

Mathematics, Mathematicians, and Desire

by

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Abstract

This thesis is about mapping the landscape of engagement with mathematics, including elucidating aspects of who we are, as human beings, when we do mathematics and of what mathematics calls us to do if we are to engage with it. Using the concept of desire in the psychoanalytic theory of Jacques Lacan and the forms of desire as elucidated by the Lacanian theorist, Mark Bracher, I seek to find out what the mathematical encounter takes (the demands and costs) and what it gives (the offers and rewards). My central theme is that the mathematical experience is impelled and sustained by desire which takes various forms in the involvement with mathematics. I explore the construct of desire as it relates to the notions of the subject, subjectivity, and the Other of mathematics and mathematicians. Drawing on two sources, written accounts (autobiographical and biographical) of mathematical journeys and oral accounts from interviews I conducted with practising mathematicians, I discern the mathematical subject, the one who we are when we confront the discipline of mathematics, and I show how our involvement with mathematics turns on desire. I further show the importance of this kind of inquiry in building awareness of the forces that shape the cultural endeavour that is the teaching and learning of mathematics.

Keywords: Affect; desire; emotions; subject; subjectivity

Dedication

For my parents, Mr. and Mrs. Roodal Persad

Look to this day!

For it is life, the very life of life

In its brief course lie the verities and

realities of our existence

The bliss of growth,

the glory of action,

the splendour of achievement...

... from the Sanskrit

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Chapter 1:

Introduction

When I came upon the sentence, “Insofar as a cultural phenomenon succeeds in interpellating subjects—that is, in summoning them to assume a certain subjective (dis)position—it does so by evoking some form of desire or by promising satisfaction of some desire”, in Mark Bracher’s *Lacan, discourse and social change: A psychoanalytic cultural criticism* (1993, p. 19), I knew that I had an argument in the making concerning what I intended to pursue in this dissertation, namely, the confluence of the discipline of mathematics as a cultural phenomenon, the community of mathematicians and their subjective (dis)positions, and the pivotal driving force of desire that impels engagement¹ with the discipline².

From my vantage point of several decades of learning and teaching mathematics and statistics at the college and university level, and bearing witness to the gamut of manners and degrees of engagement in students and adults from non-involvement to over-involvement, from denial to a degree of accommodation with and acceptance of mathematics, from a flat-out dismissal and declaration of not being “a numbers person” to working in mathematics as a profession, it is my conviction that Bracher’s sentence captures intently and pointedly the keys to beginning to understand that web of questions relating to mathematics as a human and cultural endeavour, including ones such as how and why we, as humans, take up mathematics, what draws us in or repels us (as is seen so much in the prevailing culture surrounding school mathematics), what it

¹ I hasten to point out here the difficulty with the word, engagement. In the education and mathematics education literature, the word has connotations of student engagement and motivation which are not my focus here. I am also not pursuing here the related notions of creativity and the ‘aha’ moment.

² I reserve the word, discipline, to refer to the discipline of mathematics. I reserve the word, subject, for the individual, the person confronting and engaging with the discipline of mathematics.

takes to do mathematics, what mathematics requires/demands/costs, as well as what it gives/offers/rewards.

This line of study began for me in EDUC 942 Contemporary Issues in Mathematics Education with Nathalie Sinclair when I came upon the work of Leone Burton, a UK researcher in mathematics education, in the area of coming to know mathematics. From a reading of the philosophical and sociological literature, Burton (1995, 1999) identified four challenges to knowing mathematics: objectivity, homogeneity, impersonality and incoherence. She proposed a theoretical model for the process of coming to know mathematics, with five categories: 1) person- and cultural/social-relatedness, 2) the aesthetics it invokes, 3) its nurturing of intuition and insight, 4) its recognition of different approaches and 5) its connectivities (Burton, 2004, pp. 11-12).

Burton tested her model in a study of 70 UK mathematicians, 35 male and 35 female as enquirers and practitioners (as of a craft), and found that the components were “remarkably robust” (Burton, 2004, p. 34). I, a decade later and a continent away, wondered whether the mathematicians I knew, if asked about their trajectories and experiences in mathematics, would speak of the same or similar categories. In a pilot study with two mathematician colleagues in a department of mathematics and statistics at a community college, I found only partial identification. The first category alone, relating to personal, social and cultural influences, was prominent, with the others only being addressed when specifically asked by me. However, my interviews with these two colleagues were eye-opening and revelatory. Their accounts of their histories and professional trajectories were nothing like what I expected or imagined, given my experience and opinion of them as mathematicians. Their stories of struggle and failure, disappointment and determination (indeed, not usually thought of as part of knowing mathematics) in their mathematical journeys surprised and, on occasion, astonished. As I talked with more mathematicians, I found that their unprompted narratives contained aspects only of the personal and the social/cultural. Indeed, when I read the list of Burton’s five categories to one mathematician, the response was dramatic. “That’s off”, he said, holding his hand up to his ear and waving it back and forth rapidly. I tried again; he held his head to one side as if to listen more carefully, and said again: “That’s off”, this time more emphatically. When I read the same list to other mathematicians, they

gave a slight shrug and showed no sign of resonance with it. It seemed to me that there was more to be teased out about engagement in the mathematical endeavour than these five categories in coming to know mathematics, and that the more compelling question was that of what is involved in engaging with mathematics. This, then, prompted a shift in focus from finding out about what mathematicians know to what mathematicians do and then to who mathematicians are, from knowing to doing and then to being. Who are we when we do mathematics? What subject positions does mathematics call on us to assume in order to engage with it?

This finding of journeys in mathematics being deeply and primarily personal provided the impetus for the work undertaken in this dissertation, namely research on the nature and the driver of human encounters and engagement with the discipline of mathematics. Beside the questions above relating to the individual who engages deeply and at length with mathematics, some of the other questions I hope to address include: What is the nature of our engagement with mathematics? What trajectories and journeys do we take in engaging with mathematics? What factors are at play and to what degrees? Before continuing with describing my research study, it is helpful, at this point, to examine some related considerations.

Unpacking the research problematic

Here I tease out several inter-related strands relating to mathematics that will clarify my focus. First, mathematics occupies a privileged and contested space in our society and in our lives. There is the tension, on the one hand, of the Conference Board of Canada and Ministry of Education pronouncements on mathematics as a gatekeeper to entrance and program requirements at postsecondary institutions, and on the other, the reality of students being generally unenthusiastic about the mathematics they are being asked to do in order to get on with their lives.

Second, mathematics is far more than a value-free, objective, neutral, and “inert mass of knowledge” (Whitehead, 1962, p. 2) that is to be transmitted and learned. It is one of the few disciplines in which we engage and of which we demand that our youth and citizens have some degree of knowledge, and which engenders extremes of

emotions. In a recent book, *Loving and hating mathematics: Challenging myths of mathematical life*, Reuben Hersh and Vera John-Steiner (2011), a mathematician and a Vygotskian psychologist respectively, explore the breadth and scale of responses to and relationships with mathematics with its resulting effects on ourselves, those with whom we interact, and the wider society. Feelings for and about mathematics set in at an early age, and the relationships taken on and forged as we wrestle with the discipline are often so strong that they lead to expressions of anxiety and pain (Black *et al.*, 2009). The famous psychoanalyst, Carl Jung, expressed his own anxiety and dismay at being defeated by mathematics:

The teacher pretended that algebra was a perfectly natural affair, to be taken for granted, whereas I didn't even know what numbers were. [...] No one could tell me what numbers were, and I was unable to even formulate the question. [...] All my life it remained a puzzle to me why it was that I never managed to get my bearings in mathematics when there was no doubt whatever that I could calculate properly. Least of all did I understand my own *moral* doubts concerning mathematics. (cited in Pimm, 1994, p. 115; *original emphasis*)

Jung's indication of "bearings in mathematics" reveals that, for him, mathematics is a place to be inhabited, a place where he could not find space for himself, and where he felt perpetually ("[a]ll my life") lost or disoriented. Also his emphasis on "*moral* doubts concerning mathematics" raises issues beyond the common perception of mathematics being merely about numbers, patterns, and shapes, such as mathematics being implicated in our sense of self, our feelings about ourselves, the way the world is organized, and our place within it. Papert (2006), in a chapter titled, 'The mathematical unconscious', reflects on the logical and extralogical roots of mathematics, and conjectures that "mathematics shares more with jokes, dreams, and hysteria than is commonly recognized" (p. 200).

Oftentimes, mathematics takes on the nature of a personal proving ground for many of us. Students will say: "I am a good student, all my other grades are good, it's just math", which is only one step away from, "I am a good person." Our struggles with mathematics, with being tested by the ordeal of it, and with wanting to be accepted by it as a mathematician is evident in the following statement by the author of a recent doctoral dissertation in mathematics education titled "Being (al)most a mathematician":

My frustrations, my feelings of rejection—that I did not have what it took to be in mathematics—and a sense that I still wanted to be accepted into mathematics, eventually transformed into a desire to be vindicated by others' experiences. (Beisiegel, 2009, p. 279)

For many of us, mathematics is a life-long challenge. Despite perhaps many great personal accomplishments, we are left with feelings of rejection and inadequacy, and, as was the case with Jung, puzzlement.

On the side of mathematicians, there is similar puzzlement. In a lecture before the Psychological Society in Paris in the early decades of the twentieth century and subsequently printed as an essay, *Mathematical Creation*, Henri Poincaré (in Newman, 1956/1988, p. 2017) wrote:

A first fact should surprise us, or rather would surprise us if we were not so used to it. How does it happen there are people who do not understand mathematics? If mathematics involves only the rules of logic, such as are accepted by all normal minds, if its evidence is based on principles common to all men, and that none could deny without being mad, how does it come about that so many persons are here refractory?

Indeed, a more important consideration than the fact that there are people who do not understand mathematics is that we (as people) are so used to this fact. We take for granted or we take as shared that there are people who cannot appreciate or who cannot do mathematics, when the prevailing opinion is that mathematics is everyone's entitlement and is accessible to all (Burton, 2001; Davis, 2001; Gates and Vistro-Yu, 2003).

A third aspect that compounds our complicated relationships with mathematics is the many perceptions of mathematics and mathematicians that we hold or imagine. Popular conceptions about what it takes to engage with mathematics and about who mathematicians are, what they know, and what they do, include:

- mathematics comes easily and without a struggle to mathematicians;
- those who become mathematicians understand mathematics from the very beginning;
- mathematicians are 'bright' in some way that enables them to understand the mathematics;

- those who ‘achieve’ mathematics do so effortlessly and go from one success to the next easily;
- mathematicians are endowed with special powers and insights that set them apart from the rest of us;
- the more advanced the mathematics achieved (say, in order to get a Ph. D. in the discipline), the more exalted the intellect required, and hence the more the achiever is seen as (in Lacan’s term), *le sujet supposé savoir*, the subject presumed to know.

A final consideration relating to how we perceive mathematics is the tension between seeing mathematics as a human and cultural endeavour and the received notion of mathematics as an ideal, pure and exalted. This latter notion of ‘pure’ is best exemplified in the English mathematician, G. H. Hardy (1877-1947), described in the Foreword to his (1940/2012), *A mathematician’s apology*, by C. P. Snow “as a real mathematician, not like those Diracs and Bohrs the physicists were always talking about: he was the purest of the pure” (p. 9). Hardy, in what he considered as his declining years in his powers as mathematician, felt pained to be writing about mathematics instead of doing mathematics; his opening line reads: “It is a melancholy experience for a professional mathematician to find himself writing about mathematics” (p. 61). Hardy disdains the “‘crude’ utility of mathematics”, while extolling its beauty, importance, and significance. At the other end of the spectrum, mathematics as a “social-historic reality” and a “human activity” similar to literature and music, is put forward by Hersh (1997, pp. 22-23).

Against the tangle of conceptualizations and perceptions/realities that surround the discipline of mathematics, how to begin to address this knot of the personal, the cultural, and the social with respect to the many ways that mathematics is interpreted and construed? While this inquiry may be placed in the realms of the sociocultural, the discursive or the hermeneutic, it seems to me that in light of the deeply personal³ nature of our encounters and relationships with mathematics, the landscape of engagement with mathematics and the mathematical experience are best described and understood as relating to the psyche and the psychosocial self, and that a psychoanalytic

³ Papert (2006) writes in his essay, ‘The mathematical unconscious’: “...the mathematics of the mathematician is *profoundly personal*” (p. 206, *my emphasis*).

perspective is needed to elaborate the notions relating to the person, namely, the subject and subjectivity. Indeed, in this research, I am trying to discern the mathematical⁴ subject (to be thought of much as the speaking subject and the cognizing subject), to describe who we are when we take up mathematics, and who and what mathematics calls us to be and to do when we engage with it. I have not seen this notion of the mathematical subject in the literature. For me, it captures the person or individual that mathematics requires us to be in order to engage with it. I am thus seeking to find what impels engagement with mathematics and what fuels and sustains engagement with this discipline.

I am seeking keys to understanding what drives people to become mathematical subjects, how it is that the cultural phenomenon of mathematics inducts and shapes its practitioners, how it is that some of us believe in the doctrine of mathematics, that some are still fervent believers, but that others fall away. Do we find mathematics or does mathematics find us, and what happens in that encounter?

Finding the word, desire

Hence, when in the sentence by Mark Bracher with which I began (“Insofar as a cultural phenomenon succeeds in interpellating subjects—that is, in summoning them to assume a certain subjective (dis)position—it does so by evoking some form of desire or by promising satisfaction of some desire”), I came upon the word, desire, I knew, with a flash of insight, that I had found my phenomenon of interest and my line of reasoning. I cannot quite remember which particular strand of my research I was following when I came upon Bracher, but it was of a piece with my search for a perspective that would help me gather the threads of the personal and the unconscious in examining how we invest ourselves in or what we bring to the encounter with mathematics. Somehow, most likely through some of the mathematics education literature which I will discuss in

⁴ I am clear that the word I seek here is mathematical and not mathematizing, which carries the connotation of problem solving and transforming. David Wheeler writes: “... in situations where something not obviously mathematical is being converted into something that obviously is. ... Mathematisation is *putting a structure onto a structure.*” (2001, p. 51; *original emphasis*)

the next chapter, I had made my way to Lacan. I was in the throes of reading (or attempting to read) works by the noted French psychoanalyst and psychiatrist, Jacques Lacan (1901-1981), who is seminal to this dissertation. I knew that there was more to the mathematical encounter than a simple biographical or autobiographical recounting of a mathematical journey. In order to see the driver underlying the journey, I needed the help of a psychoanalytic perspective which I knew was there to be found in Lacan, but I also realized that it would take time to make my way through the dense web that is Lacanian theory. Then I found Bracher, a Professor of Literature and a Lacanian theorist. The sentence which I have quoted twice now is the second sentence in his opening paragraph of the first chapter of his book. His invocation of desire right there and then led me through a path in the Lacanian *oeuvre*. In pursuing Lacan, I was seeking a theory that would shed light on the psychoanalytical aspects of how we, as human beings, as subjects, engage with the endeavour of mathematics. In Lacan, then, I found my central notions of subjectivity, the subject, and desire.

Hence, my research focus turned to questions of how to proceed, where to find evidence, and decisions as to what would count as data. I began by reading accounts of involvement with mathematics by people who have lived lives in mathematics, namely, biographies and autobiographies of mathematicians. When mathematicians write or speak about their involvement with mathematics, what personal knowledge and experience do they reveal about the discipline of mathematics, of what it takes to engage with it, and what the rewards and costs of such endeavour are? Written and oral accounts by and about mathematicians concerning their involvement with mathematics are, I believe, ignored and under-valued cultural artifacts of the discipline and its related field, mathematics education. In the teaching and learning of mathematics at the elementary and secondary levels, biographical data about mathematicians almost never appear in materials or curricula, and at the post-secondary level these are usually placed in footnotes and sidebars of textbooks⁵. These accounts have not been mined for the knowledge they hold: knowledge of the discipline, knowledge of the subject positions that we are called upon to assume in order to engage with mathematics, and knowledge of the demands and returns of the mathematical endeavour. It is time to redress this

⁵ Only in recent years have photographs and sketches of mathematicians been included.

and study what these accounts can tell us about mathematics and mathematicians. While they have, in some areas, been relegated to the history of mathematics, my emphasis here is different. Here, I propose to probe the psychological and social significance of these texts by and about mathematicians' journeys in mathematics. Thurston (1990, p. 847) makes the case for what mathematicians do: "[W]hat we are doing is finding ways for *people* to understand and think about mathematics" (*original emphasis*). Through analyses of these accounts, I am endeavouring to provide insights, again for people, into what it takes to become a mathematician and what it is to be a mathematician.

This dissertation, in its theoretical stance and its results, will address the central questions outlined above and extend the literature of mathematics education research in an as-yet generally uncharted area, namely, an investigation of the cultural phenomenon of mathematics and the underpinning notion of desire as the prime mover in engagement with it. I note that I am exploring terrain that is different from the huge literature on the psychological attributes of motivation and interest of student engagement, in that I am examining the phenomenon of engagement with mathematics with a psychoanalytic lens and shedding light on the construct of desire as the mover. Bracher goes on to say:

[It is] *desire* rather than knowledge that must become the focal point of cultural criticism if we are to understand how cultural phenomena move people. And if we hope to intervene in the interpellative forces of culture, we must understand, first, the various forms and roles of desire in the subjective economy, and second, the various means by which culture operates on and through these different forms of desire. (1993, p. 19; *original emphasis*)

My conviction is similar in that if we hope to understand how and why it is people take up mathematics and how we can hope to address the mathematical experiences of our students, then we have to understand "the various forms and roles of desire in the subjective economy". Further, we have to understand how the culture of mathematics "operates on and through those different forms of desire", in order to evoke a desire for belonging to its community of mathematicians. In this dissertation, I propose to map the landscape of engagement with mathematics, to describe the mathematical subject, and to interrogate the forms of desire that are at the heart of involvement with mathematics.

I intend to show that engagement with mathematics is both impelled and fuelled by desire; to adapt a phrase from Gattegno, I claim it is shot through with desire.

Of mathematics, mathematicians, and desire

Thus, my three foci in this dissertation will be mathematics, mathematicians, and desire. The questions of the nature of mathematics and, less so, mathematicians have occupied humankind for thousands of years and will continue to do so. These questions have been addressed at length in the disciplines of mathematics and the philosophy of mathematics and in the field of mathematics education research. They cannot be seen as being definitely answered if only because, as part of the human endeavour, the considerations of our relationships with these questions are ever changing and evolving, as the circumstances of the time and the society in which we find ourselves change and evolve. As this dissertation is about my investigation of the phenomenon of engagement with the discipline of mathematics, I present below, through my filter as one who has spent a life in learning and teaching mathematics and who continues to live these pursuits, some observations about what mathematics is and what it has meant for some of those who have engaged with it.

In what follows, I consider mathematics as a discipline among various disciplines of our many civilizations with no definitive description that stands for all time, place, and people. Mathematics is seen as part of human and social culture, evolving in a historical and cultural context. The mathematics in which I live and work is a particular strand of knowledge which I have been taught, and whose traditions and values I continue to uphold. There are particular qualities of abstraction and rigour, sensibilities of elegance and parsimony, and ways of reasoning that I have acquired in my learning of mathematics and which I consider a privilege and a duty to demonstrate and pass on to those to whom I teach mathematics. I acknowledge and appreciate Bertrand Russell's observation that "mathematics may be defined as the subject where we never know what we are talking about nor whether what we are saying is true." While this may be seen as unsettling to some, it causes me no concern because mathematics as a discipline can be appreciated as both theoretical, as in for its own sake, and applied. Mathematics appeared to me as a closed and logical system; you learn the rules and

then you can apply them or modify them. I could see instances of application in the physical world around me but I did not insist on a correspondence between the objects of mathematics and the material objects in the world. It was enough to appreciate the logic and the possibilities in the world of mathematics in itself. Despite various similar attacks at its foundations, both the edifice of mathematics and its practitioners continue unshaken.

So far, I have been addressing the nature of mathematics as opposed to the content of mathematics, or as the historian and philosopher of science, Leo Corry (2001) puts it, the image and the body of mathematics:

Claims advanced as answers to questions directly related to the subject matter of any given discipline build the body of knowledge of that discipline. Claims which express knowledge *about* that discipline build its images of knowledge. (p. 168; *original emphasis*)

The image of mathematics contains all the knowledge about mathematics by mathematicians (“both cognitive and normative views concerning their own discipline”, p. 169) and others including research such as mine. Standard conceptualizations of the body of mathematics include the science of patterns (Devlin, 1996) and the study of shape, quantity, space, structure, and since calculus, change. These conceptualizations are also closely tied to what mathematicians do (a view that is frequently advanced is that mathematicians principally prove theorems) which leads to approaches such as actor-network theory (ANT) of studying mathematicians as organisms in a habitat. Mathematics is then seen as a practice, an activity, and an ongoing cultural endeavour.

From the signifier, mathematics, I turn now to the other ‘player’ in the relationship, namely, mathematician or mathematicians. In probing the mover of desire in this relationship, I have chosen to use and present as evidence the accounts (both written and oral) by and about mathematicians of their journeys in mathematics. The question then arises: Why consider these? Why not look at the difficulties that people have with mathematics or the factors relating to failure in mathematics? Would that not be more helpful? To begin, there are few accounts of failure in mathematics, *per se*. It has been my experience that people only write about failure from a vantage point of success in something else, as is seen in Jung. In my life in mathematics, I have grown

up with stories of mathematicians and their forays into mathematics and have been gripped by the stories of madness and despair, of triumphs and dead-ends, of toil and achievement. As I read, I was struck by the recurring human themes that included accomplishment and failure, devotion and dedication, support and succour. It seemed to me that there was more there than a simple recounting of a journey and that attention had not been paid to the drama and the underlying psychoanalytic current of the accounts which were worthy of exploration. I had begun with Burton's (2004) mathematicians and her study of them that she undertook as a non-mathematician.⁶ Burton was interested in how those who teach university mathematics themselves came to know mathematics, what styles and tools they used, how they found the problems on which they worked, and so on. My focus is different in that I am seeking to tease out in more detail the human themes in the engagement with mathematics and the driver in becoming and being a mathematician.

What does it mean to be a mathematician? What are the ways, the guises, and representations that mathematics has appeared to those who have been attracted to its charms and powers and have engaged with it to a degree of achievement that has been recorded historically? Mathematics has long represented many things to human beings, as early as Pythagoras who, it is claimed, saw number as the essence of life and the world. My assumption is that in the study of engagement with a discipline, there is valuable knowledge to be gained from those who participate in the discipline to an appreciable extent. An apt analogy is that of waging a war; a general learns much about war and how it is best waged from the accounts of those who engage⁷ in it. I set out on this study, wanting to see what can be learned about the discipline and the nature of engagement with it from the accounts of those who have lived to tell the tale, as it were, from the mathematicians themselves, and from those who were deemed worthy to be written about. With the proviso that history is always written by and of the victors, these accounts are more than simple histories. None of the mathematicians I read or read

⁶ Burton said that in her interviews, she was treated to many lessons in mathematics. This was quite likely more than she had bargained for. It must be a weakness of those who teach mathematics; the only possible move is to explain.

⁷ The word 'engagement' comes from the French *engager*, to wager as in a bet, to join in as in to throw one's hat in the ring, or to wage war. A related word is strategy, from the Greek, *stratēgia*, meaning the art and office of a general.

about is disinterested or distant; the accounts reveal the human face/t/s of the crystal of mathematics. There is much to learn on all sides: the people who pursue mathematics and the discipline that often proves an elusive attractor/target/lover.

Some of the human face/t/s show particular representations or guises of mathematics for mathematicians. For Bertrand Russell, mathematics appeared as 'saviour', offering respite from fear and anxiety. Brought up by his grandparents in a formal and extremely religious tradition and beset by inklings of family secrets of madness, Russell put aside thoughts of suicide because he wanted to learn more about mathematics. Mathematicians who have suffered some period of isolation have turned to mathematics as solace. For Julia Robinson (Reid, 1996), it was a childhood illness and for André Weil it was time spent in prison as a conscientious objector in the war. Then there are the many examples of mathematicians who made important and memorable contributions to the discipline and fall prey or are, in some way, lured by madness and despair. This is not to say that they were driven to these states by mathematics and, indeed, the logician, Paolo Mancosu (2011) in his review of the graphic novel, *Logicomix*, rails against this notion, pointing out the percentage of madness among mathematicians is about the same and certainly no more than that in the population at large⁸. Georg Cantor suffered bouts of madness and died in a mental asylum and Kurt Gödel died of starvation because of paranoia. John Nash suffered from schizophrenia. Alexandre Grothendieck gave up mathematics and society and became a recluse.

A further representation of mathematics is that of perfection and an ideal complete with a sense of mysticism, wonder and a higher transcendent power. Plato posited God as a geometer. Pythagoras was a mystic as well as a mathematician, and Galileo Galilei claimed the grand book of the universe as written in the language of mathematics, "its characters are triangles, circles, and other geometric figures without which it is humanly impossible to understand a single word of it; without it, one is wondering in a dark labyrinth." The sense of the mystical in mathematics comes from seeing the patterns that emerge on multiplying particular numbers, or in the simplicity

⁸ Mancosu begins with the number of mathematicians listed in the World Directory of Mathematicians and comes up with a figure of six percent.

and minimalism of an equation such as $e^{i\pi} + 1 = 0$. The physicist, Paul Dirac, declared that God is a mathematician, while Arthur Eddington qualified that statement: God is a *pure* mathematician (Stewart, 2006, p. 197, *original emphasis*).

What, then, ties these two signifiers of mathematics and mathematicians? My contention is that the relation is underpinned, impelled, and sustained by desire, in all its nuances and shades. On the one hand, there is explicit mention of desire in Paul Halmos' (1985): *I want to be a mathematician: An automathography*⁹. In his charming take on the words autobiography and mathematics, Halmos writes of his love for words over numbers (he was thrown into the world of English on his arrival in America from Hungary at 13) and his decision to pursue mathematics over philosophy only coming well into graduate school. On the other, there is an outright declaration of not having any *passion* for mathematics in Hardy (1940/2012, p. 144):

I do not remember having felt, as a boy, any *passion* for mathematics, and such notions as I may have had of the career of a mathematician were far from noble. I thought of mathematics in terms of examinations and scholarships: I wanted to beat other boys, and this seemed to be way in which I could do so most decisively. (*original emphasis*)

A third illustration of desire is seen in Andrew Wiles' obsessive pursuit of the proof of Fermat's Last Theorem. Having encountered the problem in his local library while browsing the section on math books, Wiles relates in an interview that he was struck by the simplicity of its statement and by the fact that it was unproven for 300 years. There and then, he resolved to prove the theorem: "Here was a problem, that I, a 10-year-old could understand, and I knew from that moment that I would never let it go. I had to solve it." His determination and dedication, his persistence and his secretiveness are compelling. Wiles says: "I would wake up with it first thing in the morning; I would be thinking about it all day and I would be thinking about it when I went to sleep. Without distraction, I would have the same thing going round and round in my mind."¹⁰

⁹ Halmos addresses three stages in his development as a mathematician: Student, Scholar, and Senior.

¹⁰ <http://www.pbs.org/wgbh/nova/physics/andrew-wiles-fermat.html>. Accessed August, 2013.

What impels one to achieve in mathematics? What sustains one to be a mathematician? In his *Letters to a young mathematician*, the mathematician Ian Stewart (2006, p. 16) writes: “No one drifts into being a mathematician. On the contrary, it’s a pursuit from which even the talented are too easily turned away”. In the spaces of desire between the extremes, in the heights and depths of the terrain, in the broad sweep and the unexamined places is the story of this dissertation.

Overview of the dissertation

In the chapters that follow, I elucidate my journey in this area of research and give some responses to what I set out to find. I begin in Chapter 2 by situating this research in the mathematics education literature and show how the existing research has attempted to address the question of the personal and the emotional in engaging with mathematics. I trace the various ways my research has evolved, charting the shifts and phases. In Chapter 3, I elaborate the theoretical considerations underpinning the study and treat the Lacanian concepts of subject, subjectivity, and desire, before focusing on Bracher’s interpretation of forms of desire. In particular, Lacanian notions such as the three Registers, the Other, and the *objet a* of desire will be considered. I then pose my research questions and follow in Chapter 4 with some methodological considerations. I outline the methods of analysis I use in explicating desire and I reflect on the particular aspects and nuances of the study as set in the interpretative research paradigm. With this background, I present in Chapters 5 and 6 four in-depth analyses of desire working from accounts of particular mathematicians and their involvement with mathematics. Chapter 5 deals with written accounts. I present as data an example of biography and an autobiographical sketch, the journey of Sofya Kovalevskaya (1850-1891), and as an example of autobiography, that of André Weil (1906-1998), along with my analysis of these data in relation to desire. I continue in Chapter 6 with contemporary oral accounts, presenting analyses of my interviews with two mathematicians, one female and one male, each at a major North-American university. In Chapter 7, I conclude by reflecting on the study and its results with respect to the research questions I have posed.

In between some of the chapters, according to the rhythm of the dissertation, I present short pieces that I have titled, *Whence and whereof I speak*, an attempt of a sort in answer to the post-modern question of From where do you speak, *D'où parlez-vous?* In these pieces, I give voice to my personal journey in mathematics and to my feelings about a discipline to which I owe an immeasurable debt. The irony of using the mathematical term, immeasurable, to describe my feeling for mathematics has not escaped me; indeed, the description is apt.

Whence and whereof I speak (1)

Let me begin, as the postmodernists say, by declaring my positionality. Mathematics and statistics have been and continue to be my life. The renowned steel pan player, arranger, and band-leader, Jit Samaroo, of Trinidad, who started from humble beginnings, once said in an interview: “Pan has given me everything I have. Everything I am is because of pan.” By pan, Samaroo is referring to the steel pan, the national musical instrument of the island of Trinidad, the place I am from. In my life, with respect to mathematics, I affirm the first statement and qualify the second: Mathematics has given me everything I have. Almost everything I am is because of mathematics. These are powerful and sweeping statements, but they capture my feeling for my life and for the place that mathematics occupies in it.

I, too, have come from humble, but cherished beginnings. I have spent my life, since the age of five, on one side or the other of a desk, much of that time spent learning and teaching mathematics. Mathematics has given me the tools to negotiate my way in life and to appreciate life. It is an essential part of who I am, how I see life, and how I come at life. I am reminded of a singular statement by one of the mathematicians whom I interviewed for this study. He had said: “To the extent that I appreciate literature, I do so as a mathematician.” For me, that statement attests not to the narrowness of vision but to the power and extensive arc of mathematics.

Samaroo came from an Indian village in Trinidad and made his way in the arena of the steel pan, a musical form not dominated by Indians, a form to which he was an outsider, and in which he made his own mark. Growing up as a colonial citizen in Trinidad, I, too, was an outsider to school mathematics, but soon I realized that it provided both a world in which I could find a place and in which I could see myself. I already had a home, a family, a village, a community, a school, and a sense of being part of a country, but mathematics provided a special place in that it made perfect sense to me; it opened up a world where I could see how things worked. There were other

aspects of my world that were not so clean and ordered; even as a child I could not shake the feeling that we, who found ourselves on the island being of different races, religions and cultural backgrounds, were a people of shipwreck brought there by various means and circumstances that bespoke and carried the stain of larger, more ominous forces. While my world was limited, I understood its extent as I glimpsed a larger or wider world from the events and institutions around me. If I could not understand the intricate relationships around me in my family and in the other families I encountered in my village and my school, in the friendships I formed in school, and in the relationships with my teachers, I could understand the relationships in mathematics.

Besides mathematics, in my books in general, the world opened up to me. There was little of our own history, but we learned of the Knights of the Round Table, Charlemagne, and the Edict of Nantes. We learned about elves and fairies, wizards and witches. We learned from Aesop's fables, Grimm's fairy tales, and tales from Shakespeare. I held these in parallel with the teachings from the dramas of the *Mahabharata* and the *Ramayana*, the legends of Rama and Sita, Krishna and Radha, and the sayings of the saints and sages. I read of Alexander weeping¹¹ because there were no more worlds to conquer and I wondered at this. We were always reminded by our teachers in elementary school of our insignificance in the larger scheme of things, that Trinidad was "a dot on the map of the world". Still, it was a pretty significant dot to me, since it was my dot in the world. It was my world, the one into which I was born, inheriting a history of complicated journeys of my ancestors from India by way of a painful and intricate past of mercantilism and imperialism that involved slavery, Britain, the abolition of slavery and indentured labour (give thanks) to the New World of Columbus ("In 1492, he sailed the ocean blue") as he came in with his three ships, the Niña, the Pinta, and the Santa Maria, and named the island for the three hills he saw, the trinity, La Trinidad.

So, where am I in this research study that I am about to describe? What is my own mathematical journey? I begin with considering why I chose mathematics (or

¹¹ An echo of this is Andrew Wiles' weeping as he recounts solving Fermat's theorem in an interview in the BBC Nova program and having achieved his childhood dream. His was a momentous achievement in his life; other mathematicians felt cheated in that this achievement took away one of their worlds to conquer.

perhaps, why mathematics chose me). The simple unvarnished truth is that I did mathematics because I could get 10 out of 10 in an *unequivocal* manner. This may seem of little consequence, but that 10 out of 10 was far from simple.

First, it offered a temporary sense of complete satisfaction and fulfillment. That 10 out of 10 was a description of reaching perfection, a fantastic source of *jouissance*¹², a way of living forever, of temporarily overcoming death; there was no deferral. It was enticing to me; just as I was looking at it, it was beckoning to me, saying, come and get me. My father had taught me to aim high; that 10 out of 10 was the highest of the high.

Also, there was a sense that it could not be taken away from me by anyone's whim or caprice, that there was no other authority, and that mathematics was its own authority. Going to school in Trinidad at that time, we were colonial subjects, bearing allegiance to another's Queen and country, but nothing and no one, no higher power, could take away the rightness of one's answer. Mathematics was the indisputable authority. It was there on the page, for anyone to see. In other subjects like English or History, we (as students) could never tell whether the work had merit or by whose rules it was being judged. We knew that teachers could hide other evaluations, beside that of the work, behind awarding 8 out of 10. Not knowing all the rules, we could never argue with them. But in mathematics, we learned what the rules were and what deserved 10 out of 10. I was troubled by the fact that I could not figure out what was needed in English essays or art, say. I felt that I could stand on my head and still only get 7 out of 10 in an essay. I suppose, that in a sense, the valuing in math was not as subjective and that even if for some reason unknown to us or perhaps had nothing to do with us, if the logic was there on the page, there could be no question of not being given that 10 out of 10. It was not so much a matter of proving something to my teachers; it was that I realized instinctively and early on, being of the background from which I came and being in the situation in which I found myself, that there were power differentials that lay in places of which I had little knowledge. I could not have phrased it like that at the time, but I knew then what I needed to do in order to make my way in the world of school.

¹² A Lacanian theoretical term, generally translated as enjoyment, to be explained later.

Finally, I realized that I could find, to some degree, a footing in mathematics, that I could see myself in it (not that the books and objects of mathematics were reflected in my life at home, with my friends or the world around me), but I could see the meaning in it, how it cohered, how it gave a system that worked on its own. Nowadays, there is an emphasis on culturally responsive mathematics education and of providing tasks that are windows and mirrors so that students can see the world through the tasks and see themselves reflected in the tasks. I did not need these considerations. I was not disturbed that the names in my exercises were John, Mary, and Betty, names different from mine and those of the people around me. There was no angst about the letters x and y , a and b . It all made sense. In Geometry, we began with the definitions:

A point has no length and no breadth. A line has length and no breadth.
Between any two points, a line can be drawn.

And we were off; I was charmed by it. In Algebra, it was a similar thing. The teacher said: $2a$ plus $4a$ equals $6a$ and again I was charmed and drawn in. I could see that that 'a' was a powerful way of representation in that it could stand for anything. I did not need a particular referent or any referent; I understood what it signified. It was like magic; I was seduced, an instant devotee. I found that I could do the mathematics at levels different from doing art or music, say, subjects in which my teachers would shake their heads indulgently at me, knowing that I was doing well at other things.

The other day I went to pick up two mathematics books at my college library, and, as usual, I was excited to see them. The librarian, on seeing my delight, asked, did you always love mathematics from when you were a child? I hesitated, realizing that the answer would be big and complex and would take time. I ended up saying that it was something I could do and that it came easily to me. She seemed a little disappointed as if she were expecting me to wax lyrical about beauty and passion, when really it was for me, literally, a matter of life, a matter of making my life in the world. Lest the reader think that this is surely an exaggeration, my earliest and most vivid memory of school is that of my principal pointing to the chairs on which we sat and saying, remember that for each of these chairs, there is a line of girls waiting to get in. I knew then I had been given a special opportunity; finding mathematics made it more so.

Chapter 2:

Towards the psychoanalytic turn in the mathematics education literature

Because I seek to describe the person or subject involved in the relationship with the discipline of mathematics, my focus in this chapter is in showing how the field of mathematics education research has responded to and addressed the affective domain, that area of the personal and the subjective dealing with the roles of feelings and emotions in our engagement with mathematics. Starting from the interests of psychologists¹³ in mathematics as a research domain and of teachers/educators of mathematics in addressing the many issues in the teaching and learning of mathematics, the field has grown in many directions, looking to other fields such as philosophy, sociology, design science, and psychoanalysis for inspiration.

In this literature review, I begin with early research of a psychoanalytic nature which has been on the margins, as it were, interspersed in the mainstream research. Next, I pull back for the long view and present a historical summary of the waves of the research dealing with affective domain through the thirty or so years since, showing how research in mathematics education has, by various twists and turns, arrived at a greater adoption of a psychoanalytic perspective, as a framework in addressing the affective domain in the teaching and learning of mathematics. I then situate my research interest of engagement with mathematics in the mathematics education research literature in preparation for the chapters that follow. From this evidence of the use of psychoanalytical ideas by mathematics education researchers in studying responses to

¹³Today, the oldest and foremost group of researchers in mathematics education (in terms of numbers and influence) is the International Group Psychology of Mathematics Education (IGPME) which is overdue for a Kuhnian paradigm shift, insisting on keeping the word 'Psychology' and showing great resistance to its removal though the field has moved on.

the discipline of mathematics, I position the analyses that follow of accounts by and about mathematicians of their engagement with mathematics.

An underlying psychoanalytical thread

In 1977, the prominent mathematics education journal, *Educational Studies in Mathematics*, published Jacques Nimier's 'Mathématique et affectivité' in French (with an abstract in English), an article based on his 1976 book, *Mathématique et affectivité* published in France. Nimier conducted interviews with over 600 students, aged 15 to 18 years (about twenty percent more girls than boys, and about the same percent in scientific and literary streams). Noting that mathematics pedagogy then was influenced by Piaget's theory of genetic epistemology which had little to say about the affective, Nimier sought to examine the speech (*la 'parole'*) of students as they expressed their feelings for mathematics. The themes he found were of a psychoanalytic nature, beginning with *une angoisse*¹⁴ *à propos des mathématiques*,¹⁵ and having to do with feelings of separation, loss of self, and destruction of self. They were not simply to do with conscious fears such as bad grades, fear of being punished, and fear of not knowing, but pointed to something much deeper, much as the tip of an iceberg. Mathematics was conceived in various ways, such as an object of displacement as evinced by an associative chain of signifiers, a certain moral necessity such as a law, and as a means of reviving castration anxiety (defined by Lacan as the symbolic lack of an imaginary object and refers to the loss felt by the infant in its realization that it is not the phallus for the mother).

Psychoanalytic ideas were not taken up in the (English language) literature in mathematics education until the late 1980s, with Valerie Walkerdine's *Mastery of reason* in 1988. Later, in my historical review of literature showing the various twists and turns leading to the present-day psychoanalytic turn, Nimier makes a contribution in English in

¹⁴ This term is usually translated as 'anxiety' but it has more to do with anguish. At the Lacan Salon of Vancouver which I attend, this semester we are studying Lacan's Seminar X, *L'Angoisse*.

¹⁵ In 1978, Sheila Tobias published *Overcoming Math Anxiety*, describing a construct that has been well-taken up and absorbed in public discourse.

1993 on his work, then cast as defence mechanisms with respect to mathematics. For now, I wish to trace the nodes of an underlying but insistent thread pertaining to the psychoanalytic (in particular, applying the work of Winnicott and Lacan) in mathematics education from four pioneers: Philip Maher (1994), David Pimm (1991, 1993, 1994), Dick Tahta (1991, 1993a, 1993b, 1994), and Valerie Walkerdine (1988, 1994).

Walkerdine's (1988) book, regarded as a seminal work, was so radical that it was considered by Pimm (1991, p. 391) as "run[ning] the risk of being ignored, ... 'monster-barred', to use Lakatos' resonant expression ... and consigned to the category of 'other'". Conceiving of mathematics as a fantasy of control over an ordered and calculable universe, she declares that the process of mastery in mathematics "entails considerable and complex suppression. That suppression is both painful and extremely powerful. That power is pleasurable. It is the power of the triumph of reason over emotion, the fictional power over the practices of everyday life" (p. 186). I quote at length here to show the chain of signifiers: suppression, power, pleasure, reason, emotion, and fiction, namely the fiction of achievement of mastery invested in fantasy. Within mathematics as a discursive practice, Walkerdine argues that rationality is not natural but artificial and produced, and produced for particular purposes such as in the construction of 'child', which is "constituted as a bedrock of practices" (1988, p. 205). The production of rationality is enmeshed in "a series of values, fantasies, fears, [and] desires" (p. 207).

Desire is taken up at the end of Tahta's (1991) book chapter, titled 'Understanding and desire', as he begins with the structures of language, metaphor and metonymy, in the correspondence between number (a Platonic object) and numeral, the access to number being only by means of symbolic marks and operations on paper. Tahta has his eye on Lacan's linking metonymy and desire which occurs at about the half-way point in the chapter from observations on the need of mathematicians to shed metaphor. There is no easy point at which to introduce Lacan or desire; when it comes, it comes all at once as he quotes from Lacan's Seminar XI: there is a "metonymic residue which runs under the chain of signifiers, an indeterminate element, which is at

once absolute, but untenable, a necessary and misunderstood element called Desire”.¹⁶ Tahta notes the difficulty of this for the reader: “This language might be baffling at first, but bear with it a while. Lacan, who took up and developed the two polarities of language described by the linguists, has been an important influence in literary criticism¹⁷ and in psychology¹⁸; and I believe his ideas have some relevance of mathematics education” (pp. 231-232). Tahta approaches Lacan elliptically, writing another ten pages on numeration and place value, counting and cardinality, and only in the last three or four pages does he come to his final section on understanding and desire, the lead-up being arduous and careful. Tahta articulates that understanding in its various meanings is linked by psychoanalysis with our early emotional experiences of identification with the mother and the coming to terms of separation, absence, and loss, with fantasy offering a way of filling the ‘gap’, and language giving control over the loss. This control is a symbolic one and needs to be maintained, with understanding being one way in which this is done, leading to the important insight in the context of teaching and teachers, namely that those who seek to understand also seek to get others to understand. Tahta summarizes key Lacanian ideas of the registers of the Imaginary and the Symbolic, and “Desire for the Other”¹⁹, the paper ending almost cryptically as he points to the repression contained in mathematical practices, and the “painful, but seemingly inevitable, payments exacted by the control of it [the Desire for the Other]” (p. 242).

This recognition of the role of the unconscious and unconscious activity in mathematics leads Pimm (1994) to putting forward another psychology of mathematics education, one that leaves aside the social and the rational aspects and looks within for “unaware associations and subterranean roots that are no longer visible even to oneself,

¹⁶ This translation is from R. Coward and J. Ellis (1973), *Language and materialism*, Routledge and Kegan Paul, p. 120.

¹⁷ Nowadays, departments of English in universities teach courses in and house centres for psychoanalytic theory and inquiry which form a major research focus in literary criticism.

¹⁸ Lacan stresses the difference between psychology and psychoanalysis, that the one is not the other.

¹⁹ This is usually written, desire is desire *of* the Other, an important ambiguity in the preposition.

but are nonetheless active and functioning” (p. 112). His examples show themes of absence, invisibility, negation, and loss related to the objects of mathematics.

Finally, Maher (1994) engages the ideas of potential space and mathematical reality. Maher wonders how it is that writers and engineers do not talk of a ‘literary’ reality or an ‘engineering’ reality but that mathematicians are conscious of a ‘mathematical’ reality. He notes that one of the difficulties with mathematics is that it is non-representational in that it (its theories, results, etc.) has meaning independent of the external world. Maher argues that there is no such thing as Platonic mathematical reality (the belief that there exists an independent mathematical reality external to us), that the notion is highly problematic, and that its affective power “results from an unknowing conflation of the philosophical with the psychoanalytical; or, to put it slightly differently, the philosophical notion of Platonism has deep psychoanalytic roots which are all the more powerful for being unarticulated” (p. 135). A related concept is that of space, which, for Maher, is more than the spaces of mathematics (such as metric, vector, and topological spaces); he clarifies: “[I]n writing *about* mathematics the term ‘potential space’ has a psychological, indeed, psychoanalytical, meaning” (p. 134, *original emphasis*).

