AN INTERSECTIONAL READING OF GENDER & TECHNOLOGY

BY

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DISSERTATION

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Abstract

For the past thirty years, educators, researchers, parents, employers, policy-makers, and the popular press have been concerned about the gender gap in computing. Remarkably, there is little evidence of a similar scale of concern or effort at redressing gender gaps in other professions. The question is why, as a society, we care so much about girls and women’s representation in computing.

The justification for trying to reduce the gender gap in computing has been largely driven by political, social, and economic concerns. My project takes issue with this basic premise and argues that the quest to solve the gender-computing gap must also be read as an ethical quest of far-reaching consequence regarding how we think about STEM fields in the 21st century. The contemporary gender-technology story is dependent on a number of transparent social-political-intellectual imaginaries and ill-defined concepts that circumscribe ethical, biological, ontological, and methodological explanations of the gender-technology relationship and its significance. These imaginaries and concepts are themselves grounded in a specifically modernist epistemology and relationship to technology, subjects, objects, and ethics that reflects values derived from the intersection of modern science and liberal humanism. This dissertation examines the bases of the gender-technology story by analyzing documents culled from educational research and policy, national and international STEM agencies, and the popular (U.S.) press, all largely focused around computing.

The thesis presents a new reading of the gender-technology story through intersecting lenses drawn from STS, feminist theory and technoscience, political and cultural theory, and philosophies of technology. Using this multi-faceted social discourse
analysis, it argues several claims. First, the g/t story helps to constitute the problem it wants to solve. Second, methodological and epistemological beliefs, particularly surrounding objectivity and method, have made it seem prudent to focus on the gender-computing gap as a political problem of (in)equity. Third, the drive for a clear political-educational fix is a self-limiting quest. Fourth, in the story, gender and women are used as placeholders for this new ethic. Fifth, a culture that is overly skeptical of practices of ambiguity and complexity is a huge problem to overcome and limits progress towards the new ethical relationship to technology that the gender-technology story is trying to articulate.

Framing the gender-technology relationship in largely political-epistemological terms has made it seem reasonable to believe that bringing more women into computing will bring about radical social change. However, just as many tenets of modernism are proving insufficient to the challenges emerging in the 21st century (many the result of these values), so too, thinking about the gender-technology relationship (and problem) remains constrained by these same conceptual boundaries. I deconstruct the gender-technology story to reconstruct it as an expression of an emergent 21st century posthumanist desire for a new ethical relationship to technology and to the world.
To the technologies that inspired and helped me to write
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I never expected to spend this much time in Urbana-Champaign, but here I am, six and a half years later. I have had sufficient provocative scholarly conversations to make my stay worthwhile. It was a good place to get work done, as someone told me when I first visited the campus. I have learned to appreciate that quiet means little traffic and no sidewalk congestion, and to accept that the price for this is civilization, as I had previously not experienced it on the East coast.

During my first semester as a graduate student in the Educational Psychology Department, Tom Schwandt moderated the first department meeting of the year, where he outlined a set of goals for our participation in the Carnegie Initiative on Doctoral education. One question asked made it apparent that nearly everyone—faculty and students—had a first degree in psychology. Tom, myself, and a couple of others were the exceptions. Through his thoughtful guidance, Tom helped me navigate my scholarly research journey and never wavered in his expectation that I would find my way through the forest, even if some days the path seemed quite obscured. His view of scholarship and research as phrenetic practices was a powerful grounding vision, showing me, through his own intellectual generosity, how to be such a scholar, and how one could be generous with ideas and feedback even when we fear we have none to spare. In his intellectual support of my cross-disciplinary pursuits, he offered wisdom and strategic guidance. Patient “suggestions” that became inspirations to turn chapters inside out have made this dissertation a better and more readable document.
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The Unit for Interpretive Criticism and Theory, at the time directed by Michael Rothberg, was another intellectual home, where I found scholars always ready to vigorously debate cutting edge work in critical theory. Here I was able to explore ideas to bring to my own research. The Writers’ Workshop, where I worked as a writing tutor for five years, became a safe haven, writing community, and a primary source of funding, as well as a wonderful teaching experience, as I worked with writers from across the globe and across disciplines. I want to thank Libbie Morley, the enormously generous director of the workshop, for her endless patience and support. My other great support has been Alice Filmer, even though she migrated, in body, for the West Coast after she finished her PhD. Despite being in quite different fields, I was happy to find a compatriot of such intelligence
and generosity of spirit. I have also appreciated my conversations with other friends—Jason, Tysza, Mijung, Vanessa, Simon, my writing groups (particularly Amy, Kevin, and Eric), and so many others. Among the good friends acquired here in Illinois, have been my two rascal kitties, Umberto and Danto. Their nickname “bad boys” is not spurious, and I do wonder if they will be so much at home elsewhere. I did lose my old dear cat, Calvino, while here, and he was an inspiration in his persistence, cheer, and quiet dignity despite his many health complications. One thing about cats is their way of being in the world that puts inquiry on the same plane as humor, naps, and snacks.

I would not have finished this PhD if not for my friends and family back in the northeast. Their encouragement was relentless even as my spirit reached some notably low points. I recall, for example, that Jerry Pannozzo pointedly informed me that if I even contemplated dropping out he would come out here and set me straight. It is not possible to enumerate the phone calls and support. Similarly, Jolanda Burkhardt’s wry humor helped keep me going. My (too infrequent) visits to New York were filled with great conversation and tasty dinners with dear friends. Thank you also to Joan, who, during these dinners, kept my critical faculties on their toes. More thanks to Carol Loeb and Alison Posella for their compassion and desire to see me make it through the labyrinth.

My aunt Vicki has also been an enormous support in so many ways that are hard to quantify or express. Besides offering her couch for my New York City visits, she listened to my complaints, cheered me on, and helped make sure that neither I, nor the cats, starved. It was difficult to be so far from my parents while their own health took its twists and
turns, but they, too, never wavered in their encouragement, always ready to listen and provide support. I must also thank my two sisters for managing the home front.

I came to Illinois from New York, and it is no small feat that the old car (1988 Toyota) my parents drove out here six and a half years ago, is, as of this writing, still running. I was supposed to finish before the car died, and it appears that this was accomplished—knock on wood.
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Abbreviations Used

AAUW .................................. American Association of University Women

AI ........................................... Artificial intelligence

CO ........................................... Constituted outsider

CS ........................................... Computer Science

G/T ......................................... Gender & technology

ICT .......................................... Information and Communication Technologies

NSF .......................................... National Science Foundation

PC ........................................... Personal computer

SHOT ...................................... Society for the History of Technology

STS .......................................... Science & Technology Studies

STEM ........................................ Science, technology, engineering, & mathematics

UNESCO ................................... United Nations Educational, Scientific and Cultural Organization
Facet 1

Context

My life changed around 1994 when I decided to take up computer animation and 3D graphics. I had thought I was just getting a hot new skill for a better, but still arts related, day job. I wanted to support my real work as a sculptor. I was wrong, in so many ways. First, 3D computer graphics and animation turned out to be fascinating and I turned out to be quite good at it. However, in ways that never seemed to make sense, being a woman made a very large difference.

I had been painting scenery for a number of years. As a New York-based “union scenic” (United Scenic Artists, LU 829), the pay was decent and men and women by then were generally getting the same rates and got to do pretty much the same grueling, often dirty, highly skilled (or mundane) work in generally less than pleasant or healthy environs. I had seen Teamsters give women scenics due respect (or disperse when things got too messy or toxic). This was not always the case, but by the early 1990s, women had gained, by and large, professional respect across numerous entertainment and arts industries and their credentials, aptitudes, and talents were rarely questioned. In the design and fine arts, things were a little murkier; there were plenty of women, such that being a woman was not an anomaly even if we tended to be more invisible or missing at the “top.”

3D computer animation and graphics was something altogether different. I once went to an interview with my very professional 3D portfolio and the young man said my work had a distinctly feminine aesthetic. It seemed to me he was instead responding to the fact that it looked different from the rampant plasticized programmer aesthetic that was the norm of early desktop 3D. Making it more “artistic” apparently made it more feminine.
By the 1990’s, most professions had acquired some (at least publicly) professional gender etiquette. But in computer magazines, especially trade magazines on 3D graphics, women were almost always portrayed as (clueless) babes while the men and boys were nerds or cool dudes of some stripe (suits were rare, and sunglasses and sandals quite trendy)—sort of a high-tech version of Playboy. Women were almost never visible as part of the creative, technical, or production teams; when visible they tended to congregate in marketing. A woman’s technical fluency never superseded her status as woman.

