducing the term had a profound effect on how Strauss, and those who followed him, understood the purpose of theory-making. Complexity has become a term used by philosophers of science as a shorthand for the impossibility of discovering universal human truths, for a constitutive "unpredictability and unreliability that doesn't yield to human understanding".[26(p. 11)] Strauss similarly assumed that if social phenomena are so complex that generating single explanatory concepts that transcend all social context is impossible then the very purpose of grounded theory must be reconfigured to stay viable. For Strauss, this "is, of course, an old problem: abstraction (theory) inevitably simplifies, yet to comprehend deeply, to

order, some degree of abstraction is necessary. How to keep a balance between distortion and conceptualization?"[27(p. 12, brackets in original)]

The methodological gap Strauss is trying to fill is that of his contemporaries, "researchers working in various research traditions [who] describe or analyse the phenomena they study in relatively uncomplex terms, having given up on the possibility of ordering the 'buzzing, blooming confusion' of experience except for ignoring 'for a time' its complexity. Their assumption apparently [being] that later generations will build on their current endeavors".[21(p. 6-7)] The generation of grounded theorists that came after grappled less with the push toward abstraction and were more comfortable depicting rather than controlling the complexity of social phenomena. But Strauss remained caught between that era and a new era of social scientists who acknowledged the constructed nature of both perception and research. He and Glaser based their methodological approach on the assumption that grounded theory tries to "fit the realit*ies* under study in the eyes of their subject, practitioners and researchers in the area" [25(p. 14, emphasis added)] and that "*analysis* is synonymous with *interpretation* of data" [21(p. 4, emphasis added)]. Yet he continued to hold tightly to responsibility to uphold "the usual canons of 'good science'",[28(p. 418)] to build piece-by-piece the edifice of social science through the production of abstract formal theory.[29]

Strauss threw the definition of theory open to wider interpretation through his emphasis on complexity. Rather than focusing purely on formal theory, Strauss states that "depending on the purposes of the investigator, the final conclusions drawn in the course of the research can vary greatly by level of abstraction".[21(p. 4)] While Glaser considers the kind of research Strauss is allowing to be a-theoretical, low level "narrative description…[of] a central phenomenon around which all other categories are integrated",[25(p. 4)] Strauss allows that description can be "complex, systematic, and interpretive",[21(p. 4)] and even that "theory can be descriptive".[21(p. 4)] What Strauss primarily values then is the pursuit of "effective…[and] conceptually dense" [21(p. 1)] theory that meets the intended ends of the researchers creating it. Rather than insisting that only formal theory counts as theory, Strauss's conceptualization of theory allows for the kind of analytic description that generations of grounded theorists who followed him have come to rely on. For instance, while the work of Strauss's collaborator Juliet Corbin has not

been addressed in this paper, her work on Straussian grounded theory pushed the field forward. Corbin followed Charmaz by accentuating in Strauss's grounded theory writing his hints toward the "complex storytelling" [30(p. ix)] that grounded theory would come to be associated with by including "thick and rich description, case analysis, bringing about change in a difficult situation, and telling a story"[30(p. ix)] into its purposes.

3.2.3 *Charmazian*

Charmaz takes a new position on the role of abstraction and description in theory by redefining how a grounded theory accounts for exceptions. She orients her theory-producing efforts away from Strauss's desire to create dense theory and Glaser's insistence on formally abstracted theory. "Early grounded theory works stress discovering and analyzing *a* basic social process".[31(p. 173, emphasis in original)] She partially sidesteps the issue of Glaser and Strauss's creating what amount to universal norms of interaction by declining to microscopically account for the exceptions to her theoretical frameworks. For both Glaser and Strauss, a significant amount of fieldwork is devoted to finding the exceptions to any category of behaviour they've created.[4,21] Exceptions to or variations of the category are brought into the emerging theory as properties[4] or dimensions[21] of the category. In their manuscripts, paragraph after paragraph are devoted to addressing each exception and explaining what social processes precipitate the exception.[32-34]

Charmaz's version of theory works differently. Charmaz transfers the burden of rigor from exacting representations of exceptions of the processes she theorizes about to authentic representations of the words, actions, and stories—the marginalized voices[35]—of her participants. Grounded theory can be used to "reveal links between concrete experiences of suffering and social structure, culture, and social practices or policies".[36(p. 362)] Theory, then, for Charmaz, is more salient when conceived as the active process of theor*izing*, of making an "argument"[31(p. 128)] about the world. Glaser interprets Charmaz's turn toward describing and reorganizing the viewpoints of her participants as an obsession with accuracy and thus a fundamental misunderstanding of the irrelevance of accuracy when using the constant comparative method properly.[37] To Charmaz, however, the product carries with it a more pronounced sense of action and of the participants speaking through the researcher to the reader.[31] In this understanding, a theory becomes less minutely preoccupied with explaining to the reader how a given abstract process applies

to all people at all times. Instead, the purpose of the theory is to fracture and re-organize the "strands of the stor[ies]"[38(p. 7)] of the participants in a way that gives the reader the sense that the categories constructed by the researcher would be meaningful to the participants themselves.

Charmaz's *Good Days, Bad Days*[38] serves as a microcosm of this subtle but important change. The third and final part of the monograph 'Illness, the Self, and Time' is built out of her doctoral dissertation. The dissertation, *Time and Identity: The Shaping of the Selves of the Chronically Ill* , was published 18 years earlier.[39] It theorizes about how chronic illness influences sufferers' perceptions of time, a key sociological concern of her supervisory team.[34] In her *Days* monograph, the first two parts resembles the constructivist grounded theory methodological approach Charmaz later coined[31,40] while the third section more identifiably resembles the work of her supervisors. In the first two sections the categories of processes are named after actions using gerunds, participants are quoted more liberally and more often than in Glaser and Strauss's work, and the voices of the researcher and participants are blended thoroughly. In contrast, the third section focuses in on a single basic social process, "living one day at a time",[38(p. 178)] lists and explains the properties of the categories, "temporal incongruence" [7(p. 171)] and "illness as timemarker" [7(p. 198)] for example, and, most importantly, takes account of exceptions in the form of "contrast[ing]"[7(p. 177)]cases and representations of "differ[ance]".[7(p. 185)] When taking up the methodology in her own right years later, Charmaz deliberately contrasts the abstractions of "explicit theory [from]… useful analytical frameworks"[2(p. xv)] that allow room for descriptive ethnographic, narrative, and biographical work.

3.2.4 *Clarkeian*

Clarke took up Strauss's marginal inclusion of social worlds/arena as a new methodological tool for extending Charmaz's backgrounding of exceptions and difference. The social worlds/arenas theory posits that *differences* of interpretations and meaning making are the most basic aspect of social processes, *not abstract similarities.*[41] Adele Clarke studied under Anselm Strauss at UCSF, along with Kathy Charmaz. Much like my discussion of the work of Strauss was counterpointed by the work of Glaser, to fully explain Clarke's methodological choices requires a more thorough explanation of key points in Strauss's approach. When Strauss retired, Clarke inherited his university

appointment, where she built on his methodological concerns.[42] Like Charmaz, Clarke does not foreground accounting for exceptions in the production of theory. Strauss, for decades, held to the notion that the constant comparative method would lead two researchers to develop the same theory if they observed exactly the same events during the data collection process.[43] There were, however, hints in his texts that he believed categories to be "created"[21(p. 17)] and, later, that "theory does not just 'emerge' from data; rather data is itself constructed…and interpreted".[42(p. 64)] While Strauss did not engage at length with this new perception of the role of theory and persisted in developing theoretical works that attempted to present a single social process basic to human interactions regardless of context, he did begin to use a theoretical lens that indicated a growing concern, not with identifying and controlling isolated exceptions to a theory but rather one that takes exceptions and difference to be the guiding principle of the methodological process. Strauss started to use,[21] and Clarke made manifest at the core of her methodology, the social worlds/arenas theory.[20,41] Depicting social world/arenas as an inherent tool for theory-making means that constructing theory is no longer about drawing a single process across multiple contexts; instead, by *describing* the interpretations of objects, processes, and situations and the social commitments that people have to those interpretations, social worlds/arenas-focused theory production makes 'the assumption of difference and exception' the core principle upon which a theory is built.[44]

Clarke focuses in on the notion of description in Strauss's work. While "Strauss [only] nodded to the ever-widening path" toward grounded theorists becoming "scientific describers",[15(p. 133)] Clarke strode fully down it. For Clarke, the purpose of theory is to "draw attention to certain aspects of social life…[and] to particular actors and their activities".[41(p. 84-85)] She uses the description of difference as a basic organizing principle for her theory building using social worlds/arenas. In so doing, Clarke embeds concerted efforts toward expanding Strauss's concern in the 1980s with "reveal[ing] types of work not previously viewed as work per se, hidden work…and the negotiation of the actual division of labor (rather than, for example, professional claims-making about it)"[41(p. 72, brackets in original)] directly into her methodological premise. By forcing theory-building to "keep track over time [of] not only of what *is* being done in a line of work but also what

isn't",[41(p. 85)] Clarke orients the theory building process toward identifying silenced aspects of the work process. Clarke's descriptions of social situations intentionally explore things, people, and kinds of work that are not immediately obvious.

3.2.5 *Summary*

I have attempted to describe the changing nature of *theory* in grounded theory. What started with a single explanatory concept has become a complex and dense descriptive framework. This shift has significant implications for what kind of data grounded theorists collect and how it is analyzed.

3.3 Methodological implications

The move toward description-as-theory has resulted in a changing attitude toward exceptions to categories in grounded theory. This move tacitly uses description as a tool to change the focus and mandate of grounded theory from primarily behavioural to primarily sociocultural. The four schools utilize different approaches to how coding is used to develop these different theoretical products.

There is a relationship between the relative value a theoretical construct places on description and the value it places on detailed accounting for exceptions. Creating and organizing codes is the key methodological tool grounded theorists use to take primary note of exceptions to their theoretical concepts and categories. Coding thus has broad implications for both how the data is collected and for the product of the research process. For Saldana, coding is the "'critical link' between data collection and their explanation of meaning".[45(p. 33)] The kinds of codes that a researcher seeks to apply to the data shape what kind of data is collected and how it is collected. For example, in the original conception of grounded theory, thorough coding is designed to record "the full range of types or continua of the categories, its dimensions, the conditions underwhich it is pronounced or minimized, its major consequences, its relation to other categories, and its other properties".[8(p. 106)] Implementing a coding strategy capable of systematically capturing this elaborate series of variables requires a similarly elaborate system of data collection. Glaser and Strauss's coding strategies should not be considered entirely extricable from the environment in which they collected their data—months of freedom to explore across the departments of their own hospital as well as hospitals across the country and around the world—nor from the kind of theory they intended to produce.

Coding plays a significant role in determining how other methodological factors such as data collection and writing up techniques play out.

Coding creates a frame within which the analysis occurs. Saldana uses the term 'methods' to describe different kinds of codes.[45] For Saldana, the "elemental" coding methods, such as the "process" and "descriptive" coding that are used in analysis during grounded theory research, present a substantially different frame of analysis than, for example, the "narrative" coding that occurs in "literary" coding methods.[45(all in p. 59)] Though it is rarely explicitly acknowledged in the methodological literature, the grounded theorists from across the four schools code differently.[19] In methodological writing on grounded theory, the most explicit description of what a code is and what different kinds of codes exist comes from Glaser's "coding families".[4(p. 73)] Glaser distinguishes between process codes (ex. stages, phases), strategy codes (ex. tactics, manouverings), causal codes (ex. amplifying causal loops), descriptive codes (ex. person, place, and time), and many others.[4,19,25] Grounded theorists across the four schools favor one or more of these families over the others. While the use of different coding families in grounded theory research is rarely explicitly acknowledged, the differences are both simple and profound. To build the kind of theories privileged by the founders of each of the four schools, different building materials—different kinds of codes—are needed.

3.3.1 *Glaserian*

Glaserian grounded theory strives for parsimony in the coding of data and creation of categories. A grounded theorist of other schools may code the behaviors in a single incident of observing the work of a maître d'hôtel as 'watching,' 'information passing,' 'attentiveness,' 'unintrusiveness,' 'monitoring quality,' 'providing assistance,' 'information gathering,' and many others.[46] Instead, for Glaserian grounded theory, the coding and memoing process repeats as the researcher returns to the data collection, and multiple attempts are made at creating a single category that sticks, one that has grab and can be used to explain much of the observed behavior while also keeping a close eye on exceptions and properties of the category[25] This iterative process relies on the presumption of what Glaser calls emergence. Emergence is the notion that enough iterations of comparison can lead to the construction of a core category that is broadly explanatory and under which almost all other observed behaviors and reports fall.[4] For

Glaser, "labeling each incident"[25(p. 42)] within an incident, as above, leads to burdensome analysis. Coding in Glaserian grounded theory is "halfway between labeling each incident and conceptualizing many incidents".[25(p. 42)] For example, the maître d'hôtel in the above example may simply be 'cultivating relationships' with staff or clients depending on the primary concern of the participants.[25]

Ultimately, coding in Glaserian grounded theory is the most multifaceted of the four schools. In *Theoretical Sensitivity*, Glaser presents 18 coding families.[4] In 2005, he suggested 23 more.[19] Glaser's coding families cover vast swaths of social interaction and the factors that influence it. He suggests that one or more of the coding families may "naturally emerge [during the research process] when it is relevant to the substantive area under study".[25(p. 91, emphasis in original)] The diversity of the coding families he describes includes the assumption that some of them may emerge as more relevant to the data at hand. But he also, and, perhaps more importantly in our contemporary postmodern context, suggests that each of these coding families will call out to different researchers depending on their "disciplinary perspectives" [25(p. 18)] and personal interests.[25]

Glaser's flexibility in coding families has downstream methodological implications for the identification of observed exceptions to its concepts. Glaserian grounded theory research collects data through field observations and "passive non structured interviewing or listening".[37(p. 3)] "Events and…happenings"[4(p. 2)] are observed, concepts are created to describe them, concepts are turned into categories by comparing the observed concepts with other concepts or properties of concepts. In this way, categories are 'discovered' through "preconscious processing"[25(p. 18)] that identifies when concepts are comparable; that is, when they involve behaviors or reports in interviews that appear to be similar to the researcher. When new concepts are encountered and fall within an existing category their exceptions and the granular differences they bring with them in comparison to other concepts in the category are recorded as properties.[4] Properties thus describe the way in which concepts are different but related. In short, Glaserian properties are built for tracking exceptions to concepts as the theory emerges.

The burden of theorization comes from memos in Glaserian grounded theory due to the complexity of managing multiple families of codes. Glaserian grounded theory suggests that to avoid having "too many nonrelevant, not patterned-out, not integrated

concepts which do not explain, or interpret the continual solving or processing that the participants see as their main concern or basic problem"[25(p. 42)] the researcher should focus their coding of field observations and reports toward the generation of memos. Detailed recording of exceptions and properties relies on memos due to exceptions' multiple levels of connection with subcategories and core categories: the relationships require some narrative explication to make sense. While codes are not unimportant, reporting the coding structure as a unified whole is de-emphasized. Codes instead become memory and analytic aids rather than primary research products. The memoing process takes over more relative responsibility for conceptualization. Rather than taking extensive descriptive field notes, the Glaserian process of data collection relies on conceptual memoing of field observations in real time and interviews for interrogating the researcher's constantly tentative conceptualizations. The final product draws on these complex and emergent coding practices to create a "multivariate conceptual theory"[47(p. 836)] that abstractly represents a category of behaviour and or thinking that "accounts for most of the variation in processing [a] problem".[25(p. 4)]

3.3.2 *Straussian*

Strauss is interested in exceptions to his categories in a different way than Glaser. To achieve the kind of density Strauss favors, he narrows the scope of applicable coding families and deepens the tenacity and meticulousness with which he searches for exceptions. Especially in his solo methodological writing, Strauss argues for the importance of a what he calls a "coding paradigm".[21(p. 27)] His insistence on using the specific kinds of codes he suggests is so strong he maintains that "without the inclusion of the paradigm items, coding is not actually coding".[21(p. 28)] Strauss' position later softens, and is softened further for him by Corbin.[48] Ultimately, however, his primary concern with a few types of codes persisted in his own work for the duration of his career.

Strauss's coding paradigm adapts the "6 Cs"[4(p. 78)] coding family (causes, contexts, contingencies, consequences, covariances, and conditions) and the "strategies"[4(p. 76)] coding family into a single unit composed of: causal conditions, context, intervening conditions, action/interaction strategies, and consequences.[19,21,46] Despite this apparent simplification, Strauss's coding paradigm tend to densify the analysis. According to Glaser, "density is the amount of properties of a category".[25(p. 71)] Focusing

in on five types of codes forces the analyst to attend to socioculturally dense "'further away' (or, as some social scientists say, *macroscopic* or *structural*"[21(p. 78, brackets in original)] aspects of the data that are otherwise easy to ignore. To apply Strauss's coding paradigm, in what he calls 'axial coding', the analyst conducts "intense analysis done around one category at a time, in terms of the paradigm items".[21(p. 32)] Straussian grounded theory explores for each category the conditions in which it exists, the consequences which might have stayed silent, and, ultimately, its granular properties and exceptions. For Glaser, this forcing around only two coding families is the key element of Strauss's problematic "fantasmagora of rules and dictums"[25(p. 86)] that produces a "tyranny of endless questions"[25(p. 54)] and "hundreds of conceptual labels…[without] knowing which are relevant".[25(p. 42)] But an alternative reading is possible: that the coding families preferred by Strauss are useful for producing a different but equally valid type of theory.

While grounded theory analysis for Glaser is an almost completely inductive process, for Strauss it is more complicated. Rather than trusting purely in emergence and induction, Strauss's version of analysis requires that "induction, deduction, and verification…enter into inquiry".[21(p. 12)] While Glaser talks almost universally about the 'joy' and the 'high' of discovering a core category, Strauss qualifies that joy with additional attention to the "constraints and challenges of research settings and research aims"[21(p. 7)] when analysing grounded theory's "'discovered' (created) concepts".[21(p. 17, brackets in original)] These qualifying statements, and the introduction of the notion of 'created' categories are indicative of a more fundamental gap in how each understands the analytic process.

A Straussian analyst must temper the 'discovery' of a category with questions that that destabilize the category, deliberately seek out exceptions, and lead to conceptually equal but unheard or silenced areas of the data. The emergence of a core category indicates "parsimonious"[4(p. 71)] completion of the generative stages of the research according to Glaser. But for Strauss, the naming of a category initiates a series of more important downstream interrogations of that category, or what he calls "generative questions".[21(p. 22)] In the Glaserian form of analysis, the next stage of the research process would be to begin identifying the properties of the category by comparing it to other sub-categories and concepts in the data. Strauss also suggests that exceptions to categories

identified *deductively* "'in imagination' or through experiential data"[21(p. 16)] should be explored by "dimensionalizing"[21(p. 21)] and asking what different kinds of the same exception or property exist. The coding paradigm introduces a fundamental change to the way data should be collected and analyzed. Rather than allowing the codes and their exceptions to passively emerge from the data, Strauss understands the coding process as a way of "forc[ing] [the researcher] into confronting"[21(p. 25)] concepts 'in imagination' or that are implicit in the data through "microanalysis".[48(p. 46)]

These questions probe into areas that participants in the setting may not mention are important to them but that the researcher is responsible for probing to achieve the level of conceptual density Strauss desires. Techniques such as the "flip flop"[48(p.79)] or the "far out" comparison,[21(p. 57)] to which Glaser so vehemently objects,[25] are methods of creating categories during the coding process that are not explicitly in the data at hand. This category creation is intended to force the analyst to consider the cases that the present categories suggest hypothetically should be in the data but have not been observed and to bring those categories into the theory through what Strauss calls verification.[21] For Strauss effective theory is dense theory. Dense theory works to capture complexity of social phenomena by forcing the researcher to ask questions of the data that the researcher may not have immediately considered, or, as Glaser would say, that may not have emerged from the data.

3.3.3 *Charmazian*

Charmaz makes two methodological choices that significantly distinguish her version of grounded theory from that of Glaser and that of Strauss. Her first choice is to amplify the importance of gerund based process coding, and her second is to de-emphasize the importance of single core categories. Charmaz does not highlight explicitly for the reader how these changes affect the place of description and accounting for exceptions in her methodological approach, but I am arguing here that these two categories are where her changes have the most dramatic effect.

Charmaz's use of *gerunds*—nouns that refer to an active state—focuses her coding entirely within the process coding family, and provides her theoretical products with a sense of continual social, behavioral, and psychosocial action. Both Glaser and Strauss state that capturing processes is a goal of grounded theory and imply that gerunds

and the sense of action they convey during coding is a useful way of performing coding, but they do not state that it is a primary method of coding.[25] Charmaz does. For Charmaz, codes begin with gerunds.

Relying primarily on gerunds for coding has a dramatic effect on what is included during the coding process and what is not. According to Strauss, coding is a balance between abstraction and description.[21] For instance, Strauss would code a section of an interview where an aggrieved nurse describes leaving a patient's room because he is yelling as "professional composure…[rather than] expressing grief".[21(p. 29-30)] For Strauss, and for Glaser, using the latter gerund-based code would be to "remain totally or mostly at a descriptive level".[21(p. 29)] And, indeed, it does appear that there is a fundamental difference between these codes. Professional composure is not only a noun, but it is a sociological concept, and, more importantly, it does not attend to the complex interplay between researcher and researched. By choosing to code using gerunds, Charmaz turns an exercise in categorization into an interpretation of social performance.

Charmaz's choice to code with gerunds positions her to "define implicit meaning and actions"[2(p. 124)] in the social performances of everyday life. Using gerunds to code grounded data implies that any utterance or behavior is part of a larger web of "assumptions, implicit meanings, and tacit rules"[2(p. 95)] because gerunds do work. When the nurse in this example states in the interview that she is aggrieved, rather than coding immediately at the conceptual level (such as 'professional composure') the Charmazian grounded theorist choses a code that inherently implies that the interviewee is doing work on the interviewer. The verb 'expressing' does not assume that the interviewee is aggrieved in an uncomplicated way. Instead, it assumes that the interviewee's story and the way it was told, either deliberately or in "unspoken and taken for granted" [2(p. 99)] ways. meant to convey some meaning to the researcher to, in a way, perform a story.[49]

Relying on gerund-based coding, then, has two major implications for Charmazian grounded theory. The first is a turn toward description. Gerund-based coding "sticks closely to the data",[2(p. 112)] describing what is occurring. The second is a turn toward performativity and a deeper relevance of culture to behaviour, identity, and interaction. If every utterance is doing social work, then our most basic form of data is constructed at the social level. It remains impossible to strip away the performative aspect of social life,

to *capture* a research participants' 'true' or 'authentic' self with all its many exceptions; instead, the Charmazian grounded theorist is left with carefully describing the kinds of stories people tell and identifying the links between them. By attempting to faithfully collate and descriptively represent the voice of participants, "coding [in Charmazian grounded theory] should inspire us to examine hidden assumptions in *our* use of language as well as that of our participants".[2(p. 114-115)] For Charmaz, "research and writing are inherently ideological activities".[31(p. 163)] Coding using gerunds emphasizes the implicit social work performed by these ideologies for both researcher and researchee.

There is a second feature of Charmazian grounded theory that distinguishes her work methodologically from Glaser and Strauss. Charmaz's de-emphasizing the importance of the single core category fundamentally changes the meaning of the 'basic social process' in Charmazian grounded theory. Glaser's and Strauss's approach to abstract basic social process requires that they track exceptions to the process and its categories to retain the impression of rigorous trustworthiness, to "make the data objective",[37(p. 4)] and to use microscopic discussions of exceptions to help their categories transcend the complexity of the substantive area in which it was created. Admittedly, Charmaz chooses to use a single core category, 'living one day at a time,' in her seminal monograph.[38] However, she also degrades the utility and necessity of the core categories in two ways. Her core category is not sociological: it does not come from the list of theoretical codes that either Glaser or Strauss present as sociological concepts at a sufficient level of abstraction.[4,21] Charmaz explicitly states that she had trouble finding the core category, and that, ultimately she decided that "collapsing multiple different processes into one [category] would be over-simplifying".[2(p. 247)] Charmaz's approach to grounded theory remains a "realist"[40(p.271)] project about finding basic social processes, but for Glaser and Strauss, finding single core categories *was how* one discovered basic social processes. The two phrases were synonymous. Charmaz's understanding of basic social process is different. For her, a basic social process can be a descriptive narrative form in which her argument, her "interpretive rendering"[2(p. 276)] of the world, sits.[38]

3.3.4 *Clarkeian*

Clarke's approach to basic social processes and their exceptions follows the same descriptive tendency Strauss and Charmaz moved towards in earlier decades. However,

Clarke extends this focus significantly by using descriptions of difference as the cornerstone of her methodological approach. Clarkeian grounded theory is primarily a "supplemental"[20(p. xxxvii)] method of analyzing previously created codes. As is to be expected in grounded theory, the analysis of codes in Clarkeian grounded theory informs subsequent stages of data collection and so cannot be considered only as a method of post-hoc analysis. But the creation of initial concepts through the early stages of coding in a project are not Clarke's primary concern. Clarke states that coding in situational analysis is done in the traditional grounded theory method, primarily basing her citation on Straussian grounded theory.[20] Clarke takes these codes, adds a second type of initial coding family—the "frames" coding family (ex. "sociocultural discourses") [19(p. 27)]—and subjects them to a sophisticated and rigorous level of secondary analysis.