To explicate these two psychoanalytic notions with respect to mathematics, Maher draws on the psychoanalyst Donald Winnicott’s work in locating cultural experience (cultural, here, embracing mathematics as a cultural phenomenon) and Winnicott’s concepts of potential space and transitional object. The notion of potential space arose from his work on the early child-mother relationship where the child and mother are engaged in a dynamic of ‘absolute dependence and absolute independence’, the potential space being that space between mother and child at the moment when the child, after being merged with the mother, is in the process of separation from the mother by the process of weaning. The space is then filled by transitional objects to which the child becomes attached as the child negotiates between the subjective and what is perceived as objects. Maher notes that the transitional object presents a paradox which cannot be resolved, but must be accepted: the point of the transitional object is not its symbolic value, but its actuality (p. 136). With respect to mathematics, Maher maintains that when we do mathematics we are “subsumed” in a potential space, that “mathematical reality is an instantiation of potential space”, and that “one’s

mathematical objects are transitional objects” (p. 136). Maher connects the visual in mathematics with the gaze in Winnicott’s theory of the role of the mother as mirror and in Lacan’s (1949/1977) mirror stage. In their mutual gaze, the mother reflects the child to itself, and in the specular image of itself in the mother’s gaze, the child sees itself as “a total and unified whole”, which “prefigures the mind’s desire to make whole” (p. 139). This desire to make whole, Maher argues, is a crucial characteristic in mathematical activity such as when we make patterns or account for a special case such as a counterexample. Despite the doubts cast on psychoanalysis (as to its scientificity, say), Maher concludes that “psychoanalysis offers the most realistic insights in the workings of the human mind and hence into the experience, and activity, of mathematics” (p. 139).

What is interesting from these four nodes is seeing the various approaches of each researcher in encountering the ground of the unconscious and psychoanalysis as interpreted by Winnicott and Lacan, and its rendition in mathematics and mathematics education. The seeds they have sown are so radical and so on the edge or margins for the times that it has taken another couple of decades for them to flourish somewhat.

I now pull back from these four nodes in the research to provide a historical development of the research starting from early mentions of the tangle of affect and cognition, following the waves to the present-day focus on subjectivity and the psychoanalytic. I then situate my research interest of engagement with mathematics in the mathematics education research literature in preparation for the chapters that follow. From this evidence of the use of psychoanalytical ideas by mathematics education researchers in studying responses to the discipline of mathematics, I position the analyses that follow of accounts by and about mathematicians of their engagement with mathematics.

A historical tracing

In this section, I trace the progress of the mathematics education research on the affective as it advanced from the early identification of mathematics anxiety. I delineate four waves and their foci: the Early Wave (1978-1992) dealing primarily with what was then called Affect, the Middle Wave (1993) highlighting Psychodynamics, the Recent

Wave (1994-2007) in the turn to the Psychoanalytic, and the Present Wave (2008-) with the focus on Subjectivity/Identity. I hasten to point out that this tracing is far from tidy in that there are no clear separations between the waves²⁰ and that there are instances of articles that are early indications of an idea which may not have been fully developed until much later. What I am identifying here are the various emphases that can be seen historically. My purpose is to consider what theories the authors use, who their influences are, how they position themselves, and to what end.

Early wave (1978-1992): Affect

With respect to affect and mathematics, an important landmark occurred in 1978 when Sheila Tobias, a self-described “outsider to science and mathematics” coined the term, mathematics anxiety, in her book, *Overcoming mathematics anxiety*. With the term, math anxiety, and her “analysis of feelings” (1978, p. 22), Tobias attempted to pin down a phenomenon and its attendant consequences that many had observed and expressed, but could not quite address. She brought to light that nebulous and confusing bundle of emotions and mechanisms that operate alongside and oftentimes derail the cognitive in the learning of mathematics. These include avoidance, fear, and shame, as well as preferences, antagonisms, and resistances, all with ensuing debilitating effects.

Tobias’s formulation of math anxiety opened a door for mathematics education researchers (the subfield was dominated by those in psychology and counseling psychology who saw mathematics as a domain of research). By naming the unease and disorder experienced by learners of mathematics and observed, but unaddressed by teachers of mathematics, Tobias gave researchers a way to begin to speak about a very real, but intangible aspect of engaging with mathematics. The identification and the naming of the phenomenon as a means of reference were huge steps forward. Ten years on from that first study, Wood (1988) looks back at the research in mathematics education relating to mathematics anxiety and notes the difficulties with the term, both in

²⁰ I chose the word, wave, purposely to indicate that there are no neat and clear categories. I had begun with the word, period, and then tried phase. I believe that the word, wave, captures the emergent and overlapping nature of the progress of the literature.

its definition and measurement. One difficulty is that the phenomenon is ill-named as individuals who claim to have math anxiety do not exhibit the usual psychological symptoms of anxiety. Another is that the term is often confused with mathematics avoidance and with the tension students experience while doing mathematics. Wood concludes that little confidence can be placed in the experimental results thus far. Wood further considers the research on mathematics anxiety and elementary teachers, and remarks that while the construct, however ill-defined, is evident to some degree and can be eased with interventions such as computer courses, the key to alleviating mathematics anxiety in this population is the development of teacher preparation programs informed by research efforts in mathematics education (1988, p. 13).

Another early landmark in mathematics education research on affect is the 1992 then-state-of-the-art article by Douglas McLeod (1992) in the first *Handbook of Research on Mathematics Teaching and Learning* on research on affect, being one of 29 chapters and covering 23 of 734 pages. I note the comparative number of pages in order to show the breadth of the field of research in mathematics education and the relative attention to this part. McLeod defines the affective domain as an area of emotions, attitudes, beliefs, moods, and values in opposition to the cognitive domain, and notes that these subjective features have not been prominent in mathematics education research due to the difficulty in measuring or capturing phenomena considered unstable. McLeod draws on the theory of the cognitive psychologist, George Mandler, that affective factors are physiological responses to cognitive plans and schema that are interrupted in ways that are particular to the individual.

Fifteen years later, the two-volume *Second Handbook of Research on Mathematics Teaching and Learning*, in Part II: Teachers and Teaching, has one chapter out of 31, covering 59 out of 1312 pages, on Mathematics Teachers' Beliefs and Affect (Philipp, 2007). It is to be noted that the proportion of space devoted to this area of the affective has not much improved. Philipp opens with a familiar story of a colleague's daughter who left her last mathematics course hating mathematics where previously she had loved it. After citing some statistics about the various percentages of students hating mathematics more than any other subject, he goes on to discuss mathematics teachers' beliefs and their influence on student response to instruction in the discipline.

Philipp concludes with the suggestion of research into issues relating to identity as a promising route to integrating teachers' beliefs and affect.

The recognition of the notion of identity and its concomitant considerations leads the way to deeper exploration of aspects of the individual in how we confront and address the discipline of mathematics. As a harbinger of the need for a psychoanalytic perspective, two papers in 1992 give an early indication of the relevance of psychoanalysis in research in mathematics education, and explicitly use the word, psychoanalysis, in the title, namely, Blanchard-Laville (1992) in the in-service training of mathematics teachers and Early (1992) in analyzing mathematics student writings from a Jungian perspective.

Middle wave (1993): Psychodynamics

In February 1993, the journal, *For the learning of mathematics (FLM)*, put out a Special issue on Psychodynamics in mathematics education edited by the late Dick Tahta and featuring contributions by notable authors in the field. The year, 1993, was the hundredth anniversary of Freud's first written formulation of the unconscious. This landmark issue sought to address the continuing trauma that many students experience in mathematics [to quote Jung and his difficulties with mathematics again: "I was so intimidated by my incomprehension that I did not dare to ask any questions. Mathematics classes became sheer terror and torture to me" (cited in Tahta, 1993a, p. 2)]. The term, psychodynamics, indicates the systematic study of the underlying psychological forces that influence our behaviour, feelings, and emotions as mediated by our relationship between the conscious, subconscious, and unconscious. The papers in this issue all show the beginnings of psychoanalytic ideas in the search for understanding aspects of our relationships with mathematics. I give below a summary of the main ideas in order to demonstrate the range of approaches and theories relating to the psyche.

The deployment of defence mechanisms in engaging with mathematics is the basis of a striking contribution by Jacques Nimier (1993), a brief rendering in English of his work described above in 1977. Conducted in France, Belgium, Québec, and Ontario using questionnaires and interviews, Nimier's study, revealed six defence mechanisms.

Nimier did not cite any theory *per se*, but as a psychologist, he was able to tease out psychological and psychoanalytic structures in the speech of his interviewees. Guided by the psychoanalysis of Melanie Klein, Nimier (p. 30) notes the distinction between a phantasy as “the mental expression of instincts, but also as means of escape – an escape from confronting external reality or the frustrated reality within” and a defence mechanism as the “actual process” by which the phantasy is or played out or defended against. In a phantasy, the student is projecting her wishes to avoid frustration at an unrelenting mathematical situation which shows no sign of being resolved. More importantly, the student is defending herself from her own internal forces of a) wanting to know the ‘truth’ of the situation and b) anger at not being able to overcome her ignorance. Nimier identified three phobic defences (mathematics perceived as an object outside the student): Phobic Avoidance, Repression, and Projection, and three manic defences: Reparation, Introjection and Reversal into the Opposite where students find ways from ‘inside’ to engage with and conceive mathematics in ‘positive’ ways.

In Phobic Avoidance, metaphors are used to describe the inability to approach or confront the situation. Examples of these are the problems and exercises of mathematics encountered as a veil, a barrier, a black hole, and an impossibility. Using these, the student defends against facing the situation, but there is a deeper meaning of what is being repressed (such as an urge) or feared (such as punishment). In Repression, the student denies any personal meaning or relevance and is “indifferent” or even negative towards the mathematics, to the extent that they ask (p. 31): “You, seeing as you are a maths teacher, do you really believe in all these theorems?” Nimier cautions here on the value of teaching mathematics for all, and “at any price” since “mathematical education is not a return to apprenticeship; the whole personality is involved” (p. 31). In Projection, students find themselves at odds with aspects of mathematics that appear to have no place for personality or consequence, finding that mathematics variously takes one to a place of involvement too deep, or oversimplifies things to the point of taking the poetry out of things, or leads to destruction of self and of the world. The loss of ego or sense of self is, thus, keenly felt.

These three negative defences can be related to Freud’s “recognition of the unconscious on the part of the ego is expressed in a negative formula ... The content of a repressed image or idea can make its way into consciousness, on condition that it is

negated. Negation is a way of taking cognizance of what is repressed; indeed it is already a lifting of the repression, though not, of course, an acceptance of what is repressed” Freud (1925, p. 235). Freud posits four ‘Vers’: *Verneinung* (denial/negation), *Verwerfung* (foreclosure/rejection), *Verdrängung* (repression), and *Verleugnung* (disavowal), all of which figure in and relate to the above defence mechanisms.

In Reparation, students have a sense of creating or constructing in the process of doing mathematics. Nimier sees this as corresponding with the wish of the ego to repair the ‘good object’ and to avoid feelings of guilt and loss. There is also the phantasy of childbirth in doing the mathematics: “the most important thing is that which has to come from you” is a student response (p. 32). Another take on mathematics is seen in the second manic defence, Introjection, where mathematics is seen as a way of disciplining or training the mind, “get[ting] a strong character”, “acquir[ing] a well-balanced personality”, and “develop[ing] good reasoning” (p. 32). Mathematics, as a language, in its precision and its purport to brook no ambiguity is the aspect that students introject, thereby placing a semblance of order and structure in mathematics and by extension, in themselves and in their world. Mathematics is also seen as a way of finding or testing some internal stability. This defence mechanism can also be seen as a way of ‘keeping the mind busy’ so that it does not run into ideas that may not bode well, such as aggression and guilt. The final manic defence mechanism of Reversal into the Opposite is that of transforming negative disagreeable feelings of defeat and lack of intelligence into feelings of victory and some resolution about one’s abilities. Nimier refers to these feelings as reminders of the “narcissistic wound” (p. 33) and the search for the opposite as a way of addressing that wound. Nimier concludes with the notion of “splitting” where we split ourselves into good parts and bad parts, and project these on other people and things. While in much of this work, there is an assumption that “splitting” is bad or an unwelcome condition, in Lacanian theory the subject is a split, barred and decentred subject, coherence being a fantasy. These mechanisms are, then, both as a means of defence against and as a means of engagement with mathematics.

The notion of “splitting” is carried forward in Chris Breen’s (1993) contribution, Holding the tension of opposites, written from a Jungian perspective. Breen, in his work with training teachers in South Africa, investigates various conceptualizations of and

attitudes around mathematics, and suggests that a search for archetypes may be an important starting point in enriching mathematics.

Another description of reaction to mathematics is given by Mordant (1993, p. 10) of “freezing” (a physiological term, which underscores the physiological aspects of affect) by students on seeing mathematics problems. Drawing on the work of “two unusually scientific psychoanalysts, Ignacio Matte Blanco and Robert Langs”, Mordant applies the notion of symmetrisation by Matte Blanco (a symmetrisation is an attempt to work out situations that produce strong feelings) and the notion of a secure frame by Langs (those conditions in which a patient in psychotherapy feels safe) in order to see how a student can be “attuned” to the mathematics they are facing in the unconscious freezing. In considering two mathematics textbooks to see whether they encourage the phenomenon of freezing, Mordant observes that mathematics textbooks are generally presented as previously symmetrized in that the authors of such textbooks are already attuned to mathematics for its own sake and hence do nothing to address the asymmetry experienced by students.

The work of the Chilean psychoanalyst, Ignacio Matte Blanco, *The unconscious as infinite sets* is again applied in Skelton (1993). Skelton, a lecturer of mathematical logic and the foundations of mathematics, writes of his disbelief when he saw two worlds that he thought were separate and far apart, namely mathematics and psychoanalysis: “it seemed ‘natural’ to keep them apart, in case the emotional life would be spoiled by contact with ‘cold’ logic and the logical world contaminated by emotion” (p. 39). Skelton notes that in psychoanalysis, we excavate the past to see what is causing current anxieties, that we not only go back but we *relive* the past (*original emphasis*), reiterating Klein’s belief that our unconscious phantasies are at work in the day as well as in the night. Remarking on the overlap between psychoanalysis and scientific discovery, he advances the thesis that mathematics, like music, comes from a deeper layer of the psyche, at the pre-linguistic level. I am reminded of an episode of the CBC Ideas Program where the composer, Philip Glass, spoke about a conversation with the famed sitarist, Ravi Shankar. Shankar always kept a picture of his *Guru* (teacher) beside him, and Glass had asked the question: Where does the music come from? Shankar replied: By the grace of my *Guru*. I note the ‘by’ and not the ‘from’ that I was expecting.

Skelton goes on to describe the work of Wilfred Bion, a follower of Kleinian psychoanalysis, and the model theory of Alfred Tarski. According to Bion, when we “inhabit” a problem, we experience the problem “emotionally as something damaged inside us”. We live with “the pieces of the problem that have split off into bits” (p. 42), the separateness of which haunts us. Bion sees this scenario of the scientist working on a problem as similar to that of the analysand working with the analyst to unite the pieces of self that feel split off and separate, both the scientist and the analysand searching for that ‘selected fact’ which will effect this unity. Skelton cautions that “no situation or integration is ever final; at best, each resembles an uneasy truce” (p. 42). Again, there is the notion of the incoherence and tension, the sense of balance and resolution, with unity being a fantasy.

The complex inner emotional experience of school children as they negotiate difficult situations that make them anxious and hence withdraw, leaving them unable to make the requisite transformations in their learning, is explored by Nicodemus (1993), in ‘Transformations’. Using videos of classroom interactions made for prospective teachers and showing examples of teaching topics such as division, shapes, and symmetries, Nicodemus examines the various feelings that arise for children, such as vulnerability, lack of confidence, disorientation, and loss of boundaries (in mediating between self and other), and argues for thinking about the human relationships and the possibilities for places that help students “shape a metaphor for the significance of the story unfolding” (p. 27).

Psychoanalytic notions in general are highlighted in Sutherland (1993), in ‘Consciousness of the Unknown’ (a nice play on the usual take of the unconscious as unknown), where Sutherland declares at the outset that while she has always been attracted to psychoanalytic discussions of the unconscious and the unknown, she has avoided until then writing about emotional side of mathematics in students’ development. She makes the leap in this paper because she has not been able to “get to grips with theoretical explanations for what [she] observe[s] about students when [she] work[s] in the classroom” (p. 43). Referencing Lacan, she takes the view of the unconscious as a kind of unknown knowledge (thereby rendering null the argument that knowledge can be absolute), maintaining that ignorance is not an innocent term as “it is an active dynamic of negation, an active refusal of information” (Lacan cited in Felman, 1987, p. 79).

Sutherland promotes the view of teaching as confronting the resistance to knowledge. Her final paragraph is rueful as she writes of small victories gained in helping students come to terms with symbolic representations and knowledge by the use of spreadsheet activities, but the realization is that the reality of mathematics in the classroom is more often that of textbook exercises and examinations.

Finally, in 'Victoire sur les Maths', Tahta (1993b) keeps the title of the "psycho-pedagogical" book by of Lusiane Weyl-Kailey (he notes the similarity of the two names in the surname to the names of famous mathematicians) and shows that our relationships in life are inextricably tied to our relationships with number. Moreover, it goes both ways: we have to resolve the one in order to resolve the other. In particular, children's difficulties with number bear directly on the difficulties in their relationships in their lives. The refusal to countenance numbers that painfully and elementally bear memories of loss and the hold that language has on us is shown in Pimm (1993), 'The Silence of the Body'. Hence numbers are not simply signifieds, but signifiers that are susceptible to slippage and that may not be "quilted" as in Lacan's *points de capiton*. Another possibility is that for the child, number is taking the place of the Name in Lacan's Name-of-the-Father metaphor of the Law being installed, leading to Number-of-the-Father with similar consequence.

This issue on Psychodynamics was an important milestone in mathematics education research as it sought to uncover and disentangle threads relating to feelings and emotions around mathematics, and to identify and theorize the subject's experience in her encounter with it. This issue further bore witness to the importance of the unconscious in all our dealings with mathematics. While the ideas in the issue have not been taken up by the wider mathematics education community (present emotion/affect studies bear little reference to these ideas), they usher in the next wave in the turn to the psychoanalytic.

Recent wave (1994-2007): The turn to the psychoanalytic

As the research pursues the ramifications of the ideas on the cusp described above, it now takes a major turn to psychoanalysis proper, the principal theorists invoked being Lacan and Jung. Jungian theory continues to be applied by Christopher Breen

(2000; 2004) as he sharpens our awareness of the relationships in the mathematics classroom as they relate to fear. Using “scripts” in the mathematics classroom, Breen likens being in the mathematics classroom to being “in the serpents [*sic*] den”. I have not been able to find another instance of Jungian theory being taken up in mathematics education research. The choice of theory and theorist depends on many things, not least of which is inclination. My own choice of theory and theorist will be taken up in a later piece in the dissertation.

Lacanian theory now takes on a more pronounced role for some researchers. Tahta (1993a, p. 2) in his Editorial to the FLM Psychodynamics issue was prescient: “Another analyst whose work seems relevant to mathematics education is Jaques [*sic*] Lacan.” I begin with the work of Roberto Baldino and Tânia Cabral, a pair of Brazilian mathematics education researchers who are ardent proponents of Lacanian theory. Their many papers include Baldino and Cabral (1998; 1999; 2005), Cabral (2004), and Cabral and Baldino (2002). Using insights from Hegel (on whom Lacan also drew) and Žižek (a leading interpreter of Lacan), Baldino and Cabral illuminate the situation of the classroom using Lacan’s four discourses²¹, in showing how school, and in particular the mathematics classroom, may be considered as more of a learning experience and less of a credit system (Baldino and Cabral, 1998;1999). In Cabral and Baldino (2002), they again engage the ideas of Lacanian psychoanalysis to discuss pedagogical transfer and affect. Cabral (2004) continues with the concept of pedagogical transference and makes a direct call to the field of mathematics education research to “look toward psychoanalytic theory, not only for explanations about learning, but for understanding many of its other processes” (p. 157). In examining situations of what is termed ‘psychological no-growth’ in the classroom, Baldino and Cabral (2005) use Žižek extensively to illustrate the notions of ‘disavowal’, ‘castration’ and ‘fetishism’ as related to the mathematics classroom. Unfortunately these Lacanian notions are presented with little of the background that is required for understanding these allusions. This is most likely due to the constraints of the page length required for conference papers, but the

²¹ The discourse of the master, the university, the analyst (which Baldino and Cabral call the object’s discourse), and the hysteric.

resulting effect is that of leaving the reader with little appreciation for the concepts and their connections to mathematics education.

A second application of Lacanian theory (as interpreted by Žižek) in addressing the notion of human identity is given by Brown and England (2004) in conducting 'emancipatory' practitioner research (founded on the work of Habermas and seeing the teacher "as an agent of change for the better"). Using Žižek's four conceptualizations of the human subject according to Habermas, Foucault, Althusser, and Lacan, they argue that Lacan's formulation gives a way of seeing the identity of the teacher/researcher as "more fluid" (p. 68). Seeing the subject as shaped by and as a function of the social relations that circumscribe a community, Brown and England use the Lacanian notion of '*point de capiton*' to indicate the point of anchorage where an individual finds a place in the community. However, there is the realization that these social relations are never complete; they always miss something, leaving a gap, creating desire, and shaping conceptions of self that are never stable or fixed. This notion of desire as being borne out of lack is the one I take up as I develop the construct of desire in the next chapter on theory.

Brown (2005) again turns to Lacanian theory in exploring his dissatisfaction with cognitive and constructivist psychology as a means of addressing the unexpected reactions of his teacher candidates as they seek to form professional identities: "Where, on entry to the course, there had been pride and excitement at becoming a teacher, I found cynicism, disappointment and a lack of intra-psychic harmony" (p. 39). Using the writing of Blanchard-Laville and her interviewees as well as a personal experience, Brown uncovers and dissects the discomfort and disturbance that is mathematics teaching. Brown (p. 39) asks in the language of Lacan: "Is it possible that its generalisability and symbolism invests mathematics, more than other subjects, with the power to form metonymic signifiers that permit unconscious psychological processes to be signified by and through the mathematics itself?" This crucial relationship among language, mathematics (as both a discipline and a language), and the unconscious will be taken up in the next chapter on theoretical considerations.

Baldino and Cabral (2006) continue with references to Lacanian theory and the philosophy of Hegel and now address directly the notion of desire, in particular the

teacher's desire in the mathematics classroom. In confronting the issue of inclusion and diversity, they ask how it is that despite decades of research in mathematics education on various fronts, we are still dealing with problems of inclusion, diversity, and no-change within change. They note the complaints about the failure of mathematics education research to effect significant change in alleviating problems such as social exclusion and maintenance of class divisions, resulting in the widening of the social gap. For Baldino and Cabral, mathematics teaching is haunted by the phantom of repeated failure. They see the obsessive demand of better mathematics teaching for all as that of a hysteric, noting that the obsessive teacher takes pleasure in the gaze of repeated failures as it enables her to avoid other issues such as race, which leads to diversity backlash. They get to the heart of the matter, namely desire, when they write:

[A] new question must be asked and its answer should be rigorously looked for in the same field of language in which it emerges: as mathematics educators, what do we want? ... If [we] take the question as pointing to that deep inside of ourselves where we repeatedly avoid recognizing what we really do when we pretend to behave innocently just trying to teach mathematics (better, to all, etc.), then the dimension of desire emerges. (p. 32)

Mindful of Hegel's thesis that philosophy is not about solving the problem, but of posing a new problem so that answers can be found in the spaces that have been opened up, and also noting that psychoanalysis is an unlikely theoretical ground for mathematics education researchers, Baldino and Cabral suggest that the field needs a theory that addresses the notion of subjectivity and the autonomy of the 'I' of the researcher.

Psychoanalytic theory, in particular, and contemporary theory in general, underpin the edited volume, *Mathematics education within the postmodern* (Walshaw, 2004a). The theories and frameworks employed are those of the postmodern thinkers: Derrida, Deleuze, Foucault, Lacan, and Lyotard. Noting that the field of mathematics education research is ever-changing as it adopts new purposes, contents, methods and theories, Walshaw writes of the adoption of psychoanalytic theory: "Psychoanalysis presents complex and well-developed theories of subjectivity. Arguably, psychoanalysis has many shortcomings, yet it does provide us with the most promising theories of how the subject is at once fictional and real" (2004, p. 127). Walshaw demonstrates an example of self-construction and subjectivity using in part Lacan's three psychic

registers of the Imaginary, the Symbolic and the Real, and Foucault's notions of power and surveillance. A Lacanian perspective is also employed by Cabral (2004) in exploring affect and cognition in pedagogical transference and casting the "mathematical 'nonsense' produced by the student" as the object of the teacher's desire" (p. 141).

Finally, as mathematics education researchers wrestle with the notions of the self, the 'I', the subject ("who we are when we ..." or "who are we when we ..."), there is an important strand in the research relating to notions of identity. These notions are taken up in contexts that represent a move away from psychoanalysis, but they are included here because identity is an important related strand with respect to one aspect of my phenomenon of interest, namely, subjectivity. Roth *et al.* (2004) present a view of identity from a cultural historical activity theory perspective that focuses on the activity system of the individual's tools, objects, and community structures "that both enable and constrain human agency" (p. 50). For Roth *et al.*, identity is "a stable characteristic of individuals, but a contingent achievement of situated activity" (p. 48); identity then becomes a question of agency and of who is the agent. Sfard and Prusak (2005), in seeking to operationalize the notion of identity, propose that the distinction between *actual identity* and *designated identity (original emphasis)* is one of narrative, as stories told about and endorsed by the learner, while Mendick (2005) analyzes the effect of popular cultural images and representations of mathematics and perpetuations of mathematical myths as a factor in the making of young people's mathematical identities. Lastly, the relation between emotion and discursive positioning in school mathematics practices is taken up by Evans *et al.* (2006).

These various strands continue to be pursued in mathematics education research, but they now lead into the present wave where the focus is on subjectivity.

Present wave (2008-): The focus on subjectivity

While there have been hints and early indications in the above literature, there is from 2008 a clear move from the psychoanalytic in general towards the particular notions of the subject and subjectivity. It is as if in peeling back the layers, in pushing

the research to its edge, researchers have come to that which they sought in the first place, namely, knowledge of the subject and subjectivity.

Tony Brown²² (2008a; 2008b; 2008c, 2008d, 2010; 2011; 2012) has been a major mover in the endeavour. While Brown has used Lacanian theory in previous papers as shown above, his paper, Lacan, subjectivity and the task of mathematics education research (2008a), is his first volley in the literature with a focus on subjectivity. Brown begins by surveying the reliance of mathematics education researchers on theories of Piaget and Vygotsky (Vygotsky enjoying greater prominence), but finds them wanting. Brown recalls that cognitive psychology was the theory of choice for mathematics education researchers forty years ago, the field being dominated by mathematicians and psychologists who saw the learning of mathematics as a phenomenon of individual cognition. This reliance has been formally abandoned in an official motion of the major body of mathematics education researchers, the International Group for the Psychology of Mathematics Education (IGPME), but the name has been kept on for sentiment by older researchers (long overdue for a paradigm shift; however, Kuhn (1962/1996) points out that a new paradigm comes into dominance not because there has been a dawning of light and a conversion of sorts, but because the adherents to the old die out in a process of attrition). Brown further notes that a growing number of mathematics education researchers have been drawn to Peirce's semiotic theory (as seen, in particular, in a 2006 Special Issue of *Educational Studies in Mathematics*) but he argues that Peirce's notion of subjectivity is of limited relevance to mathematics education because of Peirce's conception of the individual according to Radford (2006, p. 47):

The individual remains an abstract construct and his subjectivity takes shape in reaction to the non-ego. Man for Peirce is a natural entity carried out, as Nature itself, by the laws of evolution. Man is not a cultural historical product and neither is his knowledge of the world.

Hence, according to Brown, using Peirce's theory "in its neat state, as it were, produces overly restrictive conceptions of students, teachers and of mathematics" (Brown, 2008a, p. 228). Brown demonstrates how Lacan's conception of subjectivity transcends both

²² of Manchester Metropolitan University. There are two Tony Browns; they both have had Dick Tahta as doctoral supervisor.

those of Piaget and Vygotsky and supplements that of Pierce, leading to a more sophisticated notion that moves us away from stultified perceptions of the “objects” of mathematics education discourses (namely, teachers, students, mathematics, etc.) and into focusing on contemporary social theory and broader social policy domains.

In *The psychology of mathematics education: The psychoanalytic displacement*, Brown (2008b) edits an entire volume dedicated to the psychoanalytic turn. Noting that resistance and desire are at the heart of the teaching and learning process, Brown argues that a “[p]schoanalytic theory is the only theoretical perspective that engages directly with the affective-cognitive dynamic of learning, recognizing that it is shaped by our passions and the ways in which we defend against the disturbances we experience in our relations with other individuals and groups” (2008b, p. 23). [This view is contested by Roth (2012) in a response to a later book by Brown and will be considered later in this chapter.] Several prominent mathematics education researchers are featured in the volume showcasing various theorists: I present below a few examples.

The work of Bion, Foulkes, Benjamin, and other group psychoanalytic theorists is used by Bibby (2008) in advocating a move beyond Vygotsky and the privileging of social aspects with the unclear zone of proximal development. Bibby notes that much of the desire, isolation and feelings of loneliness, and the search for intimacy and trust have to be continually negotiated, “contested, and struggled over” (p. 58). The ideas of Bion (the challenge of the group to the individual and to the group itself) and Winnicott (transitional objects and potential spaces) are used by Brown (2008d) in describing and characterizing the transition of student teacher to teacher. A Lacanian perspective is used in the papers by Margaret Walshaw and Tania Cabral to investigate aspects of classroom practice. Walshaw considers constructivist and sociocultural formulations of knowing and presents a learning theory that ‘straddl[es] the ground between Foucault and Lacan’ (p. 121) in order to examine the relation between power and the unconscious. Lacan’s three psychic registers (the Symbolic, the Imaginary, and the Real) are employed in showing ‘learning as a psychic event’ (p. 136), in her analysis of the engagement of a Year 12 student (in New Zealand) with her mathematics work and her mathematics teacher. Cabral, working in Brazil, elaborates the affective domain as portrayed in mathematics education and makes a case for psychoanalytic theory in understanding the learning process. Drawing on an examination of ‘integrated sessions’

(weekly meetings where teachers, students in teacher education programs (graduate and undergraduate), and mathematics teachers in the school district), Cabral develops the concept of 'pedagogical transference' (p. 156), extending Lacan's notion of transference.

A second example is the application of aspects of Lacanian psychoanalysis in Baldino and Cabral (2008) in considering love and mathematics anxiety. Baldino and Cabral present an alternative pedagogy, solidarity assimilation groups (SAGs), to current traditional teaching (CTT) where students in groups present their findings to their peers, essentially occupying the position of the subject supposed to know instead of the one whose object of desire is the teacher's knowledge. Lacanian (and Foucauldian) notions are invoked by Walshaw (2008) in her analysis of identity-making in one student teacher. Wilson (2008) employs Lacan's notion of transference in teaching as he explores a psychoanalytic view of the didactic contract, with further interrogation in an interaction with Tahta. Finally, Breen (2008) has the last word in the volume as he urges for a psychoanalytically informed research in mathematics education. For me, these all represent avenues to the understanding of the subject and her engagement with mathematics and again underline the necessity of working with a theorist with whom one is inclined in order to generate any result. I will return to this when I discuss my choice of theorist in the next chapter.

The most recent dialogue concerning subjectivity is being played out in the journal, *Educational Studies in Mathematics*, precipitated by Brown's (2011), *Mathematics education and subjectivity: Cultures and cultural renewal*. Here Brown signals his extension from Lacan to the philosophy of Badiou regarding mathematical truth and knowledge. Brown (2012), Radford (2006), and Roth (2012) continue a critical conversation on meaning, contextual objectivity, and subjectivity.

Beside this strand on subjectivity, the parallel strand on identity continues in the edited volume, *Mathematical relationships in education: identities and participation* (Black, Mendick, and Solomon, 2009). In a similar project, 'Mathematical images and identities', Epstein, Mendick and Moreau (2010) attend to the resources for identity-making as mathematicians (or not) in popular representations of mathematics in films, novels, and print and other media, exploring the ways young people embrace

mathematics or distance themselves from it. There is a further teasing out of the casting of identities as ‘abject’, ‘privileged’ or ‘defended’ (Mendick, Epstein, and Moreau, 2008; Mendick and Francis, 2012; Solomon, Lawson, and Croft, 2011), and an exploration of stories of choice or resistance relating to mathematics among undergraduates (Rodd, Mujtaba, and Reiss, 2010; Rodd, 2011). It is interesting to see that Mendick and Francis, in their conclusion, agree with one of their reviewers that “a stronger psycho-social analysis would be useful here to address not just who is treated in what ways and by whom but *why*” (p. 22, *original emphasis*).

Now that I have arrived at the existing research, it is now time to situate my analysis. Like all intellectual endeavour, the field of mathematics education research is enriched by cross-fertilization, drawing from many disciplines such as philosophy, psychology, and linguistics for theories and methods, a feature that is both a strength and a weakness. I am aware that there are other literatures surrounding other theorists who have their own takes on the concepts relating to my phenomenon of interest, namely, the subject, subjectivity, and desire. In the remainder of this chapter and in the next dealing with theoretical considerations, I justify my use of a psychoanalytic-informed approach in my study.

Situating my analysis

Natural considerations for framing an inquiry rest on ideologies, trends, and dispositions, indeed, on worldviews, both literally and figuratively. It is my contention that human relationships with the discipline of mathematics are primarily a function of the subject and that the keys to understanding the relationship and the engagement or lack thereof lie in a psychoanalytically-informed approach. The person confronting the mathematics is not only a bundle of cognition responding to mathematical tasks, but a human being, a product of a social determination, who finds herself in a situation, a time, and an environment that calls for and calls forth responses that are not merely of the conscious and the cognitive. This contention is supported by three quotations from the literature that resonate with me. The first is from Sherry Turkle (1976, p. 247) on Lacan and mathematics:

For Lacan, mathematics is not disembodied knowledge. It is constantly in touch with its roots in the unconscious. This contact has two consequences: first, that mathematical creativity draws on the unconscious, and second, that, mathematics repays its debt by giving us a window back to the unconscious.

Lacan increasingly used the symbols, objects, and theory of mathematics in order to express his ideas, in particular, topology, the theory of knots and string, vectors, signs²³, fractions, mathemes, formulae, diagrams, and schema. He sought in mathematics to capture his ideas in ways that carried a different force and focus than words or signifiers.

The second is from Dick Tahta (1993b, p. 48), on the book, *Victoire sur les maths* by Lusiane Weyl-Kailey:

I have been very moved by this book, and I hope it will be widely read and discussed. It reminded me that mathematics stems from the unconscious, and that it could be healing, in the sense that it may assist the symbolic resolution of certain emotional conflicts. The Symbolic need not always be destructive – it can be conquered, and in doing so you may be able to conquer bits of yourself.

And the third is quoted above from Brown (2005, p. 39) in his work with student teachers:

Is it possible that its generalisability and symbolism invests mathematics, more than other subjects, with the power to form metonymic signifiers that permit unconscious psychological processes to be signified by and through the mathematics itself?

Each of these three speaks to essential aspects of the phenomenon that I am studying; they ground the work I am doing in this dissertation. The first one speaks to the roots of mathematics in the unconscious, and indicates that to engage with mathematics is to engage with one's very self, underlining the notion that to find mathematics is to find one's self, oneself. The second speaks to the nature of mathematics and the aspect of language in which it is rendered which often makes us unable to see the mathematics

²³ Lacan, in his Seminar on Anxiety (1963/2004, p. 77), distinguished between a sign and signifier as follows: "[The] sign is what represents something for someone, but the signifier represents a subject for another signifier."

behind the language, and the third wonders about the form of the connection between mathematics and the unconscious. In trying to tease apart the elements relating to engagement with mathematics, I seek a theory that acknowledges the unconscious, the 'I' and the forces that shape subjectivity, in particular with respect to language. While I considered the usual mathematics education theories of Piaget and Vygotsky, phenomenology, hermeneutics, and embodied cognition, none of them resonated with my conviction relating to the approach that I needed. Whenever I encountered references to psychoanalysis and Lacan in the literature, they appeared interesting, but I looked on them from afar, in a head-nodding kind of way, yes, it is alright, but is it at all helpful? I had no training or inclination for matters psychological or psychoanalytic. The notions of subject and subjectivity seemed theoretical (I had not yet come upon the notion of desire as mover), but as I read (or attempted to read) Lacan and realized the ground of his work and what he was attempting to delineate and illuminate despite the all-too-real complexity and the seeming obtuseness, I knew that his was the theory that I was seeking to give structure and light on the nature of human engagement with mathematics.

In the next chapter, I provide the theoretical considerations for the notions of subjectivity, the subject, and the pivotal notion of this dissertation, desire as they relate to mathematics and its discourse. While mathematics as a cultural body of knowledge may be seen as no more unique than art or knitting, it has been and continues to be a powerful interpellative force for some and a source of anxiety and resistance for many. It is this quality about mathematics, what is in mathematics more than mathematics, that interests me and towards which I am drawn in undertaking this study.

Whence and whereof I speak (2)

In December, 2012, I had the privilege of attending a lecture by the Mexican psychoanalyst, Dr. Benjamin Mayer-Foulkes put on by the Lacan Salon of Vancouver. These are some of the notes I jotted down of what he said:

Psychoanalysis has to do with naming and then what follows after that name.

Q: How can you name something that resists signification? A: The proper name is the knife that can cut the chicken in the right place. BM-F tells a story about cutting chickens. If the knife is sharp, you can cut the chicken in the wrong place, but with a blunt knife you can only cut the chicken in the right place.

One does not choose one's own name. The proper name is the whole legacy of the signifiers that are used. The name that does not work is not the proper name for you, e.g., if you were given the name of a dead sibling, then who are you? The parent who looks on you with a gaze that distinguishes you, what about you. Mexican children receive their parents' names. Then who am I?

My necessary name singularizes me.

My name is Veda; indeed, my name is Vedawati. Veda is a Sanskrit word meaning knowledge, and *wati* is a suffix meaning having the essence of. So Vedawati means having the essence of knowledge. The root word is *vid* meaning knowing, with variations such as Ved, Vidia, Vidya, and Vidyarthi. My name was given to me by my father (my father had little traditional schooling, but he was my first teacher and to this day I am guided by his example and his teachings). My name is, indeed, my life and it has been and continues to be a journey in learning and teaching about knowledge and knowing.

The first time I entered a classroom as a teacher, I was in high school in fifth form (about fifteen years old). I was in my class listening to my teacher when my principal

appeared in the doorway. She looked at my teacher and then beckoned to me. I glanced at my teacher; she nodded at me and I went out into the corridor. My principal said: "Mrs. F. has had bad news. Can you take her class?" I nodded and went to Mrs. F.'s second form class. Mrs. F. was weeping into her handkerchief and being helped from the room. I waited by the door and then went in. I asked where they were and they showed me their books. It was algebra and they were factoring trinomials. Nowadays this topic does not appear to be taught as a set of rules (I have students now in Calculus who still do not know how to factor trinomials), but I knew how it should go. I turned to the blackboard, and began. There was no fear or worry; it felt completely normal and everyday as I was already used to explaining similar things to my younger family members and friends.

Since then, I have taught mathematics and statistics in colleges and universities with two stints in high-school (my principal formally asked me to teach mathematics after my A-levels). With no formal teacher training, I simply stood up and taught, imitating what I had seen and learned from my teachers, my focus being on listening to and engaging with my students. In fact, I ventured into a Faculty of Education because I wanted to find out what theory underpinned what I had been doing by the seat of my pants for so many years.

I am on sure ground (undoubtedly due to the footing I had found at an early age) in the mathematics and statistics that I teach, having understood the content at that level thoroughly. I have no illusions about my ability as a teacher, knowing that I have made and continue to make my share of mistakes. Whenever I get too big-headed about my teaching, I recall one memorable incident. Early on in my career as a teacher, I was in front of a class of over two hundred engineering students in a big auditorium. There I was, striding back and forth, thinking I was putting forward the subject eloquently and doing a fabulous job, when one young man, straight ahead of me, put down his pen and looking right at me, said: I'm bored. That sobered me up instantly and still keeps me sober!

Once, I was buying a jacket in a store in a mall. The clerk asked my phone number and then my name came up. She said Veda and I said yes. You have a very powerful name, she said and I said yes. She said it means knowledge and knowing, and

I said yes. She asked, do you know how I know? She continued, I am from Russia and Russian shares deep roots with Sanskrit, it is the same word in Russian except it is a very old word. She said it referred to knowledge that is deep-seated and that it is not something you know from being taught.

My name is Veda. It is my 'right' name in that it names me.

My necessary name singularizes me.

Chapter 3:

Theoretical considerations

So far, I have introduced the research problematic of mapping the landscape of engagement with mathematics, and I have laid out the terrain of the relevant research literature with the beginnings of a justification for a psychoanalytically-informed approach. In this chapter, I provide the theoretical treatment of the notions and relationships that underpin this approach in exploring my phenomenon of interest.

There are two underlying positions from which I start in this work. First, I believe that there is more to the involvement in and the experience of the mathematical endeavour than “teachers”, “students”, “curriculum”, and “tasks”, and that there is more at stake than Piaget’s levels of development, Vygotsky’s sociocultural theory, and the many theories of cognition, discourse, and semiotics. Second, I believe that while these are layers and strands worthy of consideration and making up much of the mathematics education research enterprise, at a more urgent and fundamental level, the involvement turns on the person or the individual encountering the mathematics, that is, the crux or root of the matter rests with the subject who is confronting the mathematics. It is to be noted that the subject is always more than the individual; I will distinguish later the difference between ego (*moi*) and the I (*je*), in their various formations with respect to her unconscious (history and interaction with the discourse of the Other) and her desire (with respect to the Other).

Hence, my approach in this research will not be that of the standard classroom research with students and tasks and tools, nor will it be the study of curricula or pedagogies and their reception. In order to see what obtains in engagement with mathematics, I plan to study the subjects who have undertaken and have been taken by

such engagement²⁴. By means of a study of the experiences of mathematicians who have undertaken such engagement, I seek to describe the mathematical subject (the person that mathematics calls us to be in order to engage with it), and to theorize the driver of the engagement with the discipline in the subject, which, I argue, is desire. The mathematical subject²⁵ (similar to the speaking subject, the perceiving subject, or the cognizing subject) denotes the person or the individual, the 'I' who engages with the mathematics with which it is confronted. My purpose is to describe who we (as humans) are when we encounter or engage with mathematics and to describe how the subject is constituted. What are the various subject positions (attitudes, ideals, values, beliefs) that are involved in taking up and doing mathematics? What are the demands and costs to the subject of such engagement? What are the rewards? What does mathematics bestow? Further, I contend that the primal and primordial impetus for the subject to engage with mathematics is desire, and that such engagement and involvement is fuelled by desire in its various manifestations and forms. Thus, I seek to explore the notion of desire as it relates to the subject and subjectivity in the mathematical endeavour.

To elucidate these notions of the subject, subjectivity and desire, I first explain why I have chosen to ground this study that I intend to overlay the mathematical accounts with in the theory of the psychoanalyst, Jacques Lacan. As desire is my primary construct, I then present the Lacanian notion of desire, sketching Lacan's account of the origin and nature of desire. This will entail some description of fundamental Lacanian terms. Next, I present Bracher's (1993) forms of desire based on Lacan's dictum that desire is desire of the Other. Finally, I consider a treatment of the mathematical subject as developed by Brian Rotman, a former mathematician now working in comparative literature, and I tie this to the development of the Lacanian subject.

²⁴ To do otherwise seems to me to be similar to that of a general waging a war and not studying and learning from the experiences of those on the battlefield.

²⁵ I recall that I am deliberately avoiding the term, the 'mathematizing subject' because of its connotations of problem solving and the factors that relate to problem solving.

Why Lacan?

Our reactions to and with mathematics, as a discipline, are fraught with emotions that run deep, marking our psyches and lives in myriad and mysterious ways. As I have argued above, an exploration of the phenomenon of engagement with mathematics must begin with the psychoanalytic as the essence of the interaction is the subject or the person who confronts the discipline. Such engagement or dis/non/un/engagement turns on the psychic notions of the subject, subjectivity, and desire. In order to substantiate these claims, I am guided by the psychoanalytic theory of Jacques Lacan (1901-1981).

A natural question is then, given the many modes of thought and theorists, why have I chosen Lacan as a point of reference? From the review of the literature above, there is a historical tradition inside mathematics education research of psychoanalytic theory. As well, Lacan turned to mathematics as a way to capture and convey his ideas and theories. For Lacan, the unconscious was structured like a language, but also like mathematics as well (Turkle 1978), as seen in his frequent use of mathemes (mathematical formalizations such as symbols, charts, signs, diagrams and schema). In appealing to topology, knots, and string theory, Lacan “was trying to ‘invent another geometry, a geometry of the ‘chain’” showing how in the knots, strings, and loops, “the twists and turns and intricacies of the little circles of string leads to a *choc de retour*, something like the return of the repressed” (Turkle 1978, p. 246).

As I have suggested in the last chapter, we (as researchers) respond in various ways, given our background, inclination, and temperament.²⁶ As with Lacan himself, there is no easy answer; it was a process that took time. I had seen references to Lacan in the literature as one of the leading postmodern thinkers and theorists. I had read of Alan Sokal’s hoax in 1996 and his book with Jean Bricmont (1998), *Fashionable nonsense: Postmodern intellectuals’ abuse of science*, where they ‘exposed’ the postmodern thinkers. Still, I realized as I stayed with the reading of and about Lacan, that Lacan, when working in and writing on his own ground, psychoanalysis, offered

²⁶ An analogy is the Hindu pantheon of gods. While there are many universal gods, each person has an *ishta deva*, a personal deity, one of the many gods, to whom he or she responds, by virtue of the deity’s attributes and qualities, and the person’s temperament and inclination.

much that was authentic and valuable concerning the human psyche. I was drawn to Lacan's work as a theoretical lens because, despite its complexity and difficulty, his ideas of the psyche and its mysteries resonated with me as evocative and significant. To my mind, he has given the most insightful and complete theory of the subject, subjectivity, and desire, which also encompasses the role of language and discourse in the psyche. While there are other thinkers and theories of these notions, I believe that Lacan, grappling with the human condition in his work with patients as a clinician and a practicing analyst, and expounding on his feet, thinking out loud and teasing out his ideas in his seminars over twenty-five years, provided meaningful and profound insights into aspects of the psyche and the subject. Lacan provided a rich array of conceptual tools in his model of subjectivity and its shifts by the intervention of discourse. Lacan is considered controversial in some circles, but he is revered for his work in psychoanalysis in others (more than half of the world's psychoanalysts are Lacanian).