In 2001, for the Web 3D Conference in Paderborn, Germany, I organized a panel of three women to talk about alternative gaming paradigms. We made the local paper just because we were three women talking about computer games. These sorts of experiences continued and I became increasingly curious (bemused, impatient, or frustrated also work as relevant adjectives) as to why being a woman in computing was such a big deal, especially in the arts and animation aspects.

After this long and winding path, I started on a PhD to investigate what was going on with gender and computing. The idea was to join the search for software or game designs that would fix some aspect of the gender-technology problem. From this background, I started reading the gender-technology literature in education and this dissertation is my response to a theoretical and story construction that I found more disturbing and limiting, in many ways, than the problem it characterizes. My thesis tackles, essentially, a “re-theorization” of the gender and computing relationship and contributes theoretical and practice-oriented ideas and opportunities relevant to game designers;
researchers in education, game studies, and gender and women’s studies; policy makers, and curriculum and pedagogy at the intersection of technology and games.
Facet 2

Story, Methodology, & Exposition

Introduction: Politics or Ethics?

We think the gender and computing gap is primarily a political problem.¹

Research, policy, and media discourses frame the issues in political terms: equity, access, diversity, representation, identity, human resources, a globally competitive workforce, and the digital divide, to name a few. This language supports the quest for psychological, behavioral, or social fixes to a political problem. Mainstream narratives of gender and technology (g/t) often attach an ethical dimension to this gender gap but the arguments for this ethic have relied upon essentialized constructs of gender, psychology, tool culture, and politics derived from the psychological and behavioral sciences. At the same time, this ethic has been politicized to serve largely instrumental and economic ends. That is, the justification for trying to reduce the gender gap in computing has been predominantly political and economic and women and gender become the conceptual space wherein values and ethics will not be trampled.

My project re-examines how discursive and conceptual practices have sustained this relationship and narrative and argues two main ideas. First, the desire to solve the gender-

¹ I use technology and computers interchangeably in this thesis, not because they are the same, but because this is how the terms are used across the g/t story. For example, even though the central concern is girls and women’s representation in computing, the problem is broadly referred to as a relationship between gender and technology. This transposability of technology and computing appears to be innocuous only because technology itself, within the g/t story, always refers to tools and tool culture. I will not dissect this use of technology here; a deconstruction of technology is one of the projects of this dissertation.
computing gap must also be read as an ethical story with far-reaching consequences regarding how we think about STEM fields in the 21st century and how we situate ourselves as ethical beings. Second, there are far too many assumptions and ill-defined concepts about the political, ethical, biological, ontological, and methodological dimensions attached to explanations of the g/t relationship and its significance. These concepts are themselves beholden to a specifically modernist epistemology and relationship to technology, nature, and culture. This epistemology and worldview reflects values derived from the intersection of modern science and liberal humanism that have driven the modern engine of progress. However, just as many tenets of modernism and its values are proving insufficient to the challenges emerging in the 21st century (many the result of these values), so too, thinking about the g/t relationship (and problem) remains constrained by these same conceptual boundaries. This dissertation deconstructs the conceptual boundaries and assumptions that ground the g/t story and rethinks this story as a 21st century posthumanist desire for a new ethical relationship to technology.²

Liberal humanism (and its driving epistemologies, technocratic thinking, and ethic) has functioned as the dominant organizing logic of the g/t story, yet this logic makes it difficult to effect the kind of ethical shift the g/t story is trying to articulate. The mainstream g/t story that is told through education, STEM policy, and media representations—because it unreflexively depends on these modernist lenses—stands in the

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² In this thesis, I rely on three interrelated terms. The g/t story refers to a body of research, policy, and media accounts of girls and women’s underrepresentation that has become mainstream society’s narrative of girls or women’s different connection with computing. I refer to this notion as the g/t relationship, but when making reference to the range of consequences of this g/t relationship, I use the term g/t problem.
way of the new ethical relationship to technology it anticipates. The story, in part, remains
beholden to a “feminist ethic-of-care” (e.g. Gilligan, 1982, 1993; Noddings, 1984, 2003),
that itself is more political than ethical. This ethic-of-care depends on numerous
assumptions about gender, sex, women, and men that in turn are shaped by our modern
dependence on reductivist and dichotomous thinking. Gender and technology research
tends to argue through this ethic-of-care, yet this rationale has not kept up with feminist
thinking about what it means to be a woman (or man), ideas about what technology is, or
with cross-disciplinary and complexity approaches that are shaping 21st feminism
posthumanist ethical (and political) theory. One limitation in the quest for a new ethical
relationship to technology is the g/t story itself; another is manifest in our epistemological
and political desires for certainty (e.g. in describing men versus women, technology, STEM
pedagogy, research findings, and so on). The new ethic demands much more receptiveness
to a practice of ambiguity that would better respond to the dynamic ontology of the nature-
culture relationship. Examining the assumptions that ground the mainstream g/t story, I
locate opportunities to make this desired ethical shift more prominent and possible.

A Story Thirty Years in the Making

For the past thirty years, educators, researchers, parents, employers, policy-makers,
and the popular press have been enormously concerned about the gender gap in
computing. Remarkably, despite this concern (and significant federal research dollars spent
on trying to reverse the gap), there is little evidence of a similar scale of concern or effort at
redressing gender gaps in, for example, the ranks of Fortune 500 CEOs, U.S. Supreme
Court justices, Hollywood film directors, five-star chefs, or the tenured levels of the professoriate. Thus, the question should be why, as a society, we care so much about girls and women’s representation in computing. There is a mainstream story of gender and technology that tells us we must care, as responsible educators, parents, game designers, and policy makers. But is this story about what we think it is about? This thesis examines multiple layers of the mainstream g/t story. It looks at the obvious, the taken-for-granted, and the hidden—and argues that there is much more to the story than has been assumed. Moreover, in missing these other layers, the transformative agendas of g/t research, policy, and pedagogy have been, and likely will continue to be, largely unrealized.

Beginning in the early 1980s, a paradox presented itself. The computer entered mainstream society as a new democratic hope for social, political, intellectual, and economic change yet it was concurrently perceived as the latest means for continuing oppression, automating and deskilling workers, or facilitating more socio-economic disparity. The computer revolution brought more than intelligent machines into our lives. It also provoked, depending on one’s perspective and position, high expectations for social

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3 The NSF posted to its website, on August 8, 2007, the book *New Formulas for America’s Workforce 2: Girls in Science and Engineering*. In the introduction, “Origins,” they state that the annual budget for the Program for Women and Girls, housed in NSF’s Division of Human Resource Development, Directorate for Education and Human Resources, has varied from $7 million to $10 million.

4 I use technology and computers interchangeably when referring to the g/t story, not because they are the same, but because this is how the terms are used across the g/t literature. For example, even though the central concern is girls and women’s representation in computing, the problem is broadly referred to as a relationship between gender and technology. This transposability of technology and computing appears to be innocuous only because technology itself, within the g/t story, always refers to tools and tool culture. I will not dissect this use of technology here because this kind of analysis is one of the main threads of this dissertation.
transformation or fears over impending ruptures to long-standing traditions, identities, and relationships of modern, Western, industrial society.

One artifact of the incursion of the computer into multiple facets of everyday life is the modern g/t “story.” By story, I mean a research, policy, and popular media driven narrative that has been overtly concerned with girls and women’s underrepresentation in computing fields. The main contributors to this story have been educational research, science-technology-engineering-math (STEM) educational policy, and the popular press as it reports on g/t research, parental and business concerns, or ongoing controversies over computer games. All of these sites have put a great deal of focus on the idea that girls and women’s connection to, or experience of, computers, computing culture, or its affordances, is substantively different from that of boys and men’s. This “fact” of a gendered orientation to computing is presumed to have great consequences for women, technology, education, and society. This fact is what I refer to as the g/t problem.5

I argue that this mainstream g/t story is about far more than we think it is as I explore three interwoven ideas. (a) The g/t story is itself a constituting story in that it helps sustain (and in part create) the problem it pursues. (b) Despite its intentions to provide the means for social-political-economic transformation, the g/t story is severely hampered in the ways it relies on a limited set of resources (e.g. theory, methodology, or concepts) and a number of ill-defined constructs and black-boxed imaginaries. (c) There are other, better

5 In this thesis, I rely on three interrelated terms. The g/t story refers to a body of research, policy, and media accounts of girls and women’s underrepresentation that has become mainstream society’s narrative of girls or women’s different connection with computing. I refer to this notion as the g/t relationship, but when making reference to the range of consequences of this g/t relationship, I use the term g/t problem.
resources available but finding them requires stepping out of long comfortable epistemologies, disciplinary understandings, and prescriptive research methodologies. In short, thinking about the g/t relationship (or problem) needs to become much more open to alternative ways of thinking.