Exceptions to a category are not only assumed in Clarkiean grounded theory but are basic to the approach itself. Assuming their presence and describing the exceptions is the mandate of the approach rather than the pursuit of basic social processes. According to Clarke her move is away from "Western scientific universalizing master narratives 'explaining variation' [and toward] creating representations that basically assume differences and multiplicities and to seek to explicitly map and represent them".[20(p. 19)] In Clarkeian grounded theory the pursuit of difference comes from an analysis of codes in service to three types of maps: situational maps, social worlds/arenas maps, and positional maps. Each of these maps constitutes one of the missions of Clarke's reformed understanding of the purpose of theory as descriptions of difference and hidden work. Yet underlying these three is a single and central area of commonality. Where Charmaz forgoes attempts to account for properties and exceptions to her categories, Clarke relies exactly on the presence of exceptions to create her representations of a situation. For Clarke, identifying a few properties of the context which might influence the participants' behaviours in the situation is ineffectual: "*The conditions of the situation are in the situation*. There is no such thing as context".[20(p. 71, emphasis in original)] Therefore, rather than using a depiction of a single behavior or two to explain how a problem is encountered, Clarke focuses explicitly on identifying as many sources of difference as possible.

Clarke's maps enact her broader methodological strategy. Situational maps are "strategies for articulating the elements in the situation and examining relationships

between them".[20(p. 86)] The goal of a situational map is to identify and chart the most important human, nonhuman, discursive, and symbolic elements of a situation according to the reports of those in the situation and to the impressions of the analyst.[20] The situational maps are, in essence, descriptive. They are a product of a positively reframed analytic 'forcing' that pushes the analyst toward looking for the unseen elements of the theory and the situation it is attempting to describe. While Strauss also used spatially-oriented techniques for identifying elements of the theory that lay outside the initial impressions of the researcher,[21] his efforts were devoted to finding potentially unseen behaviors or forms of work that can be brought directly into the core category. Clarke on the other hand uses coding and situational map-making for more descriptive purposes. Finding the nonhuman, discursive, and symbolic elements of a situation is an attempt to broadly describe what is going on in the situation and to force the researcher to look outside the immediate and the singularly human elements in it.

Both the social worlds/arenas and positional maps have an interpretive assumption about social processes at their core. Producing these maps inherently requires that the analyst break from reiterating social power structures. Instead the analyst must focus on stripping the positions in a debate from the people who hold them. By focusing only on describing the positions, and removing questions of hierarchy and the implied value of the positions, positional mapping uses description to create room for the interpretation of traditional power structures. For Glaser, "descriptive sociology may contribute to myth-breaking, to expose and to help the unknowledgable to know and understand a little, but it helps people in the know very little".[4(p. 13)] Yet it is exactly this kind of myth-breaking that Clarke seeks to achieve. Social worlds/arenas are "cartographies of collective commitments, relations, and sites of action".[20(p. 86)] Social worlds/arenas mapping is based on the symbolic interactionist notion that 'the social' cannot be authentically considered in aggregate but should instead consider smaller, more particular, and more situated units.[20] Positional maps are "simplification strategies for plotting positions articulated and not articulated".[20(p. 86)] Positional maps are a new strategy on an old problem: how can we make potentially valid but silenced positions heard? Positional mapping identifies the relevant major positions taken by actors as articulated in the data *on their own terms*.[20(p. 126)] Clarke suggests that the power held by certain positions can be implicitly articulated

in the text of the theoretical narratives constructed in other schools of grounded theory. Therefore, leaving these maps to their own descriptive ends is inherently analytic work that requires discursive codes belonging to families not included in the other schools.

3.3.5 *Summary*

I have attempted to show how a move toward description-as-theory has resulted in changing attitude toward exceptions to categories in grounded theory. This move tacitly used description as a tool to change the focus and mandate of grounded theory from primarily behavioural to primarily sociocultural.

3.4 Conclusion

I have attempted to show that how a researcher interprets the purpose of theory shapes the methodological choices they make. A single researcher can write for different audiences—that is, since a single researcher can be expected to create different products from the same project—and each of these products may require slightly different methodological approaches. Writing for an audience that expects single basic social processes with easy-to-follow and parsimonious theoretical structure requires different methodological tools than writing for an audience that expects complex socioculturally and historically-aware representations of a situation.

If grounded theory is indeed a methodology for analysing social processes based on the precepts of symbolic interactionism and pragmatism.[4,21,50] then what fundamentally differentiates between the four schools in our time is not the epistemology of the school itself but rather the ontological position assumed by the researcher for answering a specific question at a specific time and place. For Urquhart, grounded theory "is orthogonal not only to the type of data used but can also be appropriated by researchers with different assumptions about knowledge and how it can be obtained".[19(p. 36)] Making this shift in accountability to researchers instead of methodological schools calls into question previous assertions that good grounded theory research sticks purely to using methods from one of the four schools.[51]

Contemporary grounded theory is caught in a double bind. If the goal of Glaserian and Straussian grounded theory is to develop a single concise concept, preferably a couple words strung together, to describe what people in a certain situation do, think, and feel, then it is reasonable to suggest that grounded theory is a paternalist and modernist

project; an expert consolidating the experience and viewpoint of a generalized other. According to Kearney, "formal theories exacerbate the tension between our need to create rules of thumb to get things done and our postmodern awareness that the complexity of life can never fully be captured in any theory".[15(p. 128)] I am suggesting that it is also just as reasonable to suggest that grounded theory's focus on the interpretation of the researcher turns the grounded theorist into a weaver of narratives. Someone who splices and dices the experiences and viewpoints of others into a story about a process. It is an attempt to make bridges across gulfs of experience: bridges from those who have personal experience in a given situation to those who don't have it, and bridges from those who have personal experience in a given situation to their prior selves before they had been changed by the experience. It is my hope that identifying four schools of grounded theory and some of the methodological choices privileged by each of them will allow grounded theorists access to some increased transparency about what kind of theory they aim to produce and how they made it.

3.5 Methodological reflections

Depicting grounded theory in this chapter as a diversely applied but coherent methodology was a deliberate choice. Though I have dedicated much of this chapter to teasing the four schools apart, the empirical studies that follow this chapter show how aspects of the four schools can be woven together. In this small subsection I will briefly explain how I position my grounded theory research ontologically, epistemological, and methodologically. I will also address what methods I employed to enact those approaches and some of the consequences for my research process.

3.5.1 *Ontological*

Ontological questions ask what is real. Not all qualitative researchers choose to engage in the ontological positioning of their work. Crotty, for instance, argues that while social scientists should be expected to make clear their epistemological and methodological positions, ontological questions about truth, realism, and meaning are perhaps too personal and too uncoupled from epistemology to remain necessary elements of reflexive research.[6] On the other hand, for some, authentically performed research tracks what the researcher considers to be real and how those beliefs fit the purpose of the

research.[52,53] I lean to the latter side in this debate, and I will briefly address my ontological positioning over the course of this research.

Even though many realisms are possible, medical education researchers often mistake realism for positivism.[54] Positivism is an epistemological position and I will address epistemology shortly; realism, however, is an ontological qualifier that has many possible implications for what is real and, *indirectly*, for what can be known. I will present five possibilities before aligning my work with one called *interpretive realism*. The first, *scientific realism* posits that good scientific theories become more and more accurate predictors of things as they really are.[55] Scientific realism describes the realism familiar to traditional discourses of science and objectivity. According to Hammersley, "*subtle realism* retains from [traditional] realism the idea that research investigates independent, knowable phenomena. But it breaks with [traditional realism] in…accepting that we must always rely on cultural assumptions".[56(p. 52)] Subtle realism is a form of realism found often in the social sciences that says that scientific realism, while naïve, is an ideal worth striving for. In a *perspectival realist* stance, "scientific claims may be socially constructed, and thus for the possibility of discovering…the extent to which [it is so] can only be determined, if at all, by a detailed historical examination of the case in question".[57(p. 6)] Perspectival realism assumes that by describing an object from multiple perspectives, including the historical and the cultural, that some element of truth can be exposed. *Critical realist* approaches use causal interpretations of social structures like patriarchy to "expose biases that arise, directly and indirectly, from unexamined assumptions about sex/gender systems…to explore new lines of inquiry".[58(p. 59)] Critical realism assumes that social structures are real, though not inalienable. In *interpretive realist* texts, "experience and its meanings are filtered through the researcher's, not the [research subject's] eyes",[59(p. 100)] and they work to depict phenomena in the world while simultaneously presenting the framework with which those phenomena are interpreted. The goal becomes to make meaning of interpretation instead of making truth out of fact. The research I present here relies on this ontological stance.

The interpretive realist research I present assumes that the world in front of the researcher's eyes truly exists: the phenomena I witnessed occurred. Interpretive realism is based on a postmodern pragmatist notion of truth. For Rorty, in postmodern pragmatist

notions of truth, "the chief enemy [is] the notion of Truth as accuracy of representation".[60(p. 83)] Out from under the influence of this enemy, scientific inquiry can be seen as "adapting and coping rather than copying, [and thus] the continuity between science, morals, and art [becomes] apparent".[60(p. 83)] What I saw in the operating room happened. But, based on interpretive realist assumptions, the researcher's main responsibility is not to record a stenographer's account. Instead, I worked to make meaningful theory and transferable descriptions that would lead fellow researchers and practitioners in medical and surgical education to take note of previously unacknowledged social processes.

3.5.2 *Epistemological*

Epistemological questions ask what can be known. For the most part, it is accepted that epistemology is tightly tethered to methodology. Much of that work has been done in the philosophy of qualitative social sciences research coded under the name of 'paradigms'.[61] Research in medical education has also acknowledged multiple epistemological perspectives.[62] Early research in medical education was primarily concerned with replication of the experimental conditions in 20th century social sciences.[63] Epistemologically positivist and post-positivist research assumed not only that reality existed outside of human consciousness but that that reality could be empirically known.[6] The more medical education researchers could control variables and curtail bias, the more accurately they could measure the effectiveness of their interventions. Near the end of the 20th century, researchers in medical education's mainstream began to apply methodologies that social scientists of medicine had begun to employ three decades earlier.[64] Qualitative research methodologies that emphasized induction over deduction appeared with increasing frequency in the field's top journals. In recent years, alternative epistemological approaches such as constructivism and critical theory have emerged as viable and respected modes of inquiry.[62]

The research in this dissertation treads across all four of these epistemological approaches. Just as postmodernity questions society's grand narratives,[65] this research makes some of the same assumptions about grand narratives in the social sciences.[20] I have worked from the epistemological position that the research presented here could at times take a post-positivist approach on what can be known. For example, on many

occasions, I found myself believing, and writing into the research, that some procedural variations were undeniably ineffective. Slicing through the aorta. Leaving a perforated bowel in place. Leaving gushing bleeding to fend for itself. I believed that scientific work could accurately prove such procedural movements to be ineffective. Admittedly, though, I leaned much more heavily on epistemological constructivism and critical theory. Knowledge built from positivist epistemological beliefs ultimately had little influence on my research. What could patently ineffective variations tells us about education or assessment? The most formidable challenges in medical education are not those faced by those trainees who can be assessed for egregious technical incompetence. Instead, medical education faces significantly more nuanced problems.[66] Problems that only sustained scholarly engagement with the way people construct their reality (constructivism) and the social discourses of power that shape those constructions (critical approaches) can begin to tentatively unravel.

I took the idea of blending the four schools of grounded theory quite seriously. For me, and for others,[20,51] none of the four schools are wholly post-positivist, constructivist, or critical. Admittedly, some of the language used by the authors of the four schools indicates otherwise. Both Glaser and Strauss sound like post-positivists discovering real entities that emerge from the world. Charmaz sounds like a constructivist building a story out of the realities of many individuals. Clarke sounds like a critical theorist on the lookout for oppressed ways of thinking and being. But my argument in this chapter is that, at its core, grounded theory is an internally coherent methodological approach based in pragmatism and symbolic interactionism that favors the building of theoretical narratives to rethink key assumptions: "At some level of abstraction, [Strauss's theories] were all grounded in pragmatist theory, particularly that of John Dewey, and in dialogue with other symbolic interactionists…By observing what actually occurred in terminal wards of hospitals, Anselm and Barney were able to break…taboos and say the blunt truth: dying people do not always die when they are supposed to".[67(p. 4)] Indications to the contrary, I am arguing, are the result of the authors of the four schools abiding by disciplinary conventions situated to the time of their writing.

3.5.3 *Methods*

I used methodological strategies from all four schools. Blurring the boundaries between the schools makes identifying the methodological decisions made along the way crucially important. Sometimes, such as in Studies 1 & 3, I focused on broadly descriptive work. Other times, such as in Studies 2 & 4, I strove for the parsimonious creation of abstract theory. The conventions of medical education research have not yet caught up to the idea of multiple interacting approaches to grounded theory. Therefore, in the empirical papers that follow this chapter, I have not expressly identified how I navigated these blended methodological waters. In this subsection, I will briefly attempt to pre-empt that lack by addressing how my research made use of the four schools.

Glaser asserts that grounded theory researchers should not come to a project with a question (only a population). This approach was only partially possible in my work. My approach was to enter a situation with a research question, but to be open to questions that felt more personally interesting. Borrowing from Glaser, I thought: 'go to the workplace; stand around; ask questions of the people who will tolerate your presence; write notes.' In my initial days in the field, I made maps of the interactions between the people who were present. The maps noted to whom they said things and how they said them. When they said something that took me aback, startled me, perhaps even scared me, that's what I chose to study. At the start of this program of research, those startling realizations came mostly around the occasions when the surgeon had yet to arrive in the operating room. The nurses, surgical residents, and anesthetists seemed preoccupied with getting the room ready for *this* surgeon. I was mystified: don't all surgeons do the procedure the same way? My position as an MD/PhD student who would one day become a resident led me to wonder: if they don't all do things the same way, how do the residents figure out what they're supposed to be doing? How will *I* figure it out?

I came to understood the observational fieldwork to be 'marginal participant observation' over the course of the studies.[68] Marginal participant observation strikes a middle ground between non-participant observation and participant observation. In non-participant observation, researchers remain on the periphery of the action and take notes without interacting with research subjects. In participant observation, researchers usually have an official role within the organization being studied and carry out some form of

work while continuing to take research notes. In marginal participant observation, the researcher has some role within the organization but only occasionally participates in the work. As an MD/PhD student I sometimes found myself called by faculty and residents to speak to anatomy or act in support of various aspects of clinical work. While I was clearly not an insider (my notebook and pencil set me apart), neither was I fully a non-clinician. My position as a marginal participant played a role in sensitizing me to educational questions that felt personally important. How would I behave when asked to perform the same procedure multiple different ways?

Once I had the research question, I performed a few interviews on the topic. Based on Glaser and Strauss' writings, anywhere between two to ten interviews seemed reasonable depending on how accessible the sample and how close the analysis. For the first study I used four interviews. I used these initial interviews to identify some of the jargon the participants used to describe the phenomenon of interfaculty variations. While these interviews were ongoing, I continued to work my way into the field. I began to take exacting notes of everything that happened in the room. I wrote furiously and then would go home and re-write the notes for hours. As the weeks and months passed, and I honed in on exactly what I wanted to know, I found it increasingly difficult to take many notes describing what I was seeing without including significant dialogue. Perhaps that is a once-aspiring novelist's conceit. Regardless, it was far easier for me to describe one or two really meaningful instances during the day when I had some retrospective analysis from the participants themselves to compare them with. I collected this dialogue through interviews and integrated those interviews directly into my field notes. Over time, my field notes became primarily verbatim quotes from the field that I would ask the participants about after the case. Many times my notes were wasted, as the participants moved too quickly or were not interested in speaking with me afterwards.

Observational data is challenging to work with and requires more patience and faith than I expected. I find Glaser to be the most informative of the four on this topic. For Glaser, you don't have to make field notes of everything you see and you don't have to code every field note you write; it is the process of deciding what makes it into the codes that is crucial. On the surface, a Glaserian coding approach is primarily concerned with breadth, of being able to explain all of what you are seeing with a few elegant concepts.

Buried within the Glaserian texts, though, is the recognition that how you make meaning out of what you're seeing is done with a kind of impressionism. The things that move you: those are the ones worth noting and describing. So the coding was done in service to what I saw and heard, more as a memory aid than the analysis itself. I used the coding to give flesh to the process of writing it up. I used coding software as I wrote to interact with the data and to quickly find the codes and words that resonated.

Analyzing the interviews was a little less mystical to pin down. I open-coded the first couple interviews in each new phase of the program of research using a Charmazian, gerund-based approach. For example, in the first study, I coded each and every line of the first 4 interviews which led to over 500 codes. Charmaz's lack of clarity about how constant comparison and focused coding work leads to challenges in the sorting of these many codes. I found Strauss's axial coding to be a useful starting point. I cannot claim that I followed it to the letter. But I found that using his coding paradigm (or at least parts of it) by sorting codes into processes, properties, conditions, and consequences gave me a useful tool for keeping track of ideas that arose in the open coding process but couldn't be captured by gerund-based codes. As that study progressed, I used Clarke's situational mapping with relational analysis to help to show the analytical group how the codes relate to one another.

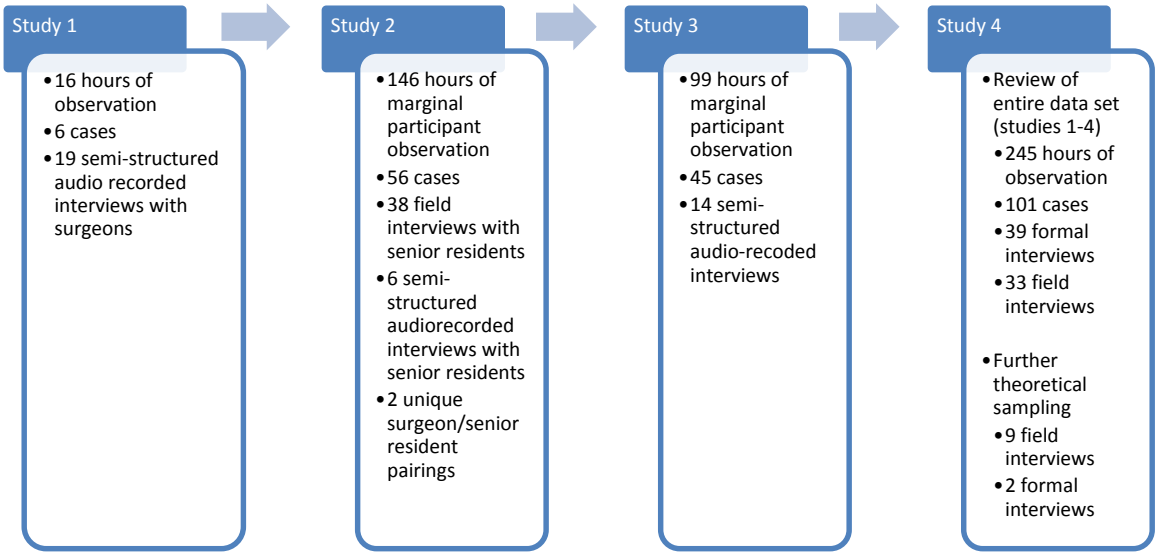
By the time I reached the third study, my approach was to open code the first one or two interviews. The results seems to be the creation of around 100 codes. I wasn't shy about creating categories as I went along the open coding process. Once I felt like there were too many categories for me to keep track of and some concepts were beginning to repeat themselves, I started to create (in parallel with the open codes) an axial coding framework. I filled in properties, dimensions, conditions, and consequences not by transposing open codes into the axial framework but by writing them anew. This parallel creating forced me to be more succinct (so I could remember what the axial framework contained), judicious (so the framework didn't become too burdensome to work with), and patient (as I knew would have to go back through and investigate each of the open codes to see how it was relevant to the axial framework) than I would otherwise have been.

After I started to come to an axial framework, I began to speak with the research team about it. Glaser talks about these analytic meetings as a painful 'leveling up' from the analysis of the primary researcher. Sometimes an outside eye is needed to give the analysis a shape that is recognizable to prospective readers. In these meetings, I tried to remember that the previous analysis I had done could fill any shape. I tried to be open to creating that shape through collaboration. In this doctoral research, the name of every category was created through consensus and the only categories that received sustained attention in the writing where the ones that the group decided were important.

Once the group came to a focused coding framework that felt was sufficiently useful, I started coding afresh for a third time. As I went along I started to make notes on a manuscript template about the things that were going to go in the published report. In the results sections, I started by describing the categories (processes) and using the properties, dimensions, conditions, and consequences in the background to inform the writing. The coding and memoing were useful in guiding the analysis, but I felt they were done in service to the writing. I wrote the sections of the manuscripts, checking back periodically with the things I thought should go in it in the first place as well as with the codes and memos. On more than one occasion, I wrote a draft of a paper to have my research team only pick out four or five sentences they thought were interesting. This happened especially in writing the discussion sections. I felt it was reasonable, especially in working with a team, to rewrite the analysis and build out from those flagged sentences as a means of thinking closely through the data yet again.

Ultimately, this doctoral work followed the precepts of grounded theory by iteratively analyzing and collecting the data. The data collection and analysis occurred simultaneously, and the data used to inform the individual studies is described in Figure 1. The analysis for each of the four studies was completed approximately three months after the previous study.

Figure 1. Data collection process for studies 1-4



3.5.4 *Final reflections*

My grounded theory, Thresholds of Principle and Preference, emerged out of a program of research that tried to balance tenets of constructivism with my own initial training in critical theory. Over the course of the research, balancing these two threads posed significant challenges. While the empirical studies mostly take on a constructivist voice, small threads of the relevance of discourse reared up. For instance, during this doctoral research, participants were generally unwilling to talking about the role of gender in thresholding. Late in the research process I came to learn that, in surgery, female residents report less confidence in their operating skills and are twice as likely to worry about competence after training.[69] In some cases, my participants admitted that gender-based preferential treatment may be occurring. I did not witness any explicit discrimination during my study, but the surgical education research insists it is a problem.[69,70] The mechanisms of this discrimination, however, remain unclear.

Thresholds may be one such mechanism. The absence of obvious discrimination in my data may only further explain why thresholds are opaque: to avoid the explicit conversation is to avoid drawing out socially-fraught conversations about power. The difficulties of navigating these challenges in surgical research are well documented. Both

the social sciences and surgical research consider *Forgive and Remember*, by Charles Bosk, to be a great achievement. The book is revered as a seminal text in the field.[71,72] In it, Bosk finds evidence to confirm his hypothesis that in surgical culture "technical and judgement errors were blameless while the normative and quasi-normative errors were blameworthy".[73(p. 217)] The book's first chapter shows how "this is the logic attendings used to either promote residents to the next level of training or to deny such promotion".[73(p. 217)] In the book, Bosk discusses two residents who are subjected to discipline. One resident, Smith, is reprimanded for his technical errors and allowed to carry on in his training. A second resident, Jones, is reprimanded for his decorum and communicative behavior. The surgeons in Bosk's hospital not only prevent Jones access to further surgical training but they question his sanity, they impugn his moral character. Bosk is proved right: normative and quasi-normative errors are fatal in ways technical errors are not.

In 2003, twenty four years after *Forgive* was originally published, Charles Bosk released a new edition with an amended appendix. In that appendix, Bosk admits he changed some of the facts in that original draft. He did it unthinkingly to preserve anonymity. But his efforts had unexpected consequences. The fact that Bosk changed? Jones was actually the only female resident in the department. She was tarred, feathered, and ridden out of town, but nobody dared ask whether gender played any role in how she was assessed by the faculty members who supervised her.

So what does this mean? It could mean nothing. Perhaps Jones was indeed unstable. But when Bosk investigated two decades later he found that she had gone on to become a prominent emergency physician. Could it be that gender-based discrimination permeates surgical culture? Current research on the topic seems to indicate that it does,[69,70] but we still have little insight into how it works.

According to Bosk, "good fieldwork account[s] contain insights unpleasant to subjects…[or] the ass end of the sacred".[73(p. 215)] His critical error, then, is to write the story as if "only the behavior of the residents is problematic. I do not stop to question whether the criteria, standards, rationalizations, or processes that attending surgeons employ might themselves be problematic".[73(p. 217)] Once afforded the clarity of hindsight, Bosk reveals a problematic choice that lived at the base of his interpretation and was

epitomized by his changing the gender of Jones to male: "I do not display any of the data that I collected that would allow others to raise these questions. The absence of such data is important"[73(p. 217)] for unpacking some of the sacred yet problematic values of surgical culture. For Bosk, choosing to ignore cultural constructions of gender symbolizes a more diffuse problem that he hid from his text. The intractable nature of the surgical hierarchy makes it difficult for residents to think through the entanglement of the discourses of evidence-based medicine and surgical autonomy and to wonder whether other discourses such a gender may play as significant a role in the negotiation of procedural variation or quasi-normative error.