In developing his theory, Lacan sought to 'reread'/rewrite/reformulate Freud. As Žižek (2006) writes, "Lacan enlisted a motley tribe of theories from the linguistics of Ferdinand de Saussure, through Claude Levi-Strauss's structural anthropology, up to mathematical set theory and philosophies of Plato, Kant, Hegel and Heidegger" (p. 4). In and with his 'return' to Freud, Lacan presents a theory of human development that excavates and elaborates the notions of the subject, subjectivity and desire. In his inimitable style, variously described as abstruse, dangerous, perverse, and unintelligible, Lacan has charted the space of the psyche, illuminating its intents and its vagaries.

There are several caveats with the use of Lacanian theory (many of these are pointed out by those who write about Lacan, but I realized these from my own experience of reading him and trying to gain an understanding of his work). The first is that Lacanian theory is of a piece; it is not possible to extract just one construct, say desire, and to consider it by itself. There are many concepts in the Lacan *oeuvre* that are, in general, inter-related and have to be expounded and come to terms with, all at the same time, in order to understand the construct at hand. So, I will try to give a linear account, despite being aware that the concepts have to be understood all at the same time. Second, Lacan continually refined his concepts to the extent over time as he worked them out, so that an assiduous reader of his work may argue Lacan *contre* Lacan, as it were. Third, there are many Lacanian perspectives of the same concept as

the interpretation of his concepts often depends on the adopter and expositor. Lacanians remind me of statisticians: from my experience as a statistician, if you put five statisticians in a room, six opinions will emerge. It is a similar thing at the Lacan Salon of Vancouver which I attend; Lacanians of long standing will put forth different views of fundamental concepts and make different pronouncements on what Lacan was about and what he intended in his various seminars and writings.

Recall that the centrepiece of my dissertation is the following declaration from Bracher (1993, p. 19): “Insofar as a cultural phenomenon succeeds in interpellating subjects—that is, in summoning them to assume a certain subjective (dis)position—it does so by evoking some form of desire or by promising satisfaction of some desire.” I read that sentence in the light of mathematics as a cultural phenomenon with its subjects being mathematicians. Hence, my purpose in this dissertation is to elaborate, using some of its cultural objects/artifacts (written and oral accounts of engagement with mathematics), how desire is an interpellating force invoked by the discipline in shaping its subjects. As desire is my primary and principal construct, I begin with an exposition of the Lacanian notion of desire and then develop the related notions of the subject and subjectivity.

Desire

Desire is an everyday word, but in this dissertation, I am using the word in a specific, technical sense as a philosophical and intellectual concept. Desire has been the object of attention from earliest times, in philosophy from Plato onwards, in various religious traditions, and in social and cultural theory. In the *Rig Veda* it is stated: “Desire links Being and Non-Being. Thought gives rise to desire” (quoted in Bailly, 2005, p.128). Lao-Tzu in the *Tao* declares: “Free from desire, you realize the mystery. Caught in desire, you see only the manifestations.” Notable among philosophers are Plato for whom the two horses of passion and reason guide the soul towards its objects of desire, and Hegel who, in *The phenomenology of spirit*, asserts that consciousness is desire. Freud posited dreams as the site of wish-fulfillment, the satisfaction of unconscious repressed desire, while the literary critic and Marxist theorist, Frederic Jameson (1977, p. 340) writes of the “logic of wish-fulfillment, *le désir*, as the organizing principle of all

human thought and action". Indeed, desire is at the heart of all personal, social and cultural change and is closely tied to destiny. It occupies and permeates our being, haunts and moves us as it baffles and inspires. It holds us in its grasp even as it eludes our grasp.

Desire according to Lacan

Lacan, in writing of desire, explores its crevices and expanses, and uncovers its secrets and its guises. Lacan addressed desire in many writings, but he devoted a whole year to desire; his Seminar VI 1958-1959 was 'Desire and its interpretation'. For Lacan, desire begins from a sense of lack, insisting that we, as human beings, are born too soon, unable to move, with no dentition, helpless and dependent on the one who (m)others us. From the very beginning of our development as subjects in the mirror stage, our psychical economy is particularly structured and determined. For the child, in the mirror stage from about six to eighteen months, on encountering the 'other' in a reflection of itself as a specular image, there is the dawning of a sense of self, of the foundation of ego and a sense of 'me'. There is also a separation or schism as the child identifies with something that is separate from it, marking the beginning of alienation and separation. When a child encounters another child, there is a *méconnaissance* or misrecognition, a sense of seeing the other as coherent, complete, and whole in opposition to the sense of itself as fragmented. Lacan distinguishes between the small 'o' 'other' and the big 'O' 'Other'²⁷ in his three registers, the Imaginary, the Symbolic, and the Real, in which all experience is conducted. The small other comprises the Imaginary others, the ones whom we see as complete and coherent, the ones whom we see as a reflection of ourselves. The big 'O' Other can be seen as the Symbolic order orchestrated by language into which the child is born and into which it must insert itself if it is to become a subject. There is lack in the Other as language cannot express or capture all; it cannot provide ultimate meaning. In the subject, there is a lack also, a sense of loss, alienation, separation, and, in consequence, a splitting. Thus, Lacan describes the subject as the barred subject, \$, divided and decentred: "[A]lienation, for

²⁷ These are rendered in French as *autre* (a) and *Autre* (A). This 'a' is not the *objet petit a/objet a* which I will come to shortly.

Lacan, is unavoidable and untranscendable” (Homer, 2005, p. 71). Separation, distinct from alienation, marks the beginning of the differentiation of the subject from others and the Other, and, indeed, marks the beginning of desire.

Before I go on, I must sketch in some understanding of Lacan’s three registers and his notion of the Other. For the registers, Lacan formulates three orders/levels against which human existence can be understood and among which all human activity is carried out: the Imaginary, the Symbolic, and the Real²⁸. These function interdependently as they work to form the perception and experience of the subject. The Imaginary is the realm of “images, conscious or unconscious, perceived or imagined” (Lacan, 1973/1981, p. 279), of the people and objects in the world present to us. The Symbolic derives from and is derived from the “laws” of the wider world in its structure and organization. It disturbs the shaping or the interpellating²⁹ (Latin: *inter/between*, *pellere/to drive*) of the subject and is enabled by language because language gives us the structures for the signifiers for the “I” and the Other, for loss, lack, and absence, for the mis-identification of the self with the Other. We are “halted” or interpellated by language, by the Symbolic big ‘O’ Other. Lacan writes:

[T]he human order is characterized by the fact that the symbolic function intervenes at every moment and at every state of existence ... In order to conceive of what happens in the domain proper to the human order, we must start with the idea that this order constitutes a totality. In the symbolic order the totality is called a universe ... As soon as the symbol arrives, there is a universe.” (Lacan, 1978/1991, p. 29)

We live in the Imaginary, but we have to insert ourselves in the Symbolic as we learn to fit into its code which was in place before us and goes on or continues without/ in spite of us. Since the Symbolic has to do with the meaning that we (and others) make of our lives, and since meaning is always elusive, no matter how we try to tie it down with

²⁸ As above, there are caveats: 1) Lacan’s registers do not line up neatly with Freud’s categorization of the ego, the id, and the superego, 2) there are various renditions and reformulations of these three as the theory evolves over time by Lacan and his followers, and 3) the order in which the three registers are listed varies among those who take up Lacan’s work.

²⁹ This word is most often attributed to Althusser and his interpellation of subjects by a political ideology.

definitions and other attempts at closure, there is always a lack or void. The Real is the unmarked backdrop or background against which the Imaginary (image-based) and the Symbolic (word-based) come into play, the screen on which images and words unfold and move. Levine (2008, p. xvii) describes the Real as “[t]his blankness of the page, like that of the body and world prior to the mappings and markings of language”. Lacan saw these three orders interlinked as a Borromean knot (three circles linked so that if one is cut, then the other two fall apart). These knots occupied him to such an extent that his later seminars always included careful drawings of knots (Turkle 1978, p. 235). However, as Levine (2008) notes, the letters R, S, I when taken together and pronounced in French sound similar to the word *hérésie* which is “a typical Lacanian example of asserting that these three orders completely cover the whole truth of human experience” (p. xvi).

When I first encountered the three Registers, I saw the Imaginary and the Symbolic as two ‘squarish’ circles ‘side’ by ‘side’ with one ‘side’ in common, and surrounding them as in a Venn diagram, the Real. I saw The Real as both outside and inside as it were, as the Symbolic seemed to me to be a torus containing the ‘hole’ (lack or void) of the Real, the Real intruding into the Symbolic as when momentous horrific events happen that discombobulate us, such as the earthquake in Haiti. I saw The Subject as being played out or in the throes of constitution in the interface between the Imaginary and the Symbolic, against the foreground and the background of the Real. I have since moved on in my thinking in appreciating that the relationships cannot be captured so cleanly, and especially as I have read Žižek (2001, p. 82) who maintains that each Register contains all three Registers, leading to three by three or nine registers!³⁰ The Real of Lacan is that which is not symbolized. According to Žižek (2012, p. 381), the Lacanian Real is

opaque, inaccessible, out of reach, *and* undeniable, impossible to by-pass or remove—in it, lack and surplus coincide ... [I]t is always already

³⁰ “[W]e have the ‘real Real’ (the horrifying Thing, the primordial object ...), the ‘symbolic Real’ (the signifier reduced to a senseless formula, like the quantum physics formulae which can no longer be translated back into – or related to – the everyday experience of our life-world), AND the ‘imaginary Real’ (the mysterious *je ne sais quoi*, the unfathomable ‘something’ that introduces a self-division into an ordinary object, so that the sublime dimension shines through it)”.

lost, left behind, mediated, and so on, and yet simultaneously something we can never get rid of, something which forever insists, continues to haunt us. (*original emphasis*)

The Real has a dual nature, both as full and as being a hole, presence and absence. The Real is a place of no lack as well as a place of lack. It is both outside the Symbolic and it tears a hole and a gap in the Symbolic, around which the Symbolic is structured.

The concept of the Other is used in philosophy, phenomenology, and various areas of critical theory such as film studies and post-colonial studies, to indicate that which is not the 'self' and which is different from the self. The Other stands as a pole in opposition to the self/subject/individual. By the big Other, Lacan indicates the Symbolic order which stands for the laws and the wider code by which the subject is formed (other people are indicated by the (small) other in the Imaginary order). The subject is not under her own control, but is 'spoken' by the Symbolic order. Hence Lacan refers to the unconscious as the 'discourse of the Other'. This concept of the Other proved to be a big stumbling block as I began this work. First, my peers smiled (with some eye-rolling) at the mention of the (big) Other, and second the Other was conceived as an actual person. For the first, I sought clarification from Lacanians, but they could not see what the difficulty was in that it was a given for them. It was difficult for me to navigate two worlds; on the one side, those for whom this concept was elemental and on the other, those for whom the concept appeared risible. I was taken aback that a concept with such pedigree (Husserl, Levinas, Said, and Sartre, to name a few) could be so little appreciated in some circles. For the second, I pointed out that the Symbolic order is animated by those who embody the code such as parents and judges, and closer to the field of mathematics education, teachers and mathematicians. I will connect this more closely to the discipline of mathematics and the community of mathematicians as I go on, but the important thing is that the big Other is not psychological, not of the subject's experience, but that it is "purely *virtual*, as an ideal structure of reference; that is, it exists only as the subject's presupposition" (Žižek, 2012, p. 185).

To return to the exposition of desire according to Lacan, desire is to be distinguished from need or demand. Examples of need are hunger and thirst in that they can be satisfied. Greater than need is the subject's demand in its dawning recognition

and search of self in relation to others and the Symbolic order. In Lacanian arithmetic, when need is subtracted from demand, what remains is desire; “it is this irreducible ‘beyond’ of the demand that constitutes desire” (Homer, 2005, p. 77).

Desire, created and expressed through language, is borne out of the desire of Imaginary others and the symbolic Order/Other and out of the lack in the subject and in the Other. The subject seeks to find its place in the Other’s desire and to differentiate itself and its desire from the Other’s desire. While the subject cannot realize the Other’s desire (there is something always unattainable or exceeding in the Other’s desire), there is something in the subject that remains, the remainder, the *objet petit a*, the object-cause of desire that makes the subject a desiring subject (what is in you more than you, according to Žižek). Lacan provides an elaborate graph of desire³¹ built up in successive stages, culminating in the ‘*che vuoi?*’ (in Italian, What do You (meaning the Other) want, what is it that the Other is asking of the subject?). In regard to mathematics and mathematicians, what is in mathematics more than mathematics, what is mathematics asking of us, what is it asking us to do or to be? For Lacan, the subject is constituted by the Other and hence his dictum: Desire is desire of the Other.³² Hence, the subject, constructed and borne out of the Symbolic Order, has no desire except for the Other’s desire.

To give some more grounding for these ideas, I address the following notions: The Other, the *objet (petit) a*, jouissance, and fantasy, and then continue with the discussion of desire.

The Other

Lacan distinguishes between the small other(s) and the big Other. The other people whom the individual encounters and interacts with are small others of the Imaginary order. The ego is also a small other, of the Imaginary from the Mirror Stage,

³¹ I have placed a discussion of this graph in the Appendix.

³² A minor point is that Lacan said, “[M]an’s desire is desire of the Other” but this is commonly rendered as “Desire is desire of the Other: “... man’s desire is the Other’s desire [*le désir de l’homme est le désir de l’Autre*] in which the *de* provides what grammarians call a “subjective determination”—namely, that it is *qua* Other that man desires (this is what provides the true scope of human passion).” (Lacan, 1966/2006, p. 690)

projected and reflected in the specular image, a mirror or other people beginning with the mutual gaze of the mother(er) and the infant. The big Other is of the Symbolic order; it is that “radical otherness” or “radical alterity” which is beyond the Imaginary. It is the wider social order, the law, the set of hypotheses, the code in which we have to insert ourselves in order to become subjects. It is also language and the world of signifiers. We become subjects by accessing language.

The big Other is both structural and virtual; it is any object/person/entity that stands in opposition to subjectivity, that creates or supports subjectivity. The big Other may be embodied by a person (the mother(er) is the first big Other for the child who faces the realization that the mother(er) has a desire beyond him or her) or an authority figure such as a judge, a teacher, or a mathematician. The big Other may also be an abstract concept such as Nature or Justice. It may take the “form of a charismatic political figure, government, society itself or God, ..., the supreme authority” (Bracher, 1993, 137).

The Other is omnipresent and pervasive in our lives; we are structured by it. The Other exists in each of the three registers: In the Imaginary order it is the small others, in the Symbolic it is the big Other, and in the Real, it is the *objet a*. So with respect to the discourse of mathematics, in the Imaginary, the Other are the other mathematicians, the community of mathematicians that gives life to the discipline. In the Symbolic, it is the discipline itself, whose rules and constraints to which we have to bend in order to engage with it. In the Real, again mathematics is the *objet a*, the object cause of our desire, what we pursue in mathematics, what is in mathematics more than mathematics.

The *objet (petit) a*

This term suggests an object, but there is no object of desire³³, simply an object-cause of desire, the *objet a*. The *objet a* is not an empirical, material object, but is the embodiment and the place-holder of lack. It is of the Real, that which resists all symbolization. It is what falls out in the formation of the subject, in the intersection of the Imaginary and the Symbolic. It is what is left over, what sticks out, the indissoluble

³³ You can't always get what you want/But if you try sometimes you find/You (just) might get what you need. Mick Jagger and the Rolling Stones, 1969.

remainder, or residue, what sticks to your shoe (“glued to the heel”). The *objet a* sits in the intersection of the rings in the Borromean knot of the three Registers, and is produced by the objects in the Imaginary, the structuring force of the signifiers in the Symbolic, and the drives of the Real. Examples of the *objet a* are the voice, and the gaze; we make our desire known to others by our gaze and the tone of our signifiers.

Hence, the subject’s desire in the Real is to regain that missing part of its being or through its own being to be the *objet a* for the Other. The *objet a* is then the ultimate object around which the drives circle and upon which fantasy is constructed.

Jouissance

Lemaire (1970/1977, p. xv) writes: “There is no real English equivalent for *jouissance*, which covers the fields, ‘pleasure’, ‘domination’, ‘possession’, ‘appropriation’, etc.” *Jouissance* has a sexual connotation, derived from the French verb, *jouir*, slang for the verb, to ‘come’. It is generally translated in English as enjoyment (underwhelming and inaccurate for some readers), but it is different from the French, *plaisir*, which is ruled by homeostasis, seeking balance. It is the beyond of Freud’s pleasure principle; it is painful pleasure, jittery excitation, suffering, renunciation. Žižek explains: “It is never fully achieved, always missed, but, simultaneously we never can get rid of it—every renunciation of enjoyment generates an enjoyment in renunciation, every obstacle to desire generates a desire for an obstacle and so on” (2012, p. 308). Žižek further explains that “*jouissance* is simultaneously something always already lost and something we cannot ever rid ourselves of. What Freud calls the compulsion to repeat is ground in this radically ambiguous status of the Real: what repeats itself is the Real itself, which, lost from the very beginning, persists in returning again and again” (2012, p. 381). *Jouissance* is not about satisfaction but, about the pleasurable feeling of never achieving one’s desire, of ‘coming close’.

With respect to the *jouissance* of the Other, the subject then must figure out what she has to do or who she has to be in order to be desired by the Other, what it is that the Other wants of her. The subject is therefore challenged by the enigma of the desire of the Other as well as the enigma of its own desire.

Fantasy

The role of fantasy is in structuring and staging desire, in creating and sustaining desire. Žižek³⁴ (1997/2008, p. 7) writes: “a fantasy constitutes our desire, provides its coordinates; that is, it literally ‘teaches us how to desire’”. Indeed, as Lacan says, fantasy is the support of desire. Žižek also points to the intersubjective nature of desire in that,

the desire ‘realized’ (staged) in fantasy is not the subject’s own, but is the *other’s* desire: fantasy, phantasmic formation is an answer to the enigma of ‘*Che vuoi?*’ – ‘You’re saying this, but *what do you really mean by saying it?*’ – which established the subject’s primordial, constitutive position. The original question of desire is not directly ‘What do I want?’ but ‘What do others want from me? What do they see in me? What am I to others?’ (p. 9, *original emphasis*)

The subject enmeshed in relations with her Imaginary others and the Symbolic Other has to fathom their “impenetrable” desire: “at its most fundamental, fantasy tells me what I am to my others” (1997/2008, p. 9). Further, Žižek argues that fantasy is “a screen for the desire of the Other”, in the sense that “desire structured through fantasy is a defence against the desire of the Other”, and that “*desire is itself a defence against desire*” (1989/2008, p. 133, *original emphasis*). Indeed, it turns out that, at some point, you need your fantasies to protect yourself.

Lacan’s matheme of fantasy is $\$ \diamond a$. The symbol, \diamond , is read “lozenge” and is made up of the logical connectives, \wedge and \vee , for ‘and’ and ‘or’. The subject can assume either the position of the active, desiring subject ($\$$) or the passive object (a) of the Other’s desire. The fantasy “stages the desire (\diamond) of the subject, $\$$, for the *plus-de-jouir* a , a surplus of jouissance over and above what the subject currently attains” (Bracher, 1993, p. 43). There is a similar matheme for drive, $\$ \diamond D$, where D indicates demand.

To resume the discussion of desire, desire is a property of language; it is only in speech that we can express, create, find, discern, suspect or get an inkling of our desire. The subject ‘speaks’, but is spoken by and revealed by language, the discourse of the

³⁴ If it seems that I am quoting Žižek too often in this theory chapter, it is that Žižek is the *über*-expositor of Lacan.

Other. The unconscious is the discourse of the Other, the treasure-trove of signifiers repressed in the unconscious, which emerge in ways such as dreams, jokes, and slips of the tongue (the “psychopathology of everyday life”), in one’s speech. Hence, there is a distinction between the subject of the enunciation (*l’enunciation*) and the subject of the statement (*l’énoncé*). We think we are conscious of and know what we say, but we rarely know why we say what we say.

Desire is many things: Lacan’s metaphor for desire is a ferret, furtive and elusive, slipping and sliding, popping in and out of view, subterranean and slippery. For Lacan, desire is more a condition than an affect; it “inscribes itself” into the subject, it structures the subject. Desire is to be distinguished from drive: desire is one, indivisible and undivided, but the drives (oral, phallic, scopic, etc.) are many. There is the subject of desire, but the object of the drive. Two explanations of the difference between desire and drive is a) the difference between the aim and the goal (the aim is the path to the goal; it is in the aim that *jouissance* is to be found (Žižek 1991, p. 3), and b) the difference given by Jacques-Alain Miller of a lack and a hole: “a lack is spatial, designating a void *within* a space, while a hole is more radical, it designates the point at which this spatial order itself breaks down (as in the ‘black hole’ in physics).” (Žižek 2012, p. 496, *original emphasis*)

Desire is never satisfied while the drive is satisfied in its repeated failure to gain an object, in its repeated encircling of the object. The objects we pursue are many, but desire organizes our lives in ways of which we are barely aware. Desire is organized around imaginary (not Imaginary) objects such as the objet a, the Phallus, and the Thing (Freud’s *das Ding*), around which it circles. Žižek (2012) writes: “What comes first is the lack: the incestuous Object of desire is always missing; it eludes the subject’s grasp, all that desire can catch are the metonymies of the Thing, never the Thing itself. However this repeated failure to reach the Thing can be inverted into success if the source of enjoyment is defined not as reaching the Thing but as the satisfaction brought about by the repeated effort to arrive at it” (p. 376).

Bracher's forms of desire

In considering how desire impels and shapes engagement with mathematics, I am guided by the forms of desire as outlined by Mark Bracher, a noted Lacanian theorist. In his *Lacan, discourse, and social change: A psychoanalytic cultural criticism*, Bracher (1993) is concerned with the psychological and sociological significance of literary texts on those who consume them as objects of knowledge, their 'use value' and outcomes as cultural forms, noting that the most pressing need for cultural criticism is to explain how cultural artifacts affect people. This, along with his sentence in my opening paragraph about a cultural phenomenon shaping a discourse by the evocation or promise of satisfaction of desire, led me to my argument about the cultural phenomenon of mathematics. Bracher illustrates his thesis in the examples of pornography, the anti-abortion discourse, the rhetoric of political campaigns, postcolonial discourse in Joseph Conrad's novel, *Heart of darkness*, and the poem, 'Ode to Autumn' by John Keats.

Bracher begins with Lacan's dictum, Desire is desire of the Other, which he describes as "key to understanding desire in the subjective economy and its cultural aspect" (p. 19). Bracher exploits three "ambiguities" in the dictum, thereby developing forms of desire as a way of teasing apart desire. I describe his development of the forms of desire and specify the four that I will use in my analyses. The three ambiguities that Bracher exploits in "Desire is desire of the Other" are:

a) Desire may be the desire *to be* and the desire *to have* or possess (*original emphasis*). This distinction corresponds to Freud's opposition of narcissistic libido (towards the ego) and anaclitic libido (towards others).

b) Bracher refers to two cases of the preposition, 'of' in "of the Other", namely, the subjective genitive and the objective genitive. These indicate the two positions that the Other can take as the subject or object of desire which is Freud's distinction of the active and passive aims of the libido. In the subjective genitive sense, 'of' indicates that one desires what the Other desires, arising from a form of identification with the Other. This looms large for the subject; as subjects, we have to confront the abyss of the Other's desire, how do we know what the Other desires? In the objective genitive sense, 'of' indicates one desires the Other as the object of desire (as in, I am desirous of wine, that

is, wine is the object of my desire). Also, active and passive are attributes of both the subject and the Other; when the one is active the other is passive.

c) The Other can be formulated in each of the three Registers. According to Bracher, the Other can be the image of another person in the Imaginary Register, or the code constituting the Symbolic order or the *objet a*, the object cause of desire, in the Real (1993, p. 20). While the Other is most easily understood as a person in the Imaginary order, the Other is also the Symbolic order, the code of the discipline and discourse of mathematics itself. The Other is then embodied or animated by the community of mathematicians who uphold its traditions and practices. In the Real, the Other is the *objet a*, that residue or remainder, that lost object we seek in the pursuit of mathematics.

There are two forms of desire in a), two in b), and three in c). Hence, combining these using the *mn* principle³⁵, Bracher enumerates two by two by three or twelve forms of desire. It is to be noted that Lacan did not specifically formulate these forms of desire, but they are derived from his dictum. I will not be using all twelve forms of desire just yet. In order to show and establish desire in my analyses, I will concentrate the four forms resulting from a) and b). Later, I will come to an appreciation of some of the forms varying across the registers.

Considering the two forms from a) (narcissistic and anaclitic) by the two from b) (passive and active) gives the following four forms of desire (Bracher, 1993, pp. 20-21):

1. Passive narcissistic desire. One can desire to be the object of the Other's love (or the Other's admiration, idealization, or recognition).
2. Active narcissistic desire. One can desire to become the Other—a desire of which identification is one form and love or devotion is another.
3. Active anaclitic desire. One can desire to possess the Other as a means of *jouissance*.
4. Passive anaclitic desire. One can desire to be desired or possessed by the Other as the object of the Other's *jouissance*.

³⁵ If one thing can be done *m* ways and another *n* ways, then both can be done in *mn* ways.

I have to say that it took a very long time for me to see these four and to understand the various meanings. At first, I could only see the first three forms as it was hard to distinguish between the desirer and the object of desire. In order to see more clearly, I put these in a table; I also added equivalent statements of the forms as they relate to the Other of mathematics and the community of mathematicians who inhabit and make up that community. Then it dawned that these are forms of desire of the subject, the 'I'. So in the table, I have replaced the beginning "One" above by I.

Table 1: Bracher's four forms of desire

	To be (Narcissistic)	To have (Anaclitic)
Passive 'of' as Objective O \diamond S	1. I can desire to be the object of the Other's love (or the Other's admiration, idealization, or recognition). "I want to be recognized by mathematics and its community as a mathematician."	4. I can desire to be desired or possessed by the Other as the object of the Other's <i>jouissance</i> . "I want to be desired by mathematics as, e.g., a means of adding to its glory."
Active 'of' as Subjective S \diamond O	2. I can desire to become the Other – a desire of which identification is one form and love or devotion is another. "I want to be a mathematician." (Halmos, 1985/2004)	3. I can desire to possess the Other as a means of <i>jouissance</i> . "I want to possess mathematics as, e.g., enjoyment, as a personal treasure."

Note: From Lacan's dictum: "Desire is desire of the Other"

Besides the examples, I have further added two variations of Lacan's matheme for desire, namely, S \diamond O and O \diamond S. Reading from left to right, these show the two positions that the subject and the Other can take, namely, desirer (Active subject of desire) and object of desire (Passive), desire thus being a dance between the subject and the Other. Lacan's dictum that desire is desire of the Other has far-reaching consequences. The challenge is to see that one's desire is not one's own; it is the Other's desire. A further challenge is to see all desire as variations of these four basic forms.

One aspect of the forms to be emphasised is that the wording of the forms for Active and Passive is different. Recall that the four forms describe the subject's desire; in the Active forms, the subject is the active desirer and in the Passive forms, the subject desires to be desired. In the Active forms, the subject desires to be the Other (Active

Narcissistic) and desires to have the Other (Active Anaclitic), but in the Passive forms, the subject desires to be desired by the Other in two ways and hence the wording for both Passive forms is, I desire to be desired as While one may be expecting a clear statement of the 'to be' and 'to have' in the Passive forms, it comes in the distinction of the Other's desire. In Passive Narcissistic, the subject desires to be desired as the object of the Other's love/admiration/idealization/recognition) and in Passive Anaclitic, the subject desires to be possessed (had) by the Other as a means of its enjoyment). Hence the 'have' for Passive Anaclitic refers to the Other's desire to 'have' the subject as a means of *jouissance* (as in the legal use of the term, the right to enjoy). Thus, in Passive Anaclitic desire, the subject desires to be desired by the Other as a means of contributing to its enjoyment.

By using this framework, I seek to fathom the ways and forces by which mathematics, as a discipline and a discourse, and its embodiment by mathematicians who animate it and guard its traditions and practices, interpellate its subjects. Bracher writes:

The vector of interpellation resulting from converging and conflicting forces of discourse can be gauged by using the taxonomy of desire developed here to identify the various instances evoked by a given discourse in a given audience and then tracing the metonymic paths and metaphoric bridges by which these desires are directed toward specific actions, aims, and objects. (p. 52)

I intend to elaborate the "vector of interpellation" using the written and oral accounts of mathematicians and highlighting "metonymic paths and metaphoric bridges" in the becoming and being of mathematicians. Bracher continues:

The value of this taxonomy of desire—four basic modes in each of three registers—lies not in its capacity to serve as a totalizing system for describing and categorising the various elements of discourse. Its value lies rather in its demonstration of the multifariousness and complexity of desire and in its function as a kind of checklist prompting us to search a given text or discourse for interpellative forces that might not be immediately evident. (p. 52)

Despite the utilitarian aspect of a checklist, this framework will be vital in explaining and understanding the various kinds of involvements with mathematics that will be seen in

the biographies, autobiographies, and interviews that will be analyzed in the coming chapters.

Subjectivity

In order to present more carefully the mathematical subject who is impelled and shaped by desire, I now tease out the notions of the subject and subjectivity. In considering the subject, I am trying to clarify who is that I who thinks, speaks, acts? Is there an I? From where does it arise? How is it constituted? What forces act on it or shape it? These questions have variously been taken up by thinkers under the notions of self, personhood, and identity. It is a premise of this work that there is not a stable, cogent, unified, rational, conscious self or identity. Rather, the question of who we are is a question of the nature of subjectivity. I seek to discern the nature of subjectivity and in particular, to discern what constitutes the mathematical subject. Who are we when we do mathematics?

Subjectivity according to Lacan

For Lacan, subjectivity and our development as subjects are enacted within his three registers of all experience, the Imaginary, the Symbolic, and the Real. Lacan is careful to distinguish between the ego (*moi*, me) and the I (*je*, the subject, the I who is not me). For Lacan, the ego is an Imaginary function, based on images, illusions, and appearances, and formed from how we see ourselves in others. It is both a defensive and an inauthentic agency. Lacan in his Seminar (Book II, 1978/1991) writes: “There is no doubt that the real *I* is not the ego ... What’s important is the inverse, which must always be borne in mind – the ego isn’t the *I*, isn’t a mistake, in the sense in which classical doctrine makes of it a partial truth. It is something else—a particular object within the experience of the subject. Literally the ego is an object—an object which fills a certain function which we here call the imaginary function” (p. 44, *original emphasis*).

In his L Schema³⁶ of the intersubjective dialectic, Lacan captures the relation between the I (the subject, indicated by S), the ego (the me), and the Imaginary and Symbolic registers, and shows the subject in relation to the unconscious, the discourse of the Other.

L SCHEMA

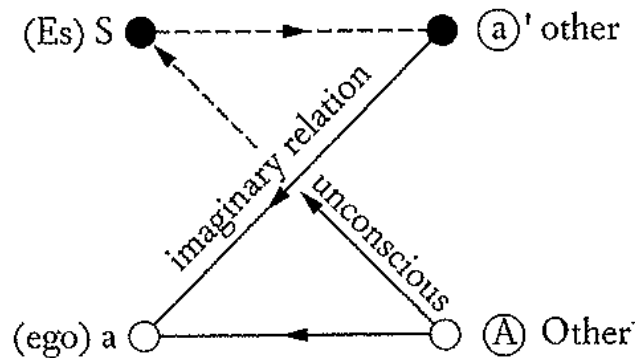


Figure 1: Lacan's L Schema (1966/2006, p. 40)

Note: Used with permission

In this schema, Lacan depicts the alienation of the subject in the ego as a consequence of the insertion in the Other by the acquisition of language. The (ego), as a (*autre*), is an other formed by the specular image, and it is as a specular image that the subject perceives an other subject, another other represented as a' . The ego, Lacan writes is “absolutely impossible to distinguish from the imaginary captation that constitute it from head to foot, in its genesis as in its status, in its function and in its actuality, by another and for another” (1966/2002, p. 374). The a and a' form the Imaginary axis, which mediates the subject's relation with herself and others. The relation of the subject to the ego is via a' , as seen by the arrow from S to a' and from a' to the (ego) a . The subject is in the position, S , but she does not apprehend herself there; she sees herself in the ego. Cutting across the imaginary axis is the axis of $A \rightarrow S$, which Lacan calls the wall of language. The alienation of the subject takes place in the Imaginary axis cut off and separated by language, the wall that blocks speech (1966/2006, p. 232).

³⁶ The schema is called the L Schema because of the Greek letter, *lambda*, being formed.

In his dictum, “the unconscious is structured as a language”, Lacan recognizes the role of language in the constitution of the subject and issues a call to “unmask the imaginary fascination and reveal the symbolic laws that governs it” (Žižek, 1991, p. viii). The subject is born into language and becomes a speaking being. Language discursively constitutes as subjects and because of the language we use, the words, and the speech acts we perform, we as subjects are “already rhetorically marked” (Guerra, 2002, p. 7). Indeed, not only do we speak language, language ‘speaks’ us.

Lacan drew on the linguistics of Saussure, but turned Saussure’s notion of the signified and the signifier on its head, maintaining the primacy of the signifier with the bar between them as a true separation between the two. Lacan begins with Saussure’s analysis of a sign or signification composed of two related components, the signifier and the signified, the signifier being the sound image related to the concept indicated by the signified. So *dog*, *chien*, and *pero* are all signifiers that indicate the signified, an animal with the characteristics of ‘dog-ness’. The signifier is completely arbitrary and is ‘negatively related’ with respect to other signifiers, in that it has value only in its difference from the others. The signifier has ‘negative value’ as it is what it is and is not another. For Lacan, only the signifiers are to be attended to as our unconscious wishes, desires, drives, and images are all signifiers which are expressed as words. There are no signifieds; each signifier points to another signifier leading to a chain of signifiers that constantly slips and slides, shifts and circulates. There is nothing to which a signifier ultimately points except another signifier. There is no *point de capiton* (upholstery button, quilting point) that centres, anchors, or pins down the signifier to any ultimate meaning. And therein lies the difficulty of constituting a stable ‘self’. Lacan maintains that the possibility of fixing (as in making constant) or stabilizing a self is an illusion created by a misperception of the relation between the body and the self. Another point is that the signifier may be the same for all of us but it may point to something different for each person, such as the signifier, I (in linguistics, a shifter), or the signifier may be the same for all of us and point to the same thing such as page 12 of a given book.

In Lacan’s theory, the notion of Subject begins from the *méconnaissance* (misrecognition) of the child in its specular image, its sense of its fragmented body, the search for completeness or wholeness, and the gap between the I and the ego. There is no sense of a stable, rational, coherent Self that guides rational thought. Butler (1995)

describes it as there being “no originary moment establishing pure identity which can be rationally unpacked” (p. 383).

Lacan recognized that the signifier was only barely linked to the signified, that the emotional load (the affect) was borne by the signifiers and not the signifieds, and that what gives meaning is the association of signifiers in a signifying chain. Signifiers, then, are representatives for subjects (similar to ambassadors for countries). Hence another of Lacan’s dicta is that the signifier represents the subject for another signifier: “My definition of the signifier (there is no other) is as follows: a signifier is what represents the subject to another signifier” (1966/2006, pp. 693-694).

Žižek explains the emergence of the subject: “a subject tries to articulate (“express”) itself in a signifying chain, this articulation fails, and by means and through this failure, the subject emerges: the subject is the failure of its signifying representation – this is why Lacan describes the subject of the signifier as ‘barred’. In this precise sense, the subject is a non-provable presupposition, something whose existence cannot be demonstrated but only inferred through the failure of its direct demonstration” (2012, p. 730).

For Lacan, meaning is conveyed by a sliding metonymic chain of signifiers that occasionally is halted by a quilting point or *point de capiton*. With respect to the discipline of mathematics, the signifiers of mathematics and mathematicians become master signifiers in that they are important for what they mean for the subject; they structure the subject and enable a discourse to gain purchase on and interpellate the subject. Bracher (1993) writes: “Since master signifiers are any signifiers that a subject has invested his or her identity in and signifiers that the subject has identified with (or against) and which thus constitutes powerful positive or negative values—they are what make a message meaningful, what make it have an impact ...” (p. 24). They are also *qua* master signifiers, necessarily empty, with meaning having to be filled in retroactively.

In his Seminar VI on ‘Desire and its interpretation’, Lacan writes: “At the very moment that we come into being as a subject by virtue of identifying with a signifier, we are solidified, petrified, by the signifier, reduced in a way to being nothing more than the

signifier that represses us” (p. 76). This produces the divided, barred, split subject, \$, the lost part of which is the objet a. This division or barring is the effect of the master signifier which serves to cover this sense of being the split subject, of failing to grasp our true selves, of failing to cohere. This gap can be seen in the difference between thinking and being. Descartes had enunciated his *cogito*. Lacan rewrites this as “either I do not think or I am not. There where I think, I don’t recognize myself; there where I am not, is the unconscious; there where I am, it is only too clear that I stray from myself” (1977, p. 47).

Subjectivity according to Rotman

As a contrast to Lacanian subjectivity, I now consider a notion of subjectivity by Brian Rotman mostly because it was developed expressly for mathematics and doing mathematics. It addresses in another way my questions of who are we when we do mathematics and who we are called to be when we do mathematics. Rotman (a mathematician and philosopher, now a professor in a Department of Comparative Studies) proposes that mathematics is a practice and an activity carried out in a community of members who communicate with themselves and others and who constantly produce standardly-written, formal texts for the benefit of themselves and others in the community in the maintenance of the discipline. So far, this is applicable to any intellectual discourse.

In describing how mathematics is done or carried out, Rotman is inspired by Charles Sanders Peirce’s formulation of how human beings who wish for something “beyond their means” then try to decide whether to go after that thing by embarking on a search of the heart and then in their imagination make “a sort of skeleton diagram, or outline sketch” which enables an examination of the state of things required “to see whether the same ardent desire is there to be discerned.” It is noteworthy here that the prompt for doing is desire, but there is no mention of why. Rotman is led to posit two types of mathematical agency: the Subject, the one who imagines and the one who is imagined as the skeleton diagram and surrogate of the Subject, namely the Agent.

The Agent is “a truncated and idealized image of the Subject” and the Subject itself is “a reduced and abstracted version of the subject—let us call him the Person—

who operates with the signs of natural language and can answer to the agency named by the 'I' of ordinary nonmathematical discourse" (Rotman, 2000, p. 13). It is to be noted that while Rotman refers to the Subject, here he uses a small s. The Person is identified by personal and demonstrative pronouns, by references to the three tenses of time and the coordinates of space occupied by the body in and of the world, and by individual and social attributes. In contrast to the Person, the Subject, being "transcultural and disembodied", has no physical location and is not called upon to make any interpretations relating to time, space or culture relating to its utterance. Rotman introduces the notions of language and narrative through his formulation of the Code ("the discursive sum of all legitimately defined signs and rigorously formulated sign practices that are permitted to figure in mathematical texts"), the meta-Code ("the penumbra of informal, unrigorous locutions within natural language involved in talking about, referring to, and discussing the Code that mathematicians sanction"), and the virtual Code (p. 19).

Hence for Rotman, all mathematical activity takes place in three inter-linked areas, the Code, the meta-Code and the Virtual Code, the actors in these areas being the Subject, the Person and the Agent, respectively. Rotman argues that "'mathematical subjectivity' cannot be the sole domain of the Subject as we then run the risk of confining the meta-Code to an epiphenomenon and hence lose any hope of seeing semiotically "how proofs achieve conviction" (p. 19). Only the presence of the Person, with the ability of natural language, can enable the Subject to be persuaded by the narrative in the meta-Code. The Agent is then the self as object, the Subject the self as subject, and the Person is the "sociocultural other through which any such circuit of selves passes" (p. 53).

Rotman's formulation is then an elaboration of how mathematics is carried out by describing the "who" in who is "doing" the mathematics. It is also a delineation of the process of signification by which mathematicians communicate, persuade, and convince by virtue of the codes, and it describes the various actors in teasing apart of mathematical agency. In comparison with Lacanian theory, the description of the Person reads like that of the ego and the imaginary function (what Rotman calls the 'I' of ordinary mathematical discourse), and that of the Subject as the 'I' who is not me. The Subject and the Agent are called forth by the Person in the attempt to see, according to

Pierce, “whether the same ardent desire is there to be discerned” (Buchler, 1940, p. 98 cited in Rotman, p. 13) and are mere means of doing and executing. This appears backwards because for Lacan, the ego is inauthentic and not the true I, the true I being a function of the unconscious and the Symbolic order, the origin of thought and action.

I have included Rotman here because he offers a perspective of the mathematical subject from the view of a mathematician (or one who used to practise mathematics). However, the framework he proposes appears to be descriptive and mechanistic and gives no indication or consideration of the ‘why’ as in why undertake or pursue mathematics? There is no sense in which it can be considered psychoanalytical or even psychological as there is no reference to the psyche or the unconscious. If we are to make any meaning of why we engage with mathematics, we have to consider more than these three ‘actors’ and skeletal selves that propel one another in the doing of mathematics. I have not seen Rotman’s theory taken up in the mathematics education literature, but that is most likely because it appears as formalistic and artificial. While it may serve as a good description of a cerebral activity, it fails to give any underpinning or insight for answering questions such as mine about the extralogical forces that impel our encounters and engagement with the discipline.

Posing the research questions

Now that I have situated my study in the literature and have laid out the theory, I state my research questions. I recall that my study probes the psychoanalytic aspects of engagement with mathematics, the demands and the rewards of the endeavour, and that I posited desire as that which fuels and sustains the engagement. Hence my research questions (RQs) are:

RQ 1: From mathematical narratives (written and oral accounts), what is the desire of mathematicians?

RQ 2: Can mathematics desire?

RQ 3: What is the mathematical subject?

I move on in the next chapter to a reflection of the methodological considerations entailed in the study which will help me answer these three research questions. I map out the various components and show by what means I look for evidence of desire in the engagement with mathematics.

Whence and whereof I speak (3)

Earlier in 'Whence and whereof I speak (2)', I had written of the Trinidadian steelpan player and arranger, Jit Samaroo, who had said: "Pan has given me everything I have. Everything I am is because of pan". I continue with these two statements as they mostly echo how I feel about the discipline of mathematics. What I have undertaken in this dissertation, and indeed, that I have undertaken it at all, is a testament to more than mathematics. It is a testament to my parents and my upbringing, the society into which I was born, and the society in which I make my livelihood and my life, with the accompanying negotiations and constraints. In my life, with respect to mathematics, I affirm the first statement and qualify the second: Mathematics has given me everything I have. Almost everything I am is because of mathematics. These are powerful and sweeping statements, but they capture my feeling for my life and for the place that mathematics occupies in it. They capture my desire relating to mathematics in some of its forms.

I had said that my life is in mathematics and not so much of mathematics. This is because with a master's degree in mathematics at a young age, I had the inclination and the means of making my livelihood. I had already had the taste of teaching and I taught in institutions (colleges and universities) that required no teacher training. I enjoyed the life of these educational institutions, but after such a long time of teaching mostly limits, derivatives, and integrals, I began to wonder how many more times I can tell someone what a derivative is. It was time to seek new vistas and new worlds. Besides searching for the theory that underpinned the teaching, I knew that there must be life after teaching first and second year university mathematics and statistics. I knew it had to involve teaching because teaching is my *métier*. I just had to find it. I often wondered what or who I would be if I were not a teacher; one possibility that comes to mind is that of being a preacher, haranguing people from a pulpit. This is mostly because as a teacher, I have spent a long time in the business of telling students what to do.

My life now is mostly a consequence of Donald Rumsfeld's epistemology of known knowns ("things we know we know"), known unknowns ("we know there are some things we do not know), and unknown unknowns ("the ones we don't know we don't know")³⁷. I realized very early on the extent and limit of my mathematical ability and knowledge. I took my master's degree in a university that had the first faculty of mathematics in Canada, with five Departments of Mathematics, one of which was Statistics. There was a very high level of mathematics around me and I learned very quickly how much I knew and how much I did not know. The mathematics that I did understand was enough for me to continue in teaching mathematics. Also, I specialised in statistics which seemed a good mix of theory and application. But I struggled with the computing and the technology. To this day, whenever a new piece of software is introduced in the places I teach, a new course management system say, I walk around for months being afraid of it. Then when I do get the hang of it, I wonder what I was afraid of, and remind myself of St. George and the dragon.

I appreciate mathematics for what it is. I appreciate the certainty of knowing where you are in a life where every other discipline and intellectual pursuit rests on too many assumptions and variables. I appreciate its history and tradition, and the clarity and purity of its expression. I attended a lecture by the director of an institute for advanced mathematics in France on the work of his star player, Mikhail Gromov. Mostly he worked from a PowerPoint presentation, but at one point, he went to the blackboard and with white chalk on a pristine green surface, he drew simple clear diagrams with a sure and practised hand that produced a *frisson* of excitement in me. I think the others in the audience (students and teachers in mathematics departments) were not as moved, but I had been so long away from such performance. I have long fallen for the charms of mathematics, its objects, its processes, its rituals, and its texts.

I appreciate the power and pleasure of language and note that we teach mathematics mostly by speaking it. We teach mostly with words, sometimes with

³⁷ Žižek has added the unknown knowns (the unconscious), "things which we do not know we know, since, for Lacan, the unconscious as *une bévue* is *un savoir qui ne se sait pas*" (2012, p. 76). This 'formulation' of two dichotomies, two by two giving four, is similar to the two by two or four forms of desire in Bracher (1993) given above. What is interesting here is how the one dichotomy, know/unknown, is made reflexive and paired with itself.

gestures and symbols, but mostly we use words. Psychoanalysis is the talking cure and Lacan had spoken of the pleasures of the mouth. I tell my students that a big part of being able to do mathematics is the ability to speak it, that you have to be able to articulate what you are going to do next in order to help you to do it, to help you to carry it out. In fact, it seems to me that if you cannot finish the sentence then you have not finished the thought. I was speaking with a friend who is in a doctoral program in interdisciplinary studies (she ran away from the English Department because it had become unintelligible with all the contemporary theory). In talking about her work which is writing about war and pain, she says: I know what I want to say, but I don't have the language to say it. And my response was: You need a theorist who will give you that language.