In its three decades of influence, the g/t story has been etched into the fabric of everyday life through the popular media and through STEM education discourses and practices. Across the story, girls, women, or gender (and increasingly, race and class) inequities have been the focus and these might be past, present, or predicted. My focus is specifically this dominant, mainstream g/t story and I do not include within this story the academic scholarship on women and technology that is most associated with science and technology studies (STS), studies in the history of technology (SHOT), or feminist technoscience studies. The reason I separate these is that the mainstream, education-engineering-policy-media g/t story is the narrative that most influences how society, girls, women, men, employers, and so on think about the g/t relationship in everyday life. The mainstream story underlies not only research agendas; it also grounds a broad set of expectations about the g/t relationship that carry significant implications. My intention in this thesis is to show this landscape to be far more complicated than has been assumed but also to highlight significant new opportunities.

By now, the beliefs and assumptions surrounding the mainstream g/t story are so embedded and black-boxed that the story itself is now an important imaginary of contemporary society, a story that I characterize as akin to a modernist meta-narrative, even if it is not actually such a narrative. Less visible is that this seemingly broadly descriptive g/t
imaginary is made possible through a number of other social imaginaries that are in turn bound to various disciplinary, social-political, and epistemological commitments that we hold dear. Contributing to this g/t imaginary are educational research and policies that remain bound to a set of methodological and disciplinary assumptions such that the activity of researching the g/t story within education does not simply represent and describe the relationship between women and technology but has created or constituted the relationship. As the g/t story became the dominant cultural understanding of the g/t relationship (and problem), particularly in U.S. education, media, and policy discourses, (similarly in Europe and somewhat less so, in other parts of the globe), it seemingly has also become increasingly intractable, in turn solidifying in status as a meta g/t story.

Of late, there is some evidence of an emerging discomfort with this meta story on more than one front. One example is Corneliussen’s (2009) thought experiment that wants to disrupt assumptions of a stable g/t relationship. A second is Abbiss’s (2008) study that pokes holes in standing assumptions regarding information technologies and women’s marginalization. While this scholarship is headed in what is likely to be a useful direction, the research is still in the formative stages and my dissertation contributes to this line of thinking. In search of new perspectives and questions, my dissertation enters the fray, via an extensive intersectional and multi-faceted reading of the g/t story. I read and reread the g/t story that emanates from education, engineering-computer science, public policy, and

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6 I am using the term education here quite broadly, to include K-12, formal and informal, undergraduate, and graduate education, as well as engineering/computer science education. I do this because the g/t story itself does this. While individual studies may examine one level or type of education, there is really no way to categorize elements the g/t story itself by educational levels, in any meaningful or useful way.
the popular media, and propose that there is reason to step back and ask a different kind and quality of questions regarding the g/t story and relationship as well as their import. Broadly, these are: (a) through what ideas and practices have understandings and representations of the g/t relationship been built and what do they accomplish? (b) What beliefs or assumptions underlie the dominant methods, disciplinary lenses and practices used to conceptualize and represent the story; how do these foreground how we conceptualize the “problem”? (c) What other possibilities are available for differently theorizing, representing, or re-imagining the g/t story or relationship? (d) What other social, political, ethical ideas could be usefully engaged to read the g/t story in light of cultural-historical contexts within which this story has unfolded (e.g. anxieties responding to the reshaping of the human-technology-society intersection)?

A broad reading of the g/t story reveals that it is largely driven by one dominant concern: women’s participation in computing was statistically much higher in the early 1980s than it is today (e.g. Cohoon & Aspray, 2006b). Not so evident is that research into the g/t relationship dates back to approximately this same period, the early 1980s. The following graph pairs the growth of g/t research with statistics that document computer science degrees awarded to men and women from 1970-2006.
Figure 1. Male/female computer science degrees & growth of g/t research.

Over the years, while research on girls and women’s underrepresentation in computing blossomed, so did the “problem.” My project begins with two questions: (a) How has research and its representation—telling the story—contributed to producing the “g/t problem”? (b) Is the real concern the quantity of women in computing or technology?

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7 Source: U.S. Department of Education, National Center for Education Statistics, Higher Education General Information Survey (HEGIS), "Degrees and Other Formal Awards Conferred" surveys, 1970–71 through 1985–86; and 1986–87 through 2005–06 Integrated Postsecondary Education Data System, "Completions Survey" (IPEDS-C:87–99), and Fall 2000 through Fall 2006. (From a table prepared June 2007.) The “growth of the G/T story” (dotted line) is not taken from the NCE data. The line illustrates a trend—as the literature on gender and technology grew, so did the gender gap in computing.
What is a “Story”?

“For a long time, the story goes,” the popular press, educators, educational and social science researchers, and policy makers have been concerned about a problem with women and technology. There is now a vast literature examining in extensive detail girls and women’s characteristics for the ways these intersect with computing technologies and cultures. Likewise, there is a desire to combine individual research studies into a representative model that will make it possible to effect broad transformation of girls and women’s participation in computing.

This meta g/t story lays claim to being broadly representative but it is deduced from a quite reductivist mix of methods and theory building that brings to mind a passage out of Invisible Cities (Calvino, 1972, 1974).

“I have also thought of a model city from which I deduce all the others,” Marco answered. “It is a city made only of exceptions, exclusions, incongruities, contradictions. If such a city is the most improbable, by reducing the number of abnormal elements, we increase the probability that the city really exists. So I have only to subtract exceptions from my model, and in whatever direction I proceed, I will arrive at one of the cities which, always as an exception, exist. But I cannot force my operation beyond a certain limit: I would achieve cities too probable to be real.” (p. 69 quoted, in italics, in original)

What resonates for me is the way that Calvino articulates Marco Polo’s initial desire to “deduce a model city” through a methodology of reflection and subtraction. Polo begins with a belief that through deduction, reduction is possible—which in his case, refers to exceptions. These exceptions increase the probability that a city exists and produce the

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8 This is the opening phrase of Foucault’s History of Sexuality, Vol, I, p. 3. A first methodological note: I use ‘story’ to characterize a long standing set of circulated ideas about circumstances, situations, attitudes, and so on that we accept as the way things are and that become transparent as a normal way of thinking about a relationship or concern.
ideal model of city, which in turn should be predictive of other cities. Quickly he realizes that in the end, these reductions construe cities “too probable to be real” (Calvino, 1972, 1974, p. 69). The g/t story articulates a similar desire and approach, one that deduces and reduces perceptions as well as conceptions of women and of technology to a representative and predictable model, yet it does so without Polo’s subsequent reflexivity.

That is, the g/t story might be “too probable to be real.” Specifically, this story is both constituted and constituting such that it effectively produces the idea of girls and women as it reduces them in relation to a similarly reduced technology. To be clear, I am not out to challenge underlying aims of equity or social transformation; rather, my target is the means for going about trying to achieve these ends. If the g/t story is in fact not so much “real” but instead a constituted and constituting story that produces girls and women as a particular kind of subject in relation to a specifically articulated notion of technology, a new approach is in order.

I am not developing a thesis or theory of “story.” I use the term in the way that Foucault (1975, 1995, 1990) uses it to ground his genealogic method. A genealogic story is built from collections of narratives; historical records; chronicles of events relating to things, institutions, groups, or individuals; and to events or interpretations of events or interactions that have happened or might happen. Rather than a representation of subjects’ accounts or experiences, the genealogic story is a kind of excavation of continuities and discontinuities from a distance. This distance makes it possible to view the events and contexts of social phenomena from a perspective other than the interviews, surveys, and observations that are the dominant tools of what Foucault calls the
disciplining sciences. The genealogic story that I draw is a composite of these other stories. That is, my genealogic story is one that views empirical studies and the understandings these have produced from an interpretive distance in order to see what else might be going on. I mean to include within the g/t story the many research studies, research reviews, and newspaper, academic, popular, and policy accountings of the g/t problem within education, educational research and policy, and the popular media. My primary focus is the U.S., although I also include a UNESCO document and along the way, occasional perspectives from outside the U.S.