As is common in grounded theory research, I only began to read many of the theoretical texts in my field once the core category of my theory emerged. Bosk's admission took my breath away. I, too, had changed the gender of the participants in some places to preserve their anonymity. In the later stages of the research, before reading Bosk, I began to wonder whether gender was indeed a relevant property of the theory. Did gender play a role the way surgeons and residents negotiate variations? For example, are the well documented gender-based inequalities in surgical training caused in part by resistance to female surgical residents negotiating or defending thresholds?

I never did find out, because few participants were willing to talk about it. Those that did would quietly speculate about the challenges female residents and surgeons *could* face in advocating for their procedural variations, but they would never agree that it was a broadly cultural problem. When I would ask, participants from multiple genders would usually avert their eyes and speak in the abstract about patient safety and doing surgeries 'the right way.' I found myself blocked, just as residents are, by the unassailability of the discourse of patient safety and the reality that I had neither the surgical expertise nor the data collection resources to test out my hypothesis that gender mattered here.

The problem may be largely a methodological one. Were I to have done an entirely Glaserian grounded theory research study, it would have been simple to ignore, just as Bosk did, the difficult question of gender.[74] While I had questions and hunches about it, because gender had not emerged tangibly from the data, I could feel comfortable excluding it as a relevant property of the theory based on traditional approaches to grounded theory.[8] Bosk regretted his decision because "[e]thnography is less good to

think with if it does not provide a rich enough database to allow readers to frame alternatives, to disagree with authorial certainty, to see things differently".[73(p. 217)] For Glaser and Strauss, grounded theory is similar.[8] Pragmatism infuses grounded theory with the mandate to overturn received knowledge and flatten hierarchies.[21] Where ethnography relies on the recording of details, the building of a database, grounded theory as it is traditionally conceived uses single concepts to do the work of reframing. But without methodological tools to remind researchers to attend to the mechanism of power, that which drives discourses underground away from the prying eyes of nosy researchers, it is all too easy to brush away uncomfortable questions. Building on the work of Strauss, Charmaz, and Clarke, grounded theory has become a tool that deliberately asks questions of a situation that are drawn from previous theory while avoiding becoming a simple restating of those theories. It has become about "breaking down romanticism and taboo and, above all, silence".[67(p. 4)] Drawing on sensitizing concepts such as feminism and attending to discourses through the sociomaterial can turn grounded theory into a potent tool for working under the discursive surface of cultures and burrowing into knotted and hidden assumptions that recapitulate traditional hierarchies.[29]

I will address in Chapter 8 how ongoing research that builds on the grounded theory found in this dissertation may begin to engage with that effort in the future. For now, this dissertation will turn to the empirical studies that led to the construction of the grounded theory at its core.

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Chapter 4

'Study the unstudied,' was a maxim we heard time and again. Do not follow the fashions, do not jump on the bandwagons of theory and public debate. Seek instead the untold stories, the quiet contributors, and the modest corners of social life where human suffering is compounded by silence. Pay no attention to the labels on the disciplinary doors bidding or forbidding you entry. Follow the questions, follow your data, and follow your own senses of inquiry and justice.

- Adele Clarke & Susan L. Star*

4 Empirical Study # 1: Adaptation & Innovation

This chapter consists of the first empirical paper of the dissertation. The data collection for this chapter started nearly 16 months before the data collection for the rest of the papers. Consequently, it is more broadly descriptive and exploratory than the others. In the analysis, I focused on how the surgeons I was speaking to socially constructed the variations in surgical practice and what ways of speaking about that variation are culturally appropriate or inappropriate. Before I turned my focus toward the educational implications of procedural variation, the research for this chapter set my baseline for the surgical culture I was about to observe. Thanks to this focus on practicing surgeons, the paper in this chapter was published in the *Journal of Evaluation in Clinical Practice* in June, 2015.[1]

4.1 Introduction

Surgical research struggles to account for the relationship between procedural variations in daily practice and traditional conceptualizations of evidence.[2] Recently published frameworks provide some guidance for understanding the issue and suggest a basis for interventions to address it.[3-7] The problem has resisted simple solutions, in part, because we lack a solid understanding of the sociocultural influences on variation, adaptation, innovation, and evidence in the surgical workplace. The creation of robust

* "On coming home and intellectual generosity." Symbolic Interaction. 1998;21(4):341-352.

theory in this area may assist the development of interventions designed to alter how surgeons interact with each other around variations and evidence in daily practice.

Many of the unavoidable contingencies of surgical practice that factor into the complex relationship between variations and evidence are well explored.[8-11] Surgeons leapfrogged from a handful of interventions on weakly anaesthized patients in the 19th century to the proliferation of thousands of surgical procedures in the next.[12] Research by Glover in 1938 and Wennberg in 1970s showed that small-area variation—differences in procedure choice from place to place—became widespread over the course of 20th century surgical practice.[13] The yet-unrealized call for an 'FDA for surgeons' in 1975,[14] and the rise of evidence-based medicine in the 1990s,[9,15] drew attention to debates about the comparative effectiveness of surgical procedures that had been ongoing for decades.[16] Today, the complexities of surgical practice that make it difficult to identify the most effective variation of a surgical procedure have become a key concern in surgical research.[10,17-19] Producing the now-expected high-level evidence of the comparative effectiveness of interventions has proven more difficult for surgery than other disciplines for many reasons, some of them contingent and unavoidable.[3-5] Clinical equipoise may be harder to maintain in surgical research.[20,21] There is uncertainty about the translatability of descriptions of procedures from literature to practice.[22] And the comparability of the same procedure performed by different surgeons is suspect.[23] Recognizing such contingencies is critical,[6,24] but it is merely a first step. To move the field forward we must develop a holistic understanding of the factors that influence how surgeons negotiate variations in the social complexities of the workplace.

Surgical research has traditionally assumed that the solution to procedural variation is the implementation of practice standardization interventions. The publication of practice guidelines and consensus statements have indeed been shown to change practices in the workplace.[25-27] But these appear to be incomplete solutions: reversion to the mean is common in medicine generally,[28] and it may be especially prevalent in surgery,[27,29] Complex factors such as "clinical context"[27(p. 625)] and surgical culture that were once assumed to be irrelevant to how surgeons judge the value of one variation over another are now suspected of playing a more significant role.[8] This sociocultural influence on variations in the workplace has been inadequately addressed in the literature:

how surgeons interpret variations they hear about or perform and what they do about them on a day-to-day basis has been left theoretically underdeveloped. Linguistic analyses,[30] grounded theory-based content analysis,[31] and other forms of qualitative research[29] have attempted to describe how surgeons speak about and define variations in naturalistic settings. But a thorough understanding of the social processes that shape how surgeons interpret and enact variations in their daily lives does not yet exist.

While many interventions have been created to address the problem of procedural variation[27] none fully attend to the role of sociocultural complexities in the surgical workplace. Naturalistic research exploring how surgeons think about and act on variations can produce insights that transcend previous "simplistic narratives"[2(p. 628)] regarding procedural variation and can be used to improve the design of such interventions. In this study, we set out to ask how surgeons conceive of variations in surgery, how they decide whether or not to adopt variations, and how their relationship to procedural variations is influenced by their interactions with others in the workplace.

4.2 Methods

This three-phase grounded theory[32] study took place over a period of 20 months beginning in January, 2013. Our grounded theory methodological approach was primarily rooted in constructivist grounded theory[33] and situational analysis.[34] The goal of grounded theory research is to develop inductively-derived theoretical representations of a social process rather than a deductive theory based on hypothesis and experimentation.[35] This focus makes grounded theory an appropriate methodology for providing fresh perspectives on intractable problems.[36]

Sampling in all three phases of the study was guided by the logic of theoretical sampling[33] where the data is collected to inform the evolving theoretical framework. The first stages of the theoretical sampling—exploration and purposive sampling, respectively—were used to develop a research question and to select rich informants.[37] Sample size in grounded theory research is not determined by effect size calculations[35,38] or concerns about generalizability[33,34]; instead, data collection is complete when saturation of the theoretical framework is achieved.[33] In this study saturation was achieved when no further elements were added to the situational map during the end stages of theoretical sampling.[34]

The final data set consisted of nineteen interviews with a mean duration of forty one minutes. We restricted sampling to surgeons at academic centres for two reasons. First, as compared with community surgeons, academic surgeons are the group one might most expect to be rich informants about innovating in surgery, given their access to the most complex patient cases and the newest technologies. Second, the perceptions of the next generation of innovators—surgical residents—will be shaped in important ways by their exposure to social processes surrounding innovation in academic training centres.

Interviews were transcribed and coded with assistance from NVivo 10 (QSR International, Melbourne, Australia) data management software. The study was approved by the Research Ethics Board of the University of Western Ontario.

4.2.1 *Phase 1: Exploration*

The initial stage of the study consisted of convenience sampling with key informant surgeons. These consultations consisted of two interviews as well as sixteen hours of observation in the operating room across six cases performed by three key informant surgeons with previous connections to our research centre. Using reflective memos from these interviews and observations,[33] we refined our research questions and developed a guide for subsequent semi-structured interviews to explore these questions.

4.2.2 *Phase 2: Purposive Sampling*

The purposive sample consisted of surgeons identified by leaders in a single institutional setting as being particularly innovative (n=7). These interviews were conducted using the semi-structured guide developed in the previous stage. The first four transcripts of the purposive sample of interviews were coded using an open, line-by-line coding technique.[32,33] The line-by-line codes were then raised into tentative categories by comparing codes with one another to create a focused coding framework.[33] Throughout this process, analytic progress was continuously tracked using reflective memos.[33]

4.2.3 *Phase 3: Final Theoretical Sampling*

Gaps in the focused code-based preliminary theoretical framework were identified using a grounded theory technique called situational mapping with relational analysis[34] that compares categories to categories to analyze how categories and their subcategories are related to one another. Theoretical sampling and coding was conducted to explore the gaps in the emerging theory. The final-stage theoretical sample (n=10) consisted of

surgeons selected to address questions about gaps in the framework, new concepts arising from the memoing process, or cases that presented as discrepant to the framework in the data collection process. The theoretical sample included female surgeons, surgeons in the first three years of practice, surgeons working in different academic centres, surgeons self-identifying as mid- to late-adopters of surgical innovations, and further sampling of known innovators. The theoretical framework was refined during this theoretical sampling process. Data collection ended after saturation of the framework was reached.[34]

4.3 Results

The surgeons in our sample reported that their decisions about disclosing and refining procedural variations depended on social interactions. The findings of this study describe this social process of surgical practice variation. The overarching process was composed of three categories: **seeking improvement**, **orienting self and others to variations**, and **acting under cultural and material conditions.** The categories and subcategories of the social process are described in full below. The categories have been represented here by synthesizing data from the coded subcategories. Extended representative quotes from each category are included in Table 2. The delineation of categories in constructivist grounded theory research should be considered holistically: while each social process is distinct, one is not necessarily exclusive of the others.

4.3.1 *Seeking improvement:*

Surgeons engaged in practice variation because they experienced *unsolved procedural problems*, they were *adapting to get the job done*, and they were *pursuing opportunities*.

Having unsolved problems was an important instigator of seeking improvement. Every sampled specialty appeared to have a few "really difficult problems that we don't have a solution for"(S12). These could be cases where adverse outcomes were rare as "1 per 1000"(S04) but when they do occur they're "catastrophic events…[that can be] a kick in the stomach" for the surgeon(S04). They could be cases with "patients who were abandoned"(S09) by the progress of surgical techniques and technologies and thus for whom there is no intervention. Or they can simply be cases where "our solutions are just okay…so any kind of contribution…can maybe make it a little less challenging"(S08). Under such circumstances, some participants felt driven to seek out improved practices

from colleagues or to investigate the potential of their own variations to solve the problem.

Variations emerged from the day-to-day process of *adapting to get the job done*. Enacting surgical expertise was described as coming to "realize that it's not always in the book"(S05) and that it is about "making individualized decisions in the heat of the moment"(S15). Solving the problems of daily practice appeared to foster "improvisation"(S06) and "ingenuity"(S01) and to elicit "little trick[s] of the trade"(S03). While it was suggested that, for these adaptations, "there's probably not the evidence to support it being in the textbook"(S03), they can sometimes be improvements that make "it simpler technically…[and have] less complication risk"(S07). In some cases, if the "community recognizes…[it] as a challenging problem"(S08) then it "may lead to the adaptation sticking…[because] if the adaptation worked for some, you know, then it will work for others"(S09). Our participants described actively remembering these adaptive variations for later personal use or as potential innovations to be shared with others.

The process of *pursuing an opportunity* to explore a variation could follow from an adaptive variation or from more strategic concerns. "External pressures"(S16) from hospital administration, clinical departments, or patients themselves also prompted surgeons to pursue investigating variations that were new to them. Other times, an interesting variation could be suggested by a colleague or resident, or an "industry person [could bring a] technology" (S07) forward to the surgeon to try. In these cases, the variations in practice could appear to the surgeon considering them to be opportunities to put "things in the literature that are of value to surgeons and would be of value to patients"(S05). Pursuing these types of opportunities made a significant difference to surgeons who aspired to secure an academic position and feel called to "stand up and do something different and be different…[to get] a good job"(S13). Pursuing variations was thus not limited to adaptive variations felt to fill procedural gaps but was influenced by personal, professional, and institutional goals.

4.3.2 *Orienting self and others to variations*

This second category in the framework involves *taking stock* of a variation, *sharing stories* of variations with others, and *placing trus*t in the variations perceived in the course of practice and socialization.

Deciding how to move forward with a variation elicited a process for the participants in our sample of *taking stock* of how the variation might promote various interests. Considerations about the variation included "how easy it's going to be to reproduce"(S09); whether or not the variation could make "a quality of life impact"(S10); whether the variation was "kosher…[or it] broke these principles of surgery" (S01) and thus would be riskier to promote; or whether it could "generate the publications you need to keep going"(S15). The personal costs of getting "a trial going, which in our day and age would need to be multicentred, which is very skill-specific and resource-specific kind of study to undertake"(S10) were also taken into account. The perceived benefit was weighed against these logistical complexities of surgical research "which usually means you have to recruit surgeons to participate in the study and be willing to either be randomized or [adopt] new ways of doing things"(S17) which can become "a big barrier…to mak[ing] it worthwhile"(S17). Local conditions such as the "deliverables and expectations provided to [the surgeon]"(S02) when he or she is hired shaped how the surgeon perceived the value of pursuing further exploration of the variation. The perceived value of a variation depended on characteristics such as its reputational riskiness, its logistics for further exploration, and its place in the surgeon's career trajectory rather than on its perceived utility. Further, these logistics and contingencies were subject to change; therefore, participants described continually revisiting taking stock as new information became available and their social environment evolved.

Sharing stories was a way of gauging the reactions of colleagues to variations. The process of sharing stories could occur during the natural flow of work when a second surgeon is called in to assist, a different surgical service is consulted, or new members of the surgical team come aboard. As one participant stated, stories are shared inside the operating room: new trainees, especially fellows, can be a "way for me to learn about how the other surgeons do certain things, techniques, or some tricks and whatnot"(S11). Sharing stories of variations outside of the operating room also seemed to be "a regular source of conversation…[where one can] acknowledge that there are different ways of doing things"(S10). According to one surgeon in our sample, "even in this immediate transmission, electronic era, that's the main way by which innovative knowledge is passed along, by the old traditional caveman methodology, storytelling… [and] there's

informal storytelling and formal storytelling"(S09). Formal storytelling about variations was acknowledged as an important part of discussing and disseminating them, yet, especially across our purposive sample, the importance of informal storytelling was highly emphasized: "It's very rare to learn anything new when you sit there and listen to talks [at conferences]. What you learn more is just communicating with people, during the day, one-on-one"(S03). The process of sharing informal stories about variations during "hallway conversations, [and] being in clinic together"(S08) and "coffee breaks at [specialty] meetings…[and] when we're not examining"(S09) at licensing exams were reported as both rich sources of learning and important testing ground for variations under consideration.

The process of *placing trust* in the stories and variations of others was present in the entire sample and particularly pervasive amongst the known innovators in our purposive sample. Placing trust refers to the act of using the thoughts and opinions of others to gauge the value of variations. The surgeons in our sample built relationships around procedural variation and reported making clinical decisions using that information. It was suggested that "the surgical model of training is still very much an apprenticeship-based model where you have a master and an apprentice"(S15). In this model the "principles…the outlined dogma of surgery…you learn those in residency"(S14). Principles were understood to be ideas "passed down from generation to generation over centuries of things that you're supposed to do to have a good outcome"(S01). It was suggested that a surgeon can "coach residents to make a distinction between a preference and a true, true principle…[but] the more common the operation, the more diverse the techniques become"(S12). Deciding whose of these variations or opinions to trust could depend on "reputation"(S01), "credibility"(S17), authority or positions of "leadership"(S10), a "supportive atmosphere"(S09), "seeing someone who is really technically expert"(S12), or, most commonly, on having a relationship upon which participants can rely on for "support [for their] ideas and intuitions"(S13). While the process of placing trust was ubiquitous across the sample, the surgeons in the purposive sample especially discussed seeking out a faculty "mentor and friend"(S08) who would be open-minded, "where there is no real [procedural] rights or wrongs"(S06) whom they could "bounce things off"(S08). When considering investing the time and resources into investigating a variation,

innovators in the purposive sample felt that the genesis of research depended on finding a mentor where "if something goes bad [while doing a variation, the mentor] is going to be stepping up"(S13) and protecting the innovator's reputation. Proceeding to explore that variation was reported to require a relationship of mutual trust with a mentor "whose opinion you can look to when the evidence and the research is ambiguous"(S13) or who can efficiently give orienting information on a variation such as "yeah, I tried that in 1971 and it didn't work"(S09).

4.3.3 *Acting under cultural & material conditions*

The process of acting under cultural and material conditions regarding practice variation depended on *positioning image*, *being wary*, *showing the logic* of the variation, and *making use of academic resources* to do so.

Positioning image involves negotiating variations and who uses them at what time. In "surgery, traditionally… image management reigns supreme" (S09). As one participant stated, "I know a couple surgeons who, whatever one says, the other won't do and vice versa, even if it makes sense…That's not so much the technical credibility part as it is the underlying social, cultural environment that goes around this issue"(S17). Participants describe assessing variations—the risk profile, the potential value—and making decisions about the use of those variations based on the kind of image he or she is working to cultivate. Establishing a solid reputation based in collaboration and open communication around variations is a potential consequence of "team-based management where patient outcomes rather than surgeon autonomy is the new paradigm"(S09). As one participant tells it: "I don't have to clear [a variation] by anybody. But, at the same time, I would want to avoid my colleagues looking at what I'm doing and saying 'why is he doing this?'…[so] I would probably run it by them in an informal way"(S15). The result is a social process around variations where, "instead of being the cowboy, instead of being the lone ranger or the bullfighter…I [speak] with people and [say] OK…we're going to do this"(S13).

Surgeons also approached procedural variations and decisions about their use with suspicion. Participants described *being wary* of both innovations and current best practices: "The evidence, the actual scientific evidence, for any kind of innovation, usually lags a long time between the idea and it coming up… [W]ith each incremental

change, you've had to say, 'OK, I have to give up what I thought I knew, and re-evaluate this whole new thing'… It leads you to begin to say, 'do we ever really know anything'?"(S12). This wariness shaped how interactions around variations took place. Our participants suggested that those who fail to understand being wary as a cultural norm may be less likely to be trusted by their peers. It may not be culturally appropriate to say to a peer, "I can't believe you did it this way"(S15); rather, it may be more appropriate to wait until asked and say "why don't you try this, it worked for me once"(S17). These norms for informal conversation were also found in the formal storytelling and research context. Participants suggested that being wary of behaviors that prioritized the presenting surgeon instead of the research on the variation itself is part of being a good critical assessor. In these cases, if "they've got kind of a slick style …[it raises] a question of trusting what they're saying…and that they're not sort of trying to build their reputation and maybe inflating their results or minimizing complications"(S08). This kind of wariness was pervasive in participants' descriptions of both informal and formal storytelling.

Participants perceived *showing the logic* to be a component of abiding by cultural and material conditions during the process of sharing stories. From teaching in the OR to publishing in peer-reviewed journals, time and other resources were invested in showing *why* a variation works. On the teaching side, "you'll say something like, 'I'm sure you will have been taught a number of different ways'…or 'I know there's controversy around it but…I'm most comfortable with this approach.' Then very often you'll finish the statement with something like 'because X,Y, and Z'"(S10) or "this is a deviation from what you will have read in the textbook, but here's the justification for it" (S07). On the research side, this cultural expectation pushes surgeons away from publishing case studies or descriptions of using a variation, as "for the most of us, we would describe that as being low-level research because that's a look-at-me, look-what-I-did kind of thing"(S01). Instead of publishing a "one-off"(S16), it was perceived as a simple matter of "interest and a matter of devoting the time"(S06) to collect the culturally appropriate data. Surgeons reported that these cultural and material conditions may "detract from a lot of interesting innovations coming to fruition from the community"(S06), but that academic surgeons feel it is "expected to do those things"(S06), to investigate the discrete steps and biophysiological mechanisms that underlie proposed variations. As one participant in our

sample told it, "[w]e came up with the [X] technique…[but] we didn't actually go into the steps right away"(S04). What had to come first, he explained, was a years-long process of collaborative research on the steps and biophysiological mechanisms that guide them.

Making use of resources in academic centres was a consequence of perceiving an imperative to show the logic. Residents and other learners act as vectors of information about variations in academic centres. Surgeons can "learn some of [their] colleagues' tricks through the fellow"(S16) or resident, and programs of research can be "provoked by a resident or fellow saying 'I've not seen that before'"(S08). Learners also provide a source of labor in building complex programs of research "to do some scut work, like do the statistics, to do the measurements"(S04). The process of showing the logic, or showing *why* a variation works, can rely on these human resources specific to academic centres: "[W]e know it happens, but we don't know why…So then one of our residents who is very involved in basic sciences is taking biopsies of these and taking them to the lab, understanding, moving forward"(S13).

Table 2. The surgical practice variation social process framework

Seeking improvement	Having unsolved problems	"When it happens it's a catastrophic event because…you have significantly more bleeding and mortality in the patients…You say 'why did this happen, why did it happen to me, and what have I done wrong here?' You always try to blame yourself, you say 'did I do something wrong or did something happen due to an accident?'...[So] I wanted to see what are the reasons and see if we can solve the problem." (S04)
	Adapting to get the job done	"As you do become a surgeon, you'll realize that it's not always in the book…[It] is a bit like carpentry, you have to move forward somehow. How did I come up with that [variation]? I don't really know. I presume it's a result of many years of being in situations where you couldn't follow the plan, and I'm trying to innovate during real time…Every surgeon does…" (S05)
	Pursuing an opportunity	"I was stuck with a procedure that's usually done open, and I'm trying to do it only [minimally invasively] at the lowest cost possible because the hospital budget is cutting down on endowments so we're stuck…I was debating certain technical points so I went to the office just next door to mine. I asked my colleague 'hey, have you done this? Do you think I could try this tool?'…He said 'oh yeah, there's a video there that I've seen before.' He went to Google, found a video, and he said 'maybe you could try this place, this [tool], and whatnot'." (S11)
Orienting self and others to variations	Taking stock	"I think now this culture has evolved where people… need to know up front what it is that is expected of them and the kind of research that they need to be involved in. For some of them it's not research but it is going to be an educational piece or educational research and maybe not clinical trials or lab-based research." (S07)
	Sharing stories	"When the outcome [of a variation] is good, you then often reflect on that and say, 'well, that's pretty cool.' And, sometimes you want to share that with your colleagues and other people and say 'look what I did, wasn't that crazy, but man, I got away with it and look at how good it was'. And then, it becomes something

		that maybe you keep in your little toolbox of, 'if I ever get in a situation like that again I might do this, or maybe I'll adapt this for that situation'." (S01)
	Placing trust	"Hearing a presentation from somebody that I trust and respect, and recognising that that's probably going to be potentially a better result than what I'm getting now...[Practice change is about] relationships you've developed over the course of your residency and/or fellowship that you either know people directly or kind of secondarily and you've come to recognize that what they say is probably the result. They're being truthful about their results. They're honest about complications. And that's a big part of it." (S08)
Acting under cultural and material conditions	Positioning image	"I think the decisions I made in the first couple of years may have been less risky, because I wanted to make sure I established myself as a safe surgeon with good judgment. I feel like I have that reputation now so maybe I'm willing to step out and take a few more risks. And I've seen some colleagues, as they get near the end of their career, take less risk. I almost wonder if there's an arc to this, where you start out not wanting to be an outlier and then as you move along being more comfortable with being an outlier and then, near the end of your career maybe wanting to make sure that you don't leave everyone's remembrance of you as a sour question." (S01)
	Being wary	"I've trained with a lot of surgeons, as well, where you cannot say I saw this with Dr. Whatever and this is what we did or, I saw something else similar in another rotation and this is what we did…You would never tell somebody Dr. So-and-so does it this way, have you thought about that, unless they ask you. I think it's politeness. I think most people are polite in that way that they won't divulge that information." (S06)
	Showing the logic	"What I was taught, again, it's not in the textbooks but there's a nice little trick that you might need to do and what I will sometimes bring up to the residents, is that you flip it around and do it backwards so it sits better. But you have to say, this is a deviation from what you…will have read in the textbook, but here's the justification for it." (S07)
	Making use of academic resources	"We have the [learners] kind of as our extension...They present our work, when people ask them questions, they're essentially questioning us, technically. And then you can take some of those questions and say, okay, you can improve a lot of the stuff we do and it makes you see a lot of things in a new light, because you're always used to looking at things in a certain direction." (S06)

4.4 Discussion

The history of surgery is one of continuous innovation.[12,20] The current milieu demands evidence to support the adoption of innovations.[18,28] However, what constitutes an innovation and how innovations become accepted as evidence is an incompletely understood process in part because its social and cultural dimensions have not been well explored.[39,40] The findings of this study confirm that what counts as evidence and how surgeons use it on a day-to-day basis is shaped by complex social processes and cultural expectations around procedural variations.[24,41] Developing a new understanding about what evidence is, and how it is used, productively reframes current debates about evidence in surgical practice. Such reframing may help to improve interventions that

attempt to address surgery's perceived gap between evidence and practice by attending to the social processes and cultural expectations of procedural variation.