I appreciate the high of teaching; my sister said to me the other day, you need an audience. After all these years, I am still excited about going into the classroom. Some years ago, I was seriously ill and my only thought was of being able to walk into the classroom. I am marked by that first experience of being in front of a class. One of the things I appreciate in teaching is the opportunity to try again, to walk in the next morning and try again. The other nice thing is that you can tell, almost to the minute, when the experience gets to lift-off, that despite whatever else is going on in one's life, in that effort of communicating something to someone or some ones, you have left yourself and are wholly engaged in the experience. One person on hearing that I am a mathematics and statistics teacher said: "I revere good math teachers! I had some terrible ones who had me in tears. I adore the ones who can do it well." That kind of appreciation keeps me going.

I do not worry about being replaced as a teacher, no matter what materials or modes of delivery are created. In my interactions with students, it is ever clear to me that human beings need other human beings to mediate these materials.

I appreciate the privilege of my position as a woman in mathematics. I have seen women students get interested in the discipline because they see me in front of the class. I have had women come up to me after a class in calculus, say, and tell me what a relief it is for them to see a woman teaching a math class. I am happy to see that girls do not drop mathematics as soon as they can as happened in the past and that now we have to worry about the participation of boys.

So is there a difference between in mathematics and of mathematics? If there is, it is only a question of degree. I spend my days teaching the mathematics I know both face to face and at a distance. My face-to-face students come and chat with me about things mathematical and things not so mathematical. I pore over my distance students' scripts, not just looking for the right answers, but taking the opportunity to teach them the content and more so, the values of the discipline, from afar. I am reminded of Shulman's (2005) signature pedagogies which lead to a possible avenue of research after all my years of teaching mathematics, namely, the nature of a signature pedagogy for mathematics and what it means for me.

I had written above of the angst of calling myself a mathematician and that it was more straight-forward to call myself a statistician. This business of when one can call oneself a mathematician or when one sees one's self as a mathematician is tricky. I was surprised when one of the mathematicians I had interviewed had said that he did not consider himself a mathematician even when he was in graduate school. Another of the mathematicians I interviewed told me that he saw himself as a mathematician when he was in elementary school and learned how to multiply two binomials. I have spent a life learning and teaching mathematics and still only see myself as a mathematician, *to a degree*. It is easier for me to call myself a statistician because there is not so much vested in the word. As a signifier, 'statistician' is not as loaded a signifier, both in my eyes and in other people's eyes. But on the whole, now that I look back and reflect, I can say with some confidence, I am a mathematician. In 'Whence and whereof I speak (2)' I had written about my name, Veda, which had been given to me by my father. Now I am self-naming; I am giving myself two more names, statistician and mathematician.

Chapter 4:

Methodological considerations

In this chapter, I present the methodological framework of the study and provide the details of the procedures, methods, and deliberations involved in undertaking this research. I recall that the purpose of my study is a probing of the psychoanalytic aspects of engagement with mathematics, the demands and the rewards of the endeavour. Hence, this study is set in the qualitative and interpretive tradition (Guba and Lincoln, 1994; Tobin, 2000) of researchers attempting to make sense of, or interpret, phenomena in terms of their natural settings and the meanings people bring to them. Thus, in this light and in that of my theoretical stance in the last chapter, how would I begin to answer the research questions I have posed? What would count as evidence? What would I consider as data? How would I collect and analyze the data so as to get answers? These deliberations changed over time as I began to get a clearer idea of my phenomenon of interest and how it could be addressed. I present these deliberations under the headings: Data and data sources, Interviewing as a research tool, Methods of analysis, and Position of the researcher.

Data and data sources

Where is knowledge about engagement with mathematics to be found and whence can it be gleaned? In a simple yet powerful sentence, Tony Brown (2001, p. 91) encapsulates wherein mathematics lies: “Mathematics is accessed through the accounts of others”. Modifying this slightly, my contention is that knowledge about engagement with mathematics is to be found in the accounts and testimonies of those who have engaged with the discipline. I began my investigation by reading autobiographies and biographies of mathematicians for trajectories and influences in the journey to becoming and being a mathematician. I also looked for any quotations that expressed feelings for

or emotions about the involvement with mathematics, any influences for or against, and any obstacles or pitfalls on the way. I started with lives of mathematicians I knew about from my days as a student and a teacher of mathematics, from the shelves of libraries and from book reviews. Some lives in mathematics were suggested by peers and colleagues when they learned about my study. Also, I sought to read between the lines, to discern the mathematical subject and the impetus for the achievement. I further realized that I could hear the stories from the horse's mouth, as it were, by interviewing mathematicians. Hence my data would come from accounts of journeys in mathematics from two sources: written, from autobiographies and biographies of mathematicians (mostly no longer living) and oral, from interviews with living mathematicians (practising and retired). The British philosopher Ray Monk (2007), biographer of many major figures such as Bertrand Russell, Ludwig Wittgenstein, and Robert Oppenheimer, argues that in biography ("a profoundly non-theoretical activity"), we can find theory that will lead us to understanding and making connections, in contrast to the theoretical understanding provided by science.

Interviewing as a research tool

Why did I choose to interview? What would face-to-face interviews give me that I could not find by other means such as a questionnaire conducted by phone or over email? I recently read in a journal of statistics education research an interview with a revered and respected pioneer in the field (Rossman *et al.*, 2013). I had assumed on seeing the headline of an interview that it had been conducted face-to-face. To my surprise, it had taken place by email where the interviewers, three of them, exchanged emails with the pioneer over a four-month period. There is some advantage to this in that the interviewer can spend time crafting the questions carefully and the interviewee can take time to ponder, reflect, and phrase the answers. It also could be that there was limited access, the pioneer having been retired for some time and most likely opting not to endure the rigours of a face-to-face interview. This method was used by Denis O'Driscoll (2008) with the poet Seamus Heaney, in producing what is referred to as the closest thing to an autobiography of Heaney.

Interviewing is one strategy in qualitative research that gives an opportunity for an exchange between two parties to some end (Measor, 1985). For me, there was no hesitation in choosing to carry out face-to-face interviews. I have had the experience on being on both sides, either interviewing candidates for various positions or being interviewed. My manner is open and direct and my first instinct is always for face-to-face communication, although that aspect of my way in the world has been tempered by time and circumstance. My pilot study was with two of my colleagues where I felt as if I knew what I was doing. It turned out that I was little prepared for the range of responses I received when I undertook the interviews.

Besides my inclination for face-to-face communication, I was in agreement with Bean's (2006) observation that interview data have the potential to generate valuable information about people's lives and situations. Bean writes: "There is no substitute for prolonged and focused conversations between trusted parties to discover what is important to the interviewees and how respondents understand key elements in their own lives" (p. 361). While there is something to consider in whether my interviews would be between "trusted parties", my goal was to hear from those who had lived the experience of accomplishment in mathematics, and to get first-hand accounts. While Bean's statement is open to further psychoanalytic critique in that the essence of an analysis comes out in an interaction between analyst and analysand that is purposely NOT face-to-face, I pursued the interview method to begin to get an inkling of what is attained in the mathematical endeavour from those who 'achieve' mathematics.

For the interviewing, I began with a pilot study where, using Burton's (2004) questionnaires (Appendix A), I interviewed two colleagues in the department of mathematics and statistics in which I taught. Then I sought to interview a wider sample of mathematicians. The method used to select my interviewees was that of purposeful sampling (Creswell, 2008, p. 214). Purposeful sampling is an umbrella term that includes methods such as maximal variation sampling, critical sampling, and extreme case sampling. The intent is to present multiple and exceptional perspectives in an attempt to see as many aspects of the phenomenon as possible. Participants are chosen for their potential to shed light on a phenomenon so that a detailed understanding of the phenomenon can be developed. They are sought for their ability to provide useful information about the phenomenon, to give insights that may help others

in understanding it, and to give voice to people who may not otherwise be heard. My interviewees were drawn from people who worked in or had retired from academic departments of mathematics. I had heard of them or had seen them at conferences and meetings or they had been suggested to me by colleagues as good candidates for my study. Not all of the ones I approached followed up with me. Some agreed to an interview, but did not follow through for purported reasons of time and schedule. However, seven mathematicians agreed to be interviewed and shared their stories and experiences with me. I acknowledge here my debt of gratitude to the mathematicians who spoke with me. It was, indeed, a privilege to have had conversations with them.

I recorded the interviews using both audio and video. In the interviews, while I began with questions from Burton above, however, as is generally the case with open and semi-structured interviews, I followed where I felt the interviewee led and hence reframed or formulated questions so as to build on or draw out further information. The interviews were transcribed fully by me. All but one of the interviewees indicated that they did not wish to see the transcript. In the one case, the interviewee sent back a few corrections of names of places and people.

With regard to data collection, as human subjects were part of my study, I underwent a rigorous process with the SFU Office of Research Ethics (ORE) after having taken their mandatory online tutorial. All protocols regarding permission and consent were observed. However, conducting research with living professionals (as opposed to mining written accounts by and of dead mathematicians) in today's digital age with easily accessible information poses privacy and confidentiality concerns. A great majority of professionals in academic settings maintain personal websites that give detailed biographic data. Connecting the dots then can become merely a matter of clicks, complicating attempts to maintain anonymity in the analysis and the writing.

When it came time to write and to decide which interviews I would present for inclusion in the analysis, there was very little indecision. I decided on presenting the two that were the richest for analysis, in complexity and nuance. I had chosen from the written accounts for in-depth study one male and one female mathematician; I wanted a similar balance for the oral accounts. With the method of purposeful sampling, of the seven interviewees, I chose one male and one female interviewee whose journeys

presented different aspects of engagement with mathematics. I considered the others as well, but I needed both light and shadow (Bean, 2006) for a deep and insightful analysis. Certainly, I am highlighting two sets of data over the others, but my experience and my witnessing of all the interviews contribute to my overall assessment. I learned much from the experience of interviewing: I have included some of my reflections on the experience after I present the analyses in Chapters 5 and 6.

Method of analysis

Each interviewee and each account has its own circumstances and peculiarities relating to the individual subject. Each interview has its own rhythm, its own refrain. My intent in each analysis is to find, amidst the shouts and murmurs,³⁸ the story line of the relationship and engagement with mathematics. With so few interviewees, it is unreasonable to expect that there is a common core of issues related to engagement with mathematics. Indeed, the responses may well be diverse and far-reaching. Since this study is principally about the drivers of engagement/non-engagement with mathematics, I was willing to consider any and all responses as data.

Hence, given the data provided by the transcript and video of the interviews, what is my method of analysis? What am I looking for? How would I proceed? How to see what the data are saying and how to discern the mathematical subject being presented in the data? After much examination of the data, and after some trial and error, I found that I employed three methods of analysis to varying degrees: Looking through the Lens of Desire (Bracher, 1993), Thematic Analysis (van Manen, 1997), and Listening with Interpretive Poetics (Rogers, 2007).

Looking through the Lens of Desire

As desire is my principal construct, my principal method of considering desire is applying Bracher's forms of desire underpinned by Lacanian theory of the subject and desire as outlined in the previous chapter to tease out the presence/absence of

³⁸ To borrow a phrase from the New Yorker magazine.

desire/non-desire. I have not seen any previous research in this vein using Bracher's forms of desire, but I believe the forms are an excellent way to begin an examination of the "multifariousness and complexity" of desire as it obtains in the cultural phenomenon of mathematics and the journeys of its practitioners, the mathematicians.

In each analysis of a journey in mathematics, I identify instances of the four forms of desire and also highlight hints and manifestations of desire that are shades of these forms. With these threads, I then attempt to show how the mathematical subject is constituted. I further make use of thematic analysis as a means of identifying patterns and categories that serve to highlight both desire and the mathematical subject.

Thematic Analysis

In my readings of the biographies and autobiographies of mathematicians, and with each re-reading of the transcript/re-seeing of the videos of the interviews, I am alert to any flags that arise, any emergent themes that are noteworthy or interesting and pertain to my phenomenon of interest, namely, views on mathematics as a discipline, on being a mathematician, and on what impels engagement with mathematics. Hence, as a first pass at the data, I am, in effect, undertaking a thematic analysis (van Manen, 1997; Braun and Clarke, 2006).

Braun and Clarke position thematic analysis as a flexible method used to produce rich and detailed analyses of the data by researchers who are both tied to theory and epistemological positions and independent of them (2006, p. 78). Themes are patterns or categories that are suggested by instances that are striking and indicative of keys to answering the research questions. One factor in the determination of categories is usually frequency of occurrence, but this is not a factor for me as my purpose is a description of the landscape of engagement for each subject and a discerning of what impels such engagement. Hence, I am paying attention to any markers and nuances that are compelling and note-worthy in this regard. These themes are then a result of what the interviewees present as well as my reaction to and my reflection of the encounters. So, in each analysis, I will, of necessity as the data presents, attend to different themes as a method of trying to discern what the data says. Thus, in an important sense, I am the instrument of analysis, in that the themes that I

present in the analyses that follow are the result of my assessment, from my experience in mathematics education research and in the discipline of mathematics, of their worth, importance, and relevance.

The natural questions then are, am I looking for codes, and if there are codes, what are they, how are they to be organized, and so on? And the unprepossessing answer is that with a discipline as fraught as mathematics with various interpretations and judgements, with this method of interviewing about trajectories, dispositions, and influences, and given the various ways that things may and do turn out, can one really say that, in such individuality and eccentricity, there are codes? Codes also predate and overlay the analysis like a Cartesian grid. Besides, the data as accounts of mathematical journeys were themselves stories and narratives with plot and theme, character, image, and setting. Hence, I wanted a more literary, psychoanalytic appreciation of the issues and I wanted purposely to stay away from identifying codes and Excel spreadsheets. The process of coding, while it is an excellent organizational tool, seems to me to be a mundane and soul-destroying way of doing things. As well as being a mathematician, I am a statistician and I believe in the power of numbers and quantification to do some things, but this study calls for a more nuanced appreciation. It may well turn out that I am coding, but I do not want to identify my method as such, just yet.

Finally, with interview data, I needed a method that would help me with listening, especially to people describing their situations and circumstances. The method of Listening with Interpretive Poetics, which I describe next, enabled me to attune myself to the elements of the interview that were more than the transcript and helped me to 'read' between the lines.

Listening with Interpretive Poetics

My third method of analysis involves listening to what the interviews and the subjects are saying/not saying beyond the utterances as text. A major part of interviewing is listening, trying to take in what is being offered or withheld, trying to see where the interview may go next, trying to make meaning of the encounter. In searching for an understanding of an early interview that would be consonant with my proposed

theory, I happened upon a chapter in a handbook of narrative inquiry by Annie Rogers³⁹ (2007): 'The Unsayable, Lacanian Psychoanalysis, and the art of narrative interviewing'. Prior to this, I had found the word 'dislocation' when reading Robert Fulford's 1999 CBC Massey lecture, *The triumph of narrative: Storytelling in an age of mass culture*, the word seeming to unlock a door for me. The discovery of the word, the unsayable, similarly unlocked much of what I had been pondering after that interview:

It's a curious truth that even as we speak, we circle around what it's not possible to say, reading one another about what to elaborate, what to revise (and even try to erase), coming, almost inevitably, to what eludes any possibility of being heard. This is what I call the unsayable. (Rogers, 2007, p. 99)

Rogers, as a psychologist, dissatisfied with interpreting interviews according to various research stances (for example, phenomenology, social constructionism, and linguistic/discourse analytic), and repeatedly hearing "something in narratives I could not grasp: the presence of the unsayable *in* words, *in* language, which also fell *between* sentences, *between* words, rendering every elaboration of "meaning" in the interpretation of text inadequate" (2007, p. 105, *original emphasis*), formulated her own method, which she called Interpretive Poetics, as a means of listening to the unconscious. Rogers claims that her listening changed "radically (at the root)", since the beginning of her study of Lacan.

Rogers' method has five layers: story threads, the divided "I", the address, languages of the unsayable, and signifiers of the unconscious (2007, p. 109). The story thread is like the melody of a song that one listens for instead of listening to the message in the narrative. Listening for it in an interview is to note where it disappears and re-emerges, where it leaves its trace. It is a way of discerning contradictions or subtle hints of how a narrative is being shaped by un/conscious censorship. The divided "I" refers to the fact that the subject who is speaking has to divide herself to represent or describe herself, to be the I who is speaking and who wants to present her 'best' self and the I of the un/conscious editing. But this is of no avail because our true selves will out,

³⁹ At the time of publication of her chapter, Rogers, a professor of psychology, was in training to be a Lacanian psychoanalyst.

revealed and laid bare in our hesitations, pauses, and slips of the tongue. “The imaginary ‘I’ who upholds the ideal self is undermined by the voice of a faltering ‘i’ linked to the real and characterized by momentary incoherence in the subject’s narrative. These opposing voices define the divided ‘I’” (2007, p. 112). It is to be noted here that the “I” and “i” are not strictly Lacanian. The third layer, the address, refers to the recognition that there may be more than one addressee as the perspective of the speaker shifts, consciously or unconsciously. There may be a host of addressees: the interviewer, the interviewee’s past ‘self’, personal ‘ghosts’, or future selves, such as with Wiles in his BBC Nova interview when he breaks down in recounting his achievement. For Rogers, the languages of the unsayable are written in “negations, revisions, smokescreens (diverting attention to a safer place), and silences” (p. 110) while the signifiers of the unconscious are words that are repeated in the narrative “in ways that the subject herself cannot hear” (p. 115).

This method captures for me the threads of the subtext that flit by as we (my interviewee/co-speaker and I) speak, as we endeavour consciously to not contribute to either’s undoing. How and where is the true subject to be found? By attending to the various layers, the Interpretive Poetics method of therapeutic listening provides a means of uncovering aspects of the subject and her subjectivity.

With these three methods of analysis in varying degrees and circumstances, I present in the next two chapters my analyses of my subjects and their engagement with mathematics. The presentations of the analyses do not all follow the same scheme with the three methods in the same order. Each account of the mathematical journey is particular to the individual, with different aspects coming to the fore as I responded to the accounts and as various motifs both ‘insisted’ on being heard as well as ‘lay buried’ in my excavation of desire.

For the rest of this chapter, I turn to an important aspect of my methodology that must be confronted, namely, the position of the researcher in the research, and I conclude by addressing general challenges to the methodology as a whole.

The position of the researcher

Walkerdine, Luce, and Melody (2002) take up the issue of the place of the subjectivity of the researcher, namely, that of the place of emotions in the shaping of the analyses constructed by the researcher, noting that what gets told as ‘truth’ in research accounts is affected by the ‘dance’ between the researcher and the subject, the connections not being rational associations, but instead defences, fictions, and fantasies. Seeing the research process as the “construction of its own fiction”, they position the researcher as writing the story and being written into the story, with her own fantasies (and, I would add, desire). They corroborate a statement I made above: “The essential feature of using psychoanalysis as research tool is that the researcher is the primary instrument of inquiry” (p. 185).

Hence I, as researcher, am located in the research as co-participant in the interview encounter, but also, in the analysis, I “move outside this context of the research to become at the same time observer and observed” (Brown and England, 2004, p. 73). I am more than a ‘disinterested observer’, being vested in the research. Walkerdine *et al.* stress the importance of acknowledging our feelings as researchers. There were several instances when I felt surprise, impatience, and puzzlement. In many places my experience was consonant with that of my interviewees, but in many others, there was dissonance in that I found it hard to believe what I was hearing and seeing in front of me. As for power differentials, I mostly felt that I was on firm ground from my years of learning and teaching mathematics, but there were nuances in degree in the power relationship between my interviewees and me. As Walkerdine *et al.* note: “Looking at who reveals what to whom involves complicated plays of power” (p. 191).

Finally, I consider some of the more general challenges to the methodology in my research. In the second edition of *Doing qualitative research differently*, Holloway and Jefferson (2000/2013, p. x) write about the criticisms they received to their methodology in their research of defended subjects in the first edition. I take up three of these criticisms here as they may likely be levelled at the methodology in this study. The first is “[t]he invalidity of a case study of a single individual”, the charge being that it is insufficient and inappropriate. My reply to this is that I am not in search of typicality, of what appears generally. It is my thesis that the degree and quality of the mathematical

endeavour is a function of the individual subject. My goal is not to quantitatively measure and report averages, noting trend and deviation, and to make conclusions about some well-defined population; indeed, the population of those who achieve mathematics defies summary. As a statistician, I am well aware of the limitations of such approaches.⁴⁰ Instead, I seek to uncover and present facets of the phenomenon that I am seeking to illuminate.

The second is “[t]he problem of over-interpretation of the data”, the charge being scepticism about “the productivity of the psychoanalytic concepts/typologies for explanation or description” (Holloway and Jefferson, 2000/2013, p. xi). Both issues of the ‘scientificity’, as it were, of a method based on psychoanalytic concepts/typologies and the over-interpretation of the data (by which critics intend that the researcher finds what she sets out to find) rest on one’s ontological and epistemological commitments. This research is set in the qualitative interpretative tradition, which requires a given set of theoretical concepts. In his 1990 Tanner Lectures at Cambridge University (later printed as *Interpretation and over-interpretation* in 1992), Umberto Eco writes about the intention of the author, the intention of the reader, and the intention of the text. Eco asserts: “I accept the statement that a text can have many senses. I refuse the statement that a text can have every sense” (1992, p. 141). Eco further relies on a “consensus of community” (p. 144) to keep a check on far-fetched and improbable/impossible interpretations. I leave it to the reader to decide on his or her endorsement or not of the above theory and methods.

The third potential criticism I consider here is “[t]he ethical issues of interpreting another”, in particular, “[i]s it ‘acceptable’ to analyze a subject’s inner conflicts and to move beyond what was ‘knowingly’ given to the interviewer?” (Holloway and Jefferson, 2000/2013, p. x). This one gave me pause because at many points in the analysis of the interviews I wondered whether I was being fair to my interviewees, whether they would agree with what I saw as my insights, and whether I was being severe. Do they need to agree with my interpretations? I do not expect that they will, but I do worry whether I was being *fair* to them or making ‘wrong’ or ‘incorrect’ conclusions. Wherein lies

⁴⁰ The poet, William Blake, writes: “To generalize is to be an idiot. To particularize is the alone distinction of merit—General knowledges are those knowledges that idiots possess.”

truth/Truth or *the* truth/Truth? And from whose perspective and whose point of view is it to be found? In 'Talking and thinking about qualitative research', Ellis *et al.* (2007), seven noted qualitative researchers, deal with similar situations and ask similar questions. Ellis speaks about the difficulties in using her conversations with a friend in a book she is planning to write about her friend's end-of-life story, and Arthur Bochner writes about a research article on his conversations with his father during his father's illness and finds a bigger challenge in that his father is upset by the public knowledge of his illness. What are the ethical concerns in writing about an other, especially one who has 'given' to you of their time and consideration? It is no coincidence that the Ellis *et al.* chapter appears in a book titled, *Ethical Futures in Qualitative Research: Decolonizing the Politics of Knowledge*, as qualitative researchers wrestle with these questions and concerns.

Towards the analyses

In the next two chapters I begin to engage with my research questions about the nature of desire of mathematicians by analyzing accounts of the journeys in mathematics. In Chapter 5, I analyze written accounts of two mathematicians, Sofya Kovalevskaya (an example, primarily, of biography) and André Weil (an example of autobiography), and I follow that in Chapter 6 with analyses of oral accounts (from interviews) with two living mathematicians, Maya and Tom.⁴¹

As the reader will appreciate, with a concept as difficult and slippery as desire, I did not do the analyses in a linear, sequential fashion as laid out in the next two chapters. The research was organic, with the various activities of reading, writing and rewriting, thinking through the argument, interviewing, and analyzing being carried out very nearly simultaneously over the three years of research, the one building on the other. I had started with analyzing two pilot interviews with mathematician colleagues in my teaching institution and I had carried out my interview with Tom. I had not yet found Bracher and that pivotal word, desire. When I did find Bracher and Lacan, and with only a very little knowledge of Lacan (the three Registers), I tried my hand at writing an

⁴¹ Maya and Tom are pseudonyms.

analysis of Weil from his autobiography. Later that year, I came upon the mathematician, Kovalevskaya, by a happy accident of serendipity. I continued my study of desire with Bracher and Lacan and I was able to improve upon my analyses all the while conducting, transcribing, and analyzing interviews with other mathematicians (including Maya) and continuing my reading of biographies and autobiographies of mathematicians. With each pass at an analysis, each rereading and rethinking, I added fresh insight. As for privileging the journeys of these four mathematicians over the others that I read about or interviewed, I decided against reading 'across' in that my intent was to present rich, in-depth analyses that show desire relating to mathematics and mathematicians in its individuality.

It is important to emphasize that, in my analyses, I am not reading these accounts (what is written and said by and about mathematicians) as transparent reflections of desire; I am applying the various methods above, notably looking with the psychoanalytic lens of desire, in order to tease out desire. The analyses do not have same structure or order in that each mathematician is individual and the analysis that I present, while applying the three methods above in some manner and degree, is also individual. Further, I am not trying to triangulate with other sources; I am assessing the accounts on their own terms for what they are, for what they can potentially tell us about engagement with mathematics and what drives that engagement. I recognize and want to be clear that there is no final 'truth' to interpretation and that the interpretations are mine.

Whence and whereof I speak (4)

In this piece, I write about my journey in the field of mathematics education with my eye on the question cited earlier by Baldino and Cabral (2006) of what do practitioners in the field want:

[A] new question must be asked and its answer should be rigorously looked for in the same field of language in which it emerges: as mathematics educators, what do we want? ... If [we] take the question as pointing to that deep inside of ourselves where we repeatedly avoid recognizing what we really do when we pretend to behave innocently just trying to teach mathematics (better, to all, etc.), then the dimension of desire emerges. (p. 32)

When I first began to write out my thoughts out in my early years in the field, my title for my jottings was, 'Making my way in mathematics education: Notes from a newcomer'.⁴² I had spent my days teaching and learning mathematics but still restless and seeking challenge, I decided that I would go back to graduate school to learn about the theoretical underpinnings of what I had been doing for so many years with no formal training. I had seen a website for the study of curriculum and instruction at a major university and I thought that it would be a good place to start as my major foci in teaching were curriculum and instruction. I applied, not realizing that there was some restructuring going on. I received a letter of acceptance from a Department of Curriculum Studies where I was put into the Mathematics Education area. Had I done my research well, I would have found the other departments in a faculty of education that would cover the more general considerations of education of which I was in search. Still, I thought, alright, I can do this, I teach mathematics and I am interested in education.

⁴² Titles are important to me; if I can formulate a title, I can start writing.

But I very soon found out that much of the program was geared towards teachers in BC and the BC K-12 mathematics curriculum, matters that were very different from my post-secondary experience.

The field appeared strange to me for many reasons because the first conclusion that I came to very quickly was: There is no mathematics in mathematics education. Now in case that strikes you as somewhat outrageous, what I mean by this is that I very quickly found out that mathematics education is a different area of study from mathematics, with different concepts, modes of reasoning, and arguments, that is, it is of the social sciences since its emphasis is on the teaching and learning of mathematics which involves human subjects. It was my first real introduction to qualitative methods and traditions of enquiry and knowledge. Reading the papers was a huge culture shock; I had to read in parallel with a dictionary, I had to make lists of terms that I constantly consulted, and I had to learn to pronounce words that I had never heard before, like epistemology, phenomenology, and hermeneutics.

My next observation was: Where's the beef? I kept taking mathematics education courses and wondering what the big ideas were, the major results and the *theorems*. I could not find what the major themes in the field were. There was an official description in a course outline but professors would do as they pleased. I was amazed by the reading list for each mathematics education course, and how there did not seem to be an intersection or a core. I remember making this observation in a course and one student shared that he was on his eighth mathematics education course of his ten-course master's degree and every course had an extensive reading list with different readings; there was only one paper that appeared on the reading list of two courses. I kept thinking about what the major results were, where the seminal papers were. I hit upon the idea of asking well-known names in the field (by survey) to send me their list of ten influential papers in mathematics education or even three, say. I floated that idea past an eminent person in the field (a Canada Research Chair no less), and he said: If you ask 100 people to name 10 papers, you would have 1000 papers. So that put paid to that idea. I kept trying to ask people who the bright lights were, whom I should read, which authors were a must-read. They would hem and haw, scratch their heads, and eventually stammer out a name or two. I did find the *Classics in Mathematics Education Research* (2004), but those papers seemed quaint. So what was I looking for? It

seemed to me that if I wanted to study Group Theory or Differential Equations, I could open up a text book and find the major results and so on. So the question I was really trying to answer was: Where's the canon?

Then a third observation was: What do we call ourselves in the field? It took me a while to get used to the name, mathematics educator, which I first encountered when I saw one of my professors identify herself on a list circulated at a talk (by John Mighton) by writing 'mathematics educator' next to her name (as opposed to mathematics education faculty or professor that I was expecting). However, the above Canada Research Chair was indignant when I asked him a question starting with, As a mathematics educator, how do you....? He maintained that he saw himself as a researcher in mathematics education. I heard Barbara Jaworski at a conference argue that practitioners in the field should call themselves didacticians to incorporate the teaching and research aspects (shades of *didactique des mathématiques*). An old term in the literature is educationist, so perhaps, mathematics educationists, or to convey the aspect of being in the trenches, mathematics *educationistas*? My point is that the inability to agree on a name speaks to the inherent diversity of the field and the lack of an essential intention, leading to a fourth observation: To what end is the endeavour?

I had assumed that one of the aims of the field is to improve the teaching and learning of mathematics. But it felt to me as if mathematics education was going on in one area and that teachers and students in our schools and colleges were going about their business with little interaction, which led me to think that mathematics education is a cottage industry. It seems as if people in mathematics education were writing for other people in mathematics education and simply reproducing their own, so to speak (mathematicians do this all the time but there is a stronger sense of who they are and what they do). So my questions remained: What are we in mathematics education? Are we a field, a discipline, a hybrid of new knowledge? Wherein lies the authority? Do we need critics such as in art or theatre? I kept reading and found that others have also struggled with setting out the field's concepts, methods, and so on, and that there is great search for identity, while acknowledging the borrowing of frames and perspectives from other areas. I did find the two-volume of the 1994 ICMI (International Commission on Mathematical Instruction) study: *What is research in mathematics education and what are its results*, chaired by Jeremy Kilpatrick and Anna Sierpinska, and published as,

Mathematics education as a research domain and the search for identity (Sierpiska and Kilpatrick, 1997).

I realized that the metaphor I needed to understand where I was finding myself in mathematics education and trying to gain a perspective on the field was that of a map, a map of the terrain with markers for the big results and the extent of the field. I recalled the early map makers who, fearing the monsters beyond the edges in the unknown, would write: Here be dragons. Cartography includes:

a) map editing: setting the map's agenda and selecting traits of the object to be mapped. Traits may be physical, such as roads or land masses, or may be abstract, such as political boundaries;

b) map projections: representing the terrain of the mapped object on flat media; and

c) map design: orchestrating the elements of the map to best convey its message to its audience.

Cartography combines science, technique, and aesthetics in providing ways to communicate spatial information effectively. When I read about the fundamental aims of cartography, it seems to be a perfect description of what I am looking for as I make my way in mathematics education. In a beguiling piece, 'Of exactitude in science', the famed writer Jorge Luis Borges (1973) in his collection, *A universal history of infamy*, tells of the Cartographers of an Empire who became so accomplished at their craft that they built "a Map of the Empire that was of the same Scale as the Empire and that coincided with it point for point" (p. 143, *original emphasis*). Later generations were not so attentive and the Map was abandoned "to the Rigors of Sun and Rain. In the western Deserts, tattered Fragments of the Map are still to be found, Sheltering an occasional Beast or beggar; in the whole Nation, no other relic is left of the Discipline of Geography" (p. 143, *original emphasis*).

I realize now, after some years in the field, why one would be hard put to answer the earlier questions I had posed, given the growth and diversity of the field. Brent Davis titled his last editorial (2010) of the journal, *For the learning of mathematics*, 'What the field really needs'. I like the 'really'; it is as if all that has been done so far has been to

naught, as if it can be said once and for all, as if there is a cure-all for what ails the field. Perhaps it was his cry of anguish. After my time and study in the field, a map (or, perhaps, the equivalent of a Bourbaki which will set the field of mathematics education on some firm foundation) is no longer necessary. My earlier questions are no longer imperative to me as I have to come to terms with the sprawling, eclectic nature of the field, and am happy to have found my fragment of it.

Chapter 5:

Analysis of written accounts

In this chapter, I present analyses of written accounts of the journeys of two mathematicians, Sofya Kovalevskaya (data from biography) and André Weil (data from autobiography). My goal in general is to see what we can learn about mathematics from the testimonies of those who have engaged with mathematics. My aim in the dissertation is to answer questions such as: Who do I have to be in order to 'successfully' engage with mathematics? What do I have to give up of myself in order to do mathematics? Do I have to change myself in order to do mathematics? What demands/costs/rewards does the discipline place on us? What does mathematics require of us in order to engage with it?

I begin with an analysis of desire in the mathematical journey of Sofya Kovalevskaya as discerned from autobiographical and biographical material about her. Kovalevskaya wrote a memoir of her Russian childhood, but her mathematical journey has been gone over by many biographers, each with a personal and political slant. I present below my reading of desire as it appears in her journey.

Sofya Kovalevskaya: Mathematics as fantasy

Many persons who have not studied mathematics confuse it with arithmetic and consider it a dry and arid science. Actually, however, this science requires great fantasy.

--Sofya Kovalevskaya, Epigram in Alice Munro's (2009) novella, *Too much happiness*.

That I came upon the nineteenth-century mathematician, Sofya Kovalevskaya (1850-1891), is the happy result of a fortuitous sequence of events. I had borrowed from the public library a set of audio-discs of a collection of stories by Alice Munro (2009), *Too much happiness*. I knew that I would be in good hands with Munro; she is a master at plumbing the depths of the human condition. As I listened to the somewhat alarming stories of extreme characters and disturbing events, I felt I had to get the book, to see the words and sentences being read to me. I found the book and in reading the front and back matter, I saw that in the acknowledgment, Munro had found Kovalevskaya when she was researching something else in the Encyclopedia Britannica and was taken by the combination of novelist and mathematician. Turning to the stories, I saw that the last in the collection was a novella with the same title, 'Too much Happiness', on Kovalevskaya. Munro noted her debt to Don Kennedy's 1983 biography, *Little sparrow*⁴³: *A portrait of Sophia Kovalevsky*. How great was my surprise when, in the novella, I saw the names of Mittag-Leffler, Poincaré, and Weierstrass! These were names in my mathematics textbooks associated with concepts and theorems, and here they were, larger than life, in a short-story collection. The novella, focusing on the last few months of Kovalevskaya's life, was hard to read; from the beginning, there is foreboding and loss. "Too much happiness" were claimed to be the last words spoken by Kovalevskaya as she struggled with pneumonia contracted after undertaking an arduous journey.

Kovalevskaya was born Sofya Vasilevna Korvin-Krukovsky and took the surname of her husband, Vladimir Kovalevsky on their marriage when she was eighteen. Her surname is variously written as Kovalevski, Kovalevskii, Kovalevsky, Kovalevskaya (this is more accurate; in Russia, surnames of females end in a), Kovalevskaia, and Kowalewski. Her first name is often written as Sophia, Sophie, Sofia, Sofya, Sonja, Sonya, Sonetchka and the very intimate, Sofa. I have chosen to use Sofya Kovalevskaya⁴⁴, though the names often used in Western accounts are Sonya Kovalevskaya and Sophia Kovalevsky.

⁴³ Kovalevskaya was addressed as Little Sparrow in a letter to her from her husband. Edith Piaf (1915-1963) was also called Little Sparrow.

⁴⁴ This is the rendition in P. Kochina's (1981/1985) biography published in Moscow.

With respect to Kovalevskaya, I did not know of her as a mathematician despite all my years of learning and teaching mathematics. I came upon her serendipitously from the above literary source. I soon found that there was much more material on her; indeed there is currently a small industry on her life and work among historians of mathematics and science and a few mathematicians. Beside her memoir, *A Russian childhood*, which includes an autobiographical sketch, there are several biographies and secondary sources which give different perspectives on her life and the myths that have been created around her. As an indication of the range of views regarding her, one review of three biographies in *Physics today* is titled, 'A divergence of biographies: Kovalevskaya and her expositors', (Grabiner, 1984) which is a play on the title of one biography, *A convergence of lives; Sofia Kovalevskaja, scientist, writer, revolutionary* (Koblitz, 1983), a title which is, if anything, overblown.

A second consideration is that of translation into English and a related matter, that of citation. Much of the primary source material about Kovalevskaya is in other languages (Russian, French, and German) and the English translations are not uniform. Different translations give different words with different meanings and nuances (one example is the word, imagination, in place of fantasy in the quotation at the beginning of this section). Also since the data for my analysis are quotations by and about Kovalevskaya, it is important that, where possible, I give direct quotations. However, these are limited, with much more writing attributed to her in secondary sources such as Kennedy (1983). In his preface, Kennedy⁴⁵ notes that his wife had read and translated many of the sources, papers, letters, and diaries from the Russian; but he does not give references for quotations from her writing. Similarly, other sources that have used quotations from her writing do not, in general, give a citation. Often, when citations are given, they are to documents in other languages. I have used single quotations to indicate what is cited as Kovalevskaya's writing.

⁴⁵ One negative reviewer, Roger Cooke (1984), a mathematician, scathingly writes that Kennedy is neither a historian nor a scientist, and apparently not a writer (p. 17). In another article (Cooke, 1987), he describes Kennedy's biography as 'shoddy'. I can find no information on who Kennedy is except that his biography was published by the Ohio University Press.

A third consideration is the nature of my sources for the analysis. For Kovalevskaya, while she had written a memoir of her childhood, the inconsistent biographies and the dearth of first-hand material increased the difficulty of discerning her as a subject, of getting at how she regarded mathematics, or of seeing what her desire was with respect to it.

I begin by describing Kovalevskaya as a mathematical subject with the various subject positions (attitudes, ideals, values, beliefs) that are involved in taking up and doing mathematics. Then I study more broadly the forms of desire as they manifest in her engagement with mathematics, while noting the various other factors in her life and times that interacted with and shaped her desire with respect to mathematics. Finally, I tease out more carefully the strands of her desire.

As a mathematical subject

In the autobiographical sketch that Kovalevskaya has provided, the first indication of a stirring of intellectual ideas comes from her father's brother, Pyotr Vasilievich Korvin-Krukovsky. She writes that "my love of mathematics first showed itself" (Kovalevskaya, 1889/1978, p.213) in the stories he told and in their conversations about the things that he had taught himself from reading widely:

It was during such conversations that I first had occasion to hear about certain mathematics concepts which made a very powerful impression upon me. Uncle spoke about "squaring the circle," about the asymptote – that straight line which the curve constantly approaches without ever reaching it – and many other things which were quite unintelligible to me and yet seemed mysterious and at the same time deeply attractive. And to all this, reinforcing even more strongly the impact of these mathematical terms, fate added another and quite accidental event. (Kovalevskaya, 1889/1978, p. 214)

The accidental event occurred when she was eleven years old; the family moved to the country and the new wallpaper that had been ordered proved insufficient for all the rooms. The one room left over, the nursery, was papered with the pages of lecture notes of a course in differential and integral calculus. This was a course which her father had taken in his training as an Army officer and was given by the Academician

Ostrogradsky, member of the Petersburg Academy of Sciences. Kovalevskaya spent hours with the wallpaper:

As I looked at the nursery walls one day, I noticed that certain things were shown on them which I had already heard mentioned by Uncle ... It amused me to examine these sheets, yellowed by time, all speckled over with some kind of hieroglyphics whose meaning escaped me completely but which, I felt, must signify something very wise and interesting. And I would stand by the wall for hours on end, reading and rereading what was written there. I have to admit that I could make no sense of any of it at all then, and yet something seemed to lure me on toward this occupation. As a result of my sustained scrutiny I learned many of the writings by heart, and some of the formulas (in their purely external form) stayed in my memory and left a deep trace there. I remember particularly that on the sheet of paper which happened to be on the most prominent place of the wall, there was an explanation of the concepts of infinitely small quantities and of limit. (Kovalevskaya, 1889/1978, pp. 215-216)

For Kovalevskaya, mathematics begins with hearing the terms from her uncle and from seeing written passage. That mathematical “writings” are attractive and can hold one’s attention at that early age is, indeed, extremely rare. This passage speaks of extraordinary concentration and perseverance. Her sense that they “must signify something very wise and interesting” came from the stories that she had heard from her uncle. And she recognizes that, “yet something seemed to lure [her] on”, some feeling awakening in her. Her sustained preoccupation with the wallpaper seems too full of fancy and hardly believable, but as Lacan writes, truth has the structure of fiction. It is possible that this later recounting is a matter of making meaning retroactively of a “primal scene”.⁴⁶ Later, when she was presented with the discipline by her professor in Petersburg, it was all familiar to her: “You have understood them as though you knew them in advance” (p. 216). But we have to ask why this childhood occurrence is so significant that she wants to tell us the story. Is she saying that she was destined to be a mathematician and that the seed of her passion and pursuit of mathematics was planted here? It is to be noted that all the things she writes about concerning her uncle’s stories and the writing on the wallpaper (infinitely small quantities, the limit, asymptotes, and

⁴⁶ As in Freud’s Wolf Man where a childhood incident bore impressions and scars for life.

squaring the circle) are of the impossible and the virtual. She wants to know of things that are not real, not of this world.

Kennedy (1983) gives a slightly different version of this quotation that potentially gives greater insight into how Kovalevskaya regarded mathematics:

'Although he [her uncle] had never studied mathematics,' she wrote, 'he cherished the most profound respect for that science. He had gathered a certain amount of mathematical knowledge from various books, and loved to philosophize about them, on which occasions he often thought aloud in my presence. I heard from him for the first time, for example, about the quadrature of the circle, about the asymptotes which the curve always approaches without ever attaining them, and about many other things of the same sort – the sense of which I could of course not understand as yet, but which acted on my mind imbuing me with a reverence for mathematics, as for a very lofty and mysterious science, which opened out to those who consecrated themselves to it a new and wonderful world not attained by simple mortals.' (Kennedy, 1983, p. 17)

This is an important glimpse of how Kovalevskaya comes to hear of mathematical terms in ways that are not yet understandable to her, but are fascinating to her. These mathematical terms are signifiers which contain her nascent desire. She regards this knowledge as worthy of respect and a source of pleasure. Mathematics is elevated and sublime, not usually achieved by mere mortals. There is the religious note of "reverence" and the sacred; mathematical delights only reveal themselves to those who 'consecrate' and devote themselves to it. There is also the note of wonder; mathematics beckons from a new world of its own. Kovalevskaya makes of mathematics a sublime object. Lacan reminds us that there is nothing intrinsically sublime about or in the sublime object. It is "an ordinary, everyday object which, quite by chance, finds itself occupying the place of what he calls *das Ding*, the impossible-real object of desire ... It is its structural place - the fact that it occupies the sacred/forbidden place of *jouissance* - and not its intrinsic qualities that confers on it its sublimity" (Žižek, 1989/2008, p. 221). Indeed, Kovalevskaya partly frames her nascent interest in mathematics in the wallpaper, an object that came into her life quite by chance.

Besides the fascination with mathematics and the world of mathematics, Kovalevskaya brought deep concentration to her study of mathematics. She was intensely absorbed when doing mathematics. She refused activities with her friends to

work on mathematics: 'Now I am sitting at my writing desk in bathrobe and slippers, deeply absorbed in mathematical thoughts, without the slightest desire to take part in your excursion' (Kennedy, 1983, p. 36). She could spend long hours doing mathematics and being engrossed in the work. Her friend, Julia Lermontova (one of the first women to gain a doctorate in chemistry), wrote:

Sofa spent entire days at her writing desk doing mathematical calculations... Her ability over many hours to devote herself to concentrated mental labour without leaving her desk was really astonishing. And when, after having spent the entire day in pressing work, she finally pushed away her papers and arose from her chair, she was always so submerged in her thoughts that she would walk back and forth with quick steps across the room, and finally break into a run, talking loudly to herself and sometimes breaking into laughter. At such times she seemed completely separated from reality, carried by fantasy beyond the borders of the present. She would never consent to tell me what she was thinking on such occasions. (Kennedy, 1983, pp. 144-145)

Mathematics, thus, required complete absorption and concentration in a world that Kovalevskaya kept to herself; she did not share her thoughts with Julia presumably because Julia was not engaged in the mathematical endeavour, but more likely she wanted to keep mathematics for herself and not to share it. Kovalevskaya lost herself in her grappling with the mathematics; she faced other kinds of struggles outside of mathematics. The reference of being 'carried by fantasy beyond the borders of the present' will be addressed later.

Desire

Of the four forms of desire, the one that stands out most clearly in Kovalevskaya's life is the desire to have or possess the Other (**active anaclitic desire**): mathematics was the Other that she wanted to possess. She writes of hiding an algebra textbook under her pillow and reading it through the night as well as of her protracted fascination with the notes of a calculus course that was used as wallpaper of her nursery. It was as if she wanted mathematics to become a part of her from the long hours spent staring at those hieroglyphics and symbols (in particular, the symbol for the limit) and sleeping with those algebraic equations and expressions. Indeed, when she is introduced to these symbols later, her professor remarks that she understands them as if

she had known them in advance. She also writes of the trigonometry she devised in order to understand a physics textbook written by her neighbour. Also her passion for higher education in mathematics was inflamed by the political movement of the times (the serfs had been recently emancipated and there was much hope for reforms such as independence and higher education for women). As a woman, she was barred from attending or even auditing classes in mathematics and science, but she was smuggled into these classes at the university by men sympathetic to the cause. This furtive⁴⁷ pursuit of mathematics heightens the sense of pursuing a forbidden desire.