My premise is that the research and discourses that make up our understanding of the g/t relationship or problem may be analyzed as a relatively cohesive meta-story, but remaining cognizant that there are two points of entry to this story. One is an “education-engineering” story and the other is drawn from feminist and sociological or historical studies of technology. The boundaries between these stories are not fixed and are open to interpretation. As I mentioned earlier, I do not specifically include within the meta g/t story the g/t research that comes out of STS, SHOT, or feminist technoscience unless specific studies fit within the conceptual or methodological terrain of the mainstream g/t story. The meta g/t story represents a dominant cultural story that largely focuses on the characteristics, aptitudes, interests, psychologies, and behaviors of girls and women as these

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9 This feminist and STS g/t research has tended to examine what technologies do to women and how women are shaped by and shape technologies (Anne Balsamo’s Technologies of the Gendered Body, 1995, is a prime example). The theoretical emphasis of this work in recent years has been the idea that gender and technology are co-constructed in and through their everyday and discursive interplay. A version of this constructivism infuses the main story, which is why I mention it here, and why the boundaries of stories are sometimes porous.
are used to characterize or shape their dispositions to learn, teach, play, or persist in computing (or STEM) careers. Of late, an overly masculine culture of computing has also become a focus of research and policy interventions.

Despite the reach of this mainstream g/t narrative, this dominant, largely K-16 STEM education-based story has received little attention in feminist STS scholarship. This is a problematic gap given that important and far-reaching notions of computing and technology are instilled in society and individuals through educational policies, practices, and experiences (e.g. Bowers, 1988; Illich, 1973; Pacey, 1983, 1989). The education-engineering story can be viewed as the dominant and mainstream g/t story because it has such a wide-ranging influence. It serves as the broad discursive and conceptual base that reflects and “instructs” society in how to think about technology (as well as girls and women). I do not mean to infer that there are two separate and easily bounded g/t stories. Rather, this is my way of sorting and managing a vast literature as I read the mainstream g/t story through multiple, intersecting lenses. In this dissertation, “the g/t story” refers to the mainstream education, policy, and media version.

The following texts are the primary focus of my readings and analyses:


- *Women and Information Technology: Research on Underrepresentation*, (Cohoon & Aspray, 2006b)


Justifying Sources as Representative

Critical readers may be wondering how I will justify the salience or significance of these texts and other examples that I use to characterize the g/t story. One possibility for evaluating is to invoke a procedure academia itself often relies on, namely, the citation count. The problem is what exactly, is to be counted. Moreover, what counts? Even if one text is heavily cited, the question remains of how to accurately count or evaluate the quality of its citations. To gather numbers of citations, Googling is one strategy, but this kind of search returns too much information, much of it redundant. A recent editorial in the New York Times (Porter, 2009) likened this kind of Google search to polling. Porter describes it as a technique that Lawrence Summers, President Obama’s top economic adviser, has used to gain a perspective on the extent of American’s anxiety over the economic recession. While it does not offer any scientific certainty, Porter argues that a Google search functions...
well to capture a sense of the extent of interest in a phenomenon, and this is how I use it. My sources capture a phenomenon. A more academic alternative is Google Scholar, but it remains difficult to know just what one is counting, how much is repetitive or overlapping information. Nor does such a strategy resolve the tension between quantities and quality in evaluating sources. Web of Science and Scopus are other possibilities, but they tend to leave out books, policy, and the popular media, and thus miss too much of relevance. Given the murkiness of counting as a reliable measure, other strategies seem more productive; specifically helpful are genealogic lineage and associations as these are evidenced in bibliographies and in-text citations.

I am not out to resolve the problem of how to certify the importance of a given set of texts; instead, I draw from Foucault’s genealogic approach as well as the social science tradition of practical philosophy, as explained by Flyvbjerg (2001) and Schwandt (2004). Foucault’s genealogic logic suggests an approach to tracing a lineage of ideas, events, and shifts to gather a sense of the patterns or discontinuities in how the intersection of gender and technology has been understood and conceptualized across texts. In doing this kind of tracing and accounting, concerns over the interplay of power and knowledge make it possible to attend to what appears to have been left out of the story or individual texts. Practical philosophy (or phronetic social science, as Flyvbjerg (2001) explains it) is an alternative to the rule-driven epistemologies of the natural sciences. It builds from cases and rather than procedurally driven, research is itself an ethical-reflexive practice of making judgments while accounting for the contexts, values, and power relations wherein social life and social research unfold. The following ideas ground my selections.
First, I rely on the inter-reflexivity of texts—that is, they cite each other—and I make use of this cross-reflexivity to the extent that it is chronologically possible. I also select texts based on what they offer in terms of representing key themes in the dominant story or offer in the way of provocative arguments or potential but unrealized revisions. Texts that highlight temporal dimensions of the story, for example aspects and ideas that shift or those that have remained stable over thirty years are also foregrounded. My selections also tend to be heavily cited by others (e.g. in bibliographies, in Google Scholar citations, or regularly noted in within-text citations), although the usefulness of citations varies because some texts are quite recent. My justification for the latter is to recognize current thinking as it is published, but even here there is a kind of continuity because the texts tend to be published by MIT or other highly credible publishers with a visible history of publishing on gender and technology. I view this as “authority by association,” which is my way of describing an authority conferred by an already well-cited author or through a study’s institutional sponsor or publisher. Studies funded by the National Science Foundation (NSF) or the American Association of University Women (AAUW) are significant for their institutional stature and influence. Often, intriguing inconsistencies emerge because different arenas of scholarship, policy, and publication venues coexist in seemingly parallel universes; there is just simply so much written on g/t that there is no human way to consider them all. Thus, I too borrow a bit from Marco Polo. I reduce thousands of potential texts down to a highly select but credible representative few. The texts I have chosen represent a cultural moment (1983-2009) and are symptomatic of this moment and its tensions. Many other texts could do just as well.
The Story, to Date

The g/t story has largely focused on identifying, describing, and explaining the factors that cause inequities and injustices in computing and associating these with m-f differences in attitudes, abilities, opportunities, or values as these are expressed regarding technology. These studies aim to identify broad, prescriptive programmatic interventions that would reshape or accommodate essential m-f differences.

Conventional approaches to studying the g/t story rely heavily on paths and concerns defined by earlier g/t studies, thus a strong recursiveness is valued and subsequent studies aim to incrementally and more precisely describe factors that have stood in the way of women's participation in computing. I take a different path and pose a different set of questions driven by three concerns. First, I want to understand how the g/t story itself is constituted in and through practices of examining and telling the story—how it is constructed through social, discursive, and research practices that are conceived within a set of social imaginaries that in turn bound how we see and interpret the world around us. Second, I consider how the story is also a constituting story rather than simply a representation of reality. At issue is how conventions of thinking have framed perceptions of the g/t story and women, men, technology, or research that in turn help to shape the story through notions the story itself puts into circulation. Third, I grapple with the effects and limitations in methodological assumptions and practices, and how these become social-intellectual partners in a complex dance whereby discourses and practices can themselves be implicated as technologies of the self (Foucault, 1990; Martin, Gutman, & Hutton, 1988) and gender (Lauretis, 1987).
The constituted and constituting elements and practices of the story are not
genben, objective, or neutral in representing the g/t relationship or the relationship
between gender-technology-society. The presumed “neutral” methodological foundation of
the story needs further investigation for the ways that underlying methods, discipline-
specific knowledge, and ensuing explications of subjects, objects, gender, and technology
become constituting elements of these constructs and their relationship.

Methodology: Reflexive and Diffractive Double Reading

The g/t story has largely relied on reductive methodologies to situate and explain
subjects and objects in relation to specifically targeted educational, behavioral, cognitive, or
career concerns in order to objectively identify, describe, explain, and potentially predict or
change future behaviors, attitudes, and circumstances. The goal of the story is to explicate
an objective and true representation of the g/t relationship, in order that future relations
may be predicted or altered. I examine and deconstruct this notion of representational
objectivity and in doing so, I rely on alternative views about objectivity such as those
offered by Foucault (1972, 1980b), Haraway (1997), and Barad (2007). I aim for both the
analytic distance of Foucault while also respecting the contextual and situated dimensions
of knowing that Taylor (1995) or Haraway (1991a), for example, insist upon. These ideas
foreground the political-ethical nature of knowing. My aim is not to produce an all-
knowing and all-seeing representation of reality regarding the g/t relationship, but rather,
to show how and why a multi-faceted lens makes visible the range of allegiances, practices,
subjectivities, and effects that come into play as gender, technology, and social institutions
and practices meet and are given meaning.

**Intersectionality, reflexivity, & diffraction.** I have devised an intersectional
approach to examining the meta g/t story, where intersectionality includes within its scope
both transdisciplinarity and diffraction. While intersectionality has been recently claimed
by feminist scholars to refer to “the interaction of multiple identities and experiences of
exclusion and subordination” (Davis, 2008), I use the term more expansively to include the
intersecting discourses, practices, disciplinarities, methods, and methodologies through
which subjects and subjectivities are framed, practiced, or experienced. Intersectionality is
my way of describing the multiple lenses needed for any kind of re-examination or holistic
understanding to be possible. It is, in essence, an immensely idealistic position, and thus,
perhaps as improbable to achieve as is Polo’s ideal model. However, my incremental steps
bring together a genealogic and intersectional approach to reading the contextual and
temporal shifts that characterize social life—in this case, the g/t story. Thus,
intersectionality sets off on a more representative or probable path than does reductivism
because it recognizes at the outset that the “city” one reaches at the end might, in reality,
have changed or moved since one wrote the guide for navigating or explaining it.