4.4.1 *Reinterpreting evidence in surgery*

Procedural variation is common amongst surgeons.[2,8,18] Some surgical research has suggested that surgery's lower rate of use of traditionally expected sources of evidence[9,10] such as randomized controlled trials is caused by a lack of, and poor understanding of, high quality published evidence.[6] However, the findings of this study show that surgical practice variation is not solely caused by such deficits. The surgeons in our sample were not simply translating the newest research or guidelines into their procedural approaches in an uncomplicated fashion. Our participants, largely innovative surgeons in academic centres, were not making ground-breaking changes in individual moments of genius nor were they incrementally adjusting procedures only as far as the rigorously collected evidence told them was safe, as suggested in previous research.[12,21] Instead, they were motivated to adapt procedurally by everyday circumstances, and they exhibited a selectivity around disclosing and producing evidence for those adaptations that was based on specific social processes.

This study examined surgeons' reports of their everyday practices and found that they engaged in a continuous, small-scale process of **seeking improvement**. They reacted to perceived procedural necessity by adapting rather than only creating new procedural variations *de novo*. Adaptations were selectively shared with and taken up by other surgeons after a period of incubation shaped by complex social processes. The process of **orienting self and others** to variations required established social relationships through which to interpret and represent information about procedural variations. When they did decide to disclose their variations, and pursue maturing an adaptation into an innovation, **cultural and material conditions** shaped the form and content of their stories. We found that the evidence used by surgeons to make decisions around variations is both interpreted and produced based on from whom the variation derives and how it does or does not fit into their professional plans.

This complex relationship between everyday variation and evidence was evident in how our participants blurred the boundaries between the meanings of the terms 'variation,' 'adaptation,' and 'innovation.' Following precedents in the literature, we

have used 'adaptations' to refer day-to-day procedural variations[20,42,43] and 'innovations' to refer to procedural variations that are researched and disseminated to other surgeons.[12,31,44] Previous research on surgical variation suggested that "at some point these adaptations become 'innovation'".[20(p. 216)] Yet current surgical research claims that surgeons conceptually distinguish between innocuous day-to-day adaptations and major, research-based innovations.[31,45] The findings of this study indicate that day-to-day adaptation and innovation are different categories of the same concept in surgical practice. In our sample, they are primarily distinguished from one another by the social processes involved in choosing an adaptation to turn into a program of research rather than by being immediately identifiable as a minor adaptation or a major innovation from the moment a variation comes to light. That all three major categories included strategic social processes which previous research suggests are explicitly disavowed in surgical culture[24] supports this finding. Social processes of a highly strategic nature such as *pursuing opportunities*, *taking stock*, and *positioning image* orient surgeons to make decisions about potentially important variations based on personal and contextual factors rather than on efficacy and utility alone. The strategic commonality between these social processes transcends the major categories and suggests that understanding how variations move from incubation into maturity requires understanding of how surgeons tacitly endorse and make use of disavowed concepts.[24]

4.4.2 *Designing research-informed interventions*

The findings of this study confirm previous suggestions that surgeons' processes of sharing of information about procedural variations are socioculturally shaped. Yet suggested interventions in surgery's pursuit of higher-level evidence do not incorporate social processes into their design. The Balliol Collaboration's IDEAL framework[8,17,46,47]—**I**dea, **D**evelopment, **E**xploration, **A**ssessment, and **L**ong-term study—is one suggested approach to resolving the "difficult[y] [of] transform[ing] surgical culture into an evidence-seeking profession".[8(p. 9)] The 'Ideas Database' component is the first step of the Framework, and it is the one to which our data is most relevant. It primarily consists of a yet-to-emerge online database or repository for tracking surgeons' day-to-day procedural adaptations to facilitate research on such variations.[5]

Understanding how such a database might be used in the production of evidence has proven difficult. The Collaboration has grappled with concerns about anonymity[5] and alluded to the role that unknown social complexities may play in how evidence in surgery is perceived and used.[17] The findings of this study suggest that there are highly specific social processes and cultural expectations at play that have implications for how, and whether, the material existence of a database of variations would advance efforts to produce surgical evidence. Achieving its intended goals of capturing day-to-day adaptations and fostering research on such variations would rely on surgeons engaging with the Ideas Database and using it as a storehouse for procedural variations. This study suggests that surgical culture is built around stories of variations that take on specific forms shaped by direct social interaction. On one hand, an underlying *wariness* in surgical culture appears to necessitate lengthy and resource-intensive process of *showing the logic* of variations and an aversion to making one-off adaptations public knowledge. On the other hand, especially in our purposive sample of innovating surgeons, the social process of *placing trust* in a colleague who can listen and speak supportively about variations was a determining factor in moving a variation from incubation to maturation. It is unlikely that surgeons will either deposit meaningful descriptions of variations on an anonymous database or perform research on the variations they find there without mechanisms for attending to these relationship-building needs absent of anonymity.

There are some limitations to consider for our study. Current research shows that the process of negotiating variations in academic centres may have some unique characteristics, especially for learners.[48,49] While this study was conducted only in the academic setting, thorough understanding of the social process of practice variation will require investigating differences between how variations are negotiated in both academic and community settings. The value placed on publication in academia and academic surgeons' focus on the maturation of variations may be characteristic of the reward systems in academic practice. Further research might investigate, for instance, how adaptations in community settings mature into innovations or if such maturation is dependent on the availability of venues for sharing stories between surgeons. The implications of the practice variation process for surgical education itself were not directly explored because this study focused on surgeons alone. The findings of this study

indicate that a thorough exploration of the role of procedural variation in surgical education will require theory that is attuned to the complexity of the procedural variation process. Sociomaterial theories of learning that work to sensitize researchers to the entangled relationships between social processes like positioning image, materials like surgical tools, and discourses like procedural guidelines will play a key role in developing this new theoretical domain in the future.[50,51]

4.5 Conclusions

Complex social process and cultural expectations influence the way procedural variations are understood in surgical practice beyond traditional considerations of efficacy and utility. Understanding how such factors shape the interpretation of variations can improve the design of interventions intended to alter the way surgeons navigate variations and evidence in the workplace. Future clinical research should consider such social and cultural factors when attempting to implement changes in surgical practice. These findings suggest that further research on the practical and theoretical implications for learning in the surgical context will be required to fully understand how these social processes are enacted and cultural expectations are adopted.

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Chapter 5

...the look on his face

like that flaw in the sway of the world
where mastery fails
and a hinge in the mind
swings open—grief

or terror coming loose
and drifting, like a leaf,
into the flames.

- John Burnside*

5 Empirical Study # 2: Thresholds of Principle & Preference

The paper in this chapter is the first in the dissertation to significantly use data from intraoperative observations. Using the cultural baseline around variations in the last study, I was able to turn my attention to the more nuanced interactions around procedural variations that occur in educational contexts. This paper was accepted for publication in the Research in Medical Education conference supplement issue of *Academic Medicine*.[1] The paper in this chapter constitutes the core category of the grounded theory in this dissertation: Thresholds of Principle and Preference. The other papers add critical details about how Thresholds shapes the teaching, learning, and assessment processes. It is this paper, though, that introduces the core category of the theory itself.

5.1 Introduction

Traditional wisdom in medical education assumes that postgraduate learners acquire evidence-based best practices from their clinical supervisors.[2] This assumption seems straightforward enough, and it is the backbone of medicine's workplace-based training culture. However, we increasingly recognize that implementation of best

* "At My Father's Funeral," London Review of Books, 2012, 34(2): 18

practices is not such a straightforward process. Clinical research has shown that educators' beliefs about the relevance of best practices to their clinical work are not uniform and significant practice variation can exist.[3-6] In short, expert physicians develop their own ways of doing things and pass these on, explicitly or implicitly, to their trainees. Explicit acknowledgment of such variation and its role in training is rare,[7] and research suggests that fear of faculty disapproval limits learners' attempts to ask questions around variations.[8-10] Consequently, we understand little about how practice variation shapes workplace-based teaching,[11] learning,[12] and assessment.[13,14] The current study begins to address this knowledge gap with a grounded theory exploration of how senior residents in two tertiary care hospitals in Ontario, Canada make sense of the procedural variations of their faculty teachers.

5.2 Methods

The study was approved by the Research Ethics Board of Western University. We used marginal participant observation[15] and active in-the-field interviews[16] as a means of accessing how residents "enact"[17(p. 119)] learning in the context of procedural variations. Senior residents (n=12) in their final or penultimate year of postgraduate surgical education were purposively sampled to recruit those with sufficient experience as primary surgeons to be rich informants. Observational data was collected using field notes and reflexive memoing across 146 hours of observation in 56 cases. The number of observed cases ranged per resident from 2 to 9 (mean=4.8) and per surgeon from 1 to 12 (mean=5.3) across 25 unique resident/surgeon pairings (mean=2.1 per resident). Brief (4-5 minute) focused field interviews (n=38) were conducted with residents immediately after observed cases to explore one or two observed events related to practice variation and learning. We especially probed instances where residents asked questions or appeared to raise concerns about procedural choices during the case. Knowing the importance of silence in discussions across power hierarchies,[18] we also asked residents about apparently awkward silences related to procedural decisions. Most observed cases contained such events (68%), and those cases that did not were not followed up with interviews. Audio-recording was not feasible for these 'on-the-go' interviews, so standard 'reconstruction'[19(pp. 96)] techniques for field interviewing were used to capture residents' comments as close to verbatim as possible.[20] Interview probes about procedural variations

of faculty members, as identified by the residents in the interviews, were iteratively refined as the study progressed. Interviews increasingly asked about residents' thoughts on what procedural variations meant for their behavior and learning during surgical cases.

Data analysis followed the tenets of constructivist grounded theory.[21] Initial coding of field interviews and field notes used open, line-by-line coding to develop preliminary categories for a focused coding framework.[21,22] Categories of social processes were constructed from constant comparative analysis[23] and a core category was identified.[21,24] Following the construction of the categories, further theoretical sampling through formal interviews lasting an average of 34 minutes were conducted with senior residents (n=6). Sampling aimed to redress gaps in the emerging theoretical framework and explore its early transferability. We purposefully sampled senior residents from additional teaching hospitals in Ontario, learners of different genders, and those in both their final and penultimate years of residency. These interviews were audio-recorded, transcribed, and analyzed for both emergent concepts and those already identified in the framework. NVivo 10 data management software supported the analysis. Data collection and analysis ended when theoretical saturation was achieved and no further insights emerged regarding the core category.[21,25,26]

Data collection and coding were conducted by [first author] TA. Analysis of codes, constant comparison, and theoretical development were completed by the entire authorship group during iterative analysis meetings. Based on the tenets of constructivist grounded theory,[21] the analysis inherently carries with it the disciplinary perspectives of each member of the team: an MD/PhD student-researcher in medical education (TA), and four medical education researchers with disciplinary or specialty backgrounds in systems engineering (SC), neurology (CW), surgery (MO), and rhetoric (LL).

5.3 Results

We identified two key findings. The first is the core category itself—*thresholds of principle and preference*—as described below. The second is a grounded theoretical framework of how our participants responded to encountering these thresholds. Following recent calls to represent research findings more powerfully,[27-29] we have elected to use core narratives that evoke the central theoretical constructs rather than outlining all categories and codes that led to their construction. The narratives are 'thick

descriptions'[30] of events encountered in the field, synthesized with direct quotes from field interviews (indicated by single quotation marks) conducted after the observed events. Identifying details have been changed to anonymize participants and programs.

5.3.1 *Thresholds of principle and preference*

Resident participants grappled daily with minor and major procedural variations. We observed residents navigating these variations and trying to ascertain which way to approach a particular procedural step for a particular surgeon. These attempts were variously praised, disparaged, accepted, rejected, or ignored by faculty. As we observed faculty responses to a resident over multiple surgical cases, it became evident that each surgeon possessed "a threshold"$_{(R11)}$ of "surgical principles"$_{(R01)}$ and "preference"$_{(R13)}$ for each procedure. We characterized *principles* as surgeons' rules regarding unequivocally acceptable or unacceptable procedural variations, and *preferences* as procedural variations that are perceived to be unlikely to have significant influence on the outcome of the procedure and are thus interchangeable. The threshold is the surgeon's stance toward the possible variations for a given procedural step and is determined by their management of residents' intraoperative choices.

The first narrative (Figure 2) illustrates the core category, thresholds of principle and preference, by describing a final-year resident's experience with variations between the surgeons he has worked with. In the narrative, the resident grapples with an approach to stapling.

Figure 2. Narrative of thresholds of principle and preference

*The resident pulls the stapler apart revealing a smooth line of grey staples across the tissue. Except at one end. At one end a final, and potentially superfluous, staple hangs slightly off the edge of the tissue. The resident, nearing the end of his training, pokes at the end staple before turning to talk to his junior resident. They agree together to move forward, leaving the staple in place. The surgeon, who has been standing in the doorway says quietly, 'might want to put clips across that.' Startled to know that she's there, the resident turns quickly back toward the door. After seeing the surgeon he then turns back to the patient and flips the line of staples back and forth, examining it closely. 'OK' he says, before saying 'the staples do seem like they go all the way across.' '*Seems *like,' she replies from the doorway, drawing out the word 'seems' as a way of making her point. He picks up the clips and approaches the line. 'Fair enough,' he says as she walks out the door behind him.*

He's new to her team this week. After the case he reports that adjusting to the decisions she has been making has left him trying to decide whether they are ones he will hold, remember, and repeat, or ones he will exclude from his future practice: 'I know there are some surgeons that have a reputation for having different orientations….[but] I mean, it's only been a week or so. So it isn't really enough time to learn where that threshold lives. Our job as residents is to be adaptable, we basically spend a whole rotation trying to learn where that line is for the surgeon we're working with. And then the next rotation we start all over again.' He laces his fingers together. 'So here you'll see a lot more of those miscommunications,' he says, pushing and pulling at his interlocked fingers to demonstrate. 'But it is expected that someone at my level of training can handle that procedure. It is appropriate for me. And, like, we did that procedure yesterday, so she is comfortable with my skills.'(R10)

The resident in Figure 2 suggests an approach to staples and is overruled. The next step for the resident is to decide if the surgeon's instruction is a rule about staples that he should always remember or a preference of an experienced surgeon. Residents in our study routinely projected the operative choices they encountered into the future to anticipate how they will act when they are "in the driver's seat"(R09) holding "the steering wheel"(R14). The resident in this narrative has the complex job of interpreting whether the instruction he has been given, for a procedure he perceives he can be trusted to complete, is an instruction he must always follow in the future.

Over the course of the study residents interacted with many surgeons and, thus, with many thresholds of principle and preference. Thresholds are different for each surgeon; they are found anew for each step of each procedure residents are allowed to perform; and they are repositioned repeatedly as the resident develops over time.

5.3.2 *Responding to thresholds*

Residents appear to undergo a process of recognizing that procedural variations exist and then developing strategies for addressing the thresholds of principle and preference that they encounter. We constructed four categories of observed responses that vary in the degree of agency the resident appeared to have. The first two categories, *spotting* thresholds and *mapping* thresholds, characterize how learners recognize faculty thresholds as signposts to guide their behavior and facilitate smooth interactions with faculty surgeons. The second two categories, *negotiating* thresholds and *defending* thresholds, characterize those instances in which learners appear to engage more actively with a threshold, and, in some cases, begin to articulate their own.

5.3.2.1 Processes: spotting & mapping thresholds

Spotting thresholds and mapping thresholds are reactive processes during which residents recognize the presence of procedural variations. The existence of thresholds may not be clear to residents at the start of their training who felt that, "as juniors… [they] didn't *really* operate"(R01). What residents perceive it means to 'really operate' is explored here in the second narrative. The narrative in Figure 3 belongs to a resident halfway through the final year of her training. She considers the instructions she is being given for a procedure she may never perform again, while taking account of how and when the existence of thresholds became clear.

Figure 3. Narrative of spotting and mapping thresholds

Surgeon and resident are huddled over the surgical field. Despite the fact that she's nearing the end of her specialty training, the procedure she's working on now isn't one she'll be doing after she graduates. She would need subspecialty training for that. The surgeon holds the graspers and directs the resident where he wants her to use the cautery. He offers tissue to her to cauterize sometimes using only the movements of his tools and sometimes speaking to her in hushed tones as they bend over their task. Over and over he calmly and repeatedly adjusts small details: the angles of her hands, the plane she is cutting down.

Afterwards, she compares the kind of moment-to-moment directives he had been giving her to the simpler procedures she will be expected to do on her own. 'It has to do with your training,' she says. 'It's not scientific. You just have to have faith in the way you do it. And the old guys are sticklers for technique. It's actually useful. It's not like there's a really good study on those fine details. It's like any sport I've ever played: you could be good, but don't think for a second you can't improve.' For her, being open to improving means not only relying on clinical guidelines; instead, it means allowing room for her surgeons' suggestions on variations. That said, now, at this late stage of her training, she says she's decided to mostly use 'his way' for doing a common procedure and describes discovering that there are deeper and more finely grained procedural differences than she originally thought. 'Finding a way is about respect. When you work with a surgeon you respect, until you start really working with them, you don't see the difference. When I was a junior everybody said he was the best, and I'm like: 'Really? They all seem to do things the same way. But now I see it.'(R11)

The resident in Figure 3 retrospectively described the process of seeing variations between the surgeons and their thresholds of principle and preferences. At the earlier stages of her training there appeared to be procedural uniformity between the surgeons in her program. When she began to assume some responsibility for intraoperative decision-making as a senior—what she describes as "*really* working with them"(R11)—the existence of a threshold started to become evident. Differences in technique came to signal more fundamental differences in "decision-making"(R11). We call this process *spotting* thresholds. Residents who described this process remembered coming to "this kind of fatalistic view that it doesn't really matter what I do. What matters is doing what they want me to do, like thinking there's not much point deciding what I think is right or wrong yet because what I think at this point doesn't have much sway"(R14).

The resident in the narrative described how spotting thresholds was followed by a process of recognizing that different surgeons have different thresholds. As one resident

in our sample stated, "there's a slow uphill climb where eventually [some] staff are asking…your opinion, but some staff not all. That's sort of a nice moment when all of a sudden they start deferring to your expertise or asking you what the way you prefer to do it is. That's sort of like an independence"(R14). The residents come to see that not only is there more than one way to perform a procedure but also that the position of thresholds is "staff dependent"(R3): two surgeons who make the same procedural decisions may differ on which parts of the procedure are alterable and which are not. We call this process of interpreting the multiple thresholds of different surgeons *mapping* thresholds.

5.3.2.2 Strategies: negotiating & defending thresholds

Negotiating thresholds and defending thresholds are proactive strategies for responding to thresholds. The third and final narrative involves a senior resident who has just entered the second-to-last year of her training (Figure 4). In the narrative, she describes the difference between negotiating thresholds and defending thresholds. She acknowledges her frustrations with the tacit nature of the thresholds she encounters, and she makes note of a strategy for recording individual surgeons' variations as a means of improving her ability to navigate these thresholds. But she also implies that keeping better track of the surgeons' thresholds might provide her with the agency to confidently defend her choices as she continues into her final years of training.

Figure 4. Narrative of negotiating and defending thresholds

They have reached a critical point in the procedure. Encompassed in a small bundle of tissue lies an artery and another vessel. As the primary surgeon at the moment, the resident's job is to peel away the fat and the fibrous tissue that enclose the two vessels without nicking or cutting either of them until the time is right to sever them both. She uses the cautery to pull away small pieces of the fat. The surgeon stands beside her, and if he sees her waver for a moment he directs her where to go giving short but friendly stage directions—'let's go up here for a bit,' he says. For the most part, she responds by wordlessly taking up the plane he suggests.

She comes to the area they've both been seeking for the last few minutes. After a minute or two of peeling, a new area of semi-transparency appears—the hint of a potential window between the two vessels. Without asking first, she calls out for a new tool. The tool is a pair of graspers which, when used in reverse, can push light tissue like fat apart to open up windows. He watches, more silent than he has been up to now, as she touches down close to the point where she intends to make the window. She makes an attempt to push the graspers into the tissue and starts to open them. She pauses, adjusts her stance, and half turns her head toward him. 'Let's try the pusher,' he says before she has a chance to say something.

After he leaves, she describes how 'some staff like to use the graspers, some the cautery, and some use pushing. With each [surgeon] you have to call [an instrument] out and then gauge if you've guessed the right one.' She looks temporarily exasperated. But, she says, 'I should do a better job of taking notes about which each one likes. As a senior, when they're more confident in your skills they might let you decide which way to go at it, but as a junior you're more expected to do it their way.'(R03)

After the resident in Figure 4 called out her choice of instrument, she found herself wondering if she had guessed the instrument he prefers. The surgeon's silence confirmed for her that she had wrongly guessed his choice for this stage of the procedure. The surgeon did not openly condemn her for choosing a different one; instead, he waited for her to give him a small opening by looking at him before he guided her back toward his tool of choice. She expressed hope that in the future she might overcome the negotiating phase of thresholding and achieve the autonomy to use the way that feels most comfortable to her. "As you get more senior"(R10) the residents perceived more latitude to ask probing questions or invoke the variations of a surgeon's colleagues. The residents perceived questions as a way of negotiating thresholds, "not [as] asking to be rebellious or to resist"(R7) but as a means of showing their knowledge of alternatives and because they were "genuinely interested in how [this surgeon's] way works"(R7). This negotiating leads residents "to ask a lot of questions and make some tentative statements… just sort

of allowing [the surgeon] to guide you while not looking spineless. You make it clear that you're not making a mistake, you're just doing it the way that someone else has taught you. So, instead of them slaying you or thinking that you're incompetent for not doing it the way they think is holy, you're passing on that risk or responsibility to a previous preceptor"(R14). Negotiating these thresholds, therefore, is an important yet primarily indirect process.

Some residents also described strategies for defending thresholds. As they neared the end of their training, "it is about there being different ways to do the same thing, but by [the final] year you've usually got your own way…[and] with the staff [surgeons] that really micromanage, I get passive aggressive and quiet cause there's no point getting my back up…sometimes they get it"(R12). Strategies for defending thresholds appeared limited to those that included this kind of intentionally unresponsive acquiescence. While paying explicit attention to variations encountered during procedural work might facilitate defending thresholds, "the question that's not acceptable is asking *why* [a surgeon] do[es] it that way"(R03) while still in confines of the operating room. Before considering explicitly asking why, residents felt that "you're supposed to do what they do right? I mean, as soon as they leave the room you could do what you're comfortable with. But, like, they're still here. They're just in the lounge. So you're supposed to do what they want. It's their case right?"(R13). While strategies for defending their own evolving thresholds of principle and preference were described by residents, the surgeon's ultimate responsibility for the patient led these strategies to be limited mostly to temporarily stepping out of a decision-making role in the procedure, to quiet acquiescence.

5.4 Discussion

A primary goal of workplace-based education is for learners to acquire and implement the best practices of their faculty supervisors.[2] Two issues complicate this goal. The first is practice and procedural variation, an important topic in both the clinical practice[31,32] and medical education literatures.[5,33,34] The second is the impact of these variations on workplace-based teaching and learning.[35] Exploring the pedagogical impact of practice variation can helpfully inform current efforts to formalize workplace-based assessment through new competency-based education frameworks.[36-39] To encourage this exploration, we reflect here on the relationship between principles and preferences, the

curious way in which they are both hidden and revealed, and the roles that learner thresholding may play in medical education.