However, it was evident that true possibilities for higher education lay outside Russia, further afield in Europe. The stumbling block was that young unmarried women could not travel abroad and live independently except with parental permission and in the company of chaperones. One way of circumventing this prohibition was the undertaking of a 'nihilist' marriage (a platonic marriage of convenience). Her older sister, Anyuta, and *her* circle sought one such prospect in Vladimir Kovalevsky. He proposed marriage to Sofya who then assumed his name on marriage. Kovalevskaya later expressed feelings of guilt for the freedoms that she had gained so easily while Anyuta remained at home with their parents.

Kovalevskaya continued her pursuit of mathematics by journeying through the major university cities in Europe seeking to be admitted or to attend classes (all barred to women). She went to Vienna to ask Victor von Lang, a professor of physics, for permission to attend lectures. She decided to try her luck in Heidelberg with Professor Gustav Kirchhoff. He sent her off to others (her requests were met with amazement as they were unheard of at the time). Despite the 'delays and half-answers', she succeeded in studying with Kirchhoff for a few semesters. She also braved the prejudice of Robert Bunsen (of the Bunsen burner) who had proclaimed that "no woman would ever profane his laboratory" in order to study chemistry (Kennedy, 1983, p. 127).

On the recommendation of her professor, Leo Königsberger at Heidelberg, Kovalevskaya finally made her way to Karl Weierstrass in Berlin in the hope of being

⁴⁷ In another context of what motivates mathematicians, André Weil writes: "[N]othing gives more pleasure to the researcher [than] these obscure analogies, these murky reflections of one theory in another, these furtive caresses, these inexplicable tiffs" (1992, p. 52).

tutored by the best in the field of mathematics. Weierstrass (some thirty years older and a bachelor who lived with his spinster sisters) was so confused by her presence as a woman wanting to study mathematics that he gave her a list of problems to do in the hope that she would find them too hard and not return. She did return and amazed him with novel solutions that demonstrated unusually great depth of understanding. Kovalevskaya did original work in three areas of mathematics, any of which would have been enough for a doctorate in mathematics. She writes: "But since the doors of the University of Berlin were closed to me as a woman, I determined to try for Göttingen" (Kovalevskaya, 1889/1978, p. 219). Weierstrass presented her results in the three areas in a letter to the rector of the university (who was also a former student of Weierstrass). Kovalevskaya writes: "They were adjudged sufficiently satisfactory for the university, contrary to its established procedure, to exempt me from the requirements of an examination and public defense of my dissertation (which is essentially no more than a formality) and to award me directly the degree of Doctor of Philosophy, summa cum laude" (Kovalevskaya, 1889/1978, p. 219). The first area of her work was in solving partial differential equations (one of her results is called the Cauchy-Kovalevsky theorem). In the second, she extended some results of Euler, Lagrange and Poisson involving Abelian integrals and in the third, she extended the work of Laplace on Saturn's rings. That she pursued the study of mathematics to this extent is evidence of her enjoyment of the discipline and her desire to possess it to some degree.

Closely intertwined with active anaclitic desire is **active narcissistic desire** where the subject seeks to be one with the Other, to identify with or to be devoted to the big Other of mathematics which was embodied for Kovalevskaya in Weierstrass. Her devotion to higher mathematics led her to a relationship with Weierstrass as a colleague, no longer that of teacher and student. He was her primary model of a mathematician as she strove to adopt his style: "These studies [with Weierstrass] had the deepest possible influence on my entire career in mathematics. They determined finally and irrevocably the direction I was to follow in my later scientific work: all my work has been done precisely in the spirit of Weierstrass" (Kovalevskaya, 1889/1978, p. 218). This devotion worked to her detriment in that some mathematicians, in particular Felix Klein, charged that it was Weierstrass, and not she, who did the work for which she was given credit.

Klein wrote: “Her works are done in the style of Weierstrass and so one doesn’t know how much of her own ideas are in them” (cited in Rappaport, 1981, p. 564).

In seeking to identify with mathematics and hence with being a mathematician, Kovalevskaya carried out the work of a mathematician in writing and publishing. It was vital to her that her work was published in recognized arenas of mathematics at the time, namely *Acta Mathematica* and *Crelle’s Journal*: “At this writing *Acta Mathematica* is regarded as one of the foremost mathematics journals in scholarly importance. Its contributors include the most distinguished scholars of all countries and deal with the most ‘burning’ questions – those which above all others attract the attention of contemporary mathematicians” (Kovalevskaya, 1889/1978, p. 221). She considered it a high honour to have her work in partial differential equations published in *Crelle’s Journal*:

This honour, given to very few mathematicians is particularly great for a novice in the field, inasmuch as *Crelle’s Journal* was then regarded as the most serious mathematics publication in Germany. The best scientific minds of the day contributed to it, and such scholars as Abel and Jacobi had published their work in it in former times. (Kovalevskaya, 1889/1978, p. 219)

In these ways she worked towards belonging to the community of mathematicians (the Imaginary others of mathematics), identifying herself in the quotation above as being in their league, part of their greatness and seriousness. Indeed, she does not speak of the results that were published, but of the people.

Beside the two active forms of desire, there are two passive forms of desire. I begin with **passive narcissistic desire** (the desire to be object of the Other’s love, admiration, idealization, or recognition) which Lacan calls the strongest form of desire. Kovalevskaya sought to be recognized as a mathematician. She writes: “At that time my name was fairly well-known in the mathematics world, through my work and also through my acquaintance with almost all the eminent mathematicians of Europe” (Kovalevskaya, 1889/1978, p. 222). What is in a name and in wanting one’s name to be known? For Kovalevskaya, it was her very subjectivity and her desire for recognition and posterity in the “mathematics world”. She aspired to be recognized as a mathematician and to take her place among the circle of “eminent mathematicians of Europe”. One manifestation

of such achievement would be a teaching position in a Russian or European university. She was barred; the times dictated that her only opportunity would be at a school for girls. She was relegated to the company of the wives of mathematicians, their “perfumed conversation constricting her throat” (Munro, 2009, p. 87). Despite an enthusiastic endorsement from Weierstrass, her search for a teaching position was unfruitful until with the help of Gösta Mittag-Leffler (also a former student of Weierstrass), she secured a position teaching mathematics at Stockholm University in Sweden. This was something, but not as much as she had hoped for. This was the only university teaching position offered to her in Europe and Russia. A few years later, she was also appointed to teach mechanics at Stockholm University: Kennedy describes her as being “twice a professor” (1983, p. 235).

Kovalevskaya sought to be desired by mathematics in assuming the position of the first female editor, and only the second editor, of the mathematical journal, *Acta Mathematica* (its first editor and founder was Mittag-Leffler); such a position being occupied by a woman was again unheard of at the time. A further example of seeking the favours of mathematics was in her competing for and winning the Prix Bordin, then of the level of a Fields medal in mathematics, the high quality (due to Weierstrass’ insistence that she hone and refine her work) of her submission, ‘On the rotation of a solid body about a fixed point’, being noted and rewarded with greater prize money.

There are conflicting reports of her candidacy for this prize. Cooke (1984; 1987) and Koblitz (1983) maintain that it was common practice at the time for the mathematicians in charge to stage the contest so that the prize would be given to person who was already decided upon with the intent of rewarding a body of work, and that the topic would be set such that that person would win. They also maintain that the organizers knew what Kovalevskaya was working on and thus set the topic, leaving it deliberately vague so that she would win. In her autobiographical sketch, Kovalevskaya writes about the problem of the rotation of a solid body about a fixed point under gravitational force:

[It] had always held a strong interest for me. I began work on it long ago, almost from my student days. But my efforts remained fruitless for a long time; not until 1888 were they crowned with success ... In that same year of 1888, the Paris Academy of Sciences announced a prize competition

for the best essay “*Sur le problème de la rotation d’un corps solide autour d’un point fixe*,” with the proviso that the essay must substantially refine or supplement findings previously attained in this area of mechanics. (Kovalevskaya, 1889/1978, p. 227)

The submissions were anonymous; she submitted hers with the following maxim: “*Dit ce que tu sais, fais ce que tu dois, adviendra que pourra!* Say what you know, do what you must, and whatever will be, will be” (Kovalevskaya, 1889/1978, p. 229). It does not seem to me that she knew what the outcome would be and indeed, it seems that she was prepared to accept any outcome.

Why did Kovalevskaya pursue prizes and other trophies such as editorships? She sought to be a mathematician and to do the work of a mathematician which included being involved in professional activity as editing a journal. She sought to be taken seriously as a mathematician. As a female academic, instead of recognition, Kovalevskaya met with opposition in some quarters (for example, from the playwright, August Strindberg, who abhorred the idea of a female academic), but in Russia, the local newspaper carried this item: “Today we do not herald the arrival of some vulgar insignificant prince of noble blood. No, the Princess of Science, Madam Kovalevskaya, has honoured our city with her arrival. She is to be the first woman lecturer in all Sweden” (in Flood and Wilson, 2011, p. 167). This must have been bitter-sweet as she could not be a woman lecturer in Russia nor a member of the Russian Academy of Sciences. From her position in Sweden and the efforts of mathematicians such as Pafnuty Chebyshev, she was eventually accepted as a corresponding member of the Russian Academy of Sciences.

The remaining form of passive desire is **passive anaclitic desire** or the desire to be desired or possessed by the Other as the object of the Other’s enjoyment. I have positioned in the dissertation the Other as the discipline of mathematics and the community of mathematicians who animate the discipline, but the Other has a more general sense of the wider set of rules and hypotheses in which we find ourselves as we live our lives. In Kovalevskaya’s life, this desire, it seems to me, is intricately woven with her desire as a woman in her society in her time. She was a wife and mother, a single mother, and a widow (her husband committed suicide when she was in her thirties leaving her responsible for her life, her daughter’s life, and for clearing up the financial

and other responsibilities that were left behind). Besides the reality of her situation and a life in mathematics, she was devoted to literature, writing theatre reviews, poems (for herself), a novel, a memoir and play (she collaborated with Anna Carlotta Leffler on the play; she contributed the ideas for character, plot and theme while Leffler did the writing). According to Kennedy, Kovalevskaya writes:

'As far as I am concerned, during my life I could never decide whether I had a greater inclination toward mathematics or literature. Just as my mind would tire from purely abstract speculations, I would immediately be drawn to observations about life, about stories; at another time, contrarily when life would begin to seem uninteresting and insignificant then the incontrovertible laws of science would draw me to them. It may well be that in either of these spheres, I would have done much more, had I devoted myself to one exclusively, but I nevertheless could never give up either one completely.' (Kennedy, 1983, p. 264)

Literature has its own charms, given its preoccupation with 'stories' and 'observations about life'. For Kovalevskaya, literature provided a counterpoint to the "abstract speculations" of mathematics, both literature and mathematics being variations on the theme of the creative. It is interesting that she realizes that she could have accomplished more had she focused exclusively on one of the two, but she was willing to sacrifice that achievement in order to keep a foot in both worlds. Does that imply that her desire to pursue mathematics was not as singular or as intense to the degree that is expected of one who desires to be a mathematician? According to Lacan, every desire is born out of lack, out of alienation and separation, out of a desire for self-fulfillment. The nature of desire is that it is constant, repetitive, and forever circling. Her desire in these two spheres can be seen as an attempt to address and reconcile the various aspects of herself with respect to the registers of the Imaginary (she was interested in life, its characters, its appearances, and its illusions) and the Symbolic (the words of literature and the symbols of mathematics that she could marshal to give 'life' to her thoughts and ideas). Her desire was fed by both avenues, the one coming to the fore as interest in the other faded or was blocked in some way ("Just as my mind would tire from purely abstract speculations...").

I now undertake a further reflection of themes, examining the refrains and reverberations relating to her desire. I have chosen the words, refrains and

reverberations, deliberately for their acoustic connotation because, it seems to me, that as I read the various sources on Kovalevskaya, I was listening for the resonances and themes relating to her desire. I discuss three refrains which contribute to what Freud calls the melody of the drive. I then show how the leitmotif of her life can be seen as asymptotic desire. The refrains relating to desire that stand out for me in Kovalevskaya's life are absorption, substitutes, fake, and fantasy.

Absorption

Absorption refers to the process of taking in or being taken by, leading to both an inward and an outward captivation. An early instance of absorption can be seen when as a child, Kovalevskaya stared at the wallpaper in the nursery as described above. This was no passing attraction; she spent hours every day with the wallpaper absorbed in and by the mathematical hieroglyphics. She spent time looking for sequence and argument which would have contributed to meaning. How does one make sense of the indecipherable? The philosopher Simone Weil (sister of André Weil) writes of a way making meaning of the incomprehensible: "You stare at it until understanding dawns". Kovalevskaya's time in front of the wall was well-spent in that it seemingly produced a subliminal, unconscious understanding. Later when she was introduced to the mathematics depicted, she recognized the notation for a limit; as indicated above, her teacher remarked that it was as if she had known them in advance.

[A]s a matter of fact, at the moment when he was explaining these concepts I suddenly had a vivid memory of all this, written on the memorable sheets of Ostrogradsky; and the concept of limit appeared to me as an old friend. (Kovalevskaya, 1890/1978, pp. 122-123)

Is this a fantasy on her part, that "vivid memory" not to be trusted? Quite likely, but the hieroglyphics had become dear to her, as an old friend in a cheerless nursery.

Another instance of absorption comes when, as a young woman studying mathematics, she spent long hours by herself engrossed in the mathematics; she willingly gave up social activities with her friends to spend time with the mathematics on which she was working. Further, the absorption in the experience was complete, so

much so that she would not or could not speak about it to her close friend, Julia Lermontova, herself a scientist, with whom Kovalevskaya lived.⁴⁸ Kovalevskaya could only find release in walking quickly about the room occasionally clapping her hands. Did the clapping of hands indicate self-applause for her efforts and engagement with it? This may have been a way of letting go of the nervous energy that she must have gained from the sheer effort of doing and creating the mathematics, of being tantalizingly on the brink of possible discovery or possible despair. More likely, she was clapping for the big Other, to express her joy in the mathematics, in her doing of it, and to call attention to herself in her need to be acknowledged.⁴⁹

Besides these examples of inward absorption, there was an outward absorption in her strong identification with the style and spirit of her teacher, Weierstrass. While in the beginning they met and worked face-to-face, a great part of their mathematical interaction was through the exchange of letters.⁵⁰ Weierstrass demanded certain principles of doing and writing mathematics. He had encouraged her in a letter:

[T]he important thing is for you to get some idea of what has been done up to now in mathematical physics and of unsolved problems. In doing this you can work on some easy problems to practice exposition, where, as I have often told you, the elegant working out of details should be considered an essential thing ... I do not consider myself a scientific pedant and I do not claim that there is only one True Church in mathematics. However, what I do demand of a scientific work is unity of method, the sequential following of a definite plan, and the appropriate working out of details, and that it should bear the stamp of independent investigation. (cited in Cooke, 1984, p. 86)

⁴⁸ Novelists often write or speak in interviews about the solitude required in the creative process and the process of writing; they cannot talk about what they are doing or writing or creating, for fear that speaking the words or sharing the ideas will make the whole thing dissipate into the air or turn it into something else. I am reminded of my own experience while writing my master's thesis – with each attempt to express what I was trying to do, it seemed to go further and further away from me and that there was less and less there.

⁴⁹ In many Hindu temples, there is a bell at the entrance. When you enter the temple, you know full well that God is everywhere, but you ring the bell to get God's attention, to announce to God that you are here, that you have arrived. This is an example of Žižek's "fetishistic split": you know very well ... but at the same time....

⁵⁰ At her death, Weierstrass burned her letters to him; the extant letters are those from him to her. This burning of her letters is a curious thing but there is no indication of his reason(s). One can speculate that this came from a consideration for privacy on his part towards her.

By fashioning herself along these principles of Weierstrass, she came close to losing her mathematical self in her relationship with him, to the extent that she left herself open to Klein's charge of it being impossible to tell what was her work and what was that of Weierstrass. In fact, Weierstrass had complained to her that students of his had written up work that was his and claimed it as their own and she tried scrupulously to avoid that charge. Still, her declaration that "all my work has been done precisely in the spirit of Weierstrass" and her meticulous attention to the requirements of his style of mathematics are strong indications of her identification with the notion of what it means to do mathematics and to be a mathematician. The fusion of her mathematical self in Weierstrass as a mathematician was complete, leading to a loss of boundary with respect to her, as a separate mathematical subject, and to an erasure of self. In this quotation there is also the connection of mathematics and religion ("one True Church in mathematics"), mathematicians as believers, performing rituals and keeping the faith.

Substitutes

The second refrain in Kovalevskaya's life is that of substitutes, in that the essential supports of her life from beginning to end were gratified by substitutes. What did she not have in the beginning? To begin, she was not a boy. The eldest child in the family was a girl, Anyuta. Kovalevskaya, coming six years after Anyuta, was unwelcome as her parents were hoping for a boy. Cooke (1983, p. 7) describes her as having "a dark complexion with a very intense and serious personality." Her mother preferred her first and third children, Anyuta with her blonde curls and pleasing manner and Fedor because he was a boy: 'I often heard my nurse say that Aniuta and Fedya were mama's favourites, and that mama disliked me. I do not know whether this was true or not, but nurse always said it quite regardless of my presence' (Kennedy, 1984, p. 9).

Kovalevskaya shared a similar serious and thoughtful temperament with her father, but he was distant with the family. She was left largely in the care of her nurse who became a mother substitute for her. When she was brought into company with her nurse, her mother would dismiss them, saying to the nurse: "take your savage away, she is not wanted here". Her mother was, effectively, devaluing and disowning her. This event of narcissistic trauma marked her then and for the rest of her life, which became a search for a place where she was wanted. The children were unattended for a long time

until her father realized that they had no training: "Father all at once made the unlooked-for discovery that his children were far from being the exemplary beautifully brought-up children he had assumed they were" (Kochina, 1981/1985). Lessons were then instituted with a governess and a resident house tutor, more substitutes.

Besides these, by engaging in a platonic marriage, Kovalevskaya assumed a substitute husband, Vladimir Kovalevsky. Their relationship was fraught with tension as Kovalevsky was supposedly no more than a convenience to her. Weierstrass did not know anything about the young man who came to pick her up after lessons; she told him about her marriage only after a couple of years. Indeed, Koblitz writes that it was only after finding out about the marriage that Weierstrass thought that there might be need to have some recognition of her learning and hence undertook efforts to getting a doctorate granted. There are differing accounts of how the doctorate was obtained. Kovalevskaya writes in her autobiography that she settled on the University of Gottingen. Another source indicates that Weierstrass 'hawked' her work around the various German universities until he found one that would grant the degree. [This is not to detract from her achievement, but only to indicate once more that there is much interpretation from this remove of history.]

Another substitute in her life is seen in her relation with Weierstrass; he was a substitute father to her. Kennedy (1984, p. 150) writes:

She was never really intimate with her mother. She so much resembled her father in nature that during her late adolescence this constituted an actual barrier between them, as often happens when such pairs see their own faults as though magnified in one another. It was, therefore, as though she found in Weierstrass a surrogate father, causing him to react to her as to a foster daughter, perhaps with faintly sexual overtones.

The tone of Weierstrass' address to her in his letters slowly undergoes a change from the formal to one indicating their deepening relationship and his constant encouragement and support. In one letter, he calls himself her "Spiritual father" (*original emphasis* for the capital S). Also, as above, the charge by some such as Klein that her words were written by him leads to loss of boundary and erasure of self.

The final observation relating to substitutes concerns her statement in her memoir about being equally at home in many languages (French, German, and Swedish) besides Russian. As this is generally not the case (people rely on and return to their mother tongue to express themselves especially in times of difficulty), what is one to make of this unusual claim? Could these other languages have been substitutes for her as she made her way in societies not her own, societies in which she was forced to live and work in order to pursue her desire?

Fake

Closely tied to substitutes is the third refrain of fake. In a letter to Anyuta dated 1868, Kovalevskaya writes: "In my present life, despite its seeming logic and completeness, there is a certain false note that I cannot determine, but which I feel nonetheless" (Kochina, 1981/1095, p. 51). Nowadays, the feeling of being a fake is recognized as a psychological condition called the Impostor Syndrome where people, despite external recognition of their accomplishments, do not believe themselves to be deserving of the place or position they occupy. This feeling is common among academics who may have arrived at their positions and titles by alternative rather than orthodox means⁵¹. It is to Kovalevskaya's credit that she noted the inauthenticity of her life, but how could it have been otherwise? Both her experience of being parented and her marriage were fake, thereby perhaps leaving her with a desire to be desired and to find a place where she was desired. Also, she felt guilty about being able to escape to Europe so easily with her fake husband, when her sister, Anyuta, the true revolutionary, languished in Russia. Her marriage, after many tensions and misunderstandings, was not consummated until after eight years or so. She had found it difficult to keep up the fiction to her parents and to deal with the inauthenticity of a pretend marriage and a pretend life. But is it also that she was trying to break into a circle of male European mathematicians with established positions from which she was barred, that all that she had accomplished as a mathematician came to nought, as it were, in her own country, that she had to make her way elsewhere, teaching and leading a life in exile from her

⁵¹ In an interview, the Canadian poet, Ivan Coyote, who obtained a university position as a writer-in-residence later in her career, expressed her fear as she sits at her desk that at any moment the campus security will show up, announce that she is a fake, and escort her out of the building.

homeland and her people? Some years after her husband died, when she was teaching in Sweden, there came into her life, a Russian, Maxim (Munro writes: they fell on each other) with whom she was able to be herself; they were Russians together, in a foreign land. This relationship did not turn out well for her, as I show later.

Fantasy

On the other hand, her life was full of fantasy. In a letter from Weierstrass to her, he writes: “How fine it would be were we both here. You with your soul full of fantasy, and I, excited and refreshed by your enthusiasm. We could dream and think here about the many problems that we have to solve: of finite and infinite spaces, of the stability of the world systems, and about all the other great problems of mathematics and physics. But long ago I resigned myself to the fact that not every wonderful dream is realized” (Kochina, 1981/1985, p. 75). Her fantasies were broad and wide-ranging, but with respect to mathematics, they provided a way for her in which to find herself. This is the universal fantasy of mathematics, that we can find ourselves in it and that it will give us back to ourselves. But it is only a fantasy; the wisdom that comes from traversing this fantasy is that the big Other of mathematics (as a symbolic, complete, ordered, totality)⁵² is structural and does not exist!

The other realization is that to seek to possess mathematics is to undertake a journey towards it. It requires special effort and does not yield its secrets too easily. With Maksim Kovalevsky (a distant relation of her husband), whom Kovalevskaya found towards the end of her life, and who held the promise of happiness for her, she had to go to him; he stayed away, leaving her to come to him. This is true of her relationship with mathematics as well; she always had to go to mathematics. She learned of her mathematics from staring at the wall and from the stories the uncle told; her life was a journey in search of the fascination it portended. In some sense, mathematics is the place of the things that she wanted to be true and to come true. The fantasy of mathematics for Kovalevskaya is that it is the place of the true to countermand her

⁵² This reminds me of my days teaching calculus: I would begin by announcing that the set of real numbers is a complete, ordered, Archimedean field and then proceed to explain each term. Nowadays the pedagogy (mostly driven by the way textbooks are written) has moved on; we take the real numbers as given and carry on.

sense of being fake. Indeed, the ultimate fantasy of mathematics is that it gives us a false sense of power.

The leitmotif of her life: Asymptotic desire

These refrains underpin the central theme of asymptotic desire in Kovalevskaya's life, echoing the terms of quadrature and asymptote by which her desire to possess mathematics was awakened. Lacan had used the notion of the asymptote to describe desire, always approaching, but never attaining an object because there is no object of desire, only an object-cause of desire. Grosz (1990), in her feminist introduction to Lacan, elaborates the origin, nature, and path of desire:

Lurking beneath the demands for recognition uttered by the *cogito* (this is Hegel's 'solution' to the problem of the solipsism of the *cogito*), by the subject (to the other) and by the masculine subject (to an unknowable femininity) is a *disavowed*, repressed or unspoken *desire*. Desire is a movement, a trajectory that asymptotically approaches its object but never attains it. Desire, as unconscious, belies and subverts the subject's conscious demands; it attests to the irruptive power of the 'other scene', the archaic unconscious discourse within all rational discourses, the open-endedness of all human goals, ideals, aspirations, and objects. (p. 188, *original emphasis*)

This is a powerful evocation of desire as it points out the unconscious, unknown, and unacknowledged aspects of desire. Desire is not only asymptotic; it shifts to drive in its constant circling of the void of desire. As Žižek (1991, p. 3) explains, it is not the goal, but the aim (the path towards the goal) that gives enjoyment. For Lacan, the subject is constituted by its lack which gives rise to desire. Kovalevskaya's desire arose out of various senses of lack, the sense of not being male, of not being allowed to take her place as a mathematician, and of not being complete as a mathematician.

To begin an examination of these three components, I consider her being a woman in Russia and in her time. What does it signify? Koblitz (1986, p. 4) maintains that “[i]t is impossible to understand her without putting her in the nihilist context.” The 1850s in Russia were a time of great upheaval, with the emancipation of the serfs and great emphasis on science and education as a means of improving society. Kovalevskaya had a grand vision for herself: “My destiny, or, if you wish, the main goal of my life, but I like more the word destiny, because the goal of my life is in myself while

destiny is of divine origin. I feel that my destiny is to serve the truth that is science and to blaze the trail for women because that means to serve justice” (Kochina, 1981/1985, p. 75). It is these kind of grand delusions (whether they achieve fame or not) that is so telling in many reflections by mathematicians. Koblitz describes her as a vocal feminist, a political activist, and as a champion of women’s rights (she handled funds for revolutionary groups and smuggled female refugees out of Russia; as an advocate for higher education for women, she had dreams of ‘freeing’ and ‘developing’ women).

That she was not allowed to take her place as a mathematician can be seen in her not being able to get a teaching position in Russia or Paris as she desired (Paris then being the centre of cultural and political activity). In her desire to be desired, she was trying to find a place where she was wanted (“[t]ake away your savage, she is not wanted here”); to some extent mathematics did not want her either. Keen (1986, p. ix) writes: “Sonya Kovalevskaya was a distinguished mathematician who was considered among the best of her generation by her contemporaries”, but this was not enough to for her to be granted the position that she wanted.

Despite her striving, Kovalevskaya did not feel complete as a mathematician in that she had other aspirations pertaining to writing. Her writing included theatre reviews, poetry (for herself), plays, an autobiographical memoir, and a novel. Mostly she was influenced by the quotation attributed to Weierstrass, of not being a complete mathematician without having the soul of a poet. She yearned to be both. Had she not sought higher education, to what could she have aspired? It would be most likely marriage to someone of suitable wealth and class, and a life of raising a family. She had seen the life of her mother and desired more. Also she was influenced by Anyuta, who had given those avenues up for a serious life of study and helping the less-advantaged. Kovalevskaya yearned for more out of life, more involvement in social, political and cultural dimensions, perhaps to her detriment. In responding to the *che vuoi?* of the Other, she seemed to be always looking for another mountain to climb. Her friend, Julia, writes that she set herself difficult goals, but “I never saw her so dismal and depressed as when she reached her goal” (Kochina, 1981/1985, p. 88). This last sentence is part of a larger quotation from Julia which is helpful in explaining her many pursuits:

She slept very little at night and frequently had disturbing dreams. Often she would awaken suddenly from some fantastic dream and would ask me to sit with her. She readily related her dreams, which were always very original and interesting. Not infrequently they were like visions to which she ascribed prophetic significance and which often actually came true. In general she was distinguished by an extremely nervous temperament. She was never at peace, always setting difficult goals for herself, always wanting passionately to obtain them. Despite this, I never saw her in so depressed a state of mind as when she had achieved a particular goal. It seemed the reality of achievement never corresponded to what she had imagined. (Kennedy, 1983, p. 167)

There is much to note here about her “not being at peace”, sleeping little with “disturbing dreams”, and “setting difficult goals for herself”. Her search for self-expression and self-fulfillment kept her in constant pursuit of her goals with muted success (“the reality of achievement never corresponded to what she had imagined”). *Jouissance* is to be gained in the aim and not the goal. Also, she wanted to keep mathematics to herself; she would relate her dreams and not speak about the mathematics in which she engaged.⁵³ Further her dreams of “prophetic significance” are consonant with her grand dreams/delusions of blazing a trail, destiny, and justice.

Summing up Kovalevskaya

In the epigram at the beginning of this chapter, Kovalevskaya regards the science of mathematics as requiring great fantasy. The epigram is part of a longer quotation which appears in a letter from Kovalevskaya to a young Russian woman writer:

I understand your surprise that I can work at the same time with literature and mathematics. Many who have never had an opportunity of knowing any more about mathematics confound it with arithmetic and consider it an arid science. In reality however, it is a science which requires a great amount of fantasy, and one of the leading mathematicians of our century states the case quite correctly when he says that it is impossible to be a

⁵³ This is reminiscent of a sentence in Kennedy (1983, p. 155) over which I agonized about including, that she had extracted from Weierstrass a promise not to have another female student. I had read that sentence quickly, noted it, and put it away in my mind as it did not go with the way I was seeing her in my mind, and also because I only read it in Kennedy (only one of her many biographers).

mathematician without being a poet in soul ... one must renounce the ancient prejudice that a poet must invent something that does not exist, that fantasy and invention are identical. It seems to me that the poet has only to perceive that which others do not perceive, to look deeper than others look. And the mathematician must do the same thing. (Kovalevskaya, 1889/1978, p. 216)

A first question comes from the statement, 'this science requires great fantasy'. One might ask, why does she say mathematics requires great fantasy and not intuition or imagination, say? She worked with partial differential equations, rotations of a rigid body, and elliptic integrals, all constructs and concepts which require more than a leap of intuition or imagination. There is little in the accounts that help with understanding of her use of the word, fantasy, but it may be an effect of the translation as, in another translation, the word imagination is used. Earlier I pointed to the quotation from Julia who wrote that after long hours immersed in her work, Kovalevskaya appeared transported to another world ('carried by fantasy') that she could not or chose not to express in words, but could only find release in rapid walking back and forth. Generally we see a fantasy as a product of caprice and fiction. For Lacan, the role of fantasy is in staging and structuring desire, in creating and sustaining desire. Žižek (1997/2008, p. 7) writes: "a fantasy constitutes our desire, provides its coordinates; that is, it literally 'teaches us how to desire'". For Kovalevskaya, mathematics requires and provides fantasy for Kovalevskaya in that it gave her the means to look in a different way at a different world from the one in which she found herself. It gave her a means to be loved (from the feeling of being unloved early by her mother), to stand out and be recognized.

Next, it is not clear to which mathematician Kovalevskaya is referring with respect to needing to have the soul of a poet to be a mathematician, but the following is ascribed to Weierstrass: "It is true that a mathematician who is not also something of a poet will never be a perfect mathematician" (Bell, 1937/1965, p. 434). There is much in the connection between poetry and mathematics. In both, there is the attempt to find the essence, to strip the concepts to their bare essentials, to choose carefully the right word, phrase, symbol or matheme to capture the heart of the matter. Mathematicians pay attention to beauty, symmetry, and invariance as do poets in an attempt to apprehend the 'soul' of the experience. In other references, the last phrase of the Weierstrass quotation is rendered as ... a *complete* mathematician (*my emphasis*). This seems to

raise the bar higher and to make the injunction more grave and serious so as to take on the quality of a deterrent: does this weed out many of us who would aspire to be mathematicians?

Why does Kovalevskaya distinguish fantasy and invention and go on to say that we must abandon the notion that fantasy and invention are the same? Both fantasy and invention are creative acts in all fields, not just mathematics. In both, there is the bringing forth of thoughts and ideas that had not existed before. Perhaps, she means to indicate that they have different ends and that fantasy must not be associated with any use-value. The final thought in the quotation is helpful in showing her position that mathematics requires a depth of looking, of looking deeper than others. She writes: "It is the philosophical aspect of mathematics which has attracted me all through life. Mathematics has always seemed to me a science which opens up completely new horizons" (Kovalevskaya, 1889/1978, p. 216).

In analyzing this life in mathematics, it is helpful to go back to the beginning. Kovalevskaya's first inkling of self and identity came from hearing her nurse say: "Tell him my dear, my name is Sonetchka and my father is General Krukovsky." Kovalevskaya later recalled, 'this imprinted itself on my memory... from it I date my chronology, the first invasion upon me of a distinct idea of who I was, and what was my position in the world' (Kennedy, 1983, p.1). Clearly she saw herself as of a privileged class, but she also knew that she would have to resort to drastic measures (such as a nihilist marriage) if she wanted to pursue higher education.

At every turn, Kovalevskaya's life and work were dominated by the signifiers of 'woman', 'Russian' and 'mathematician'. None of these would have come up as an issue of struggle in a given society or community. Only when her desire was hemmed in by these that they became forces by which she was buffeted. There was little possibility that the society in which she found herself could accommodate or integrate her desire. Besides mathematics, she looked to other avenues such as literature and a second marriage in which she hoped for love. In another time and another place, her desire of taking a place in mathematics (in the positions and situations that she hope for, suitable to her talents and abilities) may have been possible and may have led to great fulfillment as a subject.

The extent to which Kovalevskaya's desire in general was met is contested in the various biographies. Some, such as Kochina (1985), Kennedy (1983) and Munro's (2009) novella show failed desire with tragic consequences, while Koblitz (1983) mocks this interpretation and insists that these interpretations are incorrect. Koblitz contends that Kovalevskaya was a full-fledged mathematician accepted by the mathematical community of the time, and that she was a pioneer and a revolutionary. Reading Koblitz gives a sense of stridency and revisionism. I do allow that my sensibilities may have been formed by my first reading of Munro's *Too much happiness*. "Too much happiness" were Kovalevskaya's last words, according to Teresa Gulden who was with her at the end. There is very little explanation of the context or of what Kovalevskaya meant. Did Kovalevskaya mean that finally after a hard twenty years of making her way and making a name and career for herself, there was the prospect of marriage to Maxsim and more happiness than she had dreamed at last, and that it was only to be snatched away?

Looking back on Kovalevskaya's life, it seems to me that the distance from the place of mathematics as fantasy that she accessed through her mathematical work to the reality of her life in the circles in which she moved was too great. The metric needed to conceptualize that distance would take a century and more of social upheaval. The costs were too inordinate to bear and the cold realization is that mathematics is indeed, even with the gifts of genius and charm, not for the faint of heart. Kovalevskaya could do mathematics, but she could not be a mathematician as she had hoped. She was capable in the doing of mathematics, in her research work and in her teaching of mathematics and science, but she was constrained by the symbolic order of being a mathematician in that time and that society. She could not take her place with the other mathematicians in the positions and institutions of the time – the highest position to which she could aspire was to teach in schools for girls and women.

In the end, she was unable to realize her dreams to the extent that she desired. She had started with quadratures and asymptotes. Her life was an ode to her attempts of squaring the circle, of being a complete mathematician amid the trajectory of asymptotic desire in search of her old friend and lost object, the limit. She was unable to realize her dreams to the extent of her desire.

I turn now to the second written account and present an analysis of the autobiography of the twentieth-century French mathematician André Weil, *Souvenirs d'apprentissage*, rendered in English as *The apprenticeship of a mathematician* (Weil, 1992).

André Weil: Mathematics as ground of being

In contrast to Kovalevskaya, I relied solely on Weil's autobiography to analyze his mathematical journey despite having read other pieces by him, his family (his daughter Sylvie's 2010 *At home with André and Simone Weil*), colleagues, and historians of mathematics and science for background. Certainly, working from the one source simplifies matters. I was also aware that Weil's autobiography was his statement, on his own terms, of how he wanted his life in mathematics to be perceived, rendered, and remembered. He, most definitely, had his eye on his legacy in the mathematical community. So in some aspects it was possible to get a clear sense of Weil-as-he-presented-himself as a mathematical subject. My purpose is to see what we can learn about mathematics and mathematicians from Weil's account. In particular, I seek to discern Weil as a mathematical subject, namely, to examine the ways in which Weil constitutes himself and is constituted as a mathematical subject.

To summarize, André Weil (1906-1998) was a French mathematician of Jewish parents (who provided no instruction or observance of Judaism). He was educated at the École Normale Supérieure (ENS) with notable teachers such as Hadamard and colleagues including Henri Cartan, Jean Delsarte, and Jean Dieudonné. He was an inveterate traveler, mostly by train, over Europe and India. With many of his peers from the ENS, he was one of the founding members of the Bourbaki group. He was a major contributor to a major new field in mathematics (the algebraization of geometry known as algebraic geometry) and formulated conjectures that were the basis of results that contributed to Wiles' proof of Fermat's last Theorem. Weil served time in prison as a conscientious objector during the Second World War and eventually went on to occupy positions at two prestigious US universities, the University of Chicago and the Institute of Advanced Study at Princeton. In his later years he turned to writing mathematics texts and wrote one of the few autobiographies of mathematicians.

I first present some initial themes obtained from my reading of the account and then I present an analysis of Weil's autobiography as a mathematical journey using the lens of Bracher's four forms of desire, showing his constitution as a mathematical subject. I give instances of each form of desire and then reflect on his journey in becoming and being a mathematician. I am aware that this is not the order in the previous analysis, but as pointed out above, the order of the analysis is individual as I attend to my reading of the individual mathematician.

As a mathematical subject

In examining Weil's autobiography, I sought to treat it as an account in itself of a life in and of mathematics. While I knew something of Weil's work from my time as a graduate student in mathematics, and while doing this research I had found many other sources about his life and his work such as the book, *At home with André and Simone Weil* (2010) by his daughter Sylvie Weil, when I read and studied the autobiography, I concentrated on looking at it *in itself*. That is, just from reading it as an evocation of a life in mathematics and as an artifact of the discipline (as a text produced in and for the discipline), what could be learned about the discipline of mathematics and desire relating to the discipline? There was much to ponder as I looked for desire in its forms, but there were over-riding impressions which I present below, under the themes of Within and Without. It took some time for me to come to these two themes; I was looking for broad descriptions of Weil as a mathematical subject and seeking to capture him and the way he responded to being in mathematics. I realized that I was coming up on the broad existential categories of Subject and Object/Other, which is eventually the dance of the relationship between the discipline and its practitioner and the dance of desire described in this dissertation.

Within/Inward

Ostensibly, Weil's autobiography is about Weil, but there is a remarkably impersonal tone to it. It is full of the requisite I's, but one gets a sense that, for all that writes, he is very much within himself and holding himself remarkably aloof. There is very little that is personal (I had tried out for this theme, Im/personal); the account is about him and yet not about him, with much that is unsaid.

To begin, there is very little about his wife, Eveline, with whom he had a long and happy marriage⁵⁴. In the front matter, there is a beautiful picture of Weil and his wife, a line of Catullus⁵⁵, and two searing lines of poetry from the Spanish poet, Federico García Lorca, that seemingly capture the place that she held for him. In the book, there is one line where he writes in a letter to her something about fractions and her son, Alain. His famed sister Simone Weil, younger by three years, also gets little mention. She appears at the beginning in some charming pictures of their childhood and youth, and at the very end, in a paragraph about her death and Weil's breaking the news to their parents. Weil writes that their relationship was "veiled in our habitual irony" (p. 99).

There is little indication of how others saw him. One memorable exception occurs when he writes of relating to Hellinger an elaborate hypothesis about God, Richard Courant, and Hitler, and Hellinger replies: "Weil, you have the meanest tongue of anyone I know" (p. 50). That is brutally honest, but one can only surmise that Weil is so sure of himself that he would include such an unflattering statement. There is a single flash of dry humour (pp. 134-135): "Fréchet took me aside to tell me the following: 'In London, people were saying you had been caught in the act of being a spy in Finland. But I didn't believe it. If that had been the case, the Finns would have shot you. They didn't, so you couldn't have been one.' His axiomatic reasoning was impeccable."

A third aspect of what is left unsaid is how little mathematics there is in the book, raising the questions of why it was written and for whom it was written. There is little mention of the depth and importance of his work. But then this may be only a quibble as it is an account of a life in mathematics and Weil, most likely, expected his readers to connect the dots for themselves. Weil moved the discipline forward through unusual connections among algebra, geometry, and number theory, and, as was noted above, some of the steps in the proof by Andrew Wiles of Fermat's Last Theorem would not have been possible without Weil's conjectures. But this appreciation of his work would come later, and by other mathematicians. However, Weil provides a telling glimpse into his inclination of working by himself. Weil writes of a Cambridge mathematician:

⁵⁴ Weil (1992, p. 11): "What shall I say, but that our marriage was one of those which give the lie to La Rochefoucauld: *Il y a de bons mariages, mais il n'y en a point de délicieux.*"

⁵⁵ *Fulsere vere candid mihi soles*: truly bright suns shone for you.

Our conversation turned to a comparison of our approaches to work. At first we seem to be on completely different wavelengths. Finally it became apparent to me that he worked fruitfully only when competing with others: having the rest of the pack at his side spurred him to greater efforts as he tried to surpass them. In contrast, my style was to seek out topics that I felt exposed me to no competition whatsoever, leaving me free to reflect undisturbed for years. (p. 94)

Weil indicates here that we wants to be alone with the lover, to commune with mathematics alone with no other suitors, but this has to be taken with a grain of salt because while he may have liked to work alone, it will be shown later that he goes to great lengths to ascertain what other mathematicians are doing. This is echoed in the lengths that Wiles undertook in order to pretend that he was *not* working on Fermat's Last Theorem.

A final aspect of what Weil leaves unsaid is his lack of feeling about his being a Jew but this is seen against the backdrop of his sensibilities and his devotion regarding another philosophy which I describe next.

Without/Outward

A striking aspect of Weil's account is his lack of mention of his Jewishness (p. 41: "my sister and I had been brought up without any semblance of religious education or religious observance") and his feeling for the philosophy and sensibilities of things Indian. This is different from the experience of the mathematician, Norbert Wiener, to whom the discovery of his Jewishness came as a great shock but proved to be instrumental in his mathematical development; Wiener devotes a whole chapter of his autobiography (Wiener, 1956/1973) to it. Weil writes that he "certainly did not consider it of any importance" (p. 42). Instead, there is his "precocious and romantic attraction to Sanskrit" (p. 31) from an early age. This was no passing attraction; he dreamed one day of being able to read the great Sanskrit texts (including the *Vedas*⁵⁶) in the original. As a young man, he went to see the distinguished Orientalist, Sylvain Lévi, who gave him a

⁵⁶ I was electrified to see my name, Veda, on these pages. The texts are referred to as the Veda but I think that that is a quirk in translation, the final 's' not being pronounced in French. This is an example of what O'Driscoll and Bishop (2004, p. 2) call the "archival jolt". It was also electrifying for me to see Arjuna and Krishna of the great Hindu epics, in the Index of Names at the back of the book.

copy of the *Bhagavad Gita*: “the beauty of the poem affected me instantly, from the very first line. As for the thought that inspired it, I felt I found in it the only form of religious thought that could satisfy my mind” (p. 41). Weil continues: “I took pains not to forget Sanskrit”. He attended Jules Bloch’s beginner’s course at the Sorbonne, Meillet’s lectures on Indo-European linguistics, and Sylvain Lévi’s on Kalidasa’s *Meghaduta* (“Sylvain Lévi excelled in bringing out the marvels of this poem. I can still hear him almost whispering...”). These texts are a source of solace and sustenance for Weil during his time in prison (pp. 142-143). He manages to get to India by being willing to teach French civilization; as it turned out, he joined a mathematics department. He felt at home in India, moving easily among his Indian hosts despite their various rituals and taboos, and making friends and acquaintances at the highest levels of the society (“the giants of India”). When he is girded as a *Brahmin*, he experiences his “second birth”: “I had been a *Brahmin* in a previous life, born to the world this time in Europe” (p. 74).

That Weil was born into a Jewish family, but chose another path is not so puzzling. Weil writes that he was “beginning to feel rather hemmed in by his Parisian horizon”; he had a longer and wider view of history and humanity. For Weil, “what really counts in the history of humanity are the truly great minds ... and their works”; he wanted to “dive headlong into the works of the great mathematicians of the past as soon as they were materially and intellectually within [his] grasp” (p. 40). In mathematics, he was searching for a place where he senses he belongs. He felt “gratitude and affection” for the mathematicians in Europe. He spent nights in Mittag-Leffler’s library in Stockholm, “... where he kept, meticulously classified, a half-century’s accumulated correspondence with all the great mathematicians of Europe. It gave me a strange thrill to steal by night into the presence of Hermite, Poincaré, and Palinglevé: within the intimate circle cast by the little lampshade, it was as if the outside world no longer existed.” (pp. 54-55). Weil speaks flatteringly of his mathematical heroes, one of whom is Max Dehn. In the following, we get a rare glimpse of how Weil sees mathematics:

Max Dehn ... —like Socrates as we picture him from the account of his disciples —possessed a radiance that makes one naturally bow down before [his] memory: a quality, both intellectual and moral, that is perhaps best conveyed by the word “wisdom”; for holiness is another thing altogether. In comparison with the wise man, the saint perhaps is just a specialist—a specialist in holiness; whereas the wise man has no specialty ... for such a man, truth is all one, and mathematics is but one

of the mirrors in which it is reflected—perhaps more purely than it is elsewhere. (p. 52)

Weil is moved by the greatness of the endeavour of mathematics and those who achieve it, in putting wisdom above holiness. As with Kovalevskaya and many other mathematicians, Weil has a strong sense of the discipline and tradition of mathematics, but again, the radical truth is that there is no big Other, that mathematics qua big Other does NOT exist as a discipline and a tradition, and that it is a fantasy. Finally, his observation that mathematics is a mirror in which truth is reflected in ways perhaps more pure than in other endeavours explains the cool, considered, and crystalline tone of his book as he shows us his part in the jewel that is mathematics. Mathematics is an undistorting mirror for him; he sees himself in this mathematical lineage, and his efforts in telling these stories are for the glory of that lineage and to place him in that line. But to develop this idea, I turn to an examination of Weil's desire.