Diffraction is Haraway (1997) and Barad’s (2007) methodological approach for
drawing on multiple lenses in order to “see” from a more intersectional perspective.
Diffraction builds from transdisciplinary approaches to inquiry but includes a more
explicitly interpretive orientation. My intersectional strategy is both reflexive and diffractive, an alternative to the predominantly reflective and recursive methods of g/t research. My reading begins with a concern similar to Calvino’s Marco Polo regarding methodological and conceptual strategies that have embraced reductivism in pursuit of universal models. That is, g/t researchers, scholars, policy makers, and journalists have developed procedures for reducing, describing, and representing subjects or objects that in turn contribute to the phenomenon of gender underrepresentation in computing. A reductivist methodology helps to constitute the problem it purports to explain or dismantle. Through ever better dissections and extractions, the intent of mainstream g/t research has been to identify a most probable model, for predictive purposes. I will show, however, that this probable model is not benign or neutral. In addition, researchers themselves have realized one dilemma of the current g/t literature, namely, a vast quantity of exceptions, contradictions, and significant discrepancies between studies have made it quite difficult to settle on or effect the transformations sought. Mainstream thinking on this particular dilemma is that more precisely articulated problem statements, variables, and methods are necessary to better locate the most generalizable models.

Foucault is one of a multitude of thinkers who see discourses themselves as a fruitful object of inquiry. Examining discourse practices is a way of interrogating the interplay between language, social practices, and the formation of subjects and subjectivities.

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10 Transdisciplinarity is extensively described as a distinct alternative to inter- or multidisciplinarity (see for example, Klein, 2004; Lawrence & Després, 2004; Nowotny, 2003; Ramadier, 2004).
What properly belongs to a discursive formation and what makes it possible to delimit the group of concepts, disparate as they may be, that are specific to it, is the way in which these different elements are related to one another: the way in which, for example, the ordering of descriptions or accounts is linked to the techniques of rewriting; the way in which the field of memory is linked to the forms of hierarchy and subordination that govern the statements of a text; the way in which the modes of approximation and development of the statements are linked to the modes of criticism, commentary and interpretation of previously formulated statements, etc. It is this group of relations that constitutes a system of conceptual formation. (Foucault, 1972, pp. 59-60)

What Foucault proposes is exhaustive and multi-faceted, and open to many interpretations. My approach combines the reflexive (Alvesson & Sköldberg, 2000; Bucholtz, 2001) and diffractive (Barad, 2007; Haraway, 1997). It builds from an interplay of critical theory, social discourse analysis that is both archaeological and genealogic (Dreyfus & Rabinow, 1982, 1983; Foucault, 1972; 1990), and a hermeneutic practice of local interpretation attentive to social-historical-political contexts and events (Flyvbjerg, 2001; Haraway, 1991, 1997; Taylor, 1995). One of my aims is to highlight how interpretations and stories are constructed, evaluated, promoted, marginalized, or lost.

Double reading. My intersectional approach also builds from Derrida’s insistence on the necessity of double reading (which I derive from Nealon (1993)). A first reading is a “maneuver that, in the end, adds up to a neutralization of the opposition…it rearranges the terms” and produces a “scholarly reconstruction of [the] text” (p. 32). A second reading examines the range of faulty or problematic constructions that constitute the ground on which the first reading is constituted. Derrida’s work on deconstruction makes evident the value to be gained through double reading but I play loosely with the notion of double to frame a rationale for multiple readings. Critchley, in a memorial reflection on Derrida’s work (2005), described double reading as: “reading the text in its original language,
knowing the corpus of the author as a whole, being acquainted with its original context and its dominant contexts of reception” (sec. 5.1). Given that I am not focused on the writings of any one scholar but rather, a broad story composed of multiple pieces, my scholarly, first reading will read specific examples and texts but also locate these within the larger “corpus” of the g/t story by pointing to the original contexts, the themes and concerns in circulation, as well as paint the spheres of influence to indicate the reception and progression of a story that began in the early 1980s (in the US).

Engaging more of the spirit of double reading, rather than any prescription (which Derrida opposed anyway), I draw out a multi-faceted reading of the g/t story. The first reading most easily fits within Derrida and Nealon’s model: it describes and analyzes the conceptual foundations of the story as it has played out within the literature. I lay out the significant terms, relations, perspectives, and proposals articulated in the story, but rearrange them in order to portray the grounds for what appears to be a coherent story. I explicate what the story itself emphasizes as significant in terms of research questions, constructs, relationships, and methods. But what does Derrida mean by a second reading that goes beyond simply neutralizing the issues extricated in the first reading, an intervention to “displace[...] a mode of thinking that leads precisely to...deadlocks” (Nealon, 1993, p. 30)?

I do not see how this can be done with only a second reading, unless second is more metaphor than fact. As I interpret double reading, the first is largely a critically reflexive analysis of a text or practice. I have found it useful to think of the second reading as diffractive, an idea borrowed from Haraway (1997) and Barad (2007). Diffraction brings
additional lenses to the observational or interpretive field with the intent of provoking challenging intersections between disciplines and theoretical conventions. The idea is to complicate assumptions and to provoke the reformulation of research questions.¹¹

Second reading aims for more than neutralizing issues extricated in the first reading. This reading is deconstructive in that it is a two-fold intervention, one that does not stop with criticizing what has been; it aims to articulate what could be (Nealon, 1993, p. 30). This is where diffraction plays a significant role—reading through multiple and unconventional lenses to avoid simply replacing the kinds of deadlocks that have limited the g/t story to date. Diffraction is a strategy for interweaving multiple content perspectives (e.g. regarding how we might conceptualize technology or gender) as well as multiple analytic strategies.

Drawing from Foucault (1972; 1975, 1995, 1980a, 1990) and Blommaert (2005), I understand a story to be analyzable for the ways in which it is (a) socially constitutive, (b) reflective of a number of black-boxed practices and beliefs, and (c) an instrument of power. I also build from Foucault, Bohman (2003), and Haraway (1991a), who each in their way suggest that doing critical theory is a practice that engages and negotiates interpretive understandings, yet also seeks an impersonal, objective explanation. Haraway describes it as a strong objectivity. All argue that both lenses are necessary to further the project of social transformation. Interweaving these makes it possible to reconsider what constitutes an objective g/t story.

¹¹ This is also the driving idea behind transdisciplinarity as explained by Julie Klein (2004), Helga Nowotny (2003), and Wickson, Carew, & Russell (2006), for example.
Contemporary feminist scholarship adds a needed dimension from two directions. One is a more specifically focused intersectionality, which in recent feminist usage emphasizes the “interaction between gender, race, and other categories of difference in individual lives, social practices, institutional arrangements, and cultural ideologies and the outcomes of these interactions in terms of power” (Davis, 2008, p. 68). Although recent g/t research seems, on the surface, to have moved forward in more responsibly in including race, class, disability, and so on, in reality the way these are framed within the g/t story remains mired in the limitations of liberal feminism. Double reading highlights some of these obstacles. The second dimension foregrounds ideas from feminist technoscience studies. Scholars I rely on most heavily are Haraway (1991a, 1997), Barad (2007), Wilson (1998), and Grosz (2005), for the ways in which they articulate new ways of thinking through the complex relationships between nature and culture and thus, essentialism, constructivism, time, causality, and an ethic of care.

My project unfolds as a progressive and multi-faceted reading of the g/t story and its methodological conventions, as conveyed in this illustration:
Figure 2. Diffraction as faceting.

My intersectional reading navigates the seven diffractions named in figure 2. This is not to say there are not more possible, but rather, that I found a way to end this reading—perhaps this is what Derrida means by second. At some point, re-reading can stop; but at some point it would also presumably pick up again to build on what has been learned or to consider what has newly emerged. This is one of the challenges of intersectional or transdisciplinary work: there are always more exciting and important additional lenses to consider. I call it a problem of exponentially intriguing ideas, but it also makes apparent the value in a critical relationality for understanding social phenomena, one that is not only contextual, but also temporal.