5.4.1 *What is the difference between a principle and a preference?*

A principle is generally understood in medicine to be unchanging—a permanent fixture or inviolable rule that clarifies the decision-making process. While the residents in our study did perceive their work of principle-finding necessary preparation to become safe surgeons, they also perceived principles to be subject to change. We deliberately did not focus on how residents decide what is safe or not, nor did we try to objectively ascertain which variations are based in principles and which are based in preferences. Instead, we asked residents how they made sense of being told to do the same thing different ways, regardless of whether they thought the difference was important or not. We found in their sense-making an interesting commonality: they struggled to explicitly describe what a principle *is*. They agreed that there were critical steps and decisions during a procedure that almost all surgeons would make. But they also spoke about how variably their surgeon supervisors would enact these principles. According to our resident participants, surgeons usually agree on what principle should be followed, but, at times, they have different interpretations of *how to follow it*. This variation noted by residents begs the question of whether their perception is a product of their level of expertise, or whether established surgeons would share their interpretation. Nevertheless, our findings suggest that residents learn to make sense of this phenomenon tacitly, without faculty input.

5.4.2 *Why are thresholds opaque?*

Residents discover thresholds of principle and preference despite a lack of transparency in the teaching they experience. In our study, as in others,[40,41] faculty surgeons were rarely explicit about variations; they did not pause mid-procedure for a detailed exegesis on the merits of a given procedural variation. Rather, the surgeons tacitly showed their thresholds—using the residents' hands, directing them, cajoling them. Teaching about thresholds, then, was generally not what Erickson calls 'deliberate'.[42] Instead, thresholds of principle and preference were opaque, largely due to the lack of explicit acknowledgement that procedural decisions could be enacted differently by different surgeons. The faculty surgeons in our sample were often explicit

about what they wanted a resident to do in a given moment, but they tended to present their directives unequivocally as though they were principles. Residents, faced with a variety of such principles from different surgeons for a given procedure, come to realize that not all are principles—some are preferences—and through this process they come to see a threshold between principles and preferences. In some ways, their daily procedural work becomes centred on finding that threshold, for individual surgeons and, eventually, for themselves. The recognition of thresholds of principle and preference, then, is a powerful example of the tacit learning which permeates apprenticeships and workplace-based education.[43,44]

Rarely did we observe a resident explicitly asking a surgeon *why* she or he prefers one variation over another. We heard residents freely ask surgeons *when* they would consider another option. We heard residents ask surgeons *where* they learned a variation. We heard residents ask *how* another variation would work. But *why* was a rare question. This begs the question, *why don't residents ask why in the operating room*? The most straightforward explanation is that there isn't time in the busy surgical environment, but the findings of this study suggest a more complex answer. Thresholds are opaque not only because the normal flow of surgical work makes them so, but also because the cultural expectations and social processes of surgical training can obscure why a surgeon's threshold is where it is. Contributing sociocultural factors likely include the ubiquity of scientific ambiguity in clinical evidence,[4,8] the hierarchical nature of medicine's apprenticeship system,[9,10,34] and an individualistic culture that prioritizes professional autonomy.[45,46] We found that thresholds are rendered opaque thanks to a complex interweaving of such logistical and sociocultural factors. In response, residents use *thresholding* to navigate the opacity of thresholds and to learn to make decisions in the face of such ambiguity, rather than asking why.

Thresholding has both potentially positive and negative implications for medical education. On one hand, medical learners routinely navigate variations between faculty practices without iterative guidance[34] because medical education's rotational structure truncates the relationships between learners and faculty that develop in more longitudinal apprenticeships.[47-49] Without continuity, a taboo against asking why may compound the phenomenon.[50] Unpacking this taboo should be a key concern for medical education

researchers. The residents in our study reasoned that the credentials and social warrant given to surgeons and the surgeon's final responsibility for the patient's care explained why thresholding is restricted to such indirect means. It follows that a resident asking why may be perceived as a resident misunderstanding their place in the surgical workflow and hierarchy.[18,41] On the other hand, thresholding may help residents to prepare for independent practice by learning which parts of procedures are inviolable and which are not, especially in moments when common solutions have failed. Thresholding, then, may be an indicator of a problematically opaque learning system that reinforces traditional hierarchies. And, by forcing residents to rapidly process subtle and tacit social cues, thresholding may also be a promoter of necessarily adaptive expertise.[51]

5.4.3 *Is thresholding developmental or situational?*

We have described four phases of thresholding: spotting, mapping, negotiating, and defending. The question remains, are they developmental or situational? The residents in our sample described the initial phases of their training as not *really* operating: their operative responsibilities appeared to be limited to acquiring basic technical skills, starting and finishing procedures, and significant time spent watching-while-retracting. When the time came to make major operative decisions, their thresholding strategies in the operating room were often limited to asking questions or temporarily stepping away from a decision-making role. If spotting, mapping, negotiating, and defending thresholds were indeed developmental phases, then we would expect to see that senior residents are not only better able to describe the variations for a given procedure but also that they become committed to a procedural variation and manage others around them to perform that variation.

Alternatively, though, if the thresholding phases are situational, we would see residents 'return' to spotting thresholds and mapping thresholds when encountering new staff, new procedures, or new hospitals. The residents in our sample did tailor their thresholding to the faculty member with whom they were working. The residents described how some faculty members are amenable to residents negotiating thresholds with targeted questions and even to them presenting a case for thresholds of their own. But they also described faculty members with low thresholds for alternative variations, where negotiating was frowned upon and defending was out of the question. So

thresholding must be at least partially situational. The answer, therefore, is likely a compromise: thresholding is both developmental and situational. Adapting to new thresholds may lead to beneficial, situated learning, and an indicator of individual competence may be that residents know when to defend their personal thresholds and when to relinquish them.

5.4.4 *What are the implications for teaching and assessing?*

Thresholds of principle and preference provides medical education with a language to describe a powerful phenomenon that appears to happen largely without explicit discussion or recognition. However, at this point in our research, we cannot straightforwardly suggest that clinical teachers adopt this new language. It remains an open question whether every threshold should be explicated for every learner. The workplace-based education literature suggests that learning tacitly is an important element of professional development of expertise[12,52,53] and that experts who attempt to render tacit knowledge explicit may sometimes distort it in the process.[44] We therefore advise cautious application of this language in workplace-based teaching settings. Advantages of its use include the possibility that expert teachers who explicitly show the logic of their thresholds may build stronger educational alliances[2] with learners and may assist learners in accurately interpreting the role of principles and preferences in expert practice.[54] Potential disadvantages include oversimplification of the concepts at play[55,56] leading to tension around the sensitive topic of individual practice variation and its relation to standards.[8,44,57] In short, there is much left to explore here regarding thresholding in professional workplaces. Research about tacit learning that "does not suffer from any delusions about how far [clinical practice guidelines] will take us nor lose awareness of just how much interpretation of guidelines may be needed when making decisions about individual cases"[44(p. 125)] will require significant further exploration of thresholds and thresholding in the future.

The new language of thresholds and thresholding also opens up new questions regarding workplace-based assessment. How, for instance, do thresholds of principle and preference influence surgeons' judgments about residents' competence? This question deserves scrutiny as medical education moves towards competency-based assessment and entrustment decisions.[58-60] We speculate that defining the frame for entrusted units of

work, described as a communal activity in the entrustable professional activity (EPA) literature, might necessitate faculty conversations about thresholds of principle and preference.[61] Our findings regarding the opacity of thresholds suggests that such conversations may be a strong departure from surgery's cultural norm. More inquiry into thresholding will assist our understanding of how faculty will make collective decisions about entrustment or even how their individual entrustment decisions may vary based on their thresholds.[62,63]

5.4.5 *Limitations*

Our study design necessarily shaped the nature and implications of our results. Asking residents about a potentially sensitive topic—their supervisors' procedural variations—within the hospital setting might have led some participants to offer socially desirable answers.[64] We addressed this challenge by continuing our observational process over eight months and by triangulating indirect communication such as silences, body language, and humor with more private, retrospective interviews.[65] The potential for observer effects[66] were handled through triangulation, rigorous field note procedures, and longitudinal observations. Finally, the study design did not explore faculty perceptions of thresholds and thresholding; their insights will undoubtedly enrich the theoretical constructs described in this work, and they are the subject of our current research.

5.5 Conclusions

Postgraduate surgical learners make sense of procedural variations by coming to understand thresholds of principle and preference. Learner thresholding plays an important and previously unacknowledged role in workplace-based teaching and learning. The importance of thresholding to residents suggests that they may alter their performance to suit the thresholds of faculty members in day-to-day teaching situations. These initial exploratory findings raise important questions about subjectivity of observations in workplace-based assessment which merit further investigation. For instance, to what degree are faculty aware of their thresholds of principle and preference? When are faculty assessments based on mimicry of preferences rather than a performance of principles? And how does the thresholding phenomenon manifest in clinical settings beyond surgery? Beginning to engage with these challenging questions may help medical

education to implement assessment strategies that account for the complexity of clinical practice and learning.

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Chapter 6

…That which is taught is thought of as a finished product…It is to a large extent the cultural product of societies that assumed the future would be much like the past, and yet it is used as educational food in a society where change is the rule, not the exception.

- John Dewey*

6 Empirical Study # 3: Surgeons' Perspectives

The third empirical study presented here follows on the observational study performed with residents by exploring how surgeons perceived residents' navigation of faculty thresholds. This paper was submitted to the *Journal of Surgical Education*.[1] To respond to the expectations of the readers of that journal, the methodology and the result are presented in a slightly different tone than the rest of the papers included here. Where, in *Academic Medicine* and *Medical Education*, readers are more likely to be comfortable with the ambiguity of social sciences research and the complexity of causal claims, readers of the *Journal of Surgical Education* expect a more linear argument. Therefore, the breadth and exhaustiveness of the data collection process is highlighted and the findings that relate more directly to safety and patient care are foregrounded.

6.1 Introduction

Surgical practices can vary broadly between surgeons. Clinical researchers routinely describe variations in procedural approaches[2-5] and investigate their impact on procedural outcomes[6,7] and system safety.[8] Yet the role of procedural variation in surgical education has not received similar attention.[9] We know little, for instance, about how intersurgeon procedural variation influences how surgeons teach postgraduate learners (residents) and assess their developing competence.[10,11] Developing this understanding will not be a simple task, as procedural variations in practice are legally and ethically fraught.[12] But ignoring the potential impact of variations on learning threatens the

* Experience and Education. New York: The MacMillian Company, 1944. p. 5

implementation of competency-based workplace assessment reforms[13] such as entrustable professional activities[14,15] in surgical education.[16,17]

In a previous study,[18] we explored senior surgical residents' perspectives on procedural variation and its influence on their learning. As they apprenticed with multiple staff surgeons, residents recognized procedural variation and made sense of it by distinguishing between absolute procedural rules, or *principles,* and interchangeable *preferences*. For residents in that study, understanding and adjusting to multiple staff surgeons meant identifying and negotiating *thresholds of principle and preference*. Failure to successfully identify and negotiate thresholds was perceived by residents to threaten their autonomy and their relationship with the staff surgeon.

Missing from that study, though, was the perspectives of surgical teachers on how procedural variation influenced the educational process. A robust understanding of an educational process requires the perspectives of learners *and* teachers, given the fundamentally social and transactional nature of education. In this study, we therefore explored how surgical faculty understand the relationship between procedural variation and resident learning.

6.2 Methods

Our qualitative approach to these questions (i.e. grounded theory[19]) aims to explore a social process that has not previously received attention in surgical research—teaching of procedural variations—in order to create *concepts* and *theories* that resonate with practitioners and researchers.[20,21] As concepts continue to emerge, the theories they belong to should be iteratively refined to improve their transferability. Transferability invites readers of qualitative research to make connections between elements of a study and their own experiences.[22,23] In line with this methodological approach, in the present study we investigated the relevance of thresholds of principle and preference to a new population.

The grounded theory study we report on here used observational and interview-based data collection strategies. Observational data was collected using marginal participant observation[24] to record detailed fieldnotes and reflexive memos across 99 hours of observation in 45 cases. Our sample included 14 surgeons at three tertiary

teaching hospitals in Ontario, Canada. Semi-structured interviews were conducted with surgeons immediately following the observational period. In two cases, logistical and patient care concerns necessitated conducting the interviews at a later date. The subject matter explored in the interviews was drawn from the fieldnotes recorded from the day's observation, data from the larger body of broad observational data, and semi-structured prompts from an evolving interview guide. The 14 interviews, lasting an average of 39 minutes, were audio recorded and transcribed.

The first 6 interview transcripts were coded using an open, line-by-line approach.[19] The line by line codes were compared with one another to create categories unique to this study. Those categories were 'constantly compared'[25] with categories from previous research by our group[18] to develop and iteratively refine a focused coding framework.[19] Following standard grounded theory practice, core categories resonating across this data and the resident data[18] were used to iteratively inform ongoing data collection towards theoretically saturating these patterns in the data set.[26,27] The focused coding framework was used to iteratively analyse the remaining 8 interviews, the fieldnotes, and the reflexive memos as each were collected. Finally, theoretical coding was used to re-analyze all 14 interviews to close gaps in the framework and consolidate categories. The analysis of the interviews was supported by NVivo10 qualitative data analysis software. The study was approved by the Research Ethics Board of Western University.

6.3 Results

We broadly defined 'procedural variation' as an intraoperative technique that had the potential to be performed differently by two surgeons. Our participants unanimously reported that procedural variations abound in surgery, that some variations matter more than others, and that understanding variation is relevant to learning to become a surgeon. Procedural variations were recognized as a means to both provide residents with a broad catalogue of approaches to challenging procedural situations and to cultivate in residents a respect for the culture of surgery.

6.3.1 *Variations abound in surgery: 'More than one way to skin a cat'*

All participating surgeons acknowledged that there are variations between their own practices and those of their peers. For example, the insistence that there is "more than one way to skin a cat"(S14) was a common idiom used by surgeons to acknowledge

that for each procedure, "although we say we do it the same way, we all do it a little bit differently"(S20). Surgeons observed that the residents coming on to their teams had to discern how they wanted things done compared to how their colleagues might have insisted they be done:

> "In each team they learn different techniques, different skills, different judgments. They have to adapt, and they probably don't like that, but that's the only way for them to learn. If I tell him [or her], 'no, we're going to do it this way,' then he [or she] needs to do it that way. The person who is making the decisions here is me, not him [or her]. I have seen some residents—when they come to my team and then when they leave—their technique is total different, totally different, totally different. When [after they leave my team], if for some reason they come back and I see them operate, [I know] they will have switched something."(S12)

The surgeons laid claim to their own "style"(S12), "method"(S11), and "ways"(S18) of approaching a procedure. They perceived their personal set of variations as based in "expert opinion"(S14), however, they maintained that "doesn't mean my method is better than anybody else's"(S11). Rarely did our participants criticize the variations of other surgeons during interviews; rather they perceived that each surgeon has "their comfort zone"(S18) gained through years of experience.

6.3.2 *Not all variations are equal: 'I want it done this way'*

Yet not all variations were seen as equal. Surgeons reported that some of the varying movements and decisions surgeons make represented inviolable principles while others represented interchangeable preferences. For example, surgeons were unanimous that "tearing veins, making knots leak, cutting things you shouldn't have cut, cauterizing things too deep or too shallow, [putting] ports in the wrong place, not dissecting out things properly, and clipping things wrong"(S8) were inviolable principles. In contrast, preferences included variations like instrument and suture choice, knowing different "little tricks"(S20), and "style things…[like] he takes his little bovie and bends the edge to curve it"(S5).

Principles superseded preferences in surgeons' accounts of what matters in intraoperative teaching. From the emphasis surgeons placed on principles, and their extensive discussion of them, we identified five common principles (see Table 1). The

first was *knowing what comes next*, or exercising sufficient "judgment"(S3) to anticipate procedural progression. The second principle was *choosing the right plane*, or having the anatomical knowledge needed to "follow the planes perfectly"(S12) and build "3-D images"(S3) of the field. The third principle was *handling tissue appropriately*, or demonstrating the technical acumen "to understand the amount of tension pressure on tissue"(S5). The fourth principle was *recognizing the abnormal*, or having the "common sense"(S18) to identify challenging cases and novel pathology. The final principle was *making safe progress*, or continually moving the case forward while avoiding or exhibiting care in "challenging areas"(S12).

Table 3. Principles: a selection of representative quotes

Knowing what comes next	"You had to anticipate the next manoeuvre. You had to be thinking one step ahead. That's what surgery is. You shouldn't have to stand back and think well, gee, what do I do now? It should become routine towards the end of your training."(S11) "As the resident and I do more cases together I say 'okay, now I know his technical stuff, now I know he's seen how I do [common procedures] a couple of times.' The third or fourth time, I'm then assessing his or her judgement, because the technical stuff we know, my routine he knows, and now I want to see how he's applying that. And then, as I get further along, I leave them to start or finish for a longer period of time so that they can start to do that. And I walk in and say 'okay, what have you done?'"(S3)
Choosing the right plane	"My priority is to have exposure, and to have a very clean dissection of the tissue and follow the planes perfectly. I try to avoid, as much as possible, blood in the field. For me, it seems very important to be able to see the edges of the structure, to see exactly where my instrument is going to go, and for that, I need it to be very dry" (S12) "So what I'm looking for in an operation like that is 'do they have a perception of what we're going to do in three dimensions in that area?'" (S18)
Handling tissue appropriately	Then the intraoperative stuff would be a lot of different things, from getting the principles and the knowledge of the procedure ahead of time and getting a basis of anatomy. Your tissue handling, how are you with the tissues. Not just the way you pick things up, but just the way you can retract things, set things up. (S7) "Tissue handling I think is very important. Finding a plane is just knowing where the anatomy differentiates to the other. Tissue handling is knowing exactly how much push, pull, tension and pressure I can place on something before it rips, and that sounds easier than it is. The same tissues for the same place in the anatomy will have very different handling properties in someone who is eighty versus someone who is twenty, someone who is malnourished versus someone who is not, [etc]…Recognizing those, how much I can push, pull, and do without causing damage, that's something that takes a while"(S5)
Recognizing the abnormal	Normally, it's a nice soft tissue plane and you just slide through without having to do very much cutting at all and it separates beautifully. There, it was like somebody had poured crazy glue in and welded the two together and he knew that. He recognized that and that was the key thing for me. He picked up on the fact that, even though you think you're okay, you cut, cut, cut: he knew you had to keep stopping and checking and eventually we would get the tear. We had to stop and he recognized at that point he shouldn't put the device in and that's great. He's got a good head on his shoulders. He's got a lot of common sense. (S18) "He knows, he has common sense…Because probably some residents would say 'just push it, just push it, just do it, I can do it.' Maybe it will work, but maybe it wouldn't, and he didn't know, so he's not going to do something if he doesn't know is going to work"(S12)

Making safe progress	"As soon as I feel like they are deviating from the correct tissue plane, or causing too much bleeding, or taking too long then I will occasionally step in"(S9) It would be a couple of things [that…]. One, just a failure to progress, where we're just trying to dick around and can't figure out where to go and what to cut, what plane to be in, and really not being able to progress, or getting into the wrong planes. When we get into the wrong planes, that's when you get into bleeding and everything else. So those would be reasons why I would go over to the other side."(S7)

While these common patterns emerged around what variations belonged to the realm of principles, surgeons retained the right to exercise "expert opinion"(S14) and enact principles by balancing the best interests of the patient and the learning needs of the resident.

> "In my own mind I am asking for perfection from residents. But what is perfection in my mind?... If they keep doing the same thing and they make their incisions in the wrong place some surgeons say 'okay, you get into trouble and I'll bail you out,' but one of the things that they may not take into account is what is happening to the patient…The apprenticeship principle works on the fact that you work with me and you follow what I do."(S16)

Given that variations could be based either on principles or preferences, surgeons recognized that part of the residents' responsibility was discerning which kind of variation they were facing with a particular surgeon in a particular situation: "you just teach them what you know, and you teach them why you do it, and then they will decide for themselves"(S9) but it remained an open question whether "the decision they make to add something or throw something away is based on well thought out grounds"(S5). Residents were expected to understand that "there are things where, 'yes, I want it done this way,' and others where they can do whatever the hell they want"(S7).

Principles were often expressed like this by surgeons, in the first person, as 'my' way, not 'surgery's way,' although there was a tacit implication that their colleagues would share them. For example, according to one surgeon in our sample, while "I try to instil in them *what I think are principles"*(S5), the idea that there were variations that "all of us would hold very dear"(S5) remained prominent. Despite that espoused consensus, our participants prioritized these principles differently in their teaching. Some surgeons talked about prioritizing "efficiency"(S5), others most wanted residents to have "elegant… tissue

handling"(S7), and still others felt "exposure, to have very clear dissection of the tissues"(S12) was the critical teaching point. While they all agreed on principles, what to do with those principles was more ambiguous.

Many of the surgeons in our sample felt that part of their job was to provide support to residents as they learned to identify principles through hands-on work: "that's my educational philosophy, as long as it's not dangerous I want him [or her] to try to work out his [or her] own understanding"(S5). Others felt that dictating principles to residents was part of their fiduciary duty to the patient, that residents "should not be practicing in the operating room"(S11). Surgeons recognised that they gave residents "more rope… [and] autonomy"(S18) around preferences than they did around principles, and they also acknowledged that it could be challenging for residents to determine what is inappropriate 'practice' and what is appropriately 'working out their own understanding.' As one surgeon put it: "who decides I am very good? That is my own judgment right? Say I do the operation with another surgeon. He [or she] might say 'no, no, do it the other way.' And that is the problem residents have"(S16). Ultimately, though, the surgeons in our sample expected that the challenge of adapting to each surgeons' preferred procedural variations was a difficult but functional element of surgical education.

6.3.3 *Variations are educationally valuable: 'Earn their autonomy'*

Our participants believed that adapting to procedural variations helped residents to build a broad catalog of procedural approaches and to synthesize multiple approaches effectively. They perceived value in pushing the residents to "put all this information together and decide how they want to do it"(S18) as they develop into surgeons in their own right:

> "I think it would be very poor training if everyone did everything exactly the same every time because no two operations are identical. No two surgeries are identical. If you become so rigid in your performance that when there's an abnormality and you don't know how to deal with it, then you're no good…Trying to stamp out all variation is not positive. There are different things that different surgeons do that residents can either add to their armamentarium or discard."(S5)

Surgeons reported that "the trainee should be able to adapt"(S11) to different surgeons' procedural variation. For surgeons, teaching residents to perform their variations

provided the residents information about which variations could threaten the safety of patients and which were safely interchangeable. More importantly, for our participants, residents performing procedural variations reinforced the necessity of versatility in an arena where the unexpected is a regular occurrence: "you have to learn different ways"(S7) to become a versatile surgeon and to "have a better appreciation of what you're doing…[to see] that some things work better in different scenarios"(S7). Surgeons maintained that exposing residents to variety both between surgeons and to the different ways the same surgeon can perform a procedure was educationally valuable because it fostered such versatility.

Variety was seen as not only serving this technical purpose of fostering procedural versatility but also in serving a sociological purpose. Surgeons suggested that, by learning to adapt to their thresholds of principle and preference, residents gained insight into their place in the broader surgical environment. Residents' efforts to interpret for each surgeon which variations were negotiable and which were not was perceived to be tantamount to demonstrating "respect for the surgeon"(S7). Surgeons suggested that adapting to particular staff-sanctioned variations was expected "not so much because…those things are important to the outcome"(S5) of the procedure but rather because such adaptation signaled that "when I'm with him [or her] I want to do the thing that he [or she] wants me to do because I respect him [or her] so much"(S5). Each one of our participants suggested that part of professionalism is developing such respect for surgical culture.

This professionalism, in turn, demands an understanding that procedural variations exist in an arena where clinical evidence is often ambiguous:

> "If I get a resident on my service, and I'm trying to teach them how I do what I do then…it would be highly unprofessional to throw your colleagues under the bus. All you can do is help residents understand that there is a diversity of practice out there and that reinforcing the importance of evidence-based surgery is part of embodying the professionalism that makes a surgeon a surgeon…Even though there is very clear evidence that some of the approaches are not as effective as others…I don't spent time dwelling on the other surgeon…all I can say is 'that would not be

> considered the standard of care'…[or] 'that's not really supported by the evidence,' or 'this is my preference'."(S9)

Just as residents do, surgeons find themselves negotiating intersurgeon variations in a context where, on one hand, sometimes "a lot of it is surgical preference"(S11) and "hocus pocus…with no evidence"(S14), and, on the other hand, sometimes "there is very clear evidence"(S9). Variation therefore becomes a complex issue in the operating room, both a matter of standard of care and a matter of professional autonomy. Surgeons' expectations around their procedural variations are used to teach residents about the kind of care that is expected when discussing colleagues: "everyone has little variations in what they do…most residents try to do it the way you want them to do it… [that's] why there is certification before they let you loose on the public. You have to earn that right to operate"(S16). Replicating such professional expectations teaches residents that surgical training is underpinned by the premise that residents must "earn their autonomy"(S9). And that autonomy is earned, in large part, by learning how to behave successfully in relation to variations.

6.4 Discussion

In a previous paper we reported that residents recognize procedural variation in surgery and work to negotiate it successfully.[18] The findings we have reported here illustrate that surgeons also recognize intersurgeon variation, appreciate that residents are working to negotiate it, and endorse the use of variation and its negotiation for teaching purposes.