Desire

I now tease apart elements of Weil's desire relating to mathematics as I provide instances of Bracher's four forms of desire as outlined in the theory above. I recall that these forms of desire are derived from a combination of the desire to be and to have and that the two positions that the subject and the Other occupy are as desirer and object of desire.

Desire to possess the Other as a means of *jouissance*: Active anaclitic desire

Weil's passion for mathematics begins at an early age and continues through his education. The following extracts from his autobiography show how the Imaginary (in the Lacanian sense) aspects of his engagement with mathematics (the content itself, the means of acquiring the content such as textbooks and teachers, and his own attempts at doing mathematics) contribute to his enjoyment of mathematics. His first observation about mathematics comes when he is eight years old: "Once when I took a painful fall, my sister Simone could think of nothing for it, but to run and fetch my algebra book, to comfort me" (Weil, 1992, p. 23). This is an astounding sentence as small children in times of pain generally turn to a parent or a favourite teddy bear. That an algebra book

is a transitional object (to use Winnicott's term) for Weil is indeed singular. As noted above, there is very little in the book about Simone (who goes on to distinguish herself as well, but as a philosopher, Christian mystic, and political activist), but they shared a close and lasting relationship, though "veiled in habitual irony". That Simone recognized that mathematics would provide comfort and that his pleasure lay in his algebra book shows a high level of communion that is rare in siblings, and their deep, unspoken bond.

Textbooks greatly influence his developing interest in mathematics: "I still have an algebra text written by Bourlet, for third, second, and first form instruction, which was given to me in Menton in the spring of 1915. Leafing through it now, I see it is not without its defects; but it must be said that this where I derived my taste for mathematics" (pp. 21-22). This will resonate with anyone who has preserved a similar textbook over the years as a keepsake of times of great delight and persuasive power. One conclusion that can be drawn from this is that mathematics (or a kind of mathematics) *lives* in books, where one must go to find it.

Weil is further swayed by a teacher, Monsieur Collin, who impressed on him the demands and fascination of mathematics: "I do not think that any teacher could have been better than Monsieur Collin in developing both rigorous thinking and creative imagination in students ... definitions had to be memorized and Mr. Collin was merciless towards any gap in solutions or proofs. With him, mathematics was truly a discipline in the fullest sense of this beautiful word" (p. 26). The word, "fullest" connotes an almost sexual feeling in the appreciation of the "beautiful word", mathematics. But the strictness, to the letter, of definitions, solutions, and proofs leaves no room for the "creative imagination" that Weil claims that Monsieur Collin developed in students. Indeed, Mr. Collin was laying down the groundwork for the approach that Weil and the rest of the Bourbaki will take in their rendition of mathematics. From Mr. Collin, Weil experiences the triumph of logic and rationality in capturing and rendering the discipline.

Weil experiences an early pleasure in seeing his name in print:

I was lucky enough to be given a subscription, starting in the fall of 1915, to the *Journal of Mathématiques Élémentaires* printed by Vuibert. ... Also published, along with the best solution received by the editors, were the names of those who had submitted correct solutions. I was surprised to discover before long that some of these questions were within my

reach. How proud I was to see my name in print for the first time! Soon it was appearing regularly, and then one glorious day, my solution was published. (p. 23)

For a writer as restrained as Weil, this is probably the only exclamation point in the book as he writes of his pride and the glory of his name in print in a mathematical journal. Did his name in print mean that he was a mathematician? Also, more than his name, there was greater glory in having his solution, his words and argument, in print. All of this is nothing compared to the intense and powerful enjoyment of creative mathematical activity:

Every mathematician worthy of the name has experienced, if only rarely, the state of lucid exaltation in which one thought succeeds another as if miraculously, and in which the unconscious (however one interprets this word) seems to play a role. In a famous passage Poincaré describes how he discovered Fuchsian functions in such a moment. About such states, Gauss is said to have remarked as follows: '*Procreare jucundum* (to conceive is a pleasure'; he added, however, '*sed partuire molestum* (but to give birth is painful)'. Unlike sexual pleasure, this feeling may last for hours at a time, even for days. Once you have experienced it, you are eager to repeat it but unable to do so at will, unless perhaps by dogged work which it seems to reward with its appearance. It is true that the pleasure experienced is not necessarily in proportion with the value of the discoveries with which it is associated. (p. 91)

Here we get to the heart of the matter, to what is at stake, *jouissance* or nothing! Similar to Kovalevskaya's "lofty", "mysterious" and "revered", Weil's "lucid exaltation", "miraculously", "one thought succeeds another" seemingly from the unconscious, are indications of mathematics as a sublime object. Weil writes of two such moments, one relating to working on Mordell's conjecture relating to his doctoral thesis and another relating to a discovery of a result resolving a problem on polynomial series. By now, Weil is versed in the highs and lows of mathematical discovery and activity and their attendant emotions. There is also the small pleasure of suitably impressing his small daughter, Nicolette, in telling her that he was responsible for the symbol⁵⁷ for the empty

⁵⁷ This is an echo of the importance of another mathematical symbol for the mathematician, Tom, to come later.

or null set (\emptyset)⁵⁸, and that it came from the Norwegian alphabet which he alone of the Bourbaki knew.

Weil finds joy and pleasure by various means in mathematics; first, in bending to the will of the master, Mr. Collin (not quite the master-slave dialectic, but perhaps the sorcerer's apprentice) as he learns the ways and wiles of mathematics, its demands and constraints. Next, he experiences greater pleasure as he comes into his own, seeing his name in print and having his solution published ("one glorious day"). At the most intense, he comes face to face with mathematical *jouissance* (a more lasting feeling than sexual pleasure), and the pain of mathematical creativity, of giving birth to new mathematics. Weil ruefully realizes that this taste of *jouissance* (painful pleasure being of the Real) cannot be called up at will, but an appearance of it may be squeezed out as a seeming reward for perseverance, the pleasure disproportionate to the value of the discovery.

Desire to become the Other (identification): Active narcissistic desire

The subject forms itself in the images of others, in the mirror of mathematics, and of what others expect and want of him/her. Lacan writes of the subject as being represented by the signifier for another signifier. Both "mathematics" and "mathematician" are master signifiers for Weil, load-bearing with respect to sense of self and emotions. From early on, Weil receives clear signs of what it means to be in or to do mathematics, and to be a mathematician. These are instrumental in shaping him as a mathematician and a mathematical subject. To what does Weil aspire in his conceptions of a mathematician and in his desire to identify as a mathematician?

From Monsieur Collin, Weil learns to appreciate the rigour and precision in mathematics: "What I remember most about Monsieur Collin's lessons prior to entering the first form is that he showed me once and for all that mathematics operates by means of rigorously defined concepts" (pp. 26-27). When it came to definitions: "I do not recall in what terms Monsieur Collin taught me the definition of the word 'function'. He could

⁵⁸ It is interesting that many of the symbols we use in mathematics and statistics have names such as the Greek letters, phi, epsilon, and mu, and the aleph-null from the Hebrew, *aleph* that we can say and have a sound image, but for the empty set, we simply say "the empty set" and write the symbol. Another example of this is the sign, \int , for the integral.

not have used the language of Bourbaki, which was as yet nonexistent, or even that of set theory with which he was probably barely acquainted. What is important is that once the definition was given, he would not tolerate anyone's using the word "function" for anything not corresponding to the definition" (p. 27). It is not surprising that Weil does not recall the terms in which the concept of a function is defined (which of us remembers a definition of a mathematical term from high school?), but similar to asymptote for Kovalevskaya, the term, function, is an empty signifier, one where the meaning is made later as he encounters other definitions for the concept.

Hence, in the Imaginary order of images and appearances, the conception of mathematics that Weil received and took to heart was a very particular one of rigour, firm foundations, and precise rendering. This was to be borne out in the way that the future Bourbaki project was conceived and executed, its express aim being to place mathematics on a careful axiomatic basis and to set the standard for rigorous exposition with pedagogical intent. Weil does not simply discover one aspect of an already-given mathematics but, rather, he focuses on these ideas/values and takes them to be the defining feature of mathematics.

With regard to identifying with the discipline and aspiring to be a mathematician, Weil's admiration and recognition of Monsieur Collin's efforts in "making a mathematician of me" is great: "I think there is no one, with the sole exception of Hadamard, from whom I learned more about mathematics than from Monsieur Collin. Before I became his pupil, I was basically self-taught: he made a mathematician of me, and he did so above all by means of his unrelenting criticism" (p. 27). Later on, Weil writes that "[t]he *bibli[othèque]* and Hadamard's seminar are what made a mathematician out of me" (p. 40). So Weil's Imaginary others are more than books and humans. Weil writes of the *bibli*, the edifice which housed mathematics as contained and rendered in books in the *bibli*, and of the seminar which 'housed' mathematical ideas. Weil was in search of the spirit and soul of mathematics that would make a mathematician out of him.

Weil further credits Monsieur Collin for teaching him "how to write-up mathematics" where he learns to limit himself to "two pages into which everything had to fit" and not to take shortcuts such as saying "it is obvious that ..." (p. 27). This is

reminiscent of a remark by the French mathematician Alain Connes (also educated at the ENS) in speaking about communicating a particular mathematical discovery, “and because I had been taught by Chevalley (also a key member of the Bourbaki), I wrote this up in half a page” to a colleague who found it somewhat terse.

How is Weil formed as a mathematical subject according to his autobiography? The first point is he has absorbed a particular style of written mathematics, with which he identifies (similar to Kovalevskaya and Weierstrass), with qualities such as conciseness, accuracy, rigour, clarity, brevity, and elegance, the prize (such as getting one’s name in print) being to write a mathematical proof that is honed and spare with no unnecessary lines or flourishes. Both Kovalevskaya (from Weierstrass) and Weil (from Monsieur Collin) have absorbed the sense of a ‘style’ of writing mathematics which they see as required by the discipline and to which they aspire. Did they see in this style a way to set themselves apart as it were, making them *pukkah* mathematicians in a class higher than humdrum, regular, working mathematicians? This style of writing is something into which mathematicians are inducted, but to whom is it addressed? Lacan writes that to determine the significance of an utterance or statement, one must locate the true addressee. The austere manner of address in this style with all references to the personal, to you and me, expunged is similar to that of a liturgy, with a similar purpose of convincing and supporting the faithful. Though the writing is by an unseen hand and mind, the expressions used are very particular, with a rigidity of structure that enables the flow of only the narrowest of logic. Such written mathematics can only be addressed to others of the tribe, others who have been similarly inducted with comparable sensibilities. That Weil took this style to heart and made it his signature (as will be seen later in the work of the Bourbaki) shows, for me, not an intention to set himself apart, to appear precocious with respect to this sophisticated thing called style or to somehow be destined to be a mathematician, but that Weil sensed a larger purpose, a purpose larger than himself in mathematics, namely of the lineage into which he was being inducted, with a keen understanding of the concomitant requirements. Csiszar (2003), in ‘Stylizing rigor; or, why mathematicians write so well’, shows how the writing in mathematical journals function to endorse and reinforce certain values as well as “to exclude all but the very few” (p. 243). Perhaps Weil intended his adoption of this style of writing

mathematics to exclude, but I think, for Weil, it was a matter of serving the larger purpose of being faithful to the demands required by mathematics.

A second point for Weil is his exposure to analysis, both grammatical and propositional, in a “non-trivial symbolism”:

[Monsieur Monbeig at the lycée] was an exceptional teacher, full of unconventional ideas. For the purposes of grammatical analysis, he had invented a personal system of algebraic notation, perhaps simply to spare both himself and his students time and effort; but it seems to me, looking back, that this early practice with a non-trivial symbolism must have been of great educational value, particularly for a future mathematician... At one time it has been thought that young children should be primed for the study of mathematics by being forced to speak of sets, bijections, cardinal numbers, and the empty set. Perhaps I was no less well prepared by my study of grammatical analysis—both verbal and, as it was called at the time, “logical” (that is, propositional) analysis—at the hands of Monsieur Monbeig. I must say in any case that nothing I later came across in the writings of Chomsky and his disciples seemed unfamiliar to me. (p. 20)

Weil recognizes in Chomsky’s writings a familiar object similar to that of Kovalevskaya’s recognition of the limit when it was introduced to her by her tutor as a familiar object from the wallpaper. This ‘non-trivial symbolism’ is an example of a fantasmic object, something that Weil would have been hard put to describe. What purpose does it serve? It would appear that giving it an algebraic veneer legitimises it or raises it to the status of a sublime object, over and above what can be communicated with language. Weil is trying to show here how unusual his ‘apprenticeship’ was, that he learned from and was formed by his high school mathematics teacher and not his language teacher, and that the ‘style’ above and the ‘non-trivial symbolism’ were formative elements for him. Again, why would he want to point these out in his autobiography? Is he trying to set himself apart, to show himself as not being like other mathematicians?

A third point is that of the preparation needed for being a mathematician. Weil writes about as the geometry of the triangle and the focal theory of conics as sharpening the “geometric imagination” and of the method of “complete enumerations” as something that is disparaged today, but leaves him with favourable memories. He notes that “a facility with algebraic manipulation is something a serious mathematician is hard put to do without” (p. 35). What inspires these statements? Is it a belief in an underlying

axiomatic image of mathematics, or a belief that the symbol is more powerful than the letter, or perhaps a tacit cultural conservatism in esteeming methods that are no longer valued? Though there is a wide range of other subjects such as poetry, history, French literature, Greek, and Latin to round out his education, Weil has found in mathematics a way of seeing things, albeit unconventional, that sets a course for a life in mathematics, for a way of setting himself apart and of distinguishing himself.

Weil fashioned himself in the example of his teacher, Jacques Hadamard:

I had formed the ambition of becoming, like Hadamard, a 'universal' mathematician: the way I expressed it was that I wished to know more than non-specialists and less than specialists of every mathematical topic. Naturally, I did not achieve either goal. (p. 55)

Hadamard has been referred to as the last 'universal' mathematician: "the last that is, to encompass the whole of the subject, before it became so large that this was impossible" (Derbyshire, 2003, p. 159). This ambition to become a 'universal' mathematician is yet another way in which Weil seeks to set himself apart from others. Again there is a striking similarity between the pair of Kovalevskaya and Weierstrass and that of Weil and Hadamard, in the sense that each of Kovalevskaya and Weil had to have a dominant father figure in order to learn and achieve mathematics, that one must learn mathematics from THE father. Lacan uses the Name-of-the-Father metaphor to indicate the law (the structural and symbolic function) that interposes and superimposes itself between the infant and its desire to be the phallus for the mother(er) whose desire is beyond the child and out of its reach. Here, with respect to mathematics, Lacan might say the Number-of-the-Father.

This romantic notion of a 'universal' mathematician, of one who understands every topic in mathematics is appealing to Weil in his wish to conquer the field. To this end, he combined his passion for touring with "a specific mathematical variety", that of visiting and meeting with mathematicians "in their natural habitat". Indeed the list of mathematicians whom he met and visited in various cities is staggering [the list includes Berlin (Brouwer, Hopf, Schmidt), Helsinki (Ahlfors, Nevanlinna), Frankfurt (Dehn, Epstein, Hellinger, Siegel, Szász), Göttingen (Courant, Noether), Hamburg (Artin), Moscow (Pontrjagin), Rome (Lefschetz, Mandelbrojt, Volterra, Zariski), and Stockholm

(Cramer, Mittag-Leffler)]. While this may be interpreted as a mere gratification of a scopophilic drive to see (and hence to possess in some way) people and landscapes, Weil describes it as a way of determining whether they [mathematicians] are worth reading (“Despite all the errors to which this method exposes one, it actually saves considerable time.”). What was Weil in search of? He claims to want to see mathematicians “in their natural habitat” but what was his natural habitat and why did he feel hemmed in by his “Parisian horizons”? Was it a feeling that the world and “glory” lay elsewhere? Or was it a possible fear of competition and a wish to see if others were gaining on him, as it were. It was not enough for Weil to read their mathematics though, which would tell him who is better in a strictly mathematical sense; he wants to be sure that there were not others with greater flair or prowess (as in “Mirror, mirror on the wall/Who is the [fairest] most mathematical of us all?”). His ambition to be the universal mathematician led him to wanting to know all that there was to know about mathematics, to find out about the various kinds of mathematics being carried out by others. In his “[n]aturally, I did not achieve either goal”, Weil admits his failure, but he takes pride and joy in it. Lacan would cast this as enjoying his symptom, the symptom being that which intrudes in our lives and returns as *jouissance* which has not been displaced by other means.

Desire to be the object of the Other’s love (admiration, idealization or recognition): Passive narcissistic desire

Why does Weil write an autobiography? Very few mathematicians have done so; these include Paul Halmos (1985/2004), Saunders Mac Lane (2005), and Norbert Wiener (1956/1973). I argue that Weil’s account of his life in mathematics can be seen as a quest for recognition from the Other of devotion and service to a Cause. There is great pride in that ‘glorious day’ when he sees his name in print for the first time in recognition of him and his work. From then on, Weil’s various mathematical results and especially his work as a major force within the Bourbaki group can be seen as contributions to the knowledge of the big Other of mathematics. Weil has a strong sense of the Symbolic order from early on:

One day my father, taking a walk with me along the boulevard told me that my first name came from the Greek word meaning “man”⁵⁹, and that

⁵⁹ from Greek *anēr* (genitive *andros*), the meaning of which is man.

this was one reason it had been given. Did he go on to say that I must prove worthy of this name? I do not recall; but certainly that was the intention of his words, and it is thus that the meaning sticks with me. (p. 13)

To be worthy of his name, given to him by his father is then the root of Weil's desire to be the object of his father's love and to distinguish himself in his father's eyes. Weil writes (p. 27) of himself at fourteen (in 1920): "... [it was] not yet obvious, either to my family or my teachers, or even to me, that I was destined for a career in mathematics". Hence Weil has an early sense of duty, as a son to his father, in his life and his autobiography is his address to that call. Weil feels a duty to himself as a mathematician of a country that has sustained serious losses among its mathematicians: "Already while at the Ecole Normale, I had been deeply struck by the damage wreaked upon mathematics in France by World War I" (p. 126). He read the "disastrous consequences" in the monument to the dead of the Ecole Normale. He continues: "Those were cruel losses; but there was more besides. Four or more years of military life, whether close to death or far away from it—but in any case far from science—are not good preparation for resuming the scientific life: very few of those who survived returned to science with the keenness they had felt for it. This was a fate that I thought it my duty or rather my *dharma* to avoid" (p. 126). The Sanskrit word, *dharma*, comes from the root word, *dhr*⁶⁰, meaning to preserve, hold together, uphold, or sustain and refers to a central concept in Hinduism. The word is often translated as righteousness or right conduct but there is more in the concept that the English words convey. The principal aim of *dharma* is the continued preservation and maintenance of all beings in all three worlds (*lokas*⁶¹). It is an intricate concept in that there are no specific commandments or dogmas that are guides for the complicated situations that we face in life. There is a related concept of individual dharma, *swa-dharma*. Each person has a *dharma* that shapes and bounds how the individual conducts himself or herself for the preservation and progress of the place in the world in which the individual finds himself or herself. At each stage of life, childhood, youth, householder, etc., there is a *dharma*

⁶⁰ There should be a dot under the r, but I could not find a symbol.

⁶¹ Earth, sky (atmosphere), and heaven. Hence the Sanskrit prayer: *Loka Samasta Sukhino Bhavantu*, May all beings in all worlds be happy.

to follow and uphold according to one's situation. So a child has a *dharma* to obey her parents, a parent to provide for her child, and so on. Why does Weil tell us about "[his] *dharma*"? Is it simply a need to show off his Sanskrit or to indicate to us that he is a man of honour? I think that it is elemental for him, so much so that he recognizes that the English word, 'duty' is wanting or lacking in order to describe what he must do and carry out in his life. It is also that in expressing his feeling for a religious concept which was important to him (when he is girded in India as a Brahmin, he regards himself as being reborn), he exalts mathematics to a place worthy dedication of one's life, like a religion, and in so doing, making of mathematics something more than a set of theorems and results.

Besides his duty to his country and its scientists, a second duty for Weil is his duty to the discipline of mathematics and the community of mathematicians; his account may also be seen as a letter addressed to mathematicians. Weil seeks to reproduce and to enhance the knowledge system in which their sense of themselves as mathematicians is inscribed. He seeks to take his place in that community and to ensure that his legacy is remembered on his own terms. Žižek (interpreting Lacan) writes that a letter always gets to its final destination, even when there is no addressee. Weil's autobiography is his attempt to stave off death, to not choose death and obscurity but to assure and secure his place in the history of the discipline on his own terms.

**Desire to be desired by the Other as the object of the Other's *jouissance*:
Passive anaclitic desire**

Passive anaclitic desire involves a subject's desire to be desired by the Symbolic Other as a bearer of one of the master signifiers (such as a subject's desire to be desired as a "man" or "mathematician"). This desire is seen mostly vividly in Weil in his co-founding of the Bourbaki project. As noted above, Weil had absorbed from his teacher, Monsieur Collin, a very specific set of ideas of what mathematics is and the rigid conventions by which it is done. This very particular conception of mathematics of rigour, firm foundations, and precise rendering is the basis of the future Bourbaki project in conception and execution, its express aim being to place mathematics on a careful axiomatic basis and to set the standard for rigorous exposition with pedagogical intent. This project grew out of Weil's dissatisfaction, as a young faculty member, with the texts that were then traditionally used (p. 99). He and Henri Cartan, another young faculty

member, had many 'discussions' on how to teach certain topics such as Stokes' formula. Weil writes that he "thought of a brilliant end to Cartan's persistent questioning ... Little did I know that at that moment Bourbaki was born" (p. 99).

Weil's aim in the beginning was pedagogical ("more or less"), with the other members, the work became for an embodiment of the ideal of the discipline. In it was the attempt to lay a foundation and set forth the standards and sensibilities of the discipline in "a unified exposition of all the basic branches of mathematics, resting on as solid foundations as I could hope to provide" (Bourbaki⁶², 1949, p. 1). Their first volume was dedicated to the memory of Euclid and his first volume, *Elements of Mathematics*. As a cultural artifact that plays a role in the interpellation of the subject, the thirty-odd volumes produced by the Bourbaki, is intended as an expression of a perceived lack of mathematics that is to be "filled up, obliterated, or somehow compensated for" (Bracher, 1993, p. 46). Bracher continues: "In gauging the interpellative force of a given text or discourse, then, one must take account not only of the different objects and positions, offered to an audience's desire but also of the evocation and/or repression of the Other's lack" (p. 46). The Bourbaki gave to mathematicians a new means of seeing their discipline by appealing to the desire for clarity, purity,

The Bourbaki did not, like God, create mathematics in their own image, but they created an ideology of how they imagined mathematics should be. They created an alter ego, complete with fictions of applying for membership in mathematical associations and submitting to mathematical journals. They created a mirror for mathematicians in which to see and fashion themselves, a fictionalized and idealized identity which has its own *jouissance*, thereby adding to the glory of mathematics and to its *jouissance*. In creating a face of the Other of mathematics, their intent was to become the ideal, to position themselves as the Other of mathematics.

⁶² In this article, Bourbaki's institution is given as the University of Nancago (a combination of *Université Nancy* and the University of Chicago), two institutions with which Weil was associated.

Summing up Weil

A cultural phenomenon such as mathematics survives and flourishes by inducting its practitioners in its ways, by offering rewards (praise and ignominy), and by stirring up desire, both attracting and repelling. From the above analysis, Weil's interpellation as a mathematical subject is then a product of forms of desire. For Weil, "mathematics" is a powerful complex of notions that function as a master signifier in the Imaginary, the Other in the Symbolic, and the object-cause of desire in the Real. Indeed, Weil's account is part of his answer to the *che vuoi?* of mathematics as the Other.

What is Weil's desire? That he becomes a mathematician and engages in a life in mathematics is primary for Weil. That his life was to be in mathematics or that he valued mathematics was not evident in the beginning: "It was not yet obvious, either to my family or to my teachers, or even to me that I was destined for a career in mathematics" (p. 28). His father had planted the seed of his name meaning 'man' in Greek. When Weil writes of Hadamard making a mathematician of him, Hadamard becomes his mathematical father and, for Weil, the expression 'making a mathematician of him' can be seen as very nearly synonymous with 'making a man of him'. The title of Weil's account in French is *Souvenirs d'apprentissage*, which has more of a flavour of a training or apprenticeship (it is only in the English rendering of the title that we get some hint of the work having to do with being in mathematics, but then the French would have known Weil as a mathematician). My reading of this is that mathematics is so elemental a signifier for Weil that it is not necessary for him to include such a sign. Lacan refers to this as "disappear[ing] as a subject beneath the signifier [that] he becomes." (1966/2006, p. 708)

What does it take to lead a life in mathematics? According to his account, Weil's life in general has mostly an even tenor, despite the hardships caused by grave forces such as war and prejudice. For Weil, mathematics requires degrees of both isolation (he completed some of his best work while in prison) and cooperation (he thrived on getting to know and keeping up with the developments of mathematics around him). It also requires episodes of creativity that cannot be summoned at will, but perhaps are given as rewards for sustained effort, and unswerving one-pointed dedication to a goal whose

sights keep coming in and out of focus. Žižek (1991) distinguishes between an aim and its goal:

A goal, once reached, always retreats anew. Can we not recognize in this paradox the very nature of the psychoanalytical notion of drive, or more properly the Lacanian distinction between its aim and its goal? The goal is the final destination, while the aim is what we intend to do, i.e., the way itself. Lacan's point is that the real purpose of the drive is not its goal (full satisfaction), but its aim: the drive's ultimate aim is simply to reproduce itself as drive, to return to its circular path, to continue its path to and from the goal. The real source of enjoyment is the repetitive movement of this closed circuit. (p. 5, *original emphasis*)

In his aim and his goal, Weil's quest in his life in mathematics was to interpret the mathematical experience.

Reading Weil's autobiography, one gets the sense of Mathematics as ground of being, that he identified so completely with the big Other of mathematics that he was a consummate mathematician and could be no other. While his life circumstances could not be described as those of ease or without restriction, he took in his stride the demands of the discipline with respect to effort and dedication. There is the sense of existential destiny (an affirmation that desire is destiny) and inevitability, a sense of little else that absorbed him. Do we find mathematics or does it find us?

I now turn to analyses of oral accounts with two living mathematicians in the next chapter.

Chapter 6:

Analysis of Oral Accounts

In this chapter, I continue with analyses of oral accounts (from interviews) with two living mathematicians, Maya and Tom (pseudonyms), whose engagement with mathematics is studied in depth.

Maya: Mathematics as Everyday Desire

I present here my analysis of an interaction⁶³ with Maya⁶⁴, an associate professor of applied mathematics at a major North-American university. While I interviewed seven mathematicians for my study, I have chosen to include Maya as the first mathematician for several reasons: she is a female mathematician, an applied mathematician, and a foreigner, not of the dominant culture. These three aspects make her noteworthy of study in my eyes, mostly because I, too, am a female mathematician and a foreigner making her livelihood by the grace of mathematics. My inquiry is about engagement with mathematics; much of what I want to find out is why people take up and do mathematics (similar to any endeavour such as music, art or literature), what is it that mathematics requires us to do in order to engage with it, and so on.

⁶³ There were two interviews conducted approximately a year apart. The first lasted one hour and the second about twenty minutes. The second was mostly for clarification of what I was seeing as I attempted to analyze the data from the first interview.

⁶⁴ While there is much metadata that is embedded in the choice of pseudonym, my intention is to indicate that Maya is female and non-White, as I am. Maya is a Sanskrit word meaning illusion, as in 'this world is Maya', meaning that the distinction between self and the Universe or God is a false one, and that we are deluded in thinking that we are separate selves.

Broad strokes from the narration

Maya had been suggested to me as a female mathematician who would be a good candidate for this study. I had understood from this that she would be willing to engage in the interview and would provide interesting insights. Just prior to interviewing Maya, I had interviewed a retired mathematics education professor who gave the barest of answers and who withheld any personal thoughts on mathematics or on mathematics education (I had the feeling that he was holding his cards close to his chest and was determined not to let me see so much as a chink in his armour; I use chink to indicate both a glimmer of light and weakness. Or perhaps it could have been that being retired, he was so far removed from either subject area that he did not have much to say). So I was somewhat apprehensive, but as it turned out, overall, the interaction with Maya went quite well. Maya was kind to speak with me twice; there was a clear sense of someone who saw talking about mathematics as part of the responsibility of being a mathematician and a professor of mathematics.

As before in my previous analyses, I seek to present the subject before me from his or her lived experience and as I seek to capture and convey the sense and meaning of the interaction in this writing, the writing itself demands and imposes further levels of attention, reflection, and assessment/discrimination. In the analysis that follows, I have quoted from the transcript extensively. This is always a point of tension, in that I, as researcher, seek to be true to the subject, but I also am the interpreter of the event and the exchange. The conversation between Maya and me flowed quite smoothly for the most part. These were relatively short interviews, but the exchange of utterances was, in many places, simple, but effective, the one following the other smoothly to form clean and pleasing episodes. There were many places where there were smiles and laughter. Maya was of small stature, but she had big expressive eyes and wide expansive gestures that she used to great effect. Except for a moment involving the mention of depression at the beginning, the interview was quite pleasant on both sides. I think now that it was pleasant for me because she was willing to share a view of what mathematics is that overlapped a great deal in some aspects with mine. Despite this, I often felt an unseen barrier, she the more accomplished mathematician, I the supplicant as it were. There were times when she gave a small smile as if to indicate the gap between us, that

her knowledge of mathematics was far removed from mine, and that she was attempting to be kind.

To elaborate more on that tense moment, I note that the nature and character of each interview varies, as I have indicated, being a function of both the person giving the responses in telling his or her story and of my questions and timing. At the start of the first interview, I explained the purpose of the interview and started with the usual questions of trajectory and influences, but somehow, within the first ten minutes with no conscious intention on my part that I was striking at anything deep, her response indicated that it was greatly personal; she simply pressed her lips together, looked at me, and did not continue. In hindsight, I realize that I had started too early down the thread of when doing mathematics becomes difficult or when it does not work so well. At the time I realized that I had somehow pushed her to, or that she had arrived at, a place from which she was not prepared to nor willing to speak. I knew then that I should not and could not press further. So almost the entire interview was about her conceptions of mathematics and what she does as a mathematician. Maya was ready to engage in discussions of what mathematics is, but perhaps, that was because she had already drawn a line in the sand, as it were.

From my study of Maya's account through the transcript and the video, I first present two themes relating to her engagement with mathematics. Then I turn to an examination of desire as it appears in her account of her journey.

Any attempt to categorize meets with the hurdle mentioned in Hacking's (2013) review, 'Lost in the Forest', of the *DSM (The Diagnostic and Statistical Manual*, arbiter and authority on mental health, now in a controversial new edition) concerning "the long-standing idea that, in our present state of knowledge, the recognized varieties of mental illness should neatly sort themselves into tidy blocks, in the way that plants and animals do" (p. 8). The categories I present below are not 'tidy blocks', but they capture the ways Maya conceives of the discipline of mathematics and of herself as a mathematician. The two themes are Being/Becoming and Seeing. These may turn out to be too broad, but for now they capture the themes in our exchange.

Being/Becoming

Maya gave a characterization of mathematics that I had seen before, mathematics as a familiar crutch, as well as some new ones, mathematics as a coping mechanism and a real barrier in life. The notion of a familiar crutch had come up in my reading, mathematics as a means of support, as something one turns to as a constant when all else around one does not seem to be working, something one turns to for a familiar feeling, as in Paul Simon's line, "I seem to lean on old familiar ways".⁶⁵

Mathematics as a coping mechanism occurred when I asked (too early in hindsight), by giving Grothendieck as an example of someone giving up mathematics and being a recluse, whether anything similar had happened in her life or whether life had always proceeded on an even keel:

M: Oh, no, no, quite the contrary, I think like a lot of mathematicians and physicists, I grapple with depression, lots of us do, and when things go bad, I tend to withdraw, you know, I tend to shut myself off and when I was younger, I would shut myself off, but I would shut down, I would not do math, I would not do anything (hands up, open, at the side), just shut down, and over the years I have learned that my mathematics can be a coping mechanism. So it's a good thing, I am not, I don't believe I do my best work when I am depressed, far from it, but it's a good (pause), it is a very familiar crutch and you know if you have tasks that are demanding, but not supernaturally hard then I find (moving hands in front of one another to indicate taking one step after another) that just working at them as a distraction and then it's helpful, I find it helpful. But I do tend to shut myself away. I do that a lot (shakes her head for emphasis).

Here was much more than I had expected or frankly was ready for: the admission of depression, the notion of grappling with depression, and the "like a lot of mathematicians and physicists". I can see the alienating aspect of and the often-perceived difficulty of mathematics making one depressed, but what could be the source of depression if mathematics were a coping mechanism? In Nimier's study of defence mechanisms (1993), students were defending against mathematics in various ways; what we are seeing here is the other side of the coin, a gravitation to mathematics as a means of pulling one's self together, from the feeling of fragmentation of self to a feeling of

⁶⁵ from the song, Still crazy after all these years.

coherence in the mirror of mathematics, similar to the mirror stage. She has learned to use *her* (“my mathematics” she had said) as a “coping mechanism”, finding things that she can do that are not “supernaturally hard”: mathematics assuages and heals her towards a more coherent self. It awakens those pieces that had been (or that she had) shut down to build her sense of self. It helps her to see what to desire again, desire helping us to see how to express ourselves, how to imagine ourselves. Mathematics enables her to desire not just mathematics; it teaches her how to bring back desire, it awakens in her the desire to desire.

I saw before me a successful mathematician, one who had gained the credentials and admission⁶⁶ to the halls of a well-known North-American university, with the additional challenges of being a foreigner and a woman (I am not sure which of these is the greater hurdle). Depression would have been the last thing that I would have associated with her. But then, I had not yet conducted an interview with a mathematician who enthralled me with tales of colleagues, one, in particular, who posted pages of the *DSM* on his office door. In hindsight, I should have been ready for such an observation, because I had read many biographies of mathematicians where madness and despair figured prominently. In fact, in selecting which mathematicians to present for this study, the question often came up: Can you not find any well-adjusted mathematicians? Indeed, it will turn out that, despite this moment, Maya is my example of a well-adjusted mathematician, one for whom mathematics is everyday, providing no reason for angst. But soon I realized that there was more there than met the eye.

Maya had already described mathematics as a coping mechanism (“over the years I have learned that my mathematics can be a coping mechanism”). Soon after she repeats this description, this time her gestures indicating a kind of coming into being when we talk about doing anything besides mathematics.

M: I couldn't imagine doing anything else... (big, big laugh) I am not very good at anything else.

I: Yeah, I know, I often wonder if I weren't a teacher what I would be ...
And so those periods where it hasn't worked so well,

⁶⁶ Kovalevskaya, in a different time and a different society had gained the credentials but not the acknowledgement.

M: (nods her head slowly) mmhmmm,

I: It's the knowledge that you do come out eventually,

M: Yes.

I: I see, I see (I had a feeling I shouldn't/couldn't push harder. She said, yes, but seemed reluctant to continue...). So, what influences, are there people or images or something that bring you out or bring you back?

M: Ahhhhh (in a questioning manner and then slowly), I think, rather than specific images or influences, I would say that climbing, climbing back (pulling in kind of gesture) is a process. It is an illness, it's... (sets her lips together, looks at me, and doesn't say more...).

I: Yes, it is something we all face to some degree...

M: Right, and so we all develop our coping mechanisms ...

I: It's lovely, mathematics as a coping mechanism.

I felt privileged to have had this conversation, to hear how much the discipline means to another human being, to see that it affords a way to find oneself and more so, to rescue oneself. Of course, the astute reader will ask, what, specifically, in mathematics affords us a way to find ourselves. What about it offers redemption and rescue? Is it in the discipline or is it in us? Maya indicated that it was "a confluence of the two". It seems to me from the mathematicians that I have spoken with and from the accounts that I have read, that the answer is: Both!

Maya goes on to give a second characterization of mathematics as "a real barrier" in life as it pervades and takes over all aspects of her life. I had been suggesting that sometimes people refer to mathematics as a demanding mistress to which she agreed:

M: I do, I do, it [mathematics] affects everything, I would say, I think I am very fortunate to have a mathematician as a spouse,

I: I see. Who is your spouse?

M: Ah ... (here she gives me his name, big smile), but prior to that and in all my relationships, mathematics was a real barrier because half of your life you spend thinking carefully and somewhat axiomatically and critically and you have to self-correct, you know you examine what you do, and in the other half your partner might find that to be exhausting or annoying or

you are being too critical or not supportive or whatever, so, indeed, it spills into your whole life.

Here, Maya is pointing to a demand of mathematics in that it requires from us a way of thinking that may be alienating to others, and that it can be excessive and all-encompassing in overtaking one's life. Further, a "barrier" suggests the concept of *Anstoss*, from the German philosopher, Johann Fichte, which means both "a check, obstacle, hindrance, something that resists the boundless expansion of our striving; and an impetus or stimulus, something that incites our activity" (Žižek, 2012, p. 150). As Žižek explains further (p. 151), *Anstoss* is similar ("homologous"⁶⁷) to Lacan's *objet a* as a magnetic field which is the focus of the activity from where the subject posits itself. Mathematics, as barrier, both constrains and impels Maya's construction of self.

Finally, Maya sees mathematics as "a very living discipline". I had asked about the various views of mathematics, namely, the Platonist, the formalist and the intuitionist:

M: Certainly mathematics for me is not a formalistic exercise on paper. I think the Bourbaki have done more damage to mathematics than anybody else. The Platonists overstate the case, I think by making it seem that there is mathematical truth which exists in perfect beauty somewhere (raises hands high) ... well that's almost religious as a viewpoint and it is not particularly helpful, I don't think. So intuitionists, if I had to pick a box, I'd say intuitionism is the best way to do it because it is more reflective of how mathematics is actually conducted, right? It is a very living discipline. The aesthetic that informs what we do, changes. The truths we hold dear have evolved, right, and this cannot fit within a Platonist framework. So that I think that it's more constructive to think about mathematics as an activity with certain characteristics which we perform in our daily lives to a certain degree, to a varying extent.

For Maya, then, mathematics evolves organically adapting to the aesthetic of the time. It is interesting that she thinks that Bourbaki has "damaged" mathematics. While there are mathematicians including René Thom who agree with that opinion, I remember holding a volume in my hands as a student and marvelling at the clarity and the purity of the exposition, taking delight in the symbols (a stylized, slightly tilted Z for a "dangerous bend") and the expressions (*abus de langage* and *wlog*, without loss of generality), all

⁶⁷ When did the word, isomorphic, fall out of fashion? I liked the 'morph' part suggesting form, shape, and structure.

very heady to me. Maya came to mathematics through physics and works in applied mathematics; hence she sees mathematics (besides being “a very living discipline”) as a human experience, a fact that can be easily occluded by Bourbaki.

Seeing

As an applied mathematician, her work spanning “the gamut from analysis all the way through modeling and simulation”, Maya describes her journey to mathematics through physics, drawing a parallel with the historical development. Mathematics starts for Maya when she can see the equations: “I have collaborations with fellow-scientists, so making progress on those requires me to read in their discipline as well, so that takes me time, but that activity becomes more mathematical the moment I can conceive of equations to write down and then you start to ask questions about the model itself.” Here there is a switch in pronoun use, but I think it is more likely a quirk of speech. The quotation is interesting because it says that the point at which she can see the mathematics formally as an equation or equations is pivotal and generative, that that moment of symbolizing is the point at which a solution originates for her. Maya says she has “very little insight into the actual physical phenomenon”, but the power of the mathematical formalism gives her the insight and provides a key to the solution she seeks. For Maya, it is the mathematizing⁶⁸ that provides keys to expression and making a contribution. Mathematics as a symbolic language, Maya says, “gives me the ability to actually contribute to science in a way that I would not be able to do if I didn’t have the mathematics, the mathematical training.” Here, Maya is speaking to the rewards of mathematics and the privileges it bestows. It opens doors and gives her a VIP pass to arenas where she could not have otherwise participated.

Maya described her sense of seeing the world mathematically. When asked what images evoke mathematics for her, she presses her lips together and looks steadily at me as if thinking hard and replies that she sees mathematics in everything except her children. Even so, she goes on to describe her children’s activities as mathematical:

⁶⁸ I was tempted to use the word ‘mathematization’, if such exists, but that seems jarring and off-putting.

M: I watch my kids, and from a very early age they are doing activities, sort of without prompting which are very mathematical as far as I can tell, you know, they are stacking blocks in a very particular way, they're jamming their dolly in a truck in this very particular way, arranging things, and arguing over, you took more than my share and I took more than your share, so these are all very mathematical things, without any formal training So I think it comes very naturally.

For Maya, it is more than simply seeing the world mathematically; indeed, she states that she does not see a difference between us and mathematics. This must be considered radical as mathematics, however it is conceived, is generally thought as outside of us. I think the general contention is while it comes from us and is of us, it is, *stricto sensu*⁶⁹, separate from us. This may not be a view of mathematics endorsed by radical participationists and embodied cognition theorists, but it is held by a majority of mathematicians and definitely by laypeople. All, but a very small percentage of the world's human beings would describe their lives as mathematical, and even then they would describe only a small fraction of their activities as mathematical.

Maya continues with how she interacts with the world:

M: In the absence of a mathematical way of approaching things, I don't know how to interact with the world, (pause and then slowly) I cannot make sense of the things people say unless I step back from what they're saying and think about using a mathematical approach. I can't make sense of anything, really, without this as a means to understanding.

This passage is stunning in its negation and use of negatives (in the two sentences, there are four negatives, emphasized below).

M: In the *absence* of a mathematical way of approaching things, I *don't* know how to interact with the world, (pause and then slowly) I *cannot* make sense of the things people say unless I step back from what they're saying and think about using a mathematical approach. I *can't* make sense of anything, really, without this as a means to understanding. (*emphasis added*)

⁶⁹ To borrow a construction from Žižek ...

Once the negation shows up, it is a sign of the unconscious: “recognition of the unconscious on the part of the ego is expressed in a negative formula” (Freud, 1925, p. 235). Earlier in Chapter 2, I had referred to Freud’s four ‘Vers’: this excerpt points to *Verneinung* (denial/negation) which shows up in at later points in the interview.

We continue with her not being able to make sense of anything without a mathematical approach:

I: Literature, art, music?

M: (Nodding), everything, everything I am very fond of poetry, but the poetry I love is very structured poetry and I find it amazing that within the confines of particular things, people are able to do such beautiful and creative things. I am very fond of reading, but there too, I read a book, but in my head I’m trying to think, okay, why is this happening here, what in the previous chapters means that this must be so and no other way, right?

I: That’s your mathematical mind.

M: It is ..., I think that all of us have that training.

Maya has used the word, training, a second time indicating structure (“the poetry I love is very structured poetry”) and it suggests that she is not in control, that mathematics dictates a certain way of looking at things. This exchange captures perfectly Maya’s way of engaging with mathematics; it speaks to the integrity of a basic essence that supports and influences her life and her world. Indeed, her first statement in the exchange is so striking it bears repeating: *In the absence of a mathematical way of approaching things, I don’t know how to interact with the world* (emphasis added). It reminds me of a statement from an interview with another mathematician: “To the extent that I appreciate literature, I do so mathematically”. For Maya, mathematics is a colouring and a way of seeing that is brought to all endeavour. Even in literature, Maya, like the other mathematician, is working out how things unfold, how things at one point are supported by what has gone on before. Another point of note is that besides the word, ‘training’, Maya also uses ‘us’ a second time, pointing to the community of which she sees herself a part, and in which she values her membership.

We resume:

I: I think that that is such a beautiful way to live and I think that that's what mathematics has given us, those of us who live and work in mathematics, this way of seeing, this way of being...

M: Yes.

I: So really, if you weren't a mathematician you can't imagine what you would be....

M: (Shakes her head) No, and it's not for want of trying.

As for the “not for want of trying” (another negation, but this might be a negation of a negation as in Hegel's *Aufhebung*, sublation) to be something other than a mathematician, Maya recounts the experience of being persuaded to undertake an MBA by a boyfriend. She studied, took the exams, and went for the interview. She continues: “...during the interview, I was asked: So what is your ambition? And I said [many facial gestures] I just want to study math, I guess, and they said: ‘Sweetheart, you know, this is not really a good fit for you’ [big laugh] so I dumped the boyfriend and did math instead!” There are many motives that impel people to take up mathematics; this one seems to be almost accidental (the “I guess” as a hedge in not admitting her real intention). This suggests that Maya may be an accidental mathematician, but I do not think that that is a correct assessment as there is still more there than meets the eye.

I turn now to an examination of Maya's trajectory with the lens of desire and show how, in Maya's case, desire is not so much unseen as unsaid and unsayable. While I have shown evidence of desire as lack and negation, I now turn to an analysis of the interaction using the forms of desire above.

Desire

My hope in the first interview was that I would see evidence of my argument for the dissertation that engagement with mathematics is impelled by desire. However, there was little explicit indication in this regard.⁷⁰ I tried writing an analysis of desire from

⁷⁰ Naïve as it makes me, I have since been cautioned not to believe simply what my interviewees tell me or what I read in the written accounts. Indeed, the *raison d'être* of the psychoanalytic method is that it gives a conceptual apparatus by which we can discern what is hidden or disavowed.

the first interview, but it proved impossible; despite my best efforts, I could not see desire in her account thus far. I then asked for and obtained a second interview. I had been warned previously as a rule not to ask my research questions too directly; but because it looked as if in the second interview we were floundering, seeming to go over the same ground, and showing no sign of what I knew must be there, I decided to lay out my argument baldly and say the word, desire.