Over time, I have come to see that there are three different kinds of interpretive methodological engagements. The first is reflective, which is the approach that has most
grounded mainstream g/t research. Barad (2007) describes this as a strategy of “mirroring and sameness,” which I take to also refer to those holy grails of replicability and generalizability (p. 71). A second interpretive engagement is grounded in a critical reflexivity, which Alvesson and Sköldberg (2000) define as paying serious attention “to the way different kinds of linguistic, social, political and theoretical elements are woven together in the process of knowledge development, during which empirical material is constructed, interpreted and written” (p. 5). Critical reflexivity makes it possible to exhume some of the underlying beliefs and practices that transparently frame the conduct of empirical research. Diffraction, according to Barad “does not take the boundaries of ...objects or subjects...for granted but rather investigates the material-discursive boundary-making practices that produce 'objects' and 'subjects' and other differences out of, and in terms of, a changing relationality” (2007, p. 93).

The third interpretive engagement is diffractive and interweaves multiple, unconventional, or newly relevant perspectives together to re-evaluate how difference, subjects, and objects have been conceived, located, and constituted. Diffractive readings build from reflexive readings and bring alternative and unconventional lenses to the table. They go beyond critical reflexivity because the aim is ultimately locating possibilities for reconstructing or alternatively conceptualizing a discourse or problem-focus so that these may become more effectively transformative. The conceptual provocation is quite deep. Rather than, for example, continuing the search for a more explanatory theory, a diffractive reading questions how the original problem has itself been construed. Intersectionality is in essence a quest to examine whether the problem as it has been laid out is the best problem
on which to focus attention. The goal is specifically opening up new kinds of research questions by reexamining the intersections between how subjects and objects and their relationship or significance may be theorized.

**Critical & genealogic faceting.** In my reflexive reading, I examine the ways in which the g/t story remains grounded in liberal feminism and Gilligan’s (1982, 1993) psychological rendering of girls and consider why intersectional feminist approaches have been inaccessible. Diffractive reading allows me to bring feminist technoscience, philosophy, and political theory to the table and to re-examine not only the definition of gender in use, but also what kinds of research questions and assumptions follow the definition of gender. This helps in thinking about a conundrum of the g/t story where it aims for a universality built upon local subjectivities.

Foucault’s archaeology and genealogy ground an aspect of how I approach reading the story. This lens disrupts assumptions of enduring foundations that are behind the concepts, theories, and accounts that ground the g/t story and that are used to justify claims of an objective science. Instead of certainty and reductivism, archeology and genealogy open up the possibility of “transformations that serve as new foundations, [...and] rebuilding ... foundations” (Foucault, 1972, p. 5). Foucault insists that this kind of reading engages questions that are more basic and broader than traditional research questions, for example: “What is a science? What is an œuvre? What is a theory? What is a concept? What is a text?” (p. 5) What is exposed is the impossibility of unities that have largely foregrounded the telling of certain stories by relying on “chains of inference, ... tables of difference, ... [to instead] describe systems of dispersion” (Foucault, 1972, p. 41). In
this spirit, my readings aim to locate, highlight, and examine the unities, concepts, and themes that ground the mainstream g/t story and then, to unpack these unities, concepts, and themes to discern what they do.

My methodological process and stance is at once integrative, critical, deconstructive, reconstructive, reflexive, and diffractive. I realize that these are also seemingly contradictory and paradoxical positions; however, contradiction and paradox are themselves useful antidotes to reductivism and certainty. The challenge of intersectional or diffractive reading is, in part, to locate significant contradictions and to use these to rethink assumptions. At the core of my approach is a social discourse analysis that is intersectional in its ambition and scope as it draws on a range of perspectives including ideas about education, philosophies of technology and computing, feminist theory, science and technology studies, and critical and cultural theory. I rely on Foucault’s (1972; 1975, 1995, 1990) deconstruction of subjectivities and the subject-object relationship, Halliday and Martin’s (1993) examinations of the constructive nature of scientific discourse, and on ideas illuminating how the constituted outsider is produced (e.g. Derrida and Haraway). Also immensely important to my project are Taylor’s (1995) scholarship on epistemology and social imaginaries; Heidegger’s (1977) explication of technology through his idea of Gestell or enframing; and Haraway’s (1991a, 1997) work on alternative conceptions of objectivity that rejects both relativism and an all-knowing disengaged knower’s questionable objectivity.

Reflexivity focuses the critical, hermeneutic, and phronetic path of my interpretive readings within texts (see Alvesson & Sköldberg, 2000) through which I examine how
subjects, objects, and knowledge are both derived and represented. However, diffraction is ultimately my intent. This is the metaphor that I borrow from Haraway and Barad to describe how I approach initiating conversations and analyses across texts, fields, disciplines, and time, in order to consider the interplay of historical, epistemological, theoretical, and methodological tensions that shape constructions, representations, or interpretations of the g/t story. These in turn become opportunities for adding new facets to the observational field. The observational “eye,” as Haraway and Barad suggest, cannot be merely a magnifying lens or mirror. Instead, my operational metaphor is that of a cut diamond, similar to Barad’s (2007) allusion to the multi-imaging eye of an insect, or the opulence and iridescence of a butterfly wing. The conceptual metaphor of this dissertation is then, faceting: I begin with two threads—the g/t story and its methodological foundations—and diffract these through a number of faceted readings.

Haraway identifies a common commitment in feminist science studies to be “avoiding what Whitehead called ‘the fallacy of misplaced concreteness’” (cited in Haraway, 1997, p. 269) and her suggestion is an alternative strong objectivity, which she describes as possible through new observational practices: “the chimeral entities emerging from the world-constructed-as-laboratory must be remapped and reinhabited by new practices of witnessing” (p. 269-270). Diffraction makes this alternative objectivity and witnessing possible.

**Faceting for a stronger objectivity.** Building on this idea of rethinking the position from which we see, diffraction is a methodology best situated to re-envision objective perception or observation. The hurdle to navigate is how traditional views of objectivity
within normal science depend on a limited observational field of reference, thus, a limited
objectivity. At the center of a diffractive practice is the intersectional scholar, who travels
across disciplinary perspectives rather than bound to a single discipline’s (or compatriot
disciplines) conventional ways of thinking about a problem. One of the points of
contention in transdisciplinary work is whether sufficiently “new” knowledge is created,
and how this knowledge is decided to be adequate or reliable. The problem is a tension
between expectations that new knowledge dig ever deeper to produce “new” knowledge
and aims that are more focused on questioning standing assumptions about knowledge
and the premises behind research problems. Intersectional diffraction is a search for new
or alternative layers to add to existing knowledge, but more significantly, it brings to the
foreground new kinds of questions. This approach ideally strengthens disciplinary
knowledge, but in a different way, by scrutinizing existing knowledge from often
oppositional conceptual or methodological lenses. This is not to discredit the disciplinary
home of such knowledge. Rather, it intends to provoke heretofore-missed opportunities for
thinking about a specific problem in a new way. This is most useful when a problem itself
has been seen to be intractable. The g/t story is, arguably, this kind of problem, as recent
studies and articles have professed. A reflexive and diffractive intersectional methodology
is my strategy for dissecting and reconfiguring the methodological and epistemological
bases for thinking about the g/t story. The aim is ultimately, multiplicity rather than
reduction, and in this sense, a stronger objective lens.

12 Most of the more recent texts I list as the objects of my analysis take this as their starting
premise, in some fashion: the g/t problem is a problem still in search of a solution.
Under consideration are conceptions of knowledge and its role in framing the interpretation or construction of subjects and objects and their intersection. Knowledge, as I understand it, is ultimately a product of the convergence of historical, political, and social factors that shape how we decide what is relevant to know and how social, political, and scientific phenomena and relationships are to be interpreted and valued (e.g. Denzin & Giardina, 2008; Gadamer, 1976; Hacking, 1999; Taylor, 1995). In this conception, the disciplines (and their stewards) not only are the intellectual locus for the creation and use of knowledge, they are cultural and political sites in a productive and legitimizing enterprise, setting the parameters of knowledge building and inquiry. The intersectional traveler focuses on the transparent effects of disciplinary boundaries and practices in order to bring these influences to the surface (Wickson, et al., 2006).

The methodological import of intersectional thinking lies in the ways it questions, by illuminating previously absent lenses, assumptions that have become transparent in standing problem articulations. Multiple scholars, across disciplines, have argued that scientific knowledge—built largely through strong disciplinary conventions—reflects social negotiations that unfold within limited spheres of influence (e.g. Keller, 1985; Knorr-Cetina, 1981; Latour, 2005). For these scholars, disciplinarity is only a “problem” to the degree that it confines our intellectual socialization within circles of disciplinary compatriots, and this is one of my concerns about the g/t story; its disciplinary and methodological lenses have been quite narrowly disciplined. This, in turn, has seriously narrowed both the kinds of questions opened to research and conceptions of the subjects and objects of that research. Intersectional thinking pursues possibilities for thinking
outside disciplinary and interdisciplinary practices. The aim is not merely the production of deeper or new knowledge about a recognized problem, but rather, new orientations to articulating the problem and developing new research questions. It is also a critical position that suggests more nuanced consideration of recent calls for greater interdisciplinarity alliances in educational research (AERA, 2009). At the least, greater reflexivity on the term interdisciplinarity and the status of critique might be useful.