6.4.1 *Finding clarity in complexity*

Our surgeons reported, like the residents before them,[18] that not all variations are created equal. Some are perceived as non-negotiable principles that, if broken, threaten the safety of the patient and the success of the procedure. Others are interchangeable preferences that either surgical tradition or clinical evidence suggest lead to equivalent outcomes. The construct of thresholds of principle and preference and the process of thresholding describe this phenomenon.[18] We suggested that residents must continuously look for thresholds between principles and preference. These thresholds are different for each surgeon, they must be found for each new step of a procedure that the resident is permitted to perform, and they shift over time as residents progress through their

programs. The study we report on here answers our previous questions about the role of surgeons in this phenomenon: surgeons recognize the constructs of principles and preferences and their influence on surgical education. But the surgeons in our sample also provided a new finding: procedural variations are endorsed in surgical learning.

Surgeons approach variation as a valuable dimension of surgical education. Their expectation—that learning the different approaches surgeons take for the same procedures creates a catalog for residents to draw on in future independent practice—signals a shared philosophy about variation: diversity is not only defensible it is also necessary for the expertise that is the hallmark of the competent surgeon. Fostering procedural versatility may well play a role in helping surgeons account for the additional variation in patient anatomy, logistical factors, and learner characteristics that they will face in the future as surgeons and faculty members.[28-30] This finding provides empirical support for the use of current theories of adaptive expertise[31] and naturalistic decision-making[32] in the surgical education literature.[28,29,33,34] In these two theories, developing impressions of workplace-based experiences that can be intuitively applied to challenging situations is a critical element of expert practice. In contrast to traditional cognitive understandings of expertise, defined by acquisition and recall of abstract knowledge, adaptive expertise interprets problem solving as an intuitive and creative enterprise influenced by multiple complex factors such as organizational culture.[31] Our participants proposed that teaching residents to adapt to the variation between surgeons helps residents to make sense of the patient and system factors that make clinical work complex.[35,36] For the surgeons in our study, fostering this adaptive form of learning was part of their responsibility as faculty members.

6.4.2 *Acknowledging challenges in assessment*

Focusing on cultivating adaptation to variations may exact some unexpected consequences for communication between surgeons and residents. The findings of our study indicate that while there is a pattern to what surgeons consider a principle, the pattern isn't made up of only black and white. The parts of the pattern that do appear to be distinct (i.e. the principles identified in our study) include:

- knowing what comes next
- choosing the right plane

- handling tissue appropriately
- recognizing the abnormal
- making safe progress

This pattern of principles overlaps with some published rubrics. Objective structured assessment of technical skill (OSATS) includes 'respect for tissue'.[37] Surgical training and assessment tool (STAT) assesses based on 'knowledge' and 'skill'.[38] Procedure-based assessment (PBA) includes 'exposure' and 'technique'.[39] And the Ottawa Surgical Competency Operating Room Score (OSCORE) uses 'knowledge of procedural steps'.[40] But none of these rubrics fully capture the pattern of principles represented in this study. Moreover, many of the rubrics include potential procedural variations that could be both principle and preference. OSATS, for example, includes 'knowledge of instruments'.[37] Sorting out such ambiguity may be challenging for learners and may poorly attend to the inherent variation in surgeon-assessors' procedural approaches.

6.4.3 *Considering the role of culture*

Ultimately, learners too will develop their own ways of doing things. Their approaches will be built on the principles of the surgeons they have learned from and overlaid with their own preferences. Reaching this state, however, requires them to navigate an often murky line between principles and preferences as they train and interact with their clinical teachers. This process is complicated by the cultural constructs of autonomy and individuality. These constructs are deeply embedded in the surgical teaching environment and they influence how surgeons and residents speak about principles, preferences, and thresholds. Both cultural constructs may contribute to blurring the line between principles and preferences for learners, leaving learning outcomes uncertain. While there are risks of oversimplification associated with making tacit learning explicit,[41,42] surgeon-educators developing curricula may wish to consider how more direct discussion about variations and thresholds could improve intraoperative teaching.

Surgical autonomy enables surgeons to prioritize safety by imposing a certain procedural variation on residents at a given moment.[43-45] In such a circumstance, a variation that one surgeon considers a preference can become a principle for another. For example, while two surgeons may begin one step of a procedure by working down

different planes, the first surgeon may insist that a resident perform the variation they prefer while the second may allow the resident to decide. In effect, the resident must then try to understand whether in the first instance the surgeon's direction reflected an inviolable safety principle (i.e., 'choosing the right plane') or simply a personal preference around procedural sequencing.

Surgical individuality enables one surgeon to treat as a principle what another might treat as a preference.[46,47] For example, the use of a particular type of suture at a particular stage of a particular operation may be a principle for one surgeon and a preference for another. If the surgeon insists that residents in their operating room use the suture they prefer, the resident must determine whether the apparent non-negotiability of suture selection in this instance makes the variation a principle or rather simply an instance of a strongly held preference.

6.4.4 *Navigating those norms*

Surgeons themselves tread lightly around the role of evidence in distinguishing principle from preference. As expressed earlier, "even though there is very clear evidence that some of the approaches are not as effective… all I can say [to residents] is 'that would not be considered the standard of care'…[or] 'that's not really supported by the evidence,' or 'this is my preference'." Because surgical culture relies heavily on autonomy and individuality, intraoperative critiques of variations employed by fellow faculty remain oblique. Residents are left in these moments to side for themselves on the application of evidence to variations or the primacy of surgeon individuality. Research on morbidity and mortality rounds shows that more explicit attention to practice variations and evidence is expected of surgeons and residents,[48,49] as in other specialties,[50] outside of the operating room. Once inside the confines of the operating room, however, our findings suggest that residents learn to remain attuned to the role of evidence in procedural learning but only insofar as that attunement does not prevent them from enacting surgical culture's basic assumptions of autonomy and individuality.

Residents engage in a complex and largely tacit social process of finding the line between principles and individual surgeons' preferences—a process we have called 'thresholding.' If, as this study suggests, residents must engage in thresholding for surgeons to perceive them as competent, then learning to speak about principles and

preferences in a manner that accounts for surgical autonomy and individuality has significant consequences. Given that both residents and faculty acknowledged that a dominant feature of residents' workplace learning is the navigation of thresholds, surgical education should prioritize teaching residents how to negotiate the nuanced variations they will encounter between patients, cases, and surgeons when operating.[51-53] The findings of this study indicate that the sociocultural constructs of surgical education may complicate this work.

6.4.5 *Limitations*

Choosing to use grounded theory to explore variations allowed us to draw attention to unacknowledged concepts in surgical education research. As a result our grounded theory research was not designed to investigate principles in a manner that affords generalizations across surgical practice. Future research using observational, chart review, and survey-based approaches would be necessary to measure both what surgeons believe about implementing principles and how they impact patient outcomes.

6.4.6 *Implications for Future Research*

Grounded theory research often creates more questions than it answers, and this study is no exception. What is at stake for learning when residents and surgeons negotiate variations intraoperatively? What are the consequences of disagreement? What role does thresholding play in intraoperative workplace-based assessment? Exploring these questions may be crucial to the successful implementation of competency-based reforms in surgical education.[16,17]

6.5 Conclusions

Variation is ubiquitous in surgical education, and, according to our participants, it is essential too. Developing an understanding of how surgical teachers and trainees understand and negotiate variations is critical in an era of increasing workplace-based education and assessment. The findings of this study confirm that surgeons endorse the use of thresholds of principle and preference to teach residents a broad catalog of procedural approaches and help them adapt to new procedural situations. In surgical education, the design of our curricula, the teaching strategies we create, and the assessment policies we implement may be improved by taking a considered look at the role of thresholds and thresholding from both sides of the operating table. Deciding

whether to explicitly address thresholds or allow the process of thresholding to remain an implicit but foundational concept in surgical education will be an important next step for the profession.

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Chapter 7

What counts as an accurate report of experience is a matter of what a community will let you get away with.

- Richard Rorty*

7 Empirical Study # 4: Staying in the Game

The final study of this dissertation more pointedly combines the exploration of social process with an analysis of policy implications. In previous chapters, the work typically focused on using the identification and description of social processes to problematize previously unquestioned assumptions about teaching. In this chapter, the analysis focuses on describing a social process that, while not currently employed in assessment policy, holds significant potential for addressing concerns about the reliability and validity of the assessment process. The paper in this chapter has been submitted to *Medical Education*.[1]

7.1 Introduction

The success of competency-based medical education (CBME)[2] depends on the success of workplace-based assessment.[3] A key premise of the CBME movement posits that licensing exams are insufficiently representative of learners' clinical performance to remain as the principal summative waypoint between supervised practice and full licensure.[4] With CBME's increased reliance on assessment in the workplace,[5] there is recognition that clinical education needs to better understand the role of observation in workplace-based assessment if CBME is to achieve its potential.[6]

Surgery provides a unique setting to study what happens in workplace-based settings where teachers closely observe learners.[7] Surgical faculty almost constantly observe residents when they operate; furthermore, surgical residents usually work with

* Philosophy as Cultural Politics: Vol. 4: Philosophical Papers. Cambridge: Cambridge University Press, 2007. p. 11

the same small group of supervisors over a period of months, allowing for repeated observations to accumulate.[8] Studying how surgeons currently enact workplace-based assessment, therefore, may provide insights that can help to strengthen workplace-based assessment programs in a variety of clinical settings.

In spite of CBME's embrace, using observations in workplace-based assessment is not without challenges. Research into rater cognition[9] and the reliability of assessment tools[10] has problematized the idea that CBME frameworks can be based on workplace-based assessments that aspire to reproducible objectivity.[11] These insights suggest a fundamental and challenging question: what is a common standard of performance? Education researchers have increasingly taken note of the *procedural variations* of surgical faculty and the *practice variations* of faculty in non-procedural specialties.[12-14] Differences in faculty practices[12,15] and care outcomes[16,17] have precipitated research that explores how procedural and practice variations are tied to cultural norms and system factors.[14] But the impact of these interfaculty variations on the process of conducting workplace-based assessment using observations has not been explored. The study of variations calls into question one of the foundational notions of assessment—that expert observers compare learners against a common standard of performance.

In this paper we asked surgeons and residents how intersurgeon procedural variations influence the intraoperative assessment of residents. This paper is the third in a series of qualitative studies[18,19] examining the role of procedural variations in surgical education, and the first of the series to deal directly with assessment. The first paper examined the way residents make sense of surgeons' procedural variations.[18] We introduced the concept of *thresholds of principle and preference* and the process of *thresholding* to describe how residents learn to navigate the variations that staff surgeons presented as absolute rules (principles) and the variations that staff surgeons presented as inconsequential personal choices (preferences). The second paper described how surgeons perceive the role of these thresholds of principle and preference in teaching.[19] We reported that surgeons endorse using intersurgeon procedural variations to teach residents about the complexity of surgical practice and the norm of autonomy in surgical culture. The final paper, presented here, asks: how *do thresholds of principle and preference affect workplace-based assessment?*

7.2 Methods

Grounded theory, the methodological approach used in this program of research, iteratively refines theories as research progresses. The data used in this program of research included observational data, in-the-field interviews, and audiorecorded semi-structured interviews collected between May, 2014 and April, 2015 in three tertiary care teaching hospitals in Ontario, Canada. The present paper answers previously unaddressed questions about assessment from three data sets of previously completed studies.[14,18,19] This paper re-examines this previous data and compares it with new data focused explicitly on assessment. Grounded theories evolve over the course of a program of research. Quality criteria for grounded theories consider the flexibility of a theory to be important for ensuring its rigor and transferability for new cultures and contexts.[20] The program of research described here followed this iterative refinement edict by exploring findings as they emerged during the year-long analysis.

The observational data set from the previous studies includes ethnographic fieldnotes and reflexive memos collected over a total of 245 hours of observation across 101 surgical cases performed by 29 participants (17 surgeons, 12 senior residents) in 36 unique pairings. The interview data set from the previous studies includes 39 formal audiorecorded semi-structured interviews (33 with surgeons, 6 with residents) and 33 focused field interviews with residents. New data were gathered to further probe emergent themes regarding the relationship between thresholds and assessment; these included 9 focused field interviews and 2 formal audiorecorded interviews. The entire body of formal, recorded interviews was transcribed verbatim, and analysis of transcripts, field interviews, fieldnotes, and memos was supported by NVivo10 qualitative data analysis software. The data collection and handling protocol for this paper was approved by the Research Ethics Board of Western University. Significant further information on our grounded theory approach to such observational and interview data is available elsewhere.[14,18,19]

The analysis for the previous papers included open line by line coding across 14 of the 39 interviews. For this current paper, the categories constructed through that previous analysis were ‘constantly compared’[21] to develop and iteratively refine a new focused coding framework that attended specifically to assessment. Constant comparison

is the foundational premise of grounded theory and it states that grounded theories are best refined when they are compared with emergent insights. Therefore, for this paper, categories from the previous studies were used to inform ongoing data collection towards theoretically saturating the concept of assessment in the data set. The new focused coding regarding assessment was applied to the existing data set of 39 recorded interviews, 33 field interviews, and the fieldnotes from all observed cases. As analysis progressed, the additional data (9 field interviews and 2 semistructured interviews) was collected to theoretically sample emergent categories until "theoretical saturation" of the core category was achieved.[22(p. 213)]

7.3 Results:

We found that surgeons use thresholds of principle and preference in the moment-to-moment assessment of who should be operating and when during a surgical procedure. We have named this social process 'staying in the game.' Below, we describe how residents and surgeons understood the role of thresholding in this assessment process. Residents used thresholding to ascertain which inter-faculty procedural variations were absolute rules and which were idiosyncrasies; both residents and surgeons reflected that getting this process right contributed to residents' staying in the game, while getting it wrong was a key factor in losing their operator role. These assessments played a central role in determining how surgeons judged residents to be competent to practice or not.

Quotes from surgeons are denoted with a subscripted 'S' (ex. S9) and quotes from residents are denoted with a subscript 'R'(ex. R12).

7.3.1 *Principles and assessment*

Surgeons perceived a responsibility to assess how long and to what degree a resident should be allowed to be in an active operator role during a procedure. How long residents were permitted to continue to manipulate tissue and make decisions depended on how well their decisions, movements, and verbal statements demonstrated a grasp of that surgeon's threshold of principle and preference. Surgeons in our study reported that their job was to assess residents and to balance the residents' efforts "to stay in the game"(S3) with a duty to "avoid complication"(S16) or "critical errors"(S8) and constantly be making "safe progress"(S5).

> "If a resident was not doing it the way the attending [surgeon] wants them to do it they would lose their spot as a primary surgeon. Personally, for me, if they're progressing…I let them continue in whatever way they want to continue…If they're working and making progress on achieving the critical view safely, I'm ok with that. Now, if a resident is struggling [to do that], then I'll help them. I'll give them my tips, my pointers. If they're still not getting it, then they'll lose their spot."(S14)

This surgeon positioned the staying in the game decision as one dependent on patient safety. The surgeon conjectures that, while *other surgeons* might take over for a resident who does not employ their favored procedural variations, for this surgeon, it is a decision based on patient safety. The surgeons in our sample universally agreed. They felt that "first and foremost, you're motivated by patient safety"(S9) which they equated with their principles:

> "One of the most important things you can look to when you want to give a resident independence and trust is that they show you a level of judgment that makes you go 'okay, they know exactly what's going on in this case…They have the judgment to say that they want to be a safe surgeons so [they think] 'I'm going to do it this way'… and you [as the surgeon] go 'ok, that's what I would have done'."(S8)

Demonstrating good 'judgment,' in this study, appeared akin to performing the procedure at the threshold of that day's surgeon. To gain trust and approval was to anticipate and perform in a way that demonstrated a grasp of the principles emphasized by a given surgeon. Surgeons reported that an impulse to be rigid in their principles, to be "controlling"(S9), "a stickler"(S14), or "obsessive with my things"(S12), was in delicate balance with offering residents opportunities to operate using unfamiliar variations. Because the surgeons in this study asserted their primary duty is to the patient, not the resident—that they "owe it to the patient to make sure it's done right"(S18)—their intraoperative assessments were presented as primarily a question of safety and of improving the resident's understanding of principles.

7.3.2 *Preferences and assessment*

Residents also reported that struggling to enact principles of a supervising surgeon expected would lead to "switching sides"(R12) or losing their operator role. Residents acknowledged that surgeons considered "whether you are doing things safely—are you handing tissues appropriately, are you seeing the planes, [and] are you staying in the planes"(R6)—when assessing their suitability to operate. However, they claimed that this assessment varied between faculty because "every single one will have their idiosyncrasies that, if you're a good resident, you'll pay attention to"(R11. Many of the surgeons in our study acknowledged that the "big secret…[is that] part of the issue is also the surgeon's comfort"(S20) with the procedure itself. Residents understood this 'secret': according to them, knowing a surgeon's preferences could be as important as knowing their principles for increasing their comfort and therefore staying in the game. Many residents believed their grades in formal end of rotation assessments tended to suffer if "you don't remember how to do it their way and you do it the way you're used to"(R1). More emphatically, though, they suggested that "if I start a procedure and I don't remember how *he* wants me to do it, then he's probably not going to let me operate…That would be it. It would be a long day of assisting"(R3). Consequently, in their efforts to keep operating, residents found themselves not only trying to uphold individual surgeons' principles, but also trying to judge when the assessment of their performance might rest on enacting the surgeon's preferences:

> "I saw his steps and I kind of memorized everything. And he's like 'okay, you're going to do it. What do you do first?' I went through it and said 'I'm going to do this.' 'What's next?' 'I'm going to do this.' 'Okay, what stitch are you going to use?' I said 'I'm going to use 2.0 prolene,' and he lost it cause it wasn't the right stitch and he switched sides with me and did the rest of the operation."(R12)

This resident perceived that the choice of stitch in this procedure was a preference rather than a principle and that failing to enact the surgeon's preference led to the command to switch sides. Making sense of the staying in the game decision required residents to tacitly appreciate the importance of such preferences. As one resident put it, "you're not asking so much 'why did you do this or that,' because you don't care. You already know how to do [the procedure]."(R15). Their goal, instead, was to stay in the game as long as

possible. They perceived that being able to tacitly acknowledge the surgeon's preferences and to "do it their way"(R1) dramatically increased their chances of staying in the game and, therefore, made intraoperative opportunities possible.

7.3.3 *Thresholds and assessment*

7.3.3.1 For surgeons

Surgeons' accounts of moment-to-moment intraoperative assessments focused exclusively on principles and patient safety. For some surgeons, the difference between principles and preferences was clear. These surgeons suggested that the division between principle and preference is always self-evident, that "there's a good way to [do it] and a bad way to [do it]" (S11) and holding residents to that standard was uncomplicated. Surgeons who felt this way also felt that strong residents adapt to all of the preferences of the surgeon they're working with: "the person who is bright will know from talking to others, when you go to [my] service [I] want it done like this. And they would say, 'okay, I'll study up on it or read up' rather than arrive fresh on day one and not have any idea what my methods are"(S11). Other surgeons acknowledged differences in how surgeons interpret thresholds of principle and preference. These surgeons suggested that what qualifies as a preference can be, at times, ambiguous:

> "They'll say to me 'how do you want me to do [this step]' and my answer is 'how do *you* want to do it?' [They respond] 'well so-and-so does it this way and so-and-so does it that way, how do you do it?'…[But] I've done it many different ways over the years...[so I say] 'I want you to tell me what you're going to do and justify it.'"(S18)

This surgeon's description suggests a fluid threshold that moves according to the resident's ability to synthesize and justify the variation that they decide to suggest to the surgeon. For both kinds of surgeon, however, how resident navigates variations—how they speak about them, how they remain silent about them, how they act in relation to them—had strong implications for moment-to-moment assessment of the resident's suitability to continue.

7.3.3.2 For residents

Residents reported that they routinely engaged in internal deliberations about which variations *should be* principles and which *should be* preferences. Outwardly, though, residents' rendered such deliberative thresholding work opaque to surgeons to

avoid being relegated to "paint[ing] by numbers"(R12), cutting where told but making few substantive decisions. Residents perceived that positive intraoperative assessments that allowed them to surpass 'cutting by numbers' were more likely when they anticipated and acted in keeping with the threshold between principles and preferences for the surgeon of the day. To accomplish that feat, residents reported that they worked and spoke as if each surgeons' preferences were principles and equally important to patient safety:

> "[Ideally] everyone is working with the same principles and the same ideas of what is acceptable and what is not…but the complicated reality is that I'm not sure that ever happens… you start to develop your own way for a lot of things fairly soon on, and so what trust is seems to be more and more how you can do something other than the thing you think is safest and most useful."(R14)

While the residents admitted that in their senior years they wanted to do the procedure the way they were most comfortable, they generally did not choose to defend of their own thresholds or make explicit mention of the potentially inconsequential nature of preferences. Ultimately, the residents acknowledged, "at the end of the day it's [the surgeon's] patient. They're the ones that have that relationship [with the patient], and so I shouldn't really be getting confrontational"(R11). Instead, residents perceived that demonstrating to a surgeon that they were capable and comfortable working at the surgeon's threshold was both a reasonable and necessary means of signalling that they warranted staying in the game.

7.4 Discussion

Assessment in medical education presupposes a common standard of performance. And medical educators hold to the idea that individual competence is like good art: you just know it when you see it. The findings of this study do not invalidate that notion of intuitive and holistic observational assessment of learners in the workplace. But they do call into question the idea that faculty members hold in their head a common vision/definition of 'competence'. Our findings suggest that interfaculty variations are deeply embedded in practice and produce varying standards in supervising faculty. Furthermore, residents are aware of this variability, and tailor their performances accordingly in order to retain the operator role. Based on these findings, we call for a

profound rethinking of what 'competence' means in workplace-based assessment, with particular regard to the nature and implications of 'subjectivity' in assessment.

7.4.1 *Is there a common standard of performance?*

Medical education considers clinical performance to be standardizable as a matter of convention. Whether or not such a standard exists in practice, even at expert levels, is a question education researchers rarely ask.[12,16,23] The surgeons in our study were unequivocal: there is a shared standard. There *must* be because the safety of patients depends on its existence. For surgeons, performing well in their jobs as surgical teachers depends on balancing operating on the patient as safely and effectively as they know how with the responsibility to initiate operative novices into the profession. However, despite their insistence that intraoperative assessment of residents was about principles and safety alone, their accounts offer hints otherwise, including the acknowledgement that they might employ principles differently than their peers.

Residents' reports further complicate the picture, as they found themselves encountering and comparing the procedural variations of many faculty. Rotation after rotation, they saw the same procedure performed multiple different ways. And, while they may have started to develop their own ideas about which variations are absolute rules of procedural safety and which are inconsequential variations, keeping thresholding tacit and employing the principles of that day's surgeon held the promise of keeping them in the game. On occasion, they may have thought a variation taught to them by another surgeon was safer or more effective or they may have felt a surgeon was insisting they needlessly alter course with a preferred variation; ultimately, however, residents learned to treat these acts of thresholding as opportunities for learning. While we may question senior surgical residents' judgments about which of their surgeons' variations are most effective,[24-26] it remains the case that residents, not faculty, are in a position to see how different surgeons conduct the same procedure, and to compare how they characterize principles and preferences. Surgeons only rarely see their colleagues operating,[27] and they may then have little basis for considering how their own principles and preferences compare with those of other surgeons. What our findings suggest, therefore, is not only that a common standard of performance may not exist, but also that surgeons may not be

in a position to realize it. Residents have the best view of the fluidity and idiosyncrasy of performance standards, but a taboo on discussing these variations keeps them tacit.[18]

7.4.2 *Rethinking the conceptual basis of assessment*

Traditionally, surgical education works to pin down shared principles and minimize rater biases that stray from those principles.[28,29] That effort remains an ideal worth striving for. However, if the assumption of a shared standard of procedural performance is more problematic than once thought,[17] where do we go from here? The best answers to this question may emerge from those who do the assessing in the first place. And getting to those answers may require asking potentially sensitive questions that have long gone unasked.[13,30] Is the finding that there may be significant variation in their staying in the game decisions and observational assessments surprising to surgical faculty? What would it mean to say that faculty agreement on principles is less than complete? Research in the philosophy of clinical science has claimed for decades that questions of principles, evidence, and what is safe are far more complex than researchers, practitioners, and policy makers acknowledge.[31-35] Yet the necessity to act, to make informed choices, remains. If medical education entertains the possibility that physicians and surgeons, even at the topmost levels of expertise, may disagree about principles of practice and procedure, then how can we best move forward with the teaching, assessing, and licensing of new doctors?