I begin with an admission from Maya that comes only at the very end of the second interview (a very valuable twenty minutes), because it throws light on and unlocks the puzzle of her desire that I had been trying to fathom from the first interview conducted a year earlier. In the last two minutes, after I had pressed hard, Maya says:

I realized very early on that I enjoyed physics and mathematics and I was good at it and I wanted to do it, but the idea of being a physicist or a mathematician (pause), I had no role models like it, there were none where I grew up, these were not desirable occupations where I grew up, so I was not trying to become somebody else, I already was what I was going to be, so desire in that sense, in the sense of striving, I don't (pause), I didn't grow, I did not want to grow up to be a mathematician, (pause) I was good at it, I enjoyed it, and then when I learned enough mathematics, I said, I guess I can call myself a mathematician. I did not aspire to be a mathematician, does that make sense?

Again there is a stunning parade of negatives (“no role models”, “not desirable occupations”, “not trying to become someone else”, “did not want to grow up to be”, “did not aspire to be”) and the “I guess I ...”, a second use of the hedge. What is striking to me, beside the negation, is how long it took for me to see it, negation as an expression of lack, desire as lack and void, drive constantly circling that lack.

Her first point is about having no role models; did she have to self-mirror? Then there is the dissonance in the “so I was not trying to become somebody else, I already was what I was going to be” and the “I did not want to grow up to be a mathematician.” Third, aspiration is an indication of desire. In that chasm between her “I did not aspire to be a mathematician, does that make sense?” and her present reality of being a mathematician at a major university is the story of her desire.

As I have said, the word, desire, did not come up explicitly in the first interview with Maya. I had conducted that interview with her well before I came upon the pivotal

notion of desire relating to engagement with mathematics and neither she nor I used the word, desire. In my interview with Tom (to be described next), the word had come up in one of my reframings of a question in an attempt to draw him out. It is my argument that people who take up mathematics, who become mathematicians, and who continue to work as mathematicians, do so because desire in some form has been evoked, the desire being evoked by the discipline in the subject (the person or individual).

A common thread with those who take up mathematics is the desire to possess mathematics as a means of enjoyment (**active anaclitic desire**). Maya relates that she started “as a young kid” being “really interested in physics, particularly in things like cosmology and electromagnetics”, and over the years, she was drawn “to how unreasonably effective mathematics is⁷¹ (huge, huge smile).” She is also drawn to the theoretical aspects of doing mathematics such as the attention to rigour, the systematic nature of it, and the opportunity of abstraction, in drawing out and capturing the essential aspects. As an applied mathematician, she relies on the intuition of others (her collaborators in other disciplines) and enjoys the ability to bring insights from mathematics, thereby gaining an opportunity to contribute to Science. Here Maya is speaking of some of the categories that Burton (2004) had identified.

What stands out and what remains from the first interview are the words, challenge and challenges, which occurred quite frequently. Maya enjoyed the challenge of taking up and doing mathematics (“part of why I liked it (slowly) was that it was challenging ... the courses I have enjoyed the most (closes eyes here) have been the ones that have been the hardest, so the easier it is the less interesting...”). Despite the complication of “crippling math anxiety”, Maya pursues the subject, delighting in the difficulty of it. In general, we lose interest once an endeavour becomes difficult. But then it is also the case, as with Maya, that the greater the obstacle over which we have triumphed, the sweeter the satisfaction. Maya had closed her eyes, as if in an ecstatic experience, in contemplation of the courses she “enjoyed the most.” Maya also described the challenge of three-dimensional visualization (“every time I work in differential geometry I find myself using my hands (more nice gesturing) or using an

⁷¹ The physicist, Eugene Wigner (1960).

apple or something...”). And she spoke about challenge in response to my questions about when the mathematics does not go so well, but then set her lips together and would not say more.

One wonders where the challenge was coming from, whether from within or without and why? What drives one to pursue a difficult endeavour? To whom does one want to prove anything? To or against what unseen or unknown authority or purpose do we struggle? These are all encounters with the Real. Here Maya smiled as she spoke about the challenges, but there were few indications of the drivers. So far, Maya had described mathematics as something she enjoyed doing, and I could see that she was before me a fully-fledged mathematician, a position she assumed with what looked like the ease that comes with competence and experience. But the question of desire was still a puzzle to me; I could see little indication or evidence of ambition, struggle or angst in the endeavour.

Clues of ambition and striving come in the second interview when I pressed further. Before me was someone who spoke of mathematics in an everyday and matter-of-fact way about mathematics, her manner belying what I knew could not be true, that it was simply a matter of steps, one after the other and a prize such as being a mathematician at a university could be had. When I pressed in the second interview about obstacles that had to be overcome, her response was halting:

M: Ummmm, (slowly), is it very useful to ponder the obstacles one has overcome, perhaps not, or I don't find it useful to dwell on them, so [we're floundering somewhat here, lots of pauses, not knowing where to go on my part], so I was a foreign student in North America, I could not get funded under the research grants that my advisor had, and so for the entire duration of my PhD, I taught, I taught every semester and there were four semesters a year, I taught every single semester while I was doing my PhD, I took a total of 27 courses during the course of my PhD.

I was struck by her seeming dismissal in putting aside “obstacles one has overcome.” In my experience, people who have triumphed over obstacles see them as notches of achievement in which great pride is taken. These were perhaps too personal. I was also struck by the number of courses she said she had taken; it seemed an inordinate

number. She assured me that her journey was by no means easy, that her family had sacrificed to send her to North America, and that she made her way alone from then.

There are still two things to tease out here regarding challenge. One is that Maya made her way as a foreigner, not of the dominant culture, and the second is that she made her way in mathematics as a woman. In that first interview, she did not mention either as a challenge. It is noteworthy and indicative of our various positions that Maya and I, both women in mathematics, went through the whole first interview and not once did the woman in mathematics question come up. I did not ask and she did not bring it up. It only came up at the end when I thought we had covered everything and having come to the end,⁷² I asked her if she had any questions. She wanted to know if this (our exchange) was what I was looking for and I replied by telling her what I was hoping to do in presenting and exploring the stories and mathematical myths. She remarked:

M: The myth that I detest the most is that you have to be young to do mathematics. Yes, we do face that.

Only then, at the mention of age, did I remember that I was talking to a woman mathematician and I hastened to ask the “being a woman in mathematics” question! It turns out that it was just as well that I had waited this long because she replied with a furrowed brow: I. Don’t. Know. (her emphasis, with periods (pauses) between the words). Here I had reached a block as my reaction was: How could this be? One has lived the experience of being a woman in mathematics, but one responds in this manner. I appreciated the challenge of making one’s way in a discipline and a profession that is seen as male, but Maya did not or could not speak to it. Perhaps it was too personal and threatened again to go too deeply, entailing too many issues. I saw then that interviewing could be both sterile and perilous, that interview subjects had to be treated with care and even when one is careful there are, for both the parties embarking on this crossing, unsuspecting mines and unseen depths.

⁷² I had carried out the interview with only questions from my head, not once consulting my notes. By then I thought that I was experienced in interviewing and could manage without notes.

Hence, despite the deceptive appearance of a mathematician fully grown and armed like Pallas Athene springing from the head of Zeus, there had been all along angst, striving, and ambition. The question of what impels engagement with mathematics for Maya still remains. A propos of Maya's journey, I wondered whether one pursues mathematics to prove something to oneself. I see Maya's striving as a desire for recognition, what Bracher terms **passive narcissistic desire** – the desire to be the object of the Other's love (or the Other's admiration, idealization or recognition) if only for herself, much like the desire for self-determination. In the beginning, it seems for Maya, it was the challenge of it, what can be seen as Hegel's fight for prestige.

I have the distinct impression that for Maya, the place at which she has now arrived in being a mathematician is no longer challenging or full of angst; it is an everyday occupation over which there is nothing to be distraught. Does this then enable her telling of the story as if no great effort or sacrifice had been demanded? Maya found mathematics as if by accident; it worked for her and she continues in it. Maya describes her feeling for mathematics, again after I persisted:

M: I'm certainly very passionate about mathematics, there is nothing else I'd rather be doing, I have spent more time with mathematics than anything else, even my children, I think the day they were born I was still thinking about mathematics so it's certainly something I feel compelled to do or want to do and I enjoy doing, the notion of doing anything else never occurred to me really.

Putting this expression with her earlier description of mathematics as a coping mechanism, leads me to see her folding herself into the embrace of mathematics as in the embrace of a lover. She had indeed pursued mathematics as a lover. Maya had mentioned the word, 'training', twice. By this she is indicating that her desire is for mathematics to be in control and to sweep her off her feet. Her desire is for mathematics to lead the way and to impose itself on her life. So though she indicates that she is always thinking about mathematics, she projects this sense of indifference that it was not in her hands. This is an example of **passive anaclitic desire**, the desire to be desired as the object of the Other's jouissance.

Mathematics taken up to an extreme degree raises the aspect of inside/outside. Is mathematics all there is? Is she inside mathematics or is mathematics inside her? Is

there any outside? Maya tells me about her boyfriend, her husband, and her children, but none of them is as important to her as mathematics (“even on the day they were born...”). It is telling that her response to being a woman in mathematics is that it is beside the point. The question of being a woman is of no interest in her story, but perhaps it is because she is a woman that she can have this relationship with mathematics. It also explains why it was difficult for her to respond to the question of when the mathematics does not go well because she cannot envision a life without mathematics and has to claw herself back to it.

The one remaining form of desire, **active narcissistic desire** (the desire to become the Other – a desire of which identification is one form and love or devotion another) cannot be seen for a reason that is now clear. It is directly in opposition to her “I did not want to grow up to be a mathematician.” Maya is a woman mathematician, an applied mathematician, and with a mathematician spouse. She was attracted by the theoretical/formal and applied aspects. Though she may have been tentative in her use of “I guess” twice, once at her interview after the MBA exam she took: “What do you want do? I just want to study mathematics, I guess”, and again when she says after she had learned enough mathematics, “I said I guess I can call myself a mathematician”, she had been drawn as a moth to a flame. In *A lover's discourse*, Barthes (1977, p. 73) writes of the amorous subject:

The amorous subject's propensity to talk copiously, with repressed feeling, to the loved being, about his love for that being, for himself, for them: the declaration does not bear upon the avowal of love, but upon the endlessly glossed form of the amorous relation.

Maya said one thing, but indicated another. In that chasm between her “I did not aspire to be a mathematician, does that make sense?” and her present reality, whatever it was or has been for her, it appears that now mathematics has become everyday and no longer a horizon of struggle. Or perhaps, some mathematicians see it as a badge of honour to show that the journey has been effortless, and to present no sign of effort or struggle.

Summing up Maya

Maya's desire shows up mostly in negation and appears to lie elsewhere in a place that she has laid aside and that she was not about to reveal to me. It seems to me that Maya could not give voice to her desire, that it was unsayable, and perhaps unknowable to her. The line that she had drawn in the sand was the boundary of the unsayable for her. And I was finding out that the dissonance that I was sensing is a part of most mathematicians' journeys, that there are still unasked and unanswered questions. In my chapter on Methodology, I had described the strands of Rogers' (2007) method of Interpretive Poetics as a means of listening to the unconscious, one of which is story threads. In this account, the story threads do not quite weave together. For Maya, mathematics and being a mathematician are now a backdrop to other unconscious and barely intimated forces. They have been so negated, so tamped down and put aside that they are now givens and no longer sources of desire.

I now follow with an analysis of my interview with the second mathematician, Tom. At the time of the interview, Tom was an emeritus professor of mathematics at a major North-American university. In the interview, my focus was discerning Tom's engagement with mathematics, namely, his trajectory, opinions, and feelings about the discipline. My larger purpose was to determine what can be learned about mathematics from his articulation of his experience in it.

Tom: Mathematics as Disappointed Desire

I chose Tom as an interviewee in my study as a result of two things: I had heard of him and his long career in mathematics from colleagues in the department of mathematics and statistics in the college where I taught (one colleague recounted how he had heard Tom say with an expansive gesture: Geometry is all there is), and I had seen him at math meetings and conferences (asking hard questions). I had gone up to him at a conference and introduced myself. I spoke of my interest in what it takes to engage with mathematics and asked for an interview.

There was elaborate preparation on Tom's part for the interview. I had met him in his office where instead of offering a greeting on seeing me appear in his doorway as

he turned from his computer screen, he simply pointed to a chair. “Do you understand French?” he had asked. He had been looking up interviews published online with another mathematician, H.⁷³ He led me to a big meeting room, bringing with him an abacus, a slide rule, and some printed pages. He sat across from me with these items arrayed in front of him. As it turned out, he had arranged with a postdoc student to help me with the recording equipment suggesting an intent (and a hope?) of having an interview similar to H.’s, perhaps for posterity. Hence, there was a third party to the interview, a silent over-hearer.

During the interview (which lasted two hours), Tom appeared relaxed and ready to undertake the interview. His demeanour indicated that he saw this process of talking about himself as a mathematician as part of the work of being a mathematician; he said that it would be silly of him not to try to do something similar too. Hence he was prepared to give some of his time and attention in addressing my request. He appeared open and generous in his responses, secure in his position and in himself.

Soon though, as with Maya, I realized that there was more there than met the eye and more there than my expectation of what it is to be a mathematician at a major North-American university. For this analysis, I watched the video and read the transcript many times. Each re-seeing and re-reading offered fresh opportunities to notice incidents, gaps, and hesitations more clearly, to catch more allusions, and to make more connections. Further, the experience of my analyses of Kovalevskaya, Maya, and Weil had heightened my awareness and sensibilities concerning desire, thereby making me more attuned and sensitized to expressions that may hint at or bespeak shades of desire, present or absent, burning or faded.

In the analysis of Tom’s articulation of his experience in and his feelings about mathematics that follows, I begin by considering three broad strokes or themes that stand out as flags in the narration which I cast as Displacement/Standing in the Shadow, Dislocation, and Disclaiming. Then with the framework of Bracher’s four forms of desire and using the themes as underlying strands, I address the nature of Tom’s desire with

⁷³ H. is a distinguished North-American mathematician. As will be seen later, H. occupies a prominent place in Tom’s experience in mathematics and it is no coincidence that Tom had researched his interviews.

respect to mathematics and to being a mathematician. I explore the resonances that echo and the phantoms that stalk a desire that is seemingly denied, diminished, and down-played.

Broad strokes from the narration

As background, Tom attended elementary school in his home country and started high school there, but this was interrupted by the event of war. He made his way to North America where he finished his last year of high school. He then continued at universities in North America for both his undergraduate degree and his master's degree, but went further afield for his doctorate. All three degrees were in mathematics, his field of study being algebra and algebraic topology. He returned to his home country and pursued another qualification in mathematics at the doctoral level. He then came back and pursued a long but relatively undistinguished career teaching mathematics at a major North-American university for many years with some research publications in his field.

There is no mistaking the similarity between a researcher attempting to make sense of an interview with respect to the views and the stance of the interviewee and an analyst discerning the subject from the speech of an analysand. While with the video, the researcher also has some gesture and body language, the major emphasis is on the speech and narration (partially rendered in the transcript), on what is consciously left in/out and unconsciously taken out/put in, spanning a world between the enunciated and the enunciation. Lacan distinguishes between the subject of the enunciation (*l'enunciation*) and the subject of the statement/enunciated (*l'énoncé*). The subject of the enunciation is the subject of the unconscious, the one revealed in our speech and signifiers "the subject not insofar as it produces discourse but insofar as it is produced [*fait*], cornered even [*fait comme un rat*] by discourse (1967/2008, p. 36). The subject of the statement is the 'I' of speech, the linguistic shifter, which only has meaning provided by the context. Language for Lacan, is not a code since in the speech of the I, as speaking subject, there is a subject which is revealed and can be detected by the words and signifiers used.

The interview was long and covered much ground. Looking back now, I see that Tom and I did not have the same expectations of what we would cover. I had thought it would be a brief recounting of his experience in mathematics and then his thoughts and feelings about his career in mathematics, what it means to do mathematics, what it takes, and so on. It turned out that this was his first opportunity, as it were, to reflect on his life and career in mathematics. As such, he went into considerable detail beginning from elementary school and it took time to arrive at his reflections on mathematics.

Based on my readings of the transcript, viewings of the session, and reflection of all that I had seen and heard in the interview, I present from the narration three themes that were unmistakable in their clarity and insistence: Displacement/Standing in the Shadow, Dislocation, and Disclaiming.

Displacement/Standing in the Shadow

From the beginning and throughout the interview, there was an eerie, almost palpable, presence of a different third person from the postdoc student in the room in that Tom began to speak of some other ghostly person, H., right off the bat in response to my expressing my thanks for the interview and continued with regular references to him. I had not heard of or read H., and since I thought I had made it clear to Tom that I had wanted to speak of *his* journey and *his* experience of being a mathematician, that first reference to H. and the recurring ones were somewhat unsettling. Where I had envisioned a conversation with Tom and me, there were now two ‘others’ in the room, a physical one and a phantom.⁷⁴ H. was in the same undergraduate cohort with Tom; there was one other person in the cohort. H. had gone on to become an eminent research mathematician of long standing and a winner of many prizes in mathematics. These two others in his cohort are stand-ins for the big Other; they authorize Tom’s discourse.

The first reference to H. came in the first two minutes of the interview in response to my thanking him for his time. Tom says, “and I actually appreciate it too because, for example, I read this essay by H. which is twenty-two pages long”. On reflection now,

⁷⁴ I had chosen Tom as a pseudonym before realizing that H. was a phantom, a phantasy Tom.

Tom had only been doing his homework; at my request for an interview, he had presumably looked up similar interviews and for reasons that will become clear later, interviews with H. would have been uppermost in his mind. Tom goes on to say, “So anyway I’ve said I was grateful for this opportunity because I’ve never done this before and I ought to have done it long before, to go back over my past and just looking at the mathematical part to sort of figure out what exactly have you done, you know. You live your life and then you’re too old to remember it. And then it’s all gone.” This passage is important in the tone it suggests and I will come back to it later in the analysis.

The second reference to H. comes in the next few minutes. After remarking on the influence of “other people” on his career in mathematics, Tom says,

I mean the most influential and if I compare [crosses arms], because I looked at H.’s essay again [gestures at the document on the table], it was very well thought out obviously and obviously he did some research, he mentioned it, that he had looked up [uncrosses arms] where some of his teachers were from and so on. [Here he leans forward, begins pushing the beads on the abacus in one column from right to left methodically working from top to bottom]. A fellow here at ___ called ___, for example, is just one of those names and he’s from ___. [Now Tom begins to move the beads in another column from left to right as if trying to achieve or complete some sort of symmetry]. I had no idea that he was from ___. So H. had obviously looked up all these things [crosses arms again and sits back in chair] and it’s a very well-written essay as you’ll see, well-thought out, well-presented. I thought well, it’s really silly for me not to try to think like that. ... It’s an interesting one for me to hold up as a kind of mirror [holds up his hand to simulate]. He’s become a great mathematician, truly great [voice rising, hands wide apart in an expansive gesture], I mean as I told you, in a category almost by himself, I mean the people that would be mentioned as the greatest [right palm up in an outward gesture] mathematicians of the last half of the 20th century would be apart from him would be people like...um ... Andrew Wiles would perhaps not quite make it, but Serre, Jean-Pierre Serre and Grothendieck, Alexander Grothendieck and uh, a few people like that, you know at most ten of that stature and so I was very lucky to have somebody, someone like that as a fellow student and I had no inkling [voice emphasis] that he would become so famous.

I quote at length here to show both the elevated position in which H. is held by Tom, and Tom’s assertion that H. is extremely well-regarded by mathematicians. Tom’s methodical play with the abacus may indicate an element of absent-mindedness, but I see it as an attempt to downplay H.’s achievement, to indicate that he was not affected

by H.'s achievement, and that if he were at all affected, then it was inconsequential. The holding up of his hand, palm upward in front of his face in the gesture of a mirror also suggests comparison as with Weil (Mirror, mirror on the wall, who is the fairest of them all? Who, indeed, is the most mathematical one of all?). This holding up-gesture recalls Lacan's mirror stage when we first begin to encounter ourselves in the reflection of others and the way Tom's life and career might have been shaped by having started out with someone who had gone on to such great heights. Tom is seeing his reflection in the mirror of the mathematician, H., which is a more direct reflection of himself in the mirror of mathematics.

Much later in the interview, Tom repeats a similar phrasing about H. with a telling gesture: "I just told you how the math department here was wrong about H. and me (holding up his hand with his index and middle fingers in a V). H. became a great mathematician, truly great (voice rising), but (with a quick downward twist of his hand, the positions of the fingers are reversed) the faculty had it the other way around." This gesture of reversal points to discomfort and shame, a feeling of not occupying a rightful place, of being falsely esteemed at the expense of another, and of being falsely given the title of heir to a future of mathematical glory that has turned out to be hollow.

Finally, in the most poignant reference, Tom is recounting his childhood and speaking about coming to North America and the attendant decisions and anxieties, and he says as if in a plea or justification: "you see this is very different from the idyllic childhood that H. had..." Tom's memory of a childhood disadvantaged by war indicates an early trauma cannot be shed and is borne throughout life.

Besides comparison, the recurring references to H. signify a clear sense of not only being displaced, but of being overtaken. I am reminded of the four-minute mile with Roger Bannister and John Landy who were both in pursuit of that particular milestone. Landy was ahead; he said that as he neared the end and wondered where Bannister was, at the very moment he turned his head to the left to look, he knew that Bannister had passed him on his right and that he, Landy, would forever be the runner-up. That moment has been captured in bronze and stands for all time.

In looking back at his life, Tom is marked by H. and his experience with H. Tom sees himself standing in the shadow, in H.'s shadow. Tom has carried this knowledge of being the lesser light despite having started in greater glory (Tom had won many scholarships to university and had been interviewed in the local paper). In *Mourning and melancholia*, Freud (1915, p. 249) writes: "The shadow of the object falls upon the ego", suggesting that the subject in the experience of a lost object and the struggle of the ego with the object is led to melancholy. While I cannot say that Tom was melancholic about this experience of paths with H. that started at the same point but then diverged quite widely, I am convinced that H. was Tom's doppelgänger in the sense that in H., Tom glimpsed (and still glimpses) a version of himself in peripheral vision, in an unmistakable realization that H. could not have been merely a reflection. H. was Tom's double (his *semblable*) and his ego ideal. Lacan writes: "The one you fight is the one you admire the most. The ego ideal is also, according to Hegel's formula which says that coexistence is impossible, the one you have to kill" (1977, p. 31). Tom carries H. with him, still.

There is a similar sense with Weil who saw in the younger newcomer, Alexander Grothendieck, a brighter, more capable rival who had the potential to accomplish far greater things. Grothendieck was Weil's H. although Weil did not show it or allow it. The displacement did not seem to affect Weil or it failed to have the same effect because Weil, in leading the more privileged life of an older established academic, was able to absorb this better; Grothendieck had suffered great privations in his young life. In effect, Weil was displaced by a son, while Tom was displaced by a brother.

Indeed, Tom has spent his entire life from his undergraduate years in H.'s shadow, and is haunted by him still. H., as a third person, suggests a triangular relationship, namely, Tom, H., and mathematics; the mathematician and the discipline being others (Imaginary and Symbolic) for Tom. Did or does mathematics shower her favours on the one more than the other?

Dislocation

I gained a little more understanding of the interview when I read the word, dislocation, in Robert Fulford's 1999 CBC Massey Lecture, *The triumph of narrative: Storytelling in the age of mass culture*. Of Nabokov, Fulford writes:

He passed along some his most poetic reactions to dislocation in *Speak, Memory*, one the great autobiographies of the century ... In many other books he led his readers through the special uncertainties of immigrants, adrift in new worlds, threatened by failure, loneliness, and poverty, threatened even by madness if they cannot accept calmly the radical change that is their fate." (p. 119)

Tom's narrative of his childhood in one country, his coming to another for some of his education, then to a third country for advanced education, a return to the country of his birth for a time and then a second return to his adopted country is considerably more than the immigrant experience, compounding the threats and uncertainties at each move. The sense and power of place, the sense of movement from place to place, and the affective events surrounding the transitions in Tom's narrative provide keys to understanding much of his trajectory.

Tom's childhood experience of the war was hard to listen to and to read even now:

I started in this idyllic ___ village and then the war threw me out of there and I wound up in ___ and then we were pushed back by the ___ Army, and it was a general mess and chaos ... the ___ Army were at our heels... Who would you ask for permission at that time, either you asked and they hanged you on a lamp post or you didn't ask...

This speaks to the primal dislocation within his home country, namely, the circumstances of his early life. It also gives a key for why Tom ended up in mathematics. Tom had begun the interview by noting the influence of "other people" in his journey in mathematics, but he quickly points out that, "mathematics is something you could do on your own; you could take it with you, despite the chaos that is going on around you." In effect, Tom was indicating that you have no need to ask for permission to do mathematics.

Tom described his grad school journey as "I was following M. around." He had described M. as the only European-class mathematician in Canada at the time. Tom continued: "M. treated me like an Asian master, he didn't say yes, (pause), he said OK, well, we'll have to see, I can't take you on and you'd better do your master's degree first." Tom's moving around as an adult is an echo of the dislocation in his childhood

and underlies his search for a place where he belongs. The senses of dislocation and of not needing to ask permission provide two explanations for taking up mathematics; mathematics is seen as a place of belonging and of not needing permission.

As humans, we put together and present to ourselves and to others a story that enables us to see ourselves as whole and in our best light despite our experiences, our setbacks, and our successes. Starting from his experience of war in childhood, and with every move, Tom faced afresh the fears and uncertainties of being adrift in new worlds. It has been my experience that people move from their homeland to an adopted country for economic or political reasons and usually they stay in the adopted country. What to make of all of Tom's journeys, his return to his homeland and then his second return to his adopted country? Perhaps there were old scenes to be revisited and old memories to be laid to rest. Tom's narrative as a whole, in its careful and delicate rendering in the attempt to be faithful to the events and relationships as they happened and to present himself as whole and unscathed, can be seen as his fantasy over dislocation.

Disclaiming

Who is a mathematician? When is one a mathematician? When does one see oneself as a mathematician? When does one call oneself a mathematician? These are all considerations surrounding the signifiers, mathematician, and ultimately, mathematics. Teasing these apart, there is a first consideration is seeing oneself as a mathematician and taking for oneself the name of mathematician. When does that happen? A second is the conferring of the label of mathematician, who confers it and on whom? A third is when is the desire to be a mathematician or to identify with being a mathematician aroused?

It was a big surprise and puzzlement to me that Tom did not see himself as a mathematician or call himself a mathematician for a long time. "Oh, hell, no!" he had replied emphatically, "Not even when I was in the master's program." How to interpret this explosive negation and reluctance? How is it that one can be in a master's program in mathematics and not call oneself a mathematician or see oneself as a mathematician? The mathematicians I interviewed gave various answers to this question of when do you consider yourself a mathematician: one said in Grade 6 when he could multiply two binomial terms. Nowadays we encourage young children to regard

themselves as mathematicians when they carry out mathematical processes or engage in mathematical thinking. With Tom: "... it happens very late (emphatically)...it takes a long, long time, if you read H.'s essay you see that even for him it took until second year at university until he saw himself as a mathematician." The master signifier of mathematics is so loaded for Tom that he cannot begin to see himself as a mathematician, even when for the rest of us, he is so far ahead in being in the master's program in mathematics. Again, Tom was making it clear: H. is a mathematician and I'm not. Tom's position of not seeing himself as a mathematician until late is echoed in the findings of Beisiegel (2009), where almost every graduate student in the mathematics program under study did not yet see themselves as mathematicians.

Tom goes on to describe himself as a mathematician in a way that I had not foreseen: "I became just a sort of a run-of-the-mill mathematician ..., but I think that if Sputnik hadn't happened, maybe I wouldn't have been a mathematician." In using the expression "run-of-the-mill", Tom shows that there were no big triumphs, no discoveries, and no prizes. Again, there is the comparison in the degree of mathematician, a 'real' mathematician as opposed to a run-of-the-mill one, echoing Weierstrass' "complete" mathematician. Tom is also torn by his father's wishes that he follow in his footsteps and become an engineer ("with my father I had battles") and, as he explains, it was only the interest and the money in mathematics that came with Sputnik that brought his father around. Tom had entered the Honours Mathematics and Physics program and stuck with Physics until the last year of his undergraduate program. The mention of his father and the "battles" with him hint at and echo other untold stories. Travelling a winding and twisting path to becoming a professor at mathematics at an established university, Tom seemed to be caught in a web of influences and no clear path or awakening to desire.

Desire

It is my argument in the dissertation that mathematics as a cultural phenomenon succeeds in interpellating its subjects by awakening some form of desire. In this section, following on the themes developed above, I continue the analysis by examining Tom's narrative with respect to Bracher's forms of desire and the spectrum of desire (presence/absence/degrees in between).

As I am finding with these analyses of engagement with mathematics, the one form of desire that stands out and is easiest to identify is **active anaclitic desire** (the desire to have or possess the Other as a means of jouissance). This is natural in that those who go on to become mathematicians generally seek out mathematics for the joys and pleasures that it brings.

Desire to have or to possess the Other: Active anaclitic desire

Early on in the interview, Tom speaks of small joys, the discoveries of carrying, logarithms, and finding the square root of 2. He describes these as “little victories” in that he had accomplished these by himself (and with the slide rule in the case of logarithms): “It gave me the feeling that in mathematics you can figure out things by yourself.” They gave him the realization that mathematics is an individual activity; that it could be done by one’s self without anyone’s help. The joy in mathematics is short-lived. In one year in high-school, “math is a horror show”, in another, he “disdained the kind of math they were doing, they were rationalizing surds (in a drawn-out bemused manner), basically doing a little bit of number theory and quadratic fields without saying so, and I already understood it, of course, and I kind of looked at it disdainfully and continued my thing”. In one year at university, “math was a hodgepodge and, uh, unpleasant” and, “... in the material we were fed in class I saw no joy. It wasn’t bad either, it wasn’t a kind of turn-off either, but it was just blah, physics was more entertaining.” There was little positive expression of seeking or finding pleasure in mathematics.

As to how mathematics happens or begins, the desire to know mathematics, Tom muses:

... somehow there’s a start, I mean, you hear something or you are looking at a book ... something that you find curious and you start thinking about it, and then you go backwards and forwards until you fill it all in, and so (slowly) this is how it starts, you see something that’s a little odd and you say to yourself, well, that’s strange, how might that come about, and then if you have an idea, if you are lucky you have an idea, oh yeah, it’s probably because of this, and then you start fiddling around on paper or on the blackboard, try this calculation out, no, this is not quite it, oh, but it may be that and so, you carry on like this and if you get more deeply into it with some partial success and so on, then you stick with it

another day and so on, so it draws you in and finally you are obsessed with it.

There is much here on the origin of desire to know mathematics, to possess the knowledge of mathematics. A first observation is that the whole description, apart from the first 'I mean', is almost all in the second person, you, with some third person: this, there, and it. Is Tom describing someone else's process or is he recounting a journey that he has experienced? Second, the process is gradual and convoluted and may or may not lead to a spark that will fire the imagination. Third, there is the requirement of accomplices in paper or a blackboard. Earlier, Tom had remarked that in high school he had been introduced to millimetre paper with coordinate axes and a grid that gave space for conjecturing and generating mathematical diagrams and hypotheses. He bemoaned the present day use of blocks and rods which, he says, do not have the same potential to be generative. And finally, there is the notion of being drawn in, of a reluctant seduction, of mathematics drawing you in to the point of obsession. What is obsession, if not the desire to possess? Tom describes one incident of losing two nights sleep in a row in working on a problem, but he says it was only the one time and that he does not remember being so obsessed any other time. This intensity echoes the pleasure Weil had described and raises the question of whether this is a trait of a 'real' mathematician.

The notion of mathematics "drawing you in and finally you are obsessed with it" is a powerful one because it is at odds with the contemporary culture of students resistant to or turning away from mathematics. Mathematics is cast here as a seducer, beckoning with a promise of glory. One example of the sway of mathematics for Tom comes in his second undergraduate year: "All of a sudden we were faced with sets and the famous symbol for being a member of a set" [as he drew the symbol with his finger in the air]. He said that, that year, they had new teachers who had come from other countries and who brought the New Math with them, breathing fresh life into the department. The symbol had drawn him in. From Tom's description, the process of being drawn in is long and requires patience, "something a little odd" occurring to you, "if you are lucky you have an idea", "fiddling around", trying one thing and another, and "you carry on like this", and then perhaps a little success, and so on. It suggests almost an act of faith in a triumph of hope over experience. Indeed, it is a deepening of Tom's fantasy of

mathematics as providing the spell, charm, and magic of a way of drawing him on and leading him to greater heights of accomplishment in mathematics.

Desire to identify with or devote oneself to the Other: Active narcissistic desire

In considering Tom's desire to identify as a mathematician or to devote himself to mathematics, the threads above of Standing in the Shadow (Displacement), Dislocation, and Disclaiming all point to a negation, similar to that seen in Maya, and an almost clinical detachment from this desire. Tom presents himself as a curious onlooker, "on the outside looking in". Here are two examples. He describes being on the train to and from high school in his home country and listening in on (and sometimes helping) boys who were a year ahead of him with Geometry. A second example is that of sitting in on sessions as a university student with two mathematicians and supplying a lemma. Tom calls himself "a camp follower", but not so much out of cowardice, I think, but by curiosity, "those kids over there are playing with a different kind of object, I want to go there and see what they're playing with, why are they having so much fun, there was so much like that coming out in mathematics." This conjures up images of a boy in a playground or a toddler in a playroom and connections to potential space and mathematical reality (Maher, 1990, pp. 134-140). It also conjures up a sense of distance, of being apart from, of not being one of the insiders, of not being a mathematician.

In response to my prompts about desire⁷⁵, so to speak, in engaging with mathematics, Tom describes passion in mathematics: "but there is something about mathematics that eventually becomes passionate, a kind of cognitive passion that is aroused or something and it doesn't leave you." It is interesting that he qualifies passion as being cognitive, suggesting tones of sterility and austerity as he compartmentalizes desire. From his use of the word passion, albeit qualified, it was a surprise to hear him say that he was "lukewarm" about mathematics, even at the Master's level, and remained so for a long time:

⁷⁵ In a re-viewing of the interview, it was striking to hear myself use the words, "is there some desire that is awakened?" when, months later, I would come to my conjecture about the central notion of desire as the mover in the mathematical endeavour.

Tom: After [my first degree], I went to ___ for my master's and still I wasn't, by now I thought I was probably a mathematician,

I: Aaah (big exhale), very good,

T: Yeah, but it was a lukewarm feeling (shrugs unenthusiastically), I wasn't very enthusiastic, although I always enjoyed it, and what I tried to do was I tried to get some sense of perspective, some overview.

The dynamics of this exchange are interesting, beginning with his early start of "still I wasn't", and then the hedge "I thought I was *probably ...*" (*emphasis added*). On my side, I am finding his disclaiming of not being a mathematician inconsistent and contradictory, and I finally exhale, as if we are getting somewhere (in my eyes). But then, Tom insists with a shrug and lack of enthusiasm about a "lukewarm feeling". While I am trying to get him to admit his desire, Tom is wise enough to protect his desire. Later in the interview, when Tom was speaking about Sputnik and his father:

I: I see, so he finally came around to your doing mathematics!

T: Well, grudgingly, but it took Sputnik, the change in policy and in the education system.

I: But what I am finding striking in hearing this account is that you have gotten to the master's level and you are still lukewarm at it...

T: I think I stayed lukewarm for a long time [long pause].

I: Uh-huh, uh-huh.

T: I don't know what it, [long pause], I don't even know whether I was really lukewarm, when I say lukewarm I could see that mathematics takes an awful lot of time, it takes a lot of time and energy, and you have to give up a lot of other things, ... , H. says that, um, my interest waned [spoken slowly and with emphasis], and he also mentioned that C.⁷⁶ and I spent a lot of time with actors and poets and so on, there is a whole other part of life, that has to be ... [trails off].

I: ...That has to be acknowledged ...

T: Wwwwwell (tentatively), in my case, I felt it had to be curtailed if I wanted to be a mathematician.

⁷⁶ C. was the third person in Tom's cohort.

Tom's description of his feelings about mathematics as lukewarm seems to me to be emblematic of his desire in general, as throughout the interview, there seemed to be a downplaying of enthusiasm, a sense of compromising, of settling, of barring himself, and of denying desire. There seemed to be the poignancy of disappointed desire, both on his side and mine. On my side, the disappointment was that he was not following my script on what a mathematician is or when one can take or assume the name of 'mathematician'. Having lived a life in mathematics, as I sat facing him, I had then something (some residue, some intersection) of a meaning of those terms. I was unprepared for hearing someone, the one I presumed to know, Lacan's *le sujet supposé savoir*, who disavowed the terms with a lack of depth of feeling for something which I treasured and cherished. There was even a hint that Tom did not see himself as up to the level of the object of his affection and love, mathematics, did not see himself as deserving of the love of mathematics, and that he was not a desirable subject. His childhood experiences, especially of war, had circumscribed him in ways different from Weil. The final sentence in this extract is quiet and rueful, but simultaneously explosive in the realization that if he wanted to be a mathematician he had to forego other interests (actors and poets and so on), that there is indeed a price (perhaps, a high price) in "time and energy" and "a lot of other things" to be paid if one wanted to be a mathematician. Again, this echoes the findings in Beisiegel's (2006), in the mathematics graduate students' awareness of the costs of becoming and being a mathematician.

Continuing with examining the desire for identification for mathematics, the lukewarm aspect was also evident when I probed for an answer of what mathematics is. It was interesting that he did not give the usual descriptions of what mathematics is or even any description at all. There was great hesitation and reluctance on his part to say or to attempt to say what mathematics is. I grant that this may be a difficult question and may take a roomful of books to attempt an answer, but again I was surprised and puzzled that, given that he had spent a life in mathematics, he appeared reluctant and gave the impression that he did not think it important to be more forthcoming. Certainly, I was not expecting a categorical answer such as mathematics is the study of patterns. Mathematics is any number of things. That he was hesitant to engage in the question made me a little impatient as I had expected that as a professor of mathematics, he would be enthusiastic or even mindful of his discipline and its requirements. He said that

if there were an answer, it would have been said already. That was an extremely unsatisfying answer to me, again because I believe that his position as a professional mathematician demands a certain amount of enthusiasm for and thought on the discipline. So he disappointed me *too* as well as himself! Mathematicians do mathematics (leading to one definition of a mathematician and mathematics: Who is a mathematician? A mathematician is one who does mathematics. What is mathematics? Mathematics is what mathematicians do). Surely mathematicians must have some idea of what they do and be able to articulate it. I recently heard one mathematics education professor say that she has been collecting definitions of what mathematics is and so far, she has ten (which reminds me of another mathematics education professor who has collected 74 definitions of numeracy from the literature!). Tom ventured that “it is an experience” and that if we were to speak for another two hours, “we would still draw a blank in the end.” At one point, he threw his hands up and said that the question of what is mathematics cannot be answered and is unknowable, that it was like asking what is life or what is the unconscious, and that it was impossible to say what mathematics is. This suggests that, from Tom’s point of view, asking what mathematics is essentially a bad question or as we would say in mathematics, is not well-defined. I am willing to grant that, but I did expect some deliberation. I do think that were I to put that question to mathematicians in general (including H.), I would get responses that would attempt to address, in some way, what mathematics is. So perhaps he doesn’t see himself as worthy to speak on this topic, but my response is then, who would be, if not him, as one who has attained and occupied the position of ‘high priest’ in the discourse. I do not mean to appear strident, especially as I see now, after much reading and reflection, that Tom’s position is entirely accurate in that mathematics and mathematician, as master signifiers, are more than signifiers; they are what we identify most deeply with and what gives key meaning to how we are in the world. As Lacan points out, they are *empty* signifiers (*my emphasis*), signifiers without signifieds, and hence Tom’s inability and downright refusal to say what mathematics is). Indeed, master signifiers are things impossible to say or describe; they are potential containers for our fears and insecurities and cannot function unless subjects invest in them by their fantasies.

Desire for recognition by the other: Passive narcissistic desire

The beginning of this desire can be seen in Tom's desire to belong and to be accepted. Tom is taken (drawn in) by the new mathematical symbol for belonging in set theory in his second year (he drew it with his finger in the air), but this desire goes back to the circumstances of his childhood in war, of being an unwanted guest in the homes of other people who were forced to take these guests. His elementary school then becomes a place of refuge and solace for him. Tom remembers fondly the name of his elementary school teacher ("a kindly lady of fifty or so; children at that age have no idea of how old adults are") and that her name, when translated, meant death. This is similar to Philip Jackson in *Untaught Lessons* (1992) and his fond recollections of his algebra teacher, of whom he remembers little except the importance of solving for x (of course, he cannot say why this was important). The desire for belonging is not quite at the level of the desire to be recognized by the Other, but it is a seed that does not quite take root (or flight) into full-fledged desire for recognition. Indeed, this desire is channelled into the desire for self-sufficiency, the desire to not need anyone. Tom realizes after his 'small' victories of discovering things for himself (the carrying and logarithms, albeit with the slide rule), that mathematics is something you can do by yourself, and that you do not need other people (although he had started the interview by noting the importance of other people in his trajectory). Tom's putting up his fingers to indicate quotation marks around the word, small, in 'small victories' indicates a minimising and a diminishing of his accomplishment. His assertion that you do not need other people to do mathematics implies that it is a possession that was portable in any number of moves and it would be one less thing in being indebted to other people. Also, with mathematics, there was the notion of being able to fend for oneself intellectually, thereby reinforcing the notion of self-sufficiency. While Tom acknowledges his teachers, he uses the metaphor of learning tumbling to indicate the gradual development of skill, "at first you need teachers to help you and then you don't."

Desire to be possessed by the Other as an object of the Other's jouissance: Passive anaclitic desire

This desire does not figure so clearly in Tom's narration, but there are two other important considerations relating to desire that come up in the interview that I address next. These two considerations are that of language and that of the unsayable nature of

desire. Lacan writes in his articulation of desire and subjectivity that the individual becomes a subject through the acquisition of language and that it is only with language that the subject can begin to express and formulate desire. Tom's language shows the traces left by his experiences.

First, Tom's language shows that he was marked by war in his childhood: small victories, discovery, battles, conquer, cowardice, barbed-wire rolled out as crowd-control (to weed students out in second year). His language also showed denial; there are many instances of his saying one thing and then instant denial, or instant revision. This hedging and smoothing again speak to diminished desire. It is often the case that when one cannot say what one wants to say, then one ends up saying the opposite. The enemy was real in Tom's childhood and he carried that enemy within the rest of his life. Then there is the odd pronoun use in the first quotation of the interview cited at the beginning: "So anyway I've said I was grateful for this opportunity because I've never done this before and I ought to have done it long before, to go back over my past and just looking at the mathematical part to sort of figure out what exactly have you done, you know. You live your life and then you're too old to remember it. And then it's all gone." Tom begins with I, first person, then moves on to you, second person, and then to it, third person, in one sweep of a sentence, moving from gratitude to reflection to melancholy suggesting desire denied, desire defeated, desire disappointed. Who denied/defeated/disappointed whom? As humans we struggle with more than our ghosts, and, indeed, with our very selves.

I had come away from the interview mystified by Tom's having spent a life in mathematics and coming across as indifferent to it. I found some understanding with Rogers' story threads in her Interpretive Poetics method outlined in my methodology chapter above. The story threads in Tom's narrative are that of displacement, dislocation, and disclaiming already described. These three underlie Tom's seemingly contradictory dispassion for mathematics in a life of mathematics. In the divided "I" and the address, Tom is not himself in possession of knowing who is speaking and who is being addressed. His "you see I didn't have an idyllic childhood like H.'s", his references to H. with unerring regularity, and the unknown consequences of the events of his childhood all point to the languages of the unsayable. His language of war by which he is marked is one signifier of the unconscious. Overall, I felt that despite my peeling away

the layers and picking apart the strands, there was more there than I could have discerned.

Summing up Tom

In drawing these threads together, I consider Pimm's (1994) argument for another psychology of mathematics education that leaves "the social and the rational" behind and points inwards (p. 112), and for the role of 'unconscious activity' in mathematics. Pimm notes that meaning (one of the two major themes of mathematics education, the other being existence) is more than referential, but about associations of all kinds, and partly about "unaware associations, about subterranean roots that are no longer visible even to oneself, but are nonetheless active and functioning" (p. 112). Tom's particular narrative of a life engaged in mathematical activity reveals that overshadowing the mathematics is the subject or person, the experiences and the influences, and the relation to others, and ultimately, the ways the unconscious lays bare the self and identity.

With respect to the unconscious and mathematics, Pimm (1994) wonders about Freud's "windows into the unconscious" and asks if there any particularly mathematical ones. While his quotation of Turkle on Lacan may be taken as related to the mathematics of creation, I think some of it is still helpful here: "For Lacan, mathematics ... is constantly in touch with its roots in the unconscious" (p. 114). With respect to Tom's presentation of self and engagement with mathematics, it was interesting to me that he did not list his accomplishments, but at most talked about them in minimizing, off-hand ways, and that he spoke clinically about something in which he had engaged for nearly all his life. From his website later, I saw a list of over thirty publications in mathematical journals. For all his modesty and diffidence, there had been ample opportunity and time for what he had achieved, or perhaps he may have thought it was beyond me.