Challenging the rising fortunes of interdisciplinarity as a kind of curative, Greckhamer, Koro-Ljungberg, Sebnem, and Hayes (2008) deconstruct its possibility and impossibility. Intersectionality is a strategy that navigates the space of tension in the two opposing realities of interdisciplinarity that Greckhamer et al explicate: reverence for its sign and the negation of its possibility. What intersectionality offers is a means of opening up traditional expectations of how new knowledge is to be shaped, recognized, and stewarded.

One challenge and responsibility facing the intersectional researcher is how to include and responsibly engage a broad range of disciplinary knowledge or literatures. A potential problem is that of being construed as an outsider by experts within those same disciplines. This othering may play out in how alternative interpretations are received and in what is considered new or useful contributions to a field. Intersectionality requires jumping into both an intellectual and political stew. This is the challenging research terrain—being neither wholly inside nor outside a discipline; both situated in the problem and yet, critically disengaged from specific disciplines and their traditions.

13 Despite its allure, doing this kind of research presents numerous professional challenges.
I do not interpret intersectionality as the means of creating new disciplines (as some transdisciplinary scholars argue, e.g. Nicolescu, 2008). Instead, I prefer to think about it as articulating alternative competencies and or practices that are at once hermeneutic and critical, reflexive, diffractive, deconstructive, and constructive—a kind of “interdisciplinarity 2.0.” Transdisciplinary scholars (e.g. Klein, 2004; Lawrence & Després, 2004; Nowotny, 2003; Ramadier, 2004) have argued for a re-positioning of scientific truth to create a space for value-rational and consequential “truths.” If there is an interventionist aspect to diffractive intersectionality, it lies in its aim of realigning the balance between scientific objectivity and an ethics of value. In some ways, this notion reflects the way that transdisciplinarity has been most prominent in the natural sciences and in those social sciences similarly aligned. The real target might be said to be objectivity itself, because once this is strengthened, the social-political-temporal aspects of knowing become integral and these are where ethics and values are situated.

Intersectionality is also somewhat Deweyian in the ways inquiry is taken to be process and experience oriented. It describes particular, yet expansive, stances and methodological strategies of an inquirer engaged in research practices intent on revealing complexity and ambiguity through re-examining the premises grounding long-standing binaries of “subject/object, subjectivity/objectivity, matter/consciousness, nature/divine, simplicity/complexity, reductionism/holism, diversity/unity” (Montuori, 2008, p. xii). This practice has a different emphasis than does education research that is focused on finding “what works” or that emphasizes replicable and generalizable knowledge. Disciplinary and

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14 Thank you to Karoliina Engstrom for this idea.
interdisciplinary strategies are useful in these contexts, but not well-suited to illuminating hidden agendas or embracing the ambiguities so important to understanding the depth and range of socio-political values that complicate the possibility of actually identifying what might work across a wide spectrum of society and shifts in this society over time.

My argument for intersectional faceting is that it offers four opportunities. First, it expands the methodological lens in a way that makes it possible to rethink the kinds of assumptions through which the g/t story has been construed. Second, it provides a basis for re-evaluating long-standing problem formulations that have focused g/t researchers. Third, it brings questions of socio-political values and ethical commitments to the forefront and in so doing, expands the base of what kinds of knowledge is valued. Fourth, it becomes more possible to consider transparent power relations that stand to be missed through conventional, disengaged, scientific research methods.

In intersectional work, research attends to the ways in which power is negotiated in complex ways across and between disciplines and differently situated knowers. Klein (2004) suggests that transdisciplinarity is a response to an emergent shift in how expertise is understood to more expansively include a broader range of knowers (e.g. extra-disciplinary researchers or long-absent subjects of research).  

15 Flyvbjerg (2001) helpfully argues that “methodology must take account of the complex and unstable process according to which

discourses can be both an instrument of power and its effect, but also an obstacle, a point of resistance or a starting point for a counterposing agency” (p. 124). Intersectional reading is a strategy for navigating this complexity.

**Witnessing.** The primary aim of my reflexive-diffractive intersectional methodology, and my study, is to facet the g/t story from a number of angles. My aim is to open a space for re-imagining and re-witnessing the story and to promote a “better” position from which to theorize the g/t relationship and approach managing our technological futures. As my analytic readings unfold, I show how gender, women, and the g/t story have become a kind of technology used to manage a broad set of socio-techno anxieties. Although I do not offer a prescription for addressing whether this technology is, or will be, effective, I do suggest some alternative possible ways of conceptualizing gender, technology, and the ways these meet, through methodological lenses, in education, society, and politics.

My intersectional approach queries the locations, values, and possibilities inherent in witnessing. Haraway’s inquiries into objectivity and the stories that science produces were motivated by her dissatisfaction with the gold standard of Enlightenment science’s “modest witness,” derived from an affectation that a standardized, disembodied, and generally white, European male eye was a neutral and thus, modest, observational position. Haraway suggests an alternative lens that includes in science, non-standard observers to better “interrogate critical silences, excavating the reasons questions cannot make headway and seem ridiculous, getting at the denied and disavowed in the heart of what seems neutral and rational” (Haraway, 1997, p. 269). Diffraction is also behind what Connolly
(2002) proposes as an intellectual modesty “at the nodal points where the fundamental assumptions of contending theories differ...we should strive for reciprocal modesty” (p. 16). Thus, while a sufficiently faceted diamond may not bring visions of modest means, it is a useful metaphor for chiseling away at the standard g/t story and for beginning to imagine new ways of seeing not unities, but multiplicities. A faceted intellectual and interpretive modesty makes space for multiple perspectives to be appreciated and appreciative for what they, and others, bring to the table.

The Significance of Faceted Readings

Faceting the story is my organizing metaphor for the reflective, diffractive, intersectional analysis that I chisel at over the next eight chapters. Through multiple and layered readings, I unravel the ways in which assumptions and practices about the nature of knowledge and knowing, power relations, methodology, and conceptions or valuations of difference—as well as conceptions about the import of the gender and technology relationship itself—have been instrumental in constituting the g/t story. I conduct both a study of gender and technology by examining the assumptions used to understand both and a study of methodological assumptions, by examining how the g/t problem or relationship has been researched. I ultimately suggest new directions for re-imagining an alternative g/t story.

Statistics (as illustrated in figure 1) suggest that the gender gap in computing reflects a relatively persistent trend. The question is what to make of these statistics; thus, one contribution of this dissertation is a re-examination of how the g/t problem itself is
conceived, examined, or reproduced. The methods and constructs for examining the g/t relationship have remained consistent over thirty years of research, often disregarding the often tumultuous intellectual and cultural shifts that have changed how various pieces of the g/t puzzle fit together (gender-women, identities, nature-culture, civil society-education, social theory and objectivity, minds and bodies, society and technology, and so on). In examining the intersection of g/t and methodology, this dissertation illustrates an approach for connecting how these elements may be conceptualized and diffracted to better think about the connections between the g/t story, education and its social transformative intentions.

A significant challenge in writing has been finding a balance between the breadth necessary for diffraction and the depth needed for critical reflexivity. Thus, I acknowledge that while there is much here, so too is much left out. There are, to be sure, other examples of the g/t story, other possible questions, and many other significant theorists and perspectives that could be engaged. Thus, this thesis does not make a claim that it has exhausted the possibilities for comprehensiveness. It has not. However, this “lack” should not negate the possibilities unfolded for rethinking and re-questioning the premises or effects of the g/t story.

The “official” g/t story is, in many ways, a product of transparent yet powerful ways of conceptualizing and investigating the social world through empirical, explanatory psychological-behaviorist conceived reductivist methodologies. My intersectional, reflexive-diffractive double reading deconstructs what has been taken for granted yet is reconstructive in the ways it shows how a multi-faceting intersectional methodology paves
the way for re-imagining the g/t story in part, by rethinking the questions thought to be fundamental. The ensuing chapters articulate a seven-dimensional faceting of the g/t story, which I preview in the following section.

Exposition: Faceted Readings

Figure 3. Faceting the g/t story.