7.4.3 *Turning to situated assessment*

Some potential answers to that quandary have begun to emerge in medical education research. The findings of this study on the role of procedural variation in surgical education has developed new insights into the nature of the small, everyday entrustment decisions faculty make about residents from moment-to-moment.[36,37] Yet those insights are only a part of a growing interest in reforming assessment in medical education.[38-40] Previous research in assessment has pointed out the significant variability in faculty assessment decisions about learners, and low reliability between assessors remains a pernicious problem in medical education.[9,41] Increasingly, researchers suggest that the solution may be to expand the construct of assessment from the singular to the programmatic.[42,43] Aggregating diverse intuitive assessments from multiple assessors may

help to turn the subjectivity that appears inherent to the assessment of clinical performance from an individual weakness into a collective strength.[10,44-46]

Answering some of the questions about that subjectivity may help to significantly improve new programmatic approaches to assessment. Research on rater cognition tells us that there is a pattern to the subjectivities faculty bring to their assessments of learners.[47,48] Previously, we may have simply called these subjectivities hawks and doves, but the theory of thresholds presents us with new opportunities. Rather than simplifying such subjectivity as a problematic overlay on assessment—tricky biases that obscure the accurate identification of true individual clinical competence—thresholds suggests that clinical competence is inherently relational. If the faculty standards of practice against which we compare learners are at once locally situated, personally shaped, and culturally constructed, then assessment can be too. Educationalists use the term 'situated assessment' to refer to assessment based on finely grained moment-to-moment decisions like staying in the game.[49,50] In this case, situated assessments would aggregate the variability found in multiple surgeons' staying in the game decisions about residents on a day-to-day level. This information could be used to track resident progress and provide finely grained information about surgeon-raters. For close to two decades, education researchers have suggested that assessment in the professions could be improved by taking stock of situated assessments.[49,50] Acknowledging and then investigating the role of thresholds in assessment may help bring that suggestion to fruition.

7.4.4 *Fitting situated assessment into current frameworks*

Mechanisms already exist for taking situated assessments into account within competency-based medical education (CBME).[11] Reforms in CBME have pushed 'social judgments' into the forefront of innovation.[47,51] Approaches based on entrustment consider faculty subjectivity as an aspect of intuitive assessment rather than thinking exclusively about a generic individual standard of competence.[52-54] The literature on entrustable professional activities poses entrustment as a collective and relational concept: learners are entrusted to perform their work by multiple faculty members as part of a complex network of care provision.[55,56] As policy begins to develop around entrustment[57-59] and entrustable professional activities (EPAs),[60,61] and attempts are made to incorporate them into existing competency-based assessment frameworks,[8,62,63] this collective notion

of entrustment will need to take individual patterns into account if faculty are to successfully arrive at collective competence judgments. The inclusion of situated assessments in EPAs does not negate the reality that some practices are safer than others, but it does help to conceptualize the variability of principles in practice and indicates that conversations about principles should become more explicit. Fostering honest conversations about the role of variations and thresholds of principle and preference in medical education may help EPA-based assessment and CBME to more authentically approach the collective negotiation of competence.

7.4.5 *Limitations*

Grounded theory provides researchers with an opportunity to conceptualize how the social processes of the workplace function. It can help us to make note of previously unacknowledged patterns in the ways individuals interact with each other, with the norms of the culture they find themselves in, and with the broader societal context in which they are situated. This exploratory approach does not work to reproducibly test hypotheses. Therefore, we did not attempt to correlate surgeons' perspectives on thresholds with measurements of the length of time they allowed residents to stay in the game. Nor did we take precise recordings of other potential factors influencing surgeons' decisions to take over during procedures such as time pressure or the resident's year of training. Nor did we attempt to find 'true' principles by correlating the principles surgeons espouse for each procedure with clinical practice guidelines, operative textbooks, or clinical evidence. Nor did we test out the accuracy of our theory regionally, nationally, or internationally. Pursuit of this kind of knowledge is best left to other types of research beyond the theory building research we conducted here. That said, developing such generalizable insights may become more possible as the theory of thresholds becomes part of the conversation. We invite medical education researchers with expertise in multiple methodologies to engage in this work in the future.

7.4.6 *Future Research*

The importance of the staying in the game decision begets further questions about teaching and assessment in medical and surgical workplaces. For example, for teaching, does staying in the game work differently for junior faculty than it does for senior faculty? For assessment, how can EPA–based assessment tools that help faculty captured

their situated assessments of procedural entrustment be integrated in competence-based assessment frameworks? Answering these questions will require sustained engagement with the challenges posed by thresholds of principle and preference.

7.5 Disclosures

Contributions: Data collection and coding was conducted by TA. Analysis of codes, constant comparison, and theoretical development was completed by the entire authorship group. Initial drafts were written by TA under the supervision of LL, co-supervision of SC, and guidance of CW. Revision of manuscript drafts was completed by the entire authorship group.

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Chapter 8

There are two kinds of intelligence: one acquired
as a child in school memorizes facts and concepts
from books and from what the teacher says,
collecting information from the traditional sciences
as well as from the new sciences.

With such intelligence you rise in the world.
You get ranked ahead or behind others
in regard to your competence in retaining
information. You stroll with this intelligence
in and out of fields of knowledge, getting always more
marks on your preserving tablet.

There is another kind of tablet, one
already completed and preserved inside of you.
A spring overflowing its springbox. A freshness
in the center of the chest. This other intelligence
does not turn yellow or stagnate. It's fluid,
and it doesn't move from outside to inside
through conduits of plumbing-learning.

This second knowing is a fountainhead
from within you, moving out.

- Rumi*

8 Discussion

These four empirical papers present a rich account of residents' and surgeons' experiences with procedural variations. The papers propose four key findings that serve as stepping-stones in the process of theorizing. First, the stories that surgeons tell about variations are socioculturally shaped. Second, residents learn to navigate variations using thresholds of principle and preference. Third, surgeons endorse the use of variations and resident thresholding in their teaching. And, finally, resident thresholding plays a role in

* "Two Kinds of Intelligence." The Essential Rumi. Trans. Coleman Barks. San Francisco: Harper, 2004, p. 178

surgeons' situated assessments. Each of these findings has shaped the grounded theory of Thresholds of Principle and Preference.

Understanding the theory of Thresholds of Principle and Preference requires asking what a threshold is. Is a Threshold a material entity? Once found, is it always findable again? The products of grounded theory research are rarely so concrete. Thresholds are created when a teacher acts or directs a learner to act according to an often shifting line between what is acceptable practice and what is not. Thresholding is a social process—the work that learners must do to find thresholds. The theory of Thresholds elaborates the logic of yes/no decisions in teaching interactions. When a teacher deems a practice or a procedural variation to be unacceptable it signal to the resident that the variation violates a principle—a non-negotiable procedural rule—held by that surgeon. Unless the directive is qualified by the surgeon with the caveat that it represents a preference—a way of operating that will not change the outcome of the procedure—the resident must sort through an opaque sea of preferences to find the principles beneath.

In summation, Thresholds of Principle and Preference theorizes the means by which learners and faculty navigate the complexity of translating the directives they inherit into action. Learners are directed by many sources: peer-reviewed literature, clinical practice guidelines, outcomes they witness with their own eyes, and the instructions of faculty members. But only the last of these sources exerts direct control over the learners' opportunities to practice their craft on a day-to-day basis. Consequently, learners tacitly use the idea of Thresholds to organize the directives they receive from faculty without setting them into stone. Thresholds are dynamic: different surgeons have different thresholds and those thresholds shift over time and according to context. Faculty members were once residents. They remember what it is like to adapt to these many Thresholds. In their teaching and assessing of residents, faculty reveal long-held values: resilience, versatility, humility, willingness to assume a role as part of a team, and respect for surgical teachers. Learning to embody these values is learning to become a surgeon.

In the discussion that follows, I will refer to each of the findings of the four studies as I discuss some contributions of Thresholds to medical education research. Ideally, new grounded theories can inform policy and previous theory. Therefore, the first

section I will attend to the contributions of Thresholds to research on learner assessment in the workplace. Considering the phenomenon of Thresholding may help medical education to more closely attend to the socially-shaped entrustment decisions that inform faculty's situated assessments of residents in everyday practice. In Section II, I will discuss the potential contribution of Thresholds to the sensitizing concept that I started this doctoral research with: the theory of situated learning. Thresholds offers an opportunity to refine the mechanism of situated learning, to explain further how legitimate peripheral participation works, and to identify the materials it needs to occur. Therefore, in the second section, I will explore the theoretical boundaries of situated learning by investigating its sociomateriality—its inherent connection to human and non-human objects—and using that connection to propose that Thresholds may help to rectify a common misinterpretation of situated learning theory in medical education research. Finally, in the last section, I will conclude by briefly discussing how the theory of Thresholds might be useful for clinician educators. The complexity of acting despite the ambiguity of clinical science and evidence makes teaching learners how to act doubly difficult. The theory of Thresholds may provide a vocabulary for medical educators to acknowledge the ambiguity of clinical evidence without setting aside the imperative to act in best interests of their patients.

8.1 Contribution of Thresholds to Assessment in Surgery

Postgraduate learners balance service and education. In short, they do necessary work. Yet, while doing that necessary work, to learn is to make mistakes. In the process they attempt to be as certain as they can that their actions are helping, not hindering, the lives of their patients, and they work as best they can within the knowledge that the standards espoused by multiple faculty members may not be entirely equivalent. If the standards of one faculty member are different than those of another, how does the resident make sense of it all? If the expectations held by different faculty members directly contradict, how can the resident be assessed to have performed competently? This doctoral research found that managing amidst such complex social ambiguity has significant implications for assessment in medical education.

Research around assessment in medical education has become, at least in part, a social study. Where it was once acceptable to study assessment simply by looking at

questions of accuracy—Does the assessment accurately test real things? Does the assessment test principles? Or, in other words, is the assessment tool valid and reliable?—today, assessment research has grown to include broader sociological questions. This emerging field, which Kvale calls "epistemology and sociology of assessment",[1(p. 216)] asks what assessment means, what its consequences are, and how it should be used justly. For example, Kvale asks whether examinations might actually be evaluations of disciplinary knowledge by way of students' presentations of that knowledge rather than evaluations of the students themselves.[1] Biggs argues that assessment that reflects the situated nature of practice is underrepresented in education theory and practice.[2] And Mislevy shows how unifying sources of validity turns an exercise that appears real into a social construct—an important one, but a social construct all the same.[3]

These educationalists have been joined by a growing conversation in medical education research around the purpose of assessment. The very question that underlies the theory of Thresholds enquires along these same lines: what if a principle is not a principle is not a principle? Medical education researchers are increasingly asking about the stakes of assessment,[4] the potential for increased representation of intuitive expert judgment,[5] the importance of the subjective,[6] and the very nature of assessment as socially constructed.[7] Considering the potential role of thresholding in assessment may help to inform these developing questions in medical education scholarship. In this section, I will use the findings of my doctoral research to discuss implications of the social processes of thresholding for assessment policy. Cultural silence around principles poses some challenges for the relevance of thresholding to workplace-based assessment. However, an emerging approach to assessment called 'entrustable professional activities' holds some promise for overcoming those challenges. This emergent approach follows in the footsteps of significant changes in how education researchers conceptualize rater cognition and validity in assessment. The new theoretical vocabulary of thresholds of principle and preference may help medical education make use of the promise of these emerging ideas about assessment.

8.1.1 *Seeking a principle in a sea of preferences*

Current discourses of patient safety and evidence-based medicine necessitate assessments that aspire to a common standard of performance. Situated assessment may

be well positioned to deliver alternative, and equally valid, sources of information when trying to form judgments about learners.[8] Situated assessment means assessment based on the everyday decisions made by assessors or teachers. A key challenge exists for the use of situated assessment in surgical education: surgical culture makes acknowledging variance in principles taboo. The tacit nature of thresholding pushes situated assessments like the staying in the game decision underground. Surgeons recognize that some of variations of their peers may be less effective than others. So teaching residents the surgeon's own variations, the ones they themselves trust, is the only sure way to know that they, as the teacher, have provided the resident with all the information they need to make an informed decision. The inconsistency in principles across surgeons is not explicitly acknowledged, leaving residents to engage in a tacit process of discovering and interpreting that variability. This cultural taboo against acknowledging variation in principles held up across all four of the studies in this dissertation. In Study 1 surgeons spoke of the complex social processes they employ to suggest to their peers that they may have developed an effective variation without implying that another variation could be less effective. In Study 2, residents spoke of the indirect nature of thresholding and the cultural prohibition against asking 'why' in the operating room. In Study 3, surgeons described being unwilling to directly suggest another surgeon's variation was less effective while still teaching residents to deploy their own favored variation for a given procedural step. Finally, in Study 4, both surgeons and resident described how the staying in the game decisions surgeons causes residents to mimic surgeons' personal principles and preferences without explicitly acknowledging this thresholding work. Incorporating situated assessment into ongoing reform in medical education may require confronting surgical culture's strict adherence to the norm of autonomy that makes explicit discussion of variance in principles taboo. Developing a vocabulary around principles, as thresholds and thresholding has attempted to do, may create new opportunities for these conversations to occur.

8.1.2 *Making use of entrustment-based assessment*

It may well be that tacitly adapting to multiple thresholds fosters resilience in individual residents, as we suggested in Study 3. However, at the policy level, the tacit nature of thresholding and situated assessment may challenge the successful

implementation of workplace-based assessment reforms in competency-based medical education. Competency-based medical education takes the position that the outcomes of education—the clinical performance of learners, not their exam scores—should be *the primary basis* for deciding whether or not a learner has earned the privilege of licensure.[9,10] Competency-based medical education relies on assessment strategies that capture how learners apply their knowledge and skills to authentic situations. But how can we trust these assessments when our assessors themselves vary in their approaches to the work they are being asked to judge? Recent research suggests that 'entrustable professional activities' may constitute a means of addressing these concerns. Entrustable professional activities pose an alternative means of conceptualizing how faculty members intuitively assess the competence of learners and entrust them with increasingly complicated units of clinical work.[11,12]

The concept of thresholds and thresholding describes social processes that occur during situated assessments like the staying in the game decision. Developing assessment frameworks that combine EPAs with a focus on situated assessments like the staying the game decision may bolster assessment that assumes a shared standard of performance by making active use of rater subjectivity. While early work in competency-based assessment assumed that assessments must focus on standardized measurement tools to evaluate learners,[13] entrustable professional activities assume an inherent variation in rater cognition.[14] Work that one faculty member perceives as being entrustable to a certain learner may not be perceived in the same way by another faculty member.[15,16] In Study 4, we posited that everyday, moment-to-moment intraoperative entrustment decisions exhibit this kind of variability. Looking closely at these situated assessments presents an opportunity to further conceptualize how entrustment works. An assessment framework that allows surgeons and surgical education programs to track entrustment of professional activities may be able to leverage the many moment-to-moment intuitive judgments faculty make of learners while preserving the holism of entrustable professional activities.[17,18] For example, the Zwisch scale of intraoperative entrustment describes the process of everyday entrustment of resident in surgical education.[19] The scale consists of four 'stages of operative development' that describe the type of guidance a resident must receive to adequately complete a procedure: (1) Show and Tell, (2) Smart

Help, (3) Dumb Help, and (4) No Help. It has been used to shape assessment tools based on relational entrustment where the surgeon *could be* a variable.[17,20-22] Incorporating such entrustment-based modalities into assessment could help to account for the subjectivities inherent to observations in the workplace that thresholds describes.

Coordinating the use of tools like the Zwisch scale with entrustable professional activities may pose some organizational challenges that the theory of thresholds can help to clarify. Entrustable professional activities break the education process of an entire residency program into a few relevant units of work, compiling holistic narratives depicting how a learner acts who is capable of little, some, or full completion of the work without direct supervision, and awarding partial certification based on a consensus judgment formed by faculty members who routinely work with that learner.[23] The exhortation that lists of entrustable professional activities do not grow longer than 20 to 30 per residency program is an important one for surgical education.[24] Initial writing on EPAs suggested a cap of 10 to 20 EPAs a decade ago.[11,25] Provided that this cap stops growing, single surgical procedures alone cannot constitute entrustable professional activities. Instead, the concept of entrustable professional activities positions everyday entrustment of procedural work as one element in a holistically described course of care. For example, a resident who is entrusted to perform an appendectomy from start to finish by multiple faculty members cannot be considered to have fulfilled an entrustable professional activity. Instead, this resident has earned the everyday entrustment to perform one aspect of the care for a patient who presents with acute abdominal pain. Many other activities—both medical and surgical—are required for the care of such a patient. Therefore, in this case, entrustment of a laparoscopic appendectomy constitutes one *observable element* of a broader entrustable professional activity. The interfaculty variation in the staying in the game decision indicates that patterns in faculty members' moment-to-moment entrustment of these observable elemesnts may be recorded using targeted assessment tools such as the Zwisch scale. Recent research suggests that entrustable professional activities can be understood as composed of multiple observable professional activities such as the procedure described above.[26] Incorporating surgeons' assessment of observable professional activities within a broader entrustable professional activity framework may allow for the inclusion of situated assessments into current

assessment protocols in a manner that makes use of subjectivity. While basing assessment decisions on EPAs may be logistically complicated, developing theory around the staying in the game decision may help medical education to recognize the logic that faculty members follow along the way.

8.1.3 *Shifting approaches to rater cognition and validity*

Bolstering objective approaches to assessment with subjective sources of validity has become an emerging area of research in medical education. For instance, moving to a policy environment that includes situated assessments like the staying in the game decision would build on surgical education's recent effort to attend to Messick's unitary framework of validity.[27] For assessment to be trustworthy, Messick argues that relying on traditional approaches to validity are insufficient. For Messick,

> "It is not sufficient to merely select tasks that are relevant to the construct domain…the assessment should assemble tasks that are representative of the domain in some sense. The intent is to ensure that all important parts of the construct domain are covered, which is usually described as selecting tasks that sample domain processes in terms of their functional importance or…ecological sampling"[28(p. 17-18)]

According to Mislevy[3] and Biggs,[2] ecological sampling *is* situated assessment, and it approaches the enterprise by acknowledging the complexity of attempting to assess learners *in situ*.[2,3] Rather than only using performance on isolated tasks—and the notion of generic and transferable technical skills that such measurements imply—more current formulations of validity in assessment include multiple sources of evidence to make claims about learners and deliberately include sources of validity based on decisions being made about learners in real time.[28] In medical education, constructivist approaches to assessment advocate for assessment policies that leverage the subjectivity inherent in medicine.[29,30] As a practical science, medical education may not be able to achieve the reproducibility and reliability of more abstract fields such as the teaching of physics and math. But medical education is well positioned to make use of the many small interactions between learners and teachers that occur on a day-to-day basis. Leveraging the subjectivity implied by thresholds and situated assessment may help medical

education's workplace-based assessment infrastructure to turn the perceived weak objectivity of workplace-based assessments into a position of strength.[6,31,32]

8.2 Contribution of Thresholds to Situated Learning Theory

Medical educators ask, over and over again, 'how do we best teach residents to become good doctors'? We ask what the most effective tool is for uploading the vast body of medical knowledge into the minds of learners and how to implement that tool so that learners can retrieve the knowledge when they need it. We expend countless resources trying to improve, reinforce, and justify the teaching tools and assessment strategies used to give some seemingly reproducible information about who is good at retrieving this knowledge, and, therefore, who is safe and who isn't. Despite the primacy of tests of abstract knowledge, when all the tests have been written and the oral exams performed, the official policy of the Royal College of Physicians and Surgeons of Canada maintains that when a resident's performance on certifying examinations is borderline, the examination committees should turn for guidance to the things written about the resident by the people who worked beside them for years.[33] Even though, anecdotally, the exam committees may distrust these workplace-based assessments, the descriptions of faculty members' situated, moment-to-moment entrustment of learners are nevertheless maintained for public view at the final arbiter of a resident's competence.

Medical education's endorsement of situated assessment appears just as enmeshed in official policy as its adoption of situated learning theory. And the findings of this doctoral research suggest that the two may be linked. However, the employment of situated learning theory in medical education research exhibits an interesting disciplinary quirk. Where Lave and Wenger insisted that their emphasis on the 'periphery' in situated learning did not indicate the existence of a 'centre,' medical education puts the idea of a centre into the forefront of situated learning theory. The tendency for situated learning theory to problematize truth, proof, and evidence plays a significant role in facilitating this re-interpretation. Considering the implications of thresholds for situated learning through a sociomaterial lens may help to more effectively translate the concept of legitimate peripherality to medical education. In the section that follows, I will discuss these turns in situated learning over the last two decades and suggest how medical

education may begin to realize the potential of situated learning theory for competency-based medical education.

8.2.1 *Legitimate peripheral participation*

The concept of 'control dynamics' explains how residents and surgeons navigate dilemmas about responsibility for procedural decisions and manual control of the surgical field.[34] Surgeons recognize the need for residents to practice, so finding an appropriate "threshold for giving into *that feeling* and not letting them operate"[34(p. 82, emphasis added)] can become a complex exercise. In Study 4, it became apparent that the negotiation of control dynamics is at least partially shaped by surgeons' thresholds of principle and preference. Developing an understanding how control of operative opportunities and thresholds of principle and preference interact holds significant promise for intraoperative teaching and learning. The concept of legitimate peripheral participation called attention to the work learners have to do to gain access to such opportunities. However, early writings on situated learning suggested that further research into the mechanisms of the negotiations may be needed. Lave and Wegner, seeing how situated learning could be refined, called for further analysis around the realm of control in educational settings:

> "Legitimate peripherality is a complex notion, implicated in social structures involving relations of power….In our usage, *peripherality* is also a *positive* term, whose most salient conceptual antonyms are *unrelatedness* or *irrelevance*…In this sense, peripherality, when it is enabled, suggests an opening, a way of gaining access to sources for understanding through growing involvement. The ambiguity inherent in peripheral participation must then be connected to issues of legitimacy, of the social organization of and control over resources, if it is to gain its full analytical potential".[35(p. 36-37, emphasis in original)]

Thresholds is one such potential mechanism of control. The theory of Thresholds describes some of the complex social processes residents must navigate to gain access to the practices and forms of knowledge necessary for integrating into surgical communities of practice. Traditionally medical education has conceptualized the process of integration as one of skill and knowledge acquisition. More recently, competency-based medical education research on self-assessment of learning, self-regulation, and student-centred learning has turned attention toward maximizing the agency of students in making this

integration possible. Thresholds provides a new opportunity to do the theoretical work Lave and Wenger requested. How are residents expected to gain access to the tools, tasks, and knowledge that enable learning? How are students 'regulated' not only cognitively, but sociologically as well? Answering these questions requires a close examination of medical education's deployment of situated learning theory.

Medical education uses situated learning to theorize how learners move from novices at the periphery to experts at the centre. For medical education researchers using situated learning theory, the objective of the learner is a centripetal one. But, originally, the objective of legitimate peripheral participation was not to become more central. According to Lave and Wenger, there was no centre:

> "It seems important not to reduce the end point…to a uniform or univocal 'center,' or to a linear notion of skill acquisition. There is no place in a community of practice designated 'the periphery,' and, most emphatically, it has no single core or center. *Central participation* would imply that there is a center (physical, political, or metaphorical) to a community with respect to an individual's 'place' in it. *Complete participation* would suggest a closed domain of knowledgable or collective practice for which there might be measureable degrees of 'acquisition' by newcomers. We have chosen to call that to which peripheral participation leads, *full participation*".[35(p. 36-37)]

Situated learning theory is unequivocal. The notion of peripherality is a positive one, yet medical education research, and surgical education research in particular, significantly adjusts this normative peripherality: "Lave and Wenger developed a model of 'legitimate peripheral participation', which well describes a trainee joining a surgical team.…experts will exhibit continual centripetal movement in each new area, while non-experts will remain on the periphery of teams outside their current practice".[36(p. 831)] These authors, like others in surgical education, misconstrue the metaphor of peripherality as an ever-narrowing spiral rather than a complex network—one with many interconnections but without a centre. Though the learner's "objective is to become a full participant in the community of practice, not to learn *about* the practice",[37(p. 26)] surgical education research modifies situated learning theory to 'commodify' knowledge as an object that must be acquired before a learner can become a full participant.

8.2.2 *Tensions between situated learning and evidence*

Medical educators face a challenge when trying to reconcile the epistemological tension between a commodified version of legitimate peripherality and evidence-based medicine. Situated learning inherently problematizes truth claims such as the definitive conclusions about best practices that are expected of evidence-based medicine: "Truth claims become problematic in situative views. Here, what is knowledge is not judged by what is 'true' and 'false,' or what is 'erroneous,' but what is relevant in this particular situation, what is worth knowing and doing, and what is convenient for whom, and what to do next".[37(p. 26)] When medical education took up the language of situated learning it left the theory's inherent skepticism behind: the tension between situated learning and evidence-based medicine was lost. Without a conceptual bridge between evidence-based medicine and the erasure of truth claims that come with situated learning, the idea that learners should not be trying to learn *about* medicine but rather *participating as learning* was erased. I would contend that Thresholds of Principle and Preference can be that conceptual bridge.