This interview confirmed to me that engagement in mathematics is intensely personal and is inextricably bound to the sense of self and the psyche. Indeed, I register here my gratitude to Tom for his generosity of spirit in speaking with me. I note the child psychiatrist, Robert Coles (1989) quoting one of his teachers, the poet, William Carlos

Williams: “We have to pay closest attention to what we say ... Their story, yours, mine – it’s what we all carry with us on this trip we take, and we owe it to each other to respect our stories and learn from them” (p. 30). I have presented here aspects (as in the original sense of the Latin word, *aspicere*, to observe, to look, but also aspect as in nature, quality, character, interpretation, feature, expression) of one mathematician, who, despite his protestations, did accomplish the goal of being a mathematician and did fulfill his desire to belong. I realize that, in the previous sentence in my “despite his protestations”, that I am denying his denial, but it seems to me that as he laid bare his desire and insecurity before me, I must now put back on him, cloak him with what he what he sought to piece together in his journey, a self in mathematics, a self as mathematician. Even as he drew in the air with his finger, the symbol in set theory for belonging, \in , denoting being a member of, Tom signalled his eventual triumph to find a place for himself, however tortured, in mathematics.

Whence and whereof I speak (5)

The gift and challenge of interviewing was one for which I am deeply grateful. It changed me in that it made me more mindful, more reflective, and more appreciative of my opportunities. Two qualities that I value and strive for in my dealing with all with whom I come into contact, my family, my students, my friends and others, are grace and dignity. I was able to see first-hand these qualities in the mathematicians who spoke with me. I offer below some reflections on things that were a revelation to me in this experience of conducting and reflecting on my interviews.

1) I was surprised by the extent of what interviewees will reveal about themselves by the things they say and the things they fail to say (the pauses, the hesitations, the silences). Within ten minutes of the interview, Maya had said that she grapples with depression. Where was I to go from there? I had to be polite, careful, and sensitive to the situation. I had to bring the conversation back and I knew I could not to push too hard.

2) I was surprised by the unexpectedness of the stories. I realize that everyone has a different story, different circumstances, and different challenges, but really, there is this myth that the people who become mathematicians do so without any element of struggle or setback, that mathematics comes easily to them, and that the path to mathematics is straight-forward and clear, free of all obstacles. To hear mathematics described as a coping mechanism in the face of depression or as a familiar crutch was far from what I was expecting. To hear mathematicians speak of failure was more than I expected. My interviewees, I see now, are mirrors of my expectations. I was expecting to see myself as a mathematician reflected in them and their stories.

3) I was surprised by how relaxed I was with the female mathematicians as opposed to the male ones (it reminded me of the times when I walk into a meeting room and it turns out that everyone present is female - the power differences are still there, but not as pronounced). It felt very comfortable to me when the interviewee was female, two women working in mathematics. I hasten to add that this is my take on it; the

interviewee most likely saw it as mathematician and doctoral student, but also age played a role.

4) I was prepared for the experience of the power differences, the vast difference in the amount of mathematics the university mathematicians know, but I still felt the difference in my status as a community college mathematics and statistics instructor and theirs as a university mathematics professor. The difference was not so keen, but it was there, nonetheless. I knew my strength and experience as a teacher so I was able to speak from that expertise. But I knew that I was the supplicant coming to ask for their experience of what they know about or feel for mathematics, mathematician as high priest.

5) I realized that, notwithstanding the earlier remark that it is unexpected what people will reveal to you, there is the certainty that people will not reveal to you things that are too personal and that strike at the core of their being. It is a given that my interviewees want to present themselves in the best light, so they will speak of their failures from a position of their eventual achievement. Even as we speak, there is the constant editing, the weighing, the "I have to be careful with this" when I thought Maya was about to say something personal and then it was cast in terms of students. But then, why should my interviewees reveal themselves to a graduate student asking for more than they can say about themselves? I am trusting to the good name of the institution, to the way the academy works, to the reputation and high regard of my supervisor, to the fact that I have addressed the considerations and responsibilities imposed by the Institutional Review Board, and to the fact that they too were once graduate students trying to find their way. It has to be this need to present ourselves as whole no matter what it takes.

6) I realized that I was mistaken in thinking that it was a matter of question and answer and of it being objective similar to the way mathematics is portrayed. It was eye-opening to see that an interviewee had reached a point and could or would go no further or that I could not or should not push deeper, that the person was reluctant to continue that particular thread, and that I was not going to hear more despite the expectation on my part that it was a reasonable question. It was also interesting to notice the flow of the interview, how it threatened to go nowhere at certain points and the only response was

to take a deep breath and try again. There were times when I could not tell how to make another tack or whether I was being impertinent or out of bounds.

An interview is a delicate thing that can flow or wilt away. While it is a matter of being quick-thinking and nimble on the part of the interviewer, it is mostly a matter how much the interviewee wants to give or to reveal. It was a privilege to listen to the mathematicians, to witness those delicate balancing moments, as if it could go in any direction at any moment, similar as I would imagine to how an analyst feels in trying to discern the subject in the analysand, or a priest in listening to a confession. I learned many things about being a mathematician, about occupying a high-powered professional position, and about being gracious under the fire of questioning. Not least of all, I learned about myself, about my strengths and weaknesses. I learned that I, too, want to be seen in my best light and to present my best self, and that ultimately in this human endeavour of learning and teaching, one's subjectivity is paramount and must be attended to and guarded on all sides.

Chapter 7:

Conclusion

As I approach the end of this dissertation, I remark that the opportunity for thinking and writing in this strenuous and intellectually challenging effort has been gratifying and rewarding. As I seek to consider the entanglements and relationships in my phenomenon of interest, and, more specifically, to present the subject before me from his or her mathematical experience and as I seek to capture and convey the sense and meaning of the interaction in this writing, I note that the writing itself demands and imposes further levels of attention, reflection, assessment, and discrimination. I am mindful of the following observations that it is in the writing that meaning is made:

Writing is closely fused into the research activity and reflection itself ...
The object of human science research is essentially a linguistic project, to make some aspect of our lived world, of our lived experience, reflectively understandable and intelligible. (van Manen, 1997, p. 125-126)

A second comment that resonates with me is from the Toronto writer Anne Kingston: “It took me a long time to write this piece, because I was really confused about it. What you have to figure out is what your through line is.” Once, I hit upon the pivotal notion of desire, I was able to figure out my through line which gave me the structure I needed to work out my dissertation. It is no coincidence that I use the words, work out, as in a mathematics exercise because for a long time, the whole research study felt like a mathematical problem that I was trying to work out. I suspect this is so because of the way that I have been taught to think, my ‘training’ as Maya would say. Certainly my data proved to be messy and challenging, in that it was not so neat and tidy as it appears now that I have ‘worked’ through it, and in that my attempt to make sense of it has smoothed it of wrinkles and knots, which I recognize are integral but my focus was on writing my way through.

This dissertation has been a study in the phenomenon of engagement with mathematics, of the mathematical subject, the one who engages with the discipline, the one who confronts and steps into the discipline. It has been a search for the constitution of the mathematical subject, what subject positions have to be taken on in order to pursue the discipline. Principally it has been a study in seeking out what impels and sustains the phenomenon and how the discipline itself inducts and interpellates its subjects in its desire for itself.

In this summing up, I answer my research questions and discuss my contribution to research from my study in its theory, methodology, and findings. Then I discuss the pedagogical implications and avenues for further study.

Findings and contributions

I begin by recalling my research questions:

RQ 1: From mathematical narratives (written and oral accounts), what is the desire of mathematicians?

RQ 2: Can mathematics desire?

RQ 3: What is the mathematical subject?

For the first research question, I began with Lacanian theory and a psychoanalytically-informed methodology. I presented in-depth analyses in Chapters 5 and 6 of the four mathematical subjects, two based on written accounts and two based on oral accounts. I showed how the interpellative form of a discourse such as mathematics impacted on the identity/subjectivity of the individual in producing the mathematical subject by their identification with the master signifiers of 'mathematics' and 'mathematician'. Bracher (1993, p. 28) writes: "As Lacan explains, a discourse that is to move or even interest a subject must say, explicitly or implicitly, 'You are this' or 'You are that'." The discourse works by 'buttoning down' the subject by signifiers that are quilting points. The signifiers of mathematics and mathematician worked in different

ways for each of my four subjects as they encountered the demands and constraints of the discipline and its discourse, and negotiated their acceptance of the discourse.

With Weil, they took root, as it were, almost from the beginning. Weil writes that early on, it was not clear to himself or to his teachers that he would be a mathematician. But then he talks about the early influences of textbooks, flawed as they may have been, giving him and developing a “taste for mathematics”. He found mathematical exemplars and heroes in his teachers (such as Hadamard) and his numerous European fellow mathematicians. He had been taught ideals of what mathematics is and how it was to be done that he absorbed utterly. For him, mathematics was destiny, the signifier of “making a [mathematical] man out of me” sliding beneath and coinciding with that of “making a mathematician out of me”. His *Wanderjahre* (years of travel) in mathematics, forced by circumstances of birth and political events in Europe, subjected him to situations that were a test of equanimity. Through it all (or perhaps because of it all), his desire to be a mathematician was paramount. Besides the identification, his works in the discipline were all offerings at the feet of his ideal and idol, mathematics, in a desire to be the object of its desire.

Maya demonstrated the opposite of identification in her “I did not aspire to be a mathematician, does that make sense?” Her case was a complicated relationship that took me the longest to discern, and it came only after I carried around the initial interview with her in my head for a better part of a year trying to work it out and then going back to her to find what I was missing. Maya had achieved mathematics and appeared nonchalant about it, but the stirrings and the desire was there all along (I am reminded of Ian Stewart’s claim that ‘No one drifts into being a mathematician’). Though she appeared (or took great pains to appear) diffident, she cannot be seen as an accidental mathematician. I had to dig deep to see the origins of her desire, now that it had become everyday to her. She now “owned” the identification of mathematician (office and position at a university), but her disavowal was still staggering to me.

Kovalevskaya, in a different time and a different place, pursued her dream of becoming a mathematician, but she was not allowed to be one. She had found solace in mathematics even as it fired her imagination. She pursued mathematics and achieved some measure of success while facing the prejudices and roadblocks of her time. There

were times when she sought expression elsewhere in literary pursuits and in making a family life of her own. She had talent, inclination, and ambition for mathematics, but they were of little consequence in that she could not take her place in the world of mathematics as the time, having to teach at a university in a city, not her own. Is desire enough? Clearly, no, as the community and time in which she found herself did not and would not make room for her. Her legacy, however, continues as her life and work are an inspiration to mathematicians and those who would be mathematicians. The most recent work on Kovalevskaya is a passionate subjective account by Michèle Audin (2008/2011), a renowned present-day mathematician who found Kovalevskaya from her or own work on integrable systems.

My fourth subject, Tom, lived a life in mathematics (“I became a run-of-the-mill mathematician”), but his identification was only “lukewarm”. From chaotic beginnings and small successes, Tom went through the motions of becoming and being a mathematician. Tom spoke almost clinically of “*cognitive passion*” (my emphasis). But his underlying desire in mathematics was in finding a place to belong. There is more than a tinge of resignation and ruefulness; Tom had seen himself as a lesser light, as it were, being overshadowed and overtaken by a sometime peer who had gone on to great success and acclaim (as in Freud’s “the shadow of the object falls upon the ego”).

With respect to the face/t/s of desire in taking up mathematics and engaging with it, each of the four mathematicians showed a different aspect of desire in presenting varying degrees of the forms of desire. I had noted above Bracher’s observation that these forms are intended as a kind of checklist in a search of a text of a discourse to discern desire and to see more closely the interpellative forces at work. But more importantly they are not mutually exclusive in that some try to reinforce others or to subvert them. The idea of a checklist may seem utilitarian but it is one way of ‘seeing’ desire.

Throughout my analyses, in trying to tease apart and uncover the web of desire, I wrestled with whether these were the only forms of desire. What about the desire to overcome and to be accepted? I came upon instances that I thought were different, such as the desire for self-expression, self-fulfillment or self-determination. I recognized the self in all of these and was reminded that for Lacan, every instance of desire is a lack

in the subject, a want of fulfillment. I worked with the four forms, but sometimes it was easier to see with Bracher's twelve forms, namely, the four possibilities in each of the three registers, the Imaginary, the Symbolic, and the Real. So that Kovalevskaya's desire for self-expression in both literature and mathematics can be seen as a desire for recognition in one or more of the registers. In particular, it is a desire to link and resolve her Imaginary and Symbolic elements. This recognition of the Symbolic by the others, the Imaginary and Real, is played out most forcefully in mathematics by the symbols and equations that are so important in the discourse. For Weil, the desire was all of a piece, completely and clearly tied in the knot of the three registers. With Weil, it began with the symbol and his early teacher in high school, Monsieur Collin and his invented symbolism (Weil writes that nothing that he read in Chomsky later gave him pause), who showed him clearly the way in which mathematics was to be written. There was also the conversation with his father who told him the meaning of his name. In an earlier piece, I wrote about psychoanalysis being about naming and the significance of one's name. For Tom, it was also about the symbol of belonging (he expressed excitement about his teachers in second year who brought with them knowledge of the new math). For Maya, I see her desire as being of the Real, of her striving for a place to land, for a place to find herself. I have not written much about the register of the Real as it is a Lacanian notion that is difficult⁷⁷ to articulate. According to Lacan, the Real is a psychic place of unity where all is fulfilled and complete – there is no loss or lack or absence, hence no language and no need for language in the Real. The Real is the place we start from and the place to which we seek to return and never can. Hence there is always Desire. Maya, undoubtedly, has other desire, but with respect to mathematics at her stage of her journey, there is now little angst.

In looking at desire and the forms of desire, a natural question to ask with respect to these four studies, is how is it that some of the forms of desire are harder to see than others? I must confess that when I began reading Bracher and his basic four forms of desire, I understood only the first three which he helpfully named as recognition, identification, and enjoyment (*jouissance*). I spent much time and effort in getting used to his names and his taxonomy. I tried them out on Lacanians and non-Lacanians alike

⁷⁷ There are no Lacanian notions that are easy to see, but some are less hard than others.

with little success in moving my understanding forward. I tried them out on a mathematician (one of the ones I had interviewed early on, but he only succeeded in muddying the waters⁷⁸). Again the questions remained, are these the only four forms of desire, why am I having trouble understanding the fourth one (passive anaclitic, one can desire to be desired or possessed by the Other as the object of the Other's *jouissance*), and why was it easier to see some than others? The answers required a significant shift in my thinking which has to do with my second research question.

My second research question was: Can mathematics desire? And the answer to this has been all along an implicit yes, in that from the beginning I had positioned the discipline of mathematics as the Lacanian Other. It took time to see that the Other is not simply a person, that the Other has a desire, that the crux is confronting the abyss of that impenetrable desire (how do I know what the Other wants, what is the Other asking of me?), that there is a cost in being subordinated to the Other's desire, and that in going about its business to survive and thrive, the Other shapes its subjects in particular ways in order to perpetrate and sustain its desire. In helping me to confirm my understanding of the Other, Bracher writes in a personal communication: "The Other doesn't have to be a person. Animals, plants, the environment, the earth, etc. can all function as a desiring as well as a desired Other in various senses. I would say that mathematics (or any discipline) can as well. First of all, mathematics as a discipline is a set of practices established and engaged in by people, and so desire is implicated in the discipline in that way. In addition, taking desire in a rather broad sense, one could argue that mathematics "desires" certain kinds of subjects (it interpellates people to become certain kinds of subjects) in order for mathematics to be actualized." So I had my argument, desire as the mover in both directions of the two-way relationship between mathematics and its mathematicians. I believe that the difficulty in seeing some forms of desire over others comes from making the shift in seeing the discipline as the Other and not just the mathematicians who animate and guard the discipline as Imaginary others. What remains is whether there are only four forms of desire and here again the answer is yes, but this time for the reasons of the dichotomies. There is the dichotomy of to be and to have. The second dichotomy comes in the Active/Passive, the Subject and Object, the

⁷⁸ I had sought clarity which I have been taught to think is the purview of mathematicians.

desirer (the one who desires) and the object of desire. The challenge comes in seeing the Other of mathematics as desirer.

So, if mathematics has desire, who or what does it desire? What is the *che vuoi?* (what do You want?) of mathematics? Above, I had said that mathematics is an empty signifier. At the same time, it is the point at which the chain of signifiers stops its sliding, a point that knots meanings, a nodal point; it is “the point de capiton, the quilting point which, as a word, on the level of the signifier itself, unifies a given field, constitutes its identity” (Žižek, 1989/2008, p. 105, *original emphasis*). Mathematics has a desire for itself as a symbolic structure, and for a mathematical subject who is worthy of it. The desire of mathematics is a dance: mathematicians desire mathematics, and mathematics desires mathematicians; each is structured by the desire of the one for the other. Mathematics works as an interpellative force because the lack in the subject does not offer it any support as a positive identity; hence, the subject seeks to fill out its lack by identification with a master signifier that will guarantee its place in the symbolic network.

The third research question of what is the mathematical subject is thus closely tied to the question of the desire of mathematics. From the experiences of my four mathematicians subjects, some demands and costs in the endeavour are evident. Mathematics demands dedication and sustained effort, time and isolation. In Maya’s case, it required a way of thinking that was alienating to others. Tom curtailed his other interests to pay attention what mathematics required (and some of Beisiegel’s (2009) mathematics graduate student interviewees were not prepared to make the sacrifice that was being demanded and the price to be paid: “I am getting out of mathematics because it is going to eat me alive”). Weil’s time in prison in Rouen was extremely productive; indeed, when Weil arrived at the Institute of Advanced Study in Princeton, his director joked that he could arrange to put Weil in prison if that would help. Sometimes mathematics requires our all, in that we have to give everything, and to lose everything to find it (I think there may be something faintly biblical here about needing to lose one’s soul in order to gain it). While it is a lonely pursuit, in what may seem like a contradiction, it requires collaboration. Hardy, for instance, maintains that his best work was done in collaboration with Littlewood and Ramanujan.

For its gifts and rewards, mathematics gives a way to be (as with Weil) and to belong (as with Tom). With Maya, it gave a pass to arenas that she could not have entered, a chance to contribute to science in a way she could not otherwise have done. It offers solace and succour, an opportunity to make a life, redemption and rescue. On the other hand, it can exclude and leave us with feelings of being less than we are (as with Beisiegel in the Introduction) and remain forever closed. It can be Holy Grail and Heaven or for those who found themselves on the outside, Hell. There are those who find themselves lost even after promising beginnings. It gives a place to find one's self and to find out about one's self (the geometer David Henderson in Pimm (1994, p. 112), "I do mathematics to find out about myself"). In it, there is the opportunity to find one's *métier*, to reach for something higher than oneself, and to get a glimpse of perfection or heaven. There is vanity, ambition, and arrogance, comparison and competition, but recognition for achievement that cannot be denied. There is power, influence, and status, and a possibility of redemption and rescue. The eminent mathematician, Gian-Carlo Rota (1997, p. 124), explained that he advised students thus: "If you go into any other program of study, it will be very difficult to go into mathematics. However, if you start with mathematics, then you can easily go into any other program of study." The message is strong and is one that I mostly subscribe to: If you can do mathematics then you can do everything else. Yes, this smacks of hubris and sweeping assumptions (realistically it is not true), but, as I see it, the rigours of mathematics can be good preparation for almost everything else.

There were three findings that resonated across the accounts: the sense of an echo of the similarity of the qualities that were attractive about mathematics, the strong sense of discipline and tradition, and what was unsayable/unsaid about mathematics and for mathematicians. First, with respect to the echo of what is special about mathematics as an attractor, what draws people to mathematics is very often and generally the same kinds of things about mathematics, the search for knowledge, truth, certainty, the appeal of the symbols, representations, equations, the beauty of its simplicity, and minimalism (a whole world is captured in $e^{i\pi} + 1 = 0$, in one fell swoop with three letters, two numerals, and two operations). Second, as noted with all four mathematicians in varying degrees, there is a very strong sense of the discipline and the tradition of mathematics. They all have a strong sense of a complete and ordered

totality by which and in which to see themselves but the radical truth is that there is no big Other, that mathematics qua big Other does NOT exist as a discipline and a tradition, and that it is a fantasy. But mathematicians buy into mathematics; mathematics, like art and other cultural forms, relies on the *distance* to fantasy. Finally, in varying degrees, there was much that was unsayable/unsaid with respect to the effort of the mathematical endeavour and what it takes to continue and persevere in it. Tom's inability or unwillingness to say what mathematics is indicative of the empty nature of the signifier, mathematics, the endeavour being a way of circling the *objet a*, the object cause of desire. Indeed, the endeavour is singular and not universal; Žižek writes: "[I]t is in the very nature of fantasy to resist universalization: fantasy is the absolutely particular way every one of us structures his/her "impossible" relation to the traumatic Thing. It is the way everyone one of us, by means of an imaginary scenario dissolves and/or conceals the fundamental impasse of the inconsistent big Other, the symbolic order" (1991, p. 167).

Still, it seems to me that while I have provided some insights into desire and its function (what is desire for?), there are many unanswered questions. The one that is most insistent for me is what is it about the discipline of mathematics that engenders such strong emotion? It is almost as if there are battle-lines drawn. What is in mathematics more than mathematics (shades of the *objet a*)? In writing the dissertation and trying to impose some order and argument in the presentation, I had at one point tried to write a chapter called 'Mathematics Is/As', where I tried to address two questions, namely the question of what mathematics is/what is mathematics/what is mathematics really?, and the question of what mathematics has meant to us as humans. For the first, I wanted to make the point that the way we engage with mathematics is shaped by our vision of what mathematics is. But then trying to describe what mathematics is required coming to terms in some way with centuries of mathematics and mathematicians. In the end, I found that I, not unlike Tom who was wise enough to insist that there is no answer, tried to write a summary which I realized could only be inadequate and lacking, not doing justice to the discipline or its mathematicians. For the second, from my reading of biographies and autobiographies of mathematicians, I sought to show some of the ways that mathematics has had meaning for humans, including mathematics as rescuer and redeemer, as refuge/safety/saviour/solace, as a

calling, as siren/addiction, as lover/obsession, and as bestower of authority and certainty taking on near-religious fervour and ritual. But this threatened to overtake me as well. I tried the chapter in various places, after the Introduction and then after the Methodology in order to usher in the analyses but I could not make it work in the flow of the dissertation. Some things are best left unsaid.

And yet... From the experience of this work and that of my experience of learning and teaching mathematics, there are qualities of mathematics that explain for me its appeal and compelling force. Beside its high cultural and social capital, there is the sheer poetry of the language in which it is rendered. Poetry and mathematics have the same end, the desire to capture an image, emotion, or thought in a way that is succinct, evocative, and generative through the medium of words and symbols. But mostly what is compelling for me is the universal appeal of mathematics in that I, a girl in a village in an island described as a dot on the map of the world, found mathematics and in it, found a world and a life.

What does it take to engage with mathematics and be a mathematician? My answer here is that it rests with desire, desire that is evoked by the discipline, some image or ideal that the discipline presents that gives the first stirrings of ambition and achievement, that willingness to follow and to give of one's self to its wiles and its caprices (again, Ian Stewart's "On the contrary, it's a pursuit from which even the talented are too easily turned away"). The mathematician Alain Connes says in an interview for the European Mathematical Society⁷⁹:

I have often had the impression that there are concentric circles⁸⁰ in the mathematical world, that one begins to work in a totally eccentric part and one tries to get gradually close to the heart ... What I mean is that if you walk long enough, you are obliged to go toward these domains, you cannot remain outside. If you do, it is a bit out of fear. You can succeed in doing a lot of things by refining techniques in a given topic, but unless you keep moving towards this heart you feel you are left outside. It is very strange and surely subjective.

In this description, there is the sense of being drawn in inexorably, almost like being caught in a web, but also there is also the sense of attaining a much sought-after prize, a

⁷⁹ (n.d.) <http://www.alainconnes.org/docs/Inteng.pdf>. Accessed August, 2013.

⁸⁰ Suggestive of Dante's nine circles of Hell.

Holy Grail. Is there an 'essence' of mathematics, the pursuit of which draws mathematicians in? Connes says: "What I mean by the heart of mathematics is that part which is interconnected to essentially all the others. A bit like all roads lead to Rome, what I mean is that, when the mental picture you get of a mathematical subject becomes more and more precise, you realize in fact that whatever the topic you begin with, if you look at it sufficiently precisely, after a while it converges toward this heart." Towards the end of the interview, Connes says, "[e]very mathematician has a kind of Ariadne's thread which he follows from his starting point, and that he should absolutely try not to break", indicating the 'subjective' means by which the labyrinth of mathematics is to be negotiated. In this

In this dissertation, I have shown the strands of the thread of desire that served to shape the mathematicians in this study. While desire is associated with every discipline and creative endeavour, my analyses show desire specific to mathematics mainly due to its rendering and its deep connection with the Symbolic and the Real. At the beginning of the dissertation I had quoted Tony Brown (2005, p. 39) who had asked:

Is it possible that its generalisability and symbolism invests mathematics, more than other subjects, with the power to form metonymic signifiers that permit unconscious psychological processes to be signified by and through the mathematics itself?

My analyses say yes, that the powerful interpellative force of mathematics is given by its power to form unconscious significations. The symbol, which figures so largely and deeply in each of the four journeys, is at once of the Symbolic and of the Real; indeed, it is a vector of the Real. Mathematics, more than any other disciplines, by its deep psychoanalytic roots provides that space with objects (mathematical objects) which allows its subjects to find themselves in the mathematics. This dimension of mathematics gives mathematicians a glimpse of themselves and the "Truth" in the dance of mathematical desire.

Finally...

More than twenty years ago, the mathematician William Thurston (1990) observed: "Mathematics education is in an unacceptable state. Despite much popular attention this fact, real change is slow. We do not lack for dedication, resources, or intelligence: we lack direction" (p. 844). This work is a contribution to the knowledge in the field of mathematics education. It is not the usual study of tasks, teachers, classroom, and technology, but it presents an original way of examining engagement with the discipline of mathematics using contemporary theory and long-neglected artifacts of the discipline. It is based on a view of knowledge as a coming together of various lines of inquiry as indicated in David Wheeler's (1993), *Knowledge at the Crossroads*, an appreciation of a collection of essays by Michel Serres, *Hermes: literature, science, philosophy*. Wheeler writes: "I don't know any other contemporary writer who makes it so clear that the ideas and intuitions of mathematics are woven together with all the other human responses to a world which is difficult to understand" (p. 54). Pointing out Serres' method of ascertaining knowledge as a "[w]eaving a web of autonomous "readings", Wheeler continues, "[a]ccording to Serres, the usual classifications of knowledge break down as knowledge accumulates in pockets at the intersection of multiple paths, at the crossroads where several independent lines of inquiry meet" (p. 53). I see this interpretation of knowledge as consonant with the approach I take in the dissertation in "weaving a web of autonomous 'readings'" of desire in my four subjects to gain knowledge about my research interest of engagement with mathematics.

What is at stake in the pursuit mathematical knowledge both for students and teachers is the recognition of the impasse of mathematics, namely, the singular experience of our students yet we teach it as if it were universal. This is the impasse or the paradox of the attempt to mathematics; we teach it with a fetishistic split, we know very well that many of our students but just the same we teach as if for all. The outcomes can be drastic as the feeling expressed by Nimier's interviewees show.

The importance of this work lies in the recognition that identification and knowledge of the interpellative forces of a discourse is the primary means of social change (Bracher 1993, p. 28). This examination of the forms of desire in the various

registers that move individuals to take up a discourse will help in promoting and sustaining the discourse itself. With respect to the discourse of mathematics, this research is a contribution to the mathematics education literature on how we can address the mathematical experience for students and teachers by showing the faces of mathematics, its related forces and players. To teach is to communicate, by language, gesture, and manner. How do we engage our students and show what we value in mathematics? In mathematics, what is our signature pedagogy (Shulman) that conveys the values and the practices of the discipline? If mathematics is seen in certain ways, then these “reasons” for doing mathematics can become part of the discourse of mathematics. Imagine if we took up the storyline in society that mathematics was good for giving refuge, especially if you come from a chaotic family. How things would be different! How the selection of what we teach would be different! What could we or would we teach if students knew or had some idea of the effects and affects about what they are about to undertake, about its history and the significance?

Teaching from this point of view would entail showing students the culture of mathematics, its language and its norms (Bishop, 1988/1997). There would be a greater appreciation of the history of the discipline, reconceptualized for what it tells us about mathematics, and in that history of its practitioners, similar to this research. It would mean teaching the history of mathematics for the ways that people apprehend or engage or confront the discourse. It would mean continuing to expose and uncover the myths of mathematics and of engaging in mathematics, and continuing to explore what engagement with mathematics demands from us and does to us as individuals. Tom, speaking of his second year of university and the excitement of new teachers and encountering the famous symbol of inclusion for sets, shows that coming to terms with the language and symbols of mathematics is new and challenging, requiring much effort on the part of those who undertake mathematics. As noted above, do we find mathematics or does it find us? How do we as teachers enable/hinder/guide our students in their relationship with mathematics? Even for the most experienced with us, the relationship is fraught. Towards the end of writing this dissertation, I came upon biographical notes in two pieces by the well-known and well-respected mathematics education researcher Dick Tahta. They both said that “Tahta continues his love-hate relationship with mathematics and mathematics education.” That came as a surprise

because it has always seemed to me that one is one side of the divide or the other or like Tom, in the middle, lukewarm. But to hold both extremes seems to me to require unusual dexterity. The one, it seems to me, precludes the other, but perhaps this is a prompt for me to take up Tahta's work more carefully.

Earlier in the dissertation, I had cited Baldino and Cabral on the desire of the field of mathematics education (what do mathematics educators want) and their application of the concepts of transference, the four discourses, and anxiety. Having been in this field for some time now (I completed a masters in mathematics education before this doctoral program), I have come to appreciate the field more than I did as a mathematics teacher. I recognize the breadth and diversity of the field and the enormity of the challenge. Baldino and Cabral were putting forward a particular approach which does not resonate with the majority of researchers, only because the effort to understand the theory is significant. I realize that this work is on the edges of the main thrusts of research in mathematics education, but I think it is vital in that it positions human beings in the centre of the endeavour. Certainly the field has a desire to sustain itself and be generative; the question is which frameworks and theories will prove most helpful in tackling the challenges of the research.

Finally, it is my hope that we (as teachers) attend and understand our students as subjects, and recognize and heed our respective desires. A few days ago, I had an email from one of my distance students in Calculus who was telling me an all-too-common story, that it was a long time since she had done any mathematics and that she was rusty about the rules of algebra. Then she wrote, "I am starting with the very basic algebra. I had thought those rules were *beaten* into me and that I would never forget them" (*my emphasis*). The word, *beaten*, jumped out at me and reminded me, yet again, of the effect/affect of the mathematical encounter on our students and of the importance of an approach and an investigation such as mine.

Whence and whereof I speak (6)

*What we call the beginning is often the end
And to make an end is to make a beginning
The end is where we start from ...*
from 'Little Gidding', T. S. Eliot's *Four Quartets*

In my 'Whence and whereof I speak (3)' piece, I had written about my feeling for mathematics, what it has meant to me, and what it has given me. In it can be seen the forms of desire in my mathematical journey. In this final piece, I again write about *my* desire, but this time about why I have pursued the work I have done, and what I have learned about myself in the process. Early on in one of my classes in the program, David Pimm had said: "Your dissertation will be about you." I was surprised and taken aback, in that I thought that a dissertation would be 'objective', that it would be about research in mathematics/education (*mathematics* education or mathematics *education*), about pedagogy, curriculum, students, tasks, technology, etc., that it would relate to the teaching and learning of mathematics, and that it would not be 'subjective' (about me). Now, looking back, I see that it has always been about me, my work as a teacher and learner of mathematics and in mathematics education, and about how I have developed over the course of the study and the writing of the dissertation. When I began the work, did I realize that I was seeking *my* desire? Was I looking for *my* desire? Did I realize that the dissertation would be about *my* desire? At the beginning, I would have replied, No, to all three questions.

When I think about the topic of my dissertation, I realize that the topic chose me and I could not have seen myself writing about anything else. I recall an interview on CBC with a musician who, when asked about how he came to be a musician, replied, "I

couldn't be anything else. The music chose me. It made me cry.”⁸¹ When I consider how broad the field of mathematics education is, and when I consider how much out on the edge of the philosophy of mathematics education I am with this research, I still know that it is the only research path I want to pursue. It seems to me that this research addresses crucial questions about being human and being engaged in the pursuit of one of civilization's greatest achievements, mathematics. I am grateful for the opportunity to do the work.

This piece is also about finding Lacan and his work, about the challenge and the small inroads into the theory that I have been able to make. All the adjectives of being obtuse, difficult, and complex are true, but then there is elation, admiration, and knowledge to be gained. I have not been so intellectually challenged since my master's degree in mathematics. Lacan grappled with the big questions of who we truly are, the big questions of the void and the one. He provides an answer similar to God in religion, and truth and knowledge in science.

The experience of trying to understand Lacan was both frustrating and exhilarating. I read and re-read some six book-length introductions to Lacan. I spoke with many Lacanians and it was amazing how I felt that I could not get a straight answer to anything. I kept thinking that somebody needed to write a book called, *The ABCs of Lacan*. Lacanians are like expert salsa dancers; they find it hard to dance with beginners. Specialist Lacanians speak at such a high level in almost a different language. They would say: So, something, something, retroactivity. Or something, something, the non-all, all the while nodding sagely. It is as if they are skipping steps in a mathematics answer and they jump right away to the conclusion, their speech so condensed that they do not need the baby steps.

In my first term at the Lacan Salon, they were reading Žižek's (2012) *Less than nothing: Hegel and the shadow of dialectical materialism*, 1000+ pages. Everything went clear over my head. There were no introductions; they started at 7 pm and talked for two hours. Much at the Salon still goes on above my head, but it is enough for me

⁸¹ The American astrophysicist, Neil deGrasse Tyson, now director of the Hayden Planetarium in New York, says that the imprint of the night sky was so strong for him, that he is certain that he had no choice in the matter: “[T]he universe called me.”

just to be exposed to the high level of talk, argument, and discussion. I am now in my fourth term and I am happy to say that every now and then I can get in a question or a small observation. I am often called upon to explain some of the mathematical terms that come up in the readings; the most recent ones were the median (Lacan said that anxiety is not the mediating function but the median between desire and *jouissance*) and the division algorithm (Lacan used the notion of division for the insertion of the subject into the Other with a remainder, what is left over or sticks out).

As in learning a new discourse, Lacan presents a fresh intellectual challenge for me (which is ongoing). I am thinking of new lines of research. The first is to study Lacan's use of mathematics, work out the various structures, and explain them to myself and to others. Second, I want to study Lacan's discourse on anxiety and see how mathematics anxiety can be reconceptualized with Lacanian theory (a potential title: 'Lacan, anxiety, and mathematics anxiety'). A third area of study is relationship between the analytic situation and the teaching experience (the similarities and differences, if any). What knowledge is imparted or transmitted in the analytic situation? Is there a parallel in the teaching situation? Alf Coles, in his book, *Being alongside: For the teaching and learning of mathematics* (2013), kept saying that we cannot climb into people's heads. Is there no hope of knowing? It seems to me that there are elements in teaching and psychoanalysis that are worth exploring.

Sometimes I feel that in this matter of theoretical and methodological frameworks battle lines are drawn, that people pick sides in this matter of knowledge and knowing, of excavating and inventing knowledge. At a recent Lacan Salon, Brian Massumi's name came up for some reason. When I heard the name, I perked up knowing that he is cited in mathematics education research. I inquired further and one of the senior members in the group responded, I don't read those guys, they're Deleuzeans.

It was the same question I had asked in my very first discussion point in my first year of the program in EDUC 941 when the book being studied was, *The passion of the Western mind: Understanding the ideas that have shaped our world view*, by Richard Tarnas (1991). My last sentence in the one-page discussion point was about being in the middle of these various paradigms and modes of thought and asking, do I just pick a side and plant a flag? If the answer to that question is Yes, then I plant my flag behind

Lacan. I line up behind Lacan for many reasons. I was charmed by his writing as I glimpsed his reason. I had not been interested in things psychological or psychoanalytical. When I read his assertion, The unconscious is structured like a language, I thought that there might be something there. And so my interest began. His concepts were ones that I found were applicable and meaningful as a way to make sense of my life in teaching and learning mathematics, and in trying to discern how we engage with mathematics.

Lacan is many things to many people, but for me, he was an intellectual who walked his talk. He worked with his patients and taught his students, and for twenty-five years he held a seminar to audiences that were star-studded, the glitterati of the day. There were poets, artists, philosophers, psychologists, and writers, all famous in their own right and at the forefront of intellectual life, who came to hear him, who questioned and argued with him. He mapped out and held his ground. Lacan was a performer, a tightrope walker, keeping his balance, working without a net, before all the intellectuals of the day. He was no flash in the pan; he gave a sustained performance. He was an artist with arresting flair and grace, but he knew from whence and whereof he spoke, from his base as a clinician and a practising analyst. He put things in ways that were obtuse and challenging, but that was because he wanted to show a parallel of the difficulty in the attempt to discern what it means to be human and who we truly are as human beings in our myriad diversity and essential unity.

Did I find my desire? Yes, insofar as I have begun to learn about desire and its workings in the discourse and community of mathematics in which I have spent my life so far (I have barely begun to scratch the surface as is evident from the depth and breadth of the Lacan *oeuvre*). But I realized that desire *begets* desire. I have seen “desire desires desire”, “the desire to desire”, “the desire for desire”, “what is desire for?”, “desire in front of desire”, and “desire behind desire”, but I do not recall reading this word ‘begets’ so far (I am sure it is there; I have much more reading to do). It is a *propos* for me, in that while I think I have reached the end, I have realized that it is only a continuation of the pursuit of the desire to know, the desire for knowledge of self, the desire in search of Lacan’s forever elusive *objet a*, the object-cause of desire.

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Appendix A:

Burton's (2004) Questionnaires

Burton, L. (2004, pp. 205-208). *Mathematicians as Enquirers: Learning about Learning Mathematics*. Massachusetts: Kluwer Academic Publishers.

Interview

The questions below are meant to give direction if we need it but not to be a requirement of how our conversation must develop.

About you:

1. Can we chart the historical trajectory of your becoming a mathematician?
2. From your experiences, what would you say you have learnt about mathematics?
3. What would say you have learnt about yourself?
4. What would you say about how you come to know maths?
5. Is there anything you would like to say about your undergraduate or postgraduate experiences of coming to know maths?
6. How you describe your experiences of research supervision and yourself as a supervisor of research students?
7. Of which mathematical community would you claim membership? Is that membership important and in what ways?
8. Do you have experience of collaborating on any research projects? Will you describe that experience and say what you have learnt from it or explain why you think collaboration is not helpful to you?

About how you come to know mathematics:

1. What do you now believe mathematics is? That is, how would you describe the focus of your work?
2. So what IS a mathematician, do you think?
3. Who are mathematicians?
4. When you are acting as a mathematician, can you explain what you do, what choices you have, what leads you to make one choice rather than another?
5. Do you always know when you have come to know something new? How? Have you been justified/unjustified in this confidence?
6. Has it always been like this?
7. Do you know whether a result will be considered important, interesting or rejected by your community?
8. Do you share their criteria? What are they?
9. Where do you find the problems on which you work and what makes them something which engages you?

Conduct:

Anything from the above list that you do not want to discuss we can delete before the interview begins. The interview will be audio-taped and I will also take handwritten notes. Typed notes of the interview will be returned to you afterwards so that you can agree their contents, amend, change or delete. Those agreed notes will be the basis of the analysis which I do, backed up by the audiotapes where necessary. All information will be maintained as confidential. Copies of any subsequent publications will be offered to you.

Study of Practising Mathematicians/Leone Burton/School of Education/University of Birmingham

Status: Prof/Reader/SL/L/Doctoral student

Personal questions

1. At what age did you 'know' that you wanted to 'be' a mathematician? During the interview I would like to explore the historical route from that first understanding of what this means to you, to your current understanding.)
2. Where did you study (undergraduate and postgraduate)?
3. Has there been anything in your post-graduate or post-doctoral experience which has influenced your images of mathematics?
4. Are you (a) an only child? (b) an eldest child? (c) placed in the family how? Please use B (brother), S (sister) and X for you and show eldest to youngest in line, e.g. BXSS.
5. Was anybody in your family connected with mathematics in any way?
6. Would you identify any particular influences in your journey towards becoming a mathematician?

Appendix B:

Lacan's graph of desire

Lacan provides his graph of desire in his 1960 conference contribution: 'The Subversion of the Subject and the Dialectic of Desire in the Freudian Unconscious' in order to show "where desire is situated in relation to a subject defined on the basis of his articulation by the signifier" (1966/2006, p. 651). Lacan leads up to the complete graph through intermediate graphs. These must be addressed in that, as Žižek (1989/2008) notes, we miss the point if we only focus on the complete graph without noting the changing forms of the graph and the meaning to be gained retroactively. I rely on Žižek's elaboration (1989/2008, pp. 111-144) for aiding my understanding of the graphs.

In the first graph which Lacan calls the 'elementary cell' of desire, Lacan begins with just two curves: the horizontal one connecting signifiers, S and S' indicating the signifying chain from left to right, and the negatively oriented, backwards vertical loop from Δ to $\$$.

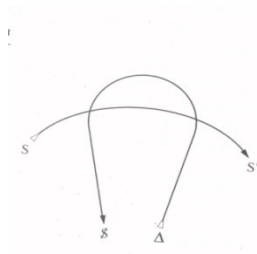


Figure 2: Graph 1 (1966/2006, p. 681)

Note: Used with permission

With respect to the signifiers in the horizontal curve, de Saussure had described the relation between the signifier and the signified by writing them as if in a fraction (but not intending the usual meaning of part and whole) with the signifier on the top, the signified below and bar between or as the two surfaces of a sheet of paper (in that you can't cut one without the other). Then the vertical loop starting at Δ , which indicates "some mythical pre-symbolic intention" (Žižek, 1989/2008, p. 112), cuts through the signifying chain and emerges through the chain as $\$$. Lacan uses the symbol, $\$$, to indicate "the

divided, split subject, and at the same time the effaced signifier, the lack of signifier, the void, an empty space in the signifier's network" (p. 112).

The points of intersection (where the two curves cross) are 'the button ties' [the quilting points or *points de capiton*] where the signifier stops its indefinite sliding of signification to the signified from Δ to $\$$. Hence the quilting points are the places from which subjectivity emerges: individuals are being interpellated into subjects by the 'call' of the signifier. Žižek emphasizes the negative backwards direction in which the "vector of subjective intention quilts the vector of the signifier's chain" (p. 112). Keeping with the notion of quilting, a needle and thread from Δ leaves the chain at a point that *precedes* the point at which it pierces the signifying chain to emerge at $\$$. This means that meaning is only fixed after the fact, that it is retroactive, and that while signifiers are 'floating' and form a sliding chain, it is only when intention pierces it and crosses it thereby sewing the meaning to the signifier that the sliding and hence is halted into the signified. So in this first graph, Lacan establishes the relation between signifiers and shows the emergence of the split subject.

Now in the second graph, Lacan puts in the lower half of the full graph.

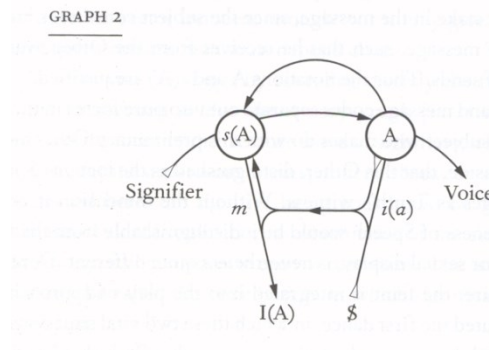


Figure 3: Graph 2 (1966/2006, p. 684)

Note: Used with permission

If we begin at the bottom, Lacan has now moved the position of the barred subject, $\$$, from the endpoint to the starting point of the vertical loop of subjective intention (so $\$$ is now on the right). He has filled in more arrows, making more connections and completing some circles. The quilting points are now labeled A (*Autre*, the big Other, language and signifiers) and s(A), the signified (the finished product of the signification

or the function of the Symbolic Other). He has also added $i(a)$, the imaginary other, moi (the imaginary ego), and $I(A)$, the symbolic identification. Lacan calls the moving of $\$$ from left to right a retroversion to indicate that the subject becomes what he was to be before, what “he will have been”.

In the third graph, Lacan completes his graph of desire by putting in the d of desire and the ‘*Che vuoi?*’ (Italian, what do You (meaning the Other) want, or what is it that the Other is asking of me?). The $\$ \diamond a$ is a matheme or an “abbreviation” that Lacan allows for multiple interpretations, “a multiplicity that is acceptable as long as what is said about it remains grounded in its algebra” (p. 691). It is a form of fantasy which “stages the desire (\diamond) of the subject, $\$$, for the *plus-de-jouir* a , a surplus of jouissance over and above what the subject currently attains” (Bracher, 1993, p. 43). Desire comes out of our relations with others and the Other as in the Lacanian dictum: Desire is desire of the Other. So out of the *point de capiton* of the Other on the right, we get the the *Che vuoi?* or the ‘bottle-opener’/question mark of desire.

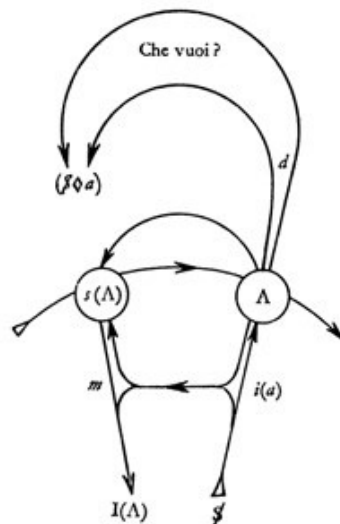


Figure 4: Graph 3 (1966/2006, p. 690)

Note: Used with permission

This third graph differentiates and encapsulates the various aspects of the subject and its desire, the distinction between the ego (*moi*) and the subject, and the Imaginary and Symbolic identification, and then shows in the upper part of the graph, the origin of

desire and the question that we, as human beings, strive to address throughout our life, the *Che vuoi?* of the Other to the Other.

There is a final graph that fills in more relationships but the above three capture the ones that are sufficient for the argument in the dissertation.