This chapter (Facet 2) has outlined a primary research problem of how to simultaneously interrogate a dominant cultural story and the dominant methodology that forms the basis of this story. It has also introduced a number of other research questions that frame the additional faceted readings to follow. Facet 3 is a first reading of the g/t story; I characterize how researchers, educators, policy makers, and the media have
conceptualized, located, or represented the problem of girls and women’s underrepresentation in computing. This chapter identifies the range of problems that the story itself emphasizes as significant. Facet 4 chisels away at the ways the story has assumed, in many regards, the mantle of a modern meta-narrative.\(^{16}\) I consider how the instrumental power of this narrative is manifest through adherence to black-boxed rules of science and scientific discourse (e.g. nominalization, essentialisms, or binary constructions) and through elements presumed stable and independent (e.g. gender, technology, education, knowledge). One of the invisible threads woven into the g/t story is a subtle determinism regarding both gender and technology that persists despite a seeming acceptance of social constructivism in explaining both.

In order to begin to dissect this determinism, Facet 5 introduces social imaginaries as an analytic lens. It identifies a set of imaginaries (gender, technology, knowledge-science-progress, education, subjectivity-identity (framed through a dominant lens of the psychological-cognitive-behavioral sciences), and research) that are important in understanding the background practices and beliefs that shape and are shaped by how we live within, perceive, and represent social relations in their many forms.\(^{17}\) Facet 6 considers technology as something greater than tools and tool culture. Drawing from Heidegger’s thinking about technology; Taylor’s deconstruction of epistemology; Derrida, Irigaray, and

\(^{16}\) Here I refer to Lyotard’s discussion but do not mean to infer that the story is such a narrative.

\(^{17}\) C. Taylor, A. Appadurai, F. Rizvi, and D. Gaonkar are some of the scholars who use social imaginaries to describe the transparent background beliefs and practices that drive societies. I refer here to both Taylor’s view of our modern social imaginary as well as his genealogic analysis of this imaginary.
Cornell’s deconstruction of difference; and Haraway’s criticisms of mainstream science’s hegemonic objectivity, I draw out a thesis of a g/t story entangled within a modern four-faceted enframing. These are our technological, epistemological, differentiated, and perceptual enframings and I examine how these collaborate to produce the constituted outsider, an essential technology of the g/t story.

Facet 7 again delves deeper into “technology” to portray a set of subliminal technologies, in particular, binary thinking, that shape the social-political-cultural landscape in which the g/t story is situated. I describe five ways of thinking about technology, society, and subjects: engineering, social constructivist, philosophical-political, the techno-rational, and as a metaphor of mind. Discussed in depth are the political technologies of neoliberalism and technique as its own rationale, to show why these are significant technologies of the g/t story. Facet 8 examines the meta story as a disciplining technology of the self and gender, where objectivity is also disciplined to delineate gender and women outside technology. I argue that these technologies make possible the gendered-ethical outsider who could reshape technology and thus ameliorate a range of technology inspired anxieties. Facet 9 uses this expanded understanding of technology to discuss our modern anxieties as responses to significant ruptures in our understanding of the human-machine relationship; our relationship to knowledge and knowing; and disruptions to what had been considered stable identities in terms of gender and class. In this milieu and in the g/t story, desire, play, and values have been differently associated, for different ends. Facet 10 argues that the meta g/t story is fundamentally a story that responds to anxieties over our ethical relationship to technology and ourselves and that
this story relies on a too-limited store of resources and is thus ill-equipped to deliver on its various promises of transformation. To remedy this limitation, I draw on emergent work in feminist technoscience and new materialisms to show what posthumanist thinking infers regarding thinking and theorizing as techno-ethical practices. I argue that these ideas offer numerous opportunities for re-thinking the intersection of gender, technology, society, and education. I also point to some remaining challenges that stand in the way of fully re-imagining the g/t story. The final chapter, facet 11, offers some thoughts about what might be done.
Facet 3

Characterizing the G/T Story

On the one hand, the meta g/t story seems quite simple: women and girls are underrepresented in computing and technology and the role of research is to locate and describe the reasons for this persistent gap and identify ways of closing it. The mainstream g/t story is organized around factors suspected of causing this state of affairs in order to put in place programmatic correctives. This is a largely instrumental lens on the problem.

Somewhat different interests are articulated in sociological, historical, feminist technoscience or cultural studies of gender and technology. These studies tend to be most concerned with investigating intersections of feminist thought, historical conditions, and technoscience practices. My focus in this chapter is the first, largely instrumental story, but highlighting some points of divergence is useful.

As the g/t story evolves over approximately thirty or so years, the mystery has been why the computing gender gap has persisted while over these same years the gap in other STEM fields has significantly narrowed. This mystery deepens when the fact that women have achieved near parity in law and medicine (at least in the practitioner domains of these professions) is brought to the table.\textsuperscript{18} There are at least two main facets to the g/t story: (a) the underrepresentation of girls and women in computing fields and (b) the perception

\textsuperscript{18} A strong gender gap remains, however, in the more elite realms of these professions. Women are near parity as students in law and medical schools but as faculty or in the higher echelons of the professions the gap remains wide (Ward, 2008, Fall). The same is true in corporate upper management—a 2005 study of women’s representation on Fortune 500 boards of directors showed a gain from 9.6 to 14.7% from 1995 to 2005, and Catalyst’s (2006) estimate is that while the gains are significant, achieving parity will take seventy years at this rate.
that a sufficient explanation of this gap remains on the table. The mainstream g/t story differs from humanities or sociological approaches in that each reflects different interests in describing and explaining a gendered relationship to technology. I explain this in more detail in a later chapter, and mention this now mainly to characterize the ways in which articulating a g/t story is a far more complicated endeavor than the overarching story of a gender gap implies.

Despite variations in approaches or interests in g/t research, there is always a central commitment to some conception of equity. Facilitating social-cultural-political change is the glue that unifies concerns over the g/t relationship. However, as will become clear in my faceted reading, these commitments reflect shifting alliances and differing dispositions to the kinds of change sought. The two approaches have different ways of conceptualizing or positioning gender and technology, of thinking about the relationship of these to equity and social change, and draw on different methodological bases. One way to think about this these is shown in figure 4:

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19 The feminist technoscience/STS focus shows a far greater openness to alternative representations and theorizations of gender, technology, and their interaction. However, technofeminist approaches are not particularly visible in mainstream understandings of the g/t relationship. Its influence is largely in academia and perhaps in some policy arenas in Europe. Further, despite what some would argue is a greater sophistication in theorizing the relationship, there is seemingly little evidence that the project of technofeminism or STS has had any greater success in turning around the acknowledged problem of underrepresentation and inequity.
Diagramed is a bifurcated gender and technology narrative. One story is largely driven by engineering and education concerns that feed and are fed by popular narratives. What I characterize as the “academic story” represents those narratives that tend to unfold in and remain within humanities departments and journals. The story on the left is the one I trace as a story concerned with three degrees of influence (reticence, utilitarianism, and women’s ethic of care). The top level is the meta-story, which refers to the broad literature, understandings, and policy aimed at describing the g/t relationship; extending out from this is an exponentially exploding collection of contested and shifting micro stories, each focused on providing ever more specific explanations or descriptions of girls and women’s relationship with technology. This is the culturally dominant story of gender and technology, in part because it sits in everyday life at least as much as it is an academic story.

Figure 4. Locating dominant g/t meta- & micro- stories.
The academic story on the right does not have the same broad-based on-the-ground influence.

The G/T Problem as Described in the Meta Story and its Micro Stories

The meta g/t story reflects a commitment to education and equity that in turn is strongly influenced by ideas about learning grounded in cognitive science and the learning sciences. Research, policy, everyday practices, and popular media representations both feed and become products of the g/t meta-story. There is a vast quantity of micro stories that span research and policy reports, funding agendas, institutional, government, and media reports, as well as largely undocumented instances enacted or told in everyday experiences of girls, women, boys, men, parents, and teachers. These stories not only describe and explain the g/t relationship and problem, they have also pursued ideas that the gender gap can be repaired because equity is the real issue at stake. Less obvious is the way these micro stories may in effect serve as a barrier to the kind of change they try to describe and promote. Characterizing these micro-level representations helps in laying a foundation for articulating the kinds of issues thought to be significant. It helps to sort out how these issues are positioned in the story and what interests they serve.

"Investigating the high-tech gender gap" was published widely in newspapers and in online news sites both in the US and globally on or around September 23, 2007 (Mintz). The article offers a glimpse into the strength and reach of the g/t story. The article begins by stating:

For more than a decade, academics and technology executives have been frowning at the widening gender gap in computer science. Everyone has a theory, but no one
has managed to attract many more women. Now some computer science researchers say one solution may lie in the design of software itself. (para. 1)

The g/t problem is not the big news. What got this story published is that someone has offered a new, potential solution. Through these few opening sentences, the g/t story is further embedded in the social imagination as a large and lingering