Thresholds makes the same inherently skeptical claim as situated learning. Principles, according to evidence-based medicine, should be defined by conclusive proof from clinical research. And the line between what is a principle and what is a preference should not be situated by interpersonal relationships, but rather by what evidence makes possible. In contrast, the theory of Thresholds tells us that while principles may be established by consensus, and while many principles may indeed protect against variations that lead to unfavorable consequences, the strength of their logic cannot be extended further. Absolute certainty is impossible. The surgeons and residents in this doctoral research spoke with exactly this skeptical approach to clinical evidence. As new variations came to light, or as residents read about new evidence that challenged the principles of their faculty surgeons, the postmodern notion of scientific skepticism at the core of situated learning emerged as a core concept in surgical education's use of Thresholds. For Bosk, in the 1970s, "the ethos [of surgery] was anti-bureaucratic, anti-rules, and, if need be, anti-rational, especially if rationality were measured before action, any anxiety about success—all these were seen as alien to the true surgeon".[38(p. 245)] Today, surgery struggles deeply with the tension between this nostalgic inheritance and

the call to ensure—for the sake of the patients—that every decision is based on the best available evidence.[39-41] Therefore, research in surgical education can consider how discourses like evidence based medicine draw attention to what situated learning theory proposes: any truth claim in surgery is tentative, and learning is not about acquiring truth claims but about embodying the practices of a community. Paying attention to the negotiation of learning helps to more fully track the complex interplay between discourses of evidence and the social processes of surgical practice, culture, and education. And the theory of Thresholds provides a language for this attending.

8.2.3 *Promise of the sociomaterial for situated learning*

Situated learning theorizes the process by which learners integrate into communities of practice. However, it tells us little about the objects and mechanism of that process or what happens when it fails. Sociomaterial theories can offer this perspective. Integration into a community of practice is a complex nonlinear process shaped by multiple social discourses. But, conventionally speaking, medical education loses sight of the social and material objects that shape the process in favor of focusing solely on cognitive structures. Thresholds abound with sociomateriality: the movements of hands, the sighting of planes, the shakes of the head, the grasping of tools, the pushing of human tissues. Considering thresholds using a sociomaterial perspective may help to bridge theoretical gap between the intent of situated learning and its uptake in medical education. Sociomaterial approaches "understand human knowledge and learning in the system to be embedded in *material action and interaction (or intra-action),* rather than focusing strictly on internalized concepts, meanings and feelings of any one participant".[42(p. 6)] The bones in the spine of the sociomaterial approach—cultural-historical activity theory, actor-network theory, and complexity theory—each possess areas of inquiry that can reframe procedural variation not simply as a clinical problem to be solved or Thresholds as an individual experience but rather as social processes reflective of a larger system, one where forces constantly intertwine and decisions are made based on shared constructions. For example, looking closely at how surgeons and residents tacitly negotiate control dynamics by silently picking up certain tools or exposing new planes can inform medical education's understanding of how discourses can act silently but forcefully in the social process of workplace-based learning. Paying

attention to cultural 'materials' like discourse through sociomaterial work allows learning theories in medical education to more directly attend to the complexity and ambiguity of learning so embedded in materials.

Complexity theory casts the individual as incompletely autonomous. Like situated learning, complexity theory considers knowledge not as an object to be acquired but as a form of interaction.[43] But unlike situated learning, in complexity theory the individual and the environment "are engaged dialectially in a mutually specifying choreography where, all at once, each specifies the other".[43(p. 118)] Each element of the system—be it a non-human material, a discourse like evidence-based surgery, or an individual person—exerts rippled effects over the rest of the system. In this study, residents carried variations from operating room to operating room (from fiefdom to fiefdom). The Thresholds they experienced with previous surgeons shaped their experience of thresholds with surgeons later in the education process. Residents spoke of variations and socially constructed interpretations of how to interact with the surgeons and the materials over which surgeons had institutional control. Understanding the rippling consequences of simple actions—like the frustrations over the unavailability of a specific tool, for example—can help medical education conceptualize how the systems of operating rooms sometimes silently resist a learner's attempts to actively engage with a surgeon's Threshold.

A second theoretical force in sociomaterial approaches, actor-network theory, destabilizes what it means to be a cognitively independent individual. Rather than thinking about persons, as in situated learning, actor-network theory "focuses on the minute negotiations that go on at points of connection. Things—not just humans, but the parts that make up humans and non-humans—persuade, coerce, seduce, resist, and compromise each other as they come together".[42(p. 10)] Rather than perceiving a surgeon's threshold of principle and preference as a static object, actor-network theory teaches us how "clinical diagnosis does not depend on sharp thresholds: its division between health and disease is more fluid".[44(p. 259)] In moments like these, actor-network theory problematizes the notions of individuality that so fundamentally undergirds surgical culture. Where much of surgical research sees individual humans taking control and acting purposefully to acquire a stable self, and the stable Threshold such a self would imply, actor-network theory sees one actor in the midst of others—human and nonhuman,

social and cultural, material and ethereal—each acting as forces in their own right. Boundary objects are objects brought from one discursive setting to another that actors use to create movement between their respective discursive communities. Procedural variations are an excellent example of such objects. And looking closely at those objects—those actors—can help to identify networked actions like thresholding that previously existed as a black box…something that seemed both important and fraught enough to be ignored.

Finally, cultural-historical activity theory (CHAT) holds that learners exert influences over the educational system. Where the teacher, for instance, acts to teach, the learner acts to shape the way teaching is performed; conversely, situated learning is perceived primarily as unidirectional change, of an individual learning become a part of a community. Activity, in CHAT, constitutes the most basic unit of analysis of human learning.[42] It is in activity that tensions and contradictions arise between the understanding of the student and the understanding of the teacher. These tensions lead to questions and learning; therefore, rather than being concerned about what knowledge a student has acquired, cultural-historical activity theory traces materials, interactions, and histories to divine insights about the 'potential development' of a learner rather than focusing solely on what has been determined by a single snapshot in time.[45(p. 86)] Bringing the CHAT perspective to the analysis of Thresholds may help medical education to better understand how a resident with the desire to learn can find themselves barred from key insights. If learning is situated in the friction between teacher and learner, then posing Thresholds as a way of understanding that activity can reframe those frictions as part of an ongoing process rather than a failure to acquire sufficient abstract knowledge.

Situated learning remains a key theoretical tool in medical education research. Bringing a sociomaterial lens to the study of Thresholds helps to identify some of the ways that medical education's use of situated learning theory can be refined by attending to the social complexity of control over key learning resources. The mechanisms of such social process are many. They are smaller and more widely dispersed than conventionally recognized. By considering the sociomaterial, we open up medical education's theoretical approach to defining what matters in a situation. Medical education has comfortably taken up situated learning theory but has been slower to take up sociomaterial approaches.

Sociomaterial approaches teach us that learning to become an expert is more complex than accruing a sufficient volume of rote physical practice. Discourses like evidence, gender, and risk that shape power relations and control over key resources—like operative opportunities—constitute the sociomaterial approach's most powerful tools in capturing the complexity of the learning process. Yet it isn't as if medical education researchers were not aware that hierarchical control over key resources was relevant to surgery. Bosk, for instance, showed in 1979 how quasi-normative errors are used to make decisions around resident competence.[38] Yet, as Bosk retrospectively admits two decades later, even his analysis failed to question the mechanisms of control over materials with sufficient rigor:

> "I undermined my own intent in developing the concept of quasi-normative error. My intent, as I understood it at the time, was to show that the world of surgery was a highly authoritarian one and that that authority had a defect—it was occasionally eccentric, arbitrary, and capricious. Yet by not showing the degree to which [the residents] were baited, I lodge[d] the defect not in authority itself, but in the underlings who are too dim to discern its workings".[38](p. 228)

This legacy of ignoring hierarchy's more capricious consequences has lasted well in surgical education research. Today, field study after field study[46-49] decrees that residents—whose "hands are underdeveloped"[47](p. 542)—struggle to learn the maneuvers because of the dexterity required. Research in this vein chooses not to ask if dissonances in the teaching residents receive play any role in their struggle. Instead, even this socioculturally-conscious ethnographic, anthropological, and critical theory-based research[46-49] chalks up the challenges of postgraduate surgical education to the difficulty of the task itself and rarely to the traditionally reinforced boundaries of surgical culture. Education research has turned to sociomaterial theories to answer the kind of questions about hierarchy, control, and material resources in teaching and learning that the theory of Thresholds invokes.[42] Rigorous theorising of the relationship between procedural control dynamics and thresholding beyond the current individual skill development approach may require further investigation of the sociomateriality of this situated learning phenomenon in the future.

8.3 Contribution of Thresholds for Clinical Educators

Using theory to see Thresholds as material raises some crucial questions for clinical educators. The advent of competency-based medical education may have opened a policy window where tangible change can occur. Engaging with Thresholds of Principle and Preference encourages clinical educators to be reflective about challenging practice-based questions that sometimes go unasked. What principles do I perform? How tightly do I hold to my preferences? This new vocabulary around clinical practice and procedures may be used to encourage faculty to ask how they themselves perform the small decisions that shape their practices. Considering whether or not the principles they hold would be the ones shared by their peers may help clinical educators to make better sense of literature, evidence, and guidelines in a way that accounts for the inherent ambiguity of clinical practice. And asking where those variations come from and how they became part of their everyday practice may help faculty not only to evaluate their own practices but also to be more cognizant of the way learners need to synthesize such information.

The vocabulary of Thresholds can also reach beyond practice and into the processes of teaching and learning on an everyday basis. Thresholds places principles and preferences as points *along the same continuum*, and that construction encourages clinical educators to ask whether there are situations where they exert their preferences as principles in the teaching environment. At the program level, could it be that inconsistencies in the observational assessments of residents may be caused, at least in part, by the effects of different faculty members holding different thresholds between principle and preference? Collaborative assessment policies, such as those envisioned for CMBE's EPA approach, may encourage more meaningful conversations about learner competence beyond mimicry of preferences. Finally, for the theory to make a tangible difference in teaching, clinical educators should consider why it is that explicitly using Thresholds in teaching appears to be taboo. What could the explicit pedagogic use of Thresholds contribute to the improvement of clinical teaching? For instance, could addressing the incongruity between multiple directives assist residents in learning to ask which variations are principles and which are preferences? If the work in this dissertation can be used to inform such teaching practices, then the exploratory theory-building performed here will have been a success.

8.4 Conclusion

The theoretical contribution of Thresholds is to more clearly explain how such negotiations in surgical education work on a day-to-day level. The tacitly negotiated nature of thresholding and the also tacit situated assessment decisions that occur at thresholds of principle and preference indicate that thresholds, thresholding, variations, principles, and preferences constitute both black box and boundary object. By identifying these concepts, medical education researchers have a better chance to answer the questions I have raised here: Are Thresholds opaque thanks to our assumption that the path toward expertise is paved with rigid hierarchy, rote memorization, technical knowledge, and individual exceptionalism? Might there be a way to teach, learn, and assess that acknowledges both the ambiguity of applying abstract knowledge to clinical settings and the sociocultural complexity of learning to work? Using the vocabulary of Thresholds will not solve these conundrums, but it might be one step in an evolving solution.

8.5 References

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Appendices

Appendix 1: Letter of information for Study 1

REB18249E: Understanding the cognitive process of 'perceiving – interpreting – acting upon' during complex surgical situations

Dear Potential Research Participant,

You are being invited to consider participating in a study exploring the mechanisms by which information from a complex surgical situation (i.e., contextual information such as visual cues) is perceived and used by surgical experts. This study is being conducted by Dr. Sayra Cristancho from the Department of Surgery and the Centre for Education Research & Innovation at the Schulich School of Medicine & Dentistry (SSMD), Dr. Michael Ott, Department of Surgery, SSMD, University of Western Ontario, Dr. Marie-Eve LeBel, Department of Surgery, SSMD, Dr. Richard Novick, Department of Surgery, SSMD, and Dr. Lorelei Lingard, Centre for Education Research & Innovation.

Participation in this Study

Participation in this study is voluntary and has no effect on your professional standing. You may choose to participate in one and/or both of the phases of the study (i.e., observations in the operating room and/or observations in the simulation setting). You may refuse to participate, refuse to answer any questions, or withdraw from the study at any time. Should you refuse participation or being recorded, your data will not be used. You can request that the observer stop taking notes or recording at any time.

Description of this Study

This study will take place at LHSC-UH from July 2011 - July 2014 and seeks to explore the features of surgical expertise during challenging surgical situations. During the study, structured observations will be implemented in both the operating room and with simulation. In the operating room, observations and video and audio recordings are directed towards the surgical site alone such that faces or other identifying details are not

recorded. During the case, a microphone will be attached to the surgeon's gown which will be connected to a digital voice recorder controlled by the observer. The observer will also record field notes about this phenomenon. After each case, the observer will interview the surgeon in order to match the identified challenges with corresponding triggering cues and to expand on the reflections about the decision-making points.

In the simulator setting, in addition to direct observations, we will audio and video record the performances through video capture of the screen of the simulator (no faces will be included in the video recordings) and a microphone attached to the participant's clothes. Existing simulation scenarios from commercial virtual reality surgical simulators will be used. Participants will be asked to review the description of two scenarios classified by complex by the manufacturer's manual and perform them while describing the steps and decision points throughout the scenario. Participation in the simulation exercise is anticipated to take one hour in time. Each participant will be identified using a generic coding.

Potential Benefits and Risks

The results of this study may serve to the benefit of participants, as the study aims to understand the features of surgical expertise in challenging situations that could be potentially implemented in simulation-based training curricula. In addition to the theoretical implications that will stem from the proposed research, there could also be repercussions to the medical supply industry as the results could serve as templates for developing commercially available simulators capable of providing training for advanced trainees to deal with surgical complications. There are no known direct long or short term risks anticipated as a result of participation in this project.

Confidentiality

In order to preserve the confidentiality of participants, all collected data will be de-identified with a generic code. Any audio recordings will be digitally anonymized. All video recordings will only be made of surgical sites and no identifying details will be recorded. Representatives of The University of Western Ontario Health Sciences Research Ethics Board may contact you or require access to your study-related records to monitor the conduct of the research.

All data will be stored on a password-protected, secured network server. Only the members of the research team will have access to the information collected by this study. Any presentation of the results obtained from this study will only appear in de-identified form.

Contact information

Please feel free to ask any questions that you may have regarding this study by contacting Dr. Cristancho at [redacted]. If you have any questions about your rights as a research participant or the conduct of the study you may contact Dr. David Hill, Scientific Director, Lawson Health Research Institute, [redacted]. You will be presented with a copy of this Letter of Information for your own records.

With regards,

Sayra M. Cristancho S., PhD.
Schulich School of Medicine & Dentistry
University of Western Ontario
[redacted]

Michael Ott, MD, M.Sc., FRCSC, FACS
Schulich School of Medicine & Dentistry
University of Western Ontario

Lorelei Lingard, PhD
Schulich School of Medicine & Dentistry
University of Western Ontario

Marie-Eve LeBel, MD, FRCSC, FACS
Department of Surgery, Division of Orthopaedic Surgery
Fowler-Kennedy Sport Medicine Clinic, 3M Centre,
[redacted]

Richard Novick, MD, M.Sc., FRCSC, FACS.
Department of Surgery, Division of Cardiac Surgery
Schulich School of Medicine & Dentistry
[redacted]

Appendix 2: Letter of information for Studies 2, 3, & 4

REB105250: Exploring the Influence of Procedural Approaches on Surgical Training and Assessment

Dear Potential Research Participant,

You are being invited participate in a study exploring how multiple procedural approaches influence surgical training and assessment. This study is being conducted by Tavis Apramian, MD/PhD Student in the Schulich School of Medicine & Dentistry's Centre for Education Research & Innovation and the Faculty of Health Sciences' Graduate Program in Health & Rehabilitation Sciences. The primary investigator for this study is Dr. Lorelei Lingard from the Department of Medicine and the Centre for Education Research & Innovation. The co-primary investigator is Dr. Sayra Cristancho from the Department of Surgery and the Centre for Education Research & Innovation.

Participation in this Study

This study involves residents and surgeons in surgical training programs and will take place from June 2014 to August 2015. The study will take place in the participants' current place of work. Participation in this study is voluntary and has no effect on your professional or educational standing. You may choose to participate in one and/or more of the elements of the study. You are being asked to allow a trained observer to observe your work in the hospital during a shift, to participate in informal interviews during a shift, or informal interview(s) outside working hours. You may refuse to participate, refuse to answer any questions, or withdraw from the study at any time. You can request that the observer or interviewer stop taking notes or recording at any time. Since this study follows an emergent design, the interview questions are not determined in advance; however, both observation notes and interview questions will pertain exclusively to the phenomenon of variations in the conduct of surgical procedures and effects of those variations on surgical training. An example of a pertinent question is: *do you keep a list of the procedural approaches you have observed during your surgical training?*

Description of this Study

There is no minimum commitment to participate. A single interview or short period of observation is sufficient. The maximum commitment is to be observed by a single researcher during your work over the course of one shift in the hospital per week for three blocks (i.e. 18 days) as well as participating in formal interview(s), which may take between approximately 30-60 minutes. This maximum commitment is not binding in any way. Participation is voluntary and you can withdraw at any time for any reason or without providing any reason whatsoever.

Potential Benefits, Risks, & Inconveniences

There are no known immediate benefits to participating in this study. However, in being afforded time to reflectively discuss their process of training trainees (for surgeons) or their process of being trained (for residents), it may be that participants are able to gain personal insight into their own educational and procedural practices.

There is a potential risk that discussing events that occur during the process of surgical training, especially contentious events such as differences in procedural approaches, may lead participants to feel a minimal degree of retrospective frustration.

Depending on the participant's interest and degree of participation, surgeons and residents participating in this study may experience some inconvenience by volunteering to spend time being observed or in formal or informal interviews. Surgeons and residents who agree to participate are agreeing to permit a trained observer to enter the operating room suite and take field notes about the interactions of the surgical team. The degree of inconvenience of being observed can be determined by the participant depending on the participant's interest in entertaining questions from the research team that interrupt or slow his or her natural workflow. Attempts will be made by the researchers to minimize interruptions. Observations will be stopped immediately if a participant indicates that the process is interfering with their work or requests the research to end for any reason whatsoever. Additionally, and similarly, the degree of inconvenience of participating in interviewing will be determined by the participant's interest in being involved in the research. Surgeons and residents who agree to participate in interviews agree to be contacted by the research coordinator to schedule a formal interview at a time, date, and location that is convenient for the participant. The participant can cancel an interview at

any time without cause. Participants who indicate during the research process that he or she is not interested in participating in informal or formal interviews or return of finding analysis will not be expected to participate.

Confidentiality

In order to preserve the confidentiality of participants, all collected data will be de-identified with a generic code. Any audio recordings will be digitally anonymized. All data will be stored on a password-protected, secured network server. Only the members of the research team will have access to the information collected by this study. Any presentation of the results obtained from this study will only appear in de-identified form.

Representatives of the University of Western Ontario Health Sciences Research Ethics Board may contact you or require access to your study-related records to monitor the conduct of the research.

Contact information

Please feel free to ask any questions that you may have regarding this study by contacting the study coordinator, Tavis Apramian, at [redacted]

If you have any questions about your rights as a research participant or the conduct of the study you may contact Dr. David Hill, Scientific Director, Lawson Health Research Institute. You will be presented with a copy of this Letter of Information for your own records.

With regards,

Sayra M. Cristancho S., PhD.
Schulich School of Medicine & Dentistry
University of Western Ontario
[redacted]

Lorelei Lingard, PhD
Schulich School of Medicine & Dentistry
University of Western Ontario
[redacted]

Tavis Apramian, MA, MSc
Schulich School of Medicine & Dentistry
University of Western Ontario
[redacted]

Appendix 3. Ethics approval for Study 1

Western Research

Research Ethics

Western University Health Science Research Ethics Board
HSREB Amendment Approval Notice

Principal Investigator: Sayra Cristancho
Department & Institution: Schulich School of Medicine and Dentistry/Surgery,Western University

HSREB File Number: 120917
Study Title: Understanding the cognitive process of 'perceiving - interpreting - acting upon' during complex surgical situations.-18249E
Sponsor: Canadian Institutes of Health Research

HSREB Amendment Approval Date: May 28, 2014
HSREB Expiry Date: December 31, 2015

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Revised Western University Protocol	Change in Co-Is: Dr. LeBel removed, Dr. T. Forbes and Dr. M. Caskin added. Addition of option to draw during interviews.	2014/02/21
Revised Letter of Information & Consent	Change in Co-Is: Dr. LeBel removed, Dr. T. Forbes and Dr. M. Caskin added. Addition of option to draw during interviews.	2014/02/24

The Western University Health Science Research Ethics Board (HSREB) has reviewed and approved the amendment to the above named study, as of the HSREB Initial Approval Date noted above.

HSREB approval for this study remains valid until the HSREB Expiry Date noted above, conditional to timely submission and acceptance of HSREB Continuing Ethics Review. If an Updated Approval Notice is required prior to the HSREB Expiry Date, the Principal Investigator is responsible for completing and submitting an HSREB Updated Approval Form in a timely fashion.

The Western University HSREB operates in compliance with the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS2), the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use Guideline for Good Clinical Practice Practices (ICH E6 R1), the Ontario Personal Health Information Protection Act (PHIPA, 2004), Part 4 of the Natural Health Product Regulations, Health Canada Medical Device Regulations and Part C, Division 5, of the Food and Drug Regulations of Health Canada.

Members of the HSREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

[redacted]

Ethics Officer, on behalf of Dr. Joseph Gilbert, HSREB Chair

Ethics Officer to Contact for Further Information

[redacted]			

This is an official document. Please retain the original in your files.

Western University, Research, Support Services Bldg., Rm 5150
London, ON, Canada N[redacted]

Appendix 4. Ethics approval for Studies 2, 3, & 4

Western Research

Research Ethics

Western University Health Science Research Ethics Board
HSREB Full Board Initial Approval Notice

Principal Investigator: Prof. Lorelei Lingard
Department & Institution: Schulich School of Medicine and Dentistry\Medicine-Dept of,Western University

HSREB File Number: 105250
Study Title: Exploring the Influence of Procedural Approaches on Surgical Training and Assessment
Sponsor:

HSREB Initial Approval Date: May 16, 2014
HSREB Expiry Date: August 31, 2015

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Other	References	20140414
Revised Western University Protocol	Protocol Revisions - Clean	20140509
Revised Letter of Information & Consent	Appendix 1. LOI revisions - clean	20140509
Revised Letter of Information & Consent	Appendix 1B. Consent form revisions - clean	20140509
Recruitment Items	Appendix 2 recruitment text revisions - clean	20140509
Response to Board Recommendations	Response to Board Recommendations	20140509

The Western University Health Science Research Ethics Board (HSREB) has reviewed and approved the above named study, as of the HSREB Initial Approval Date noted above.

HSREB approval for this study remains valid until the HSREB Expiry Date noted above, conditional to timely submission and acceptance of HSREB Continuing Ethics Review. If an Updated Approval Notice is required prior to the HSREB Expiry Date, the Principal Investigator is responsible for completing and submitting an HSREB Updated Approval Form in a timely fashion.

The Western University HSREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use Guideline for Good Clinical Practice Practices (ICH E6 R1), the Ontario Personal Health Information Protection Act (PHIPA, 2004), Part 4 of the Natural Health Product Regulations, Health Canada Medical Device Regulations and Part C, Division 5, of the Food and Drug Regulations of Health Canada.

Members of the HSREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

[redacted]

Ethics Officer, on behalf of Dr. Joseph Gilbert, HSREB Chair

Ethics Officer to Contact for Further Information

Erika Basile	Grace Kelly	Mina Mekhail	Vikki Tran

[redacted]

This is an official document. Please retain the original in your files

[redacted]

Appendix 5. Copyright release for Chapter 4

Curriculum Vitae

Name:

Tavis Alan Ingham Apramian

Degrees in Progress

M.D./Ph.D. University of Western Ontario, London, Ontario, Canada

Degree Held

M.Sc., 2010, Columbia University, New York, New York, U.S.A

M.A., 2009, Carleton University, Ottawa, Ontario, Canada

B.A. (Hons), 2008, Carleton University, Ottawa, Ontario, Canada

Peer-Reviewed Publications

Apramian, T., Cristancho, S., Watling, C., Ott, M. & Lingard, L. Thresholds of Principle and Preference: Exploring Procedural Variation in Postgraduate Surgical Education. *Academic Medicine*. Accepted June 2015. In press.

Dennhardt, S., Apramian, T., Lingard, L., Torabi, N. & Arntfield, S. Rethinking Outcomes Research in Medical Humanities: A Scoping Review and Narrative Synthesis. *Medical Education*. Accepted May 2015. In press.

Apramian, T., Watling, C., Lingard, L. & Cristancho, S. Adaptation & Innovation: A Grounded Theory Study of Procedural Variation of the Academic Surgical Workplace. *Journal of Evaluation in Clinical Practice*. Early online, June, 2015

Cristancho S., Apramian T., Vanstone M., Lingard L., Ott M., Novick R. Thinking *Like* an Expert: Surgical Decision-Making as Cyclical Process of Being Aware. *American Journal of Surgery.* Early online. May, 2015

Arntfield, S., Parlett, B., Meston, C., Apramian, T., Lingard, L. A model of engagement in reflective writing-based portfolios: Interactions between points of vulnerability and acts of adaptability. *Medical Teacher*. Early online, May, 2015

Cristancho S., Apramian T., Vanstone M., Lingard L., Ott M., Novick R. Understanding Clinical Uncertainty: What is Going on When Experienced Surgeons are not Sure What to Do? *Academic Medicine.* 88 (10): 1516-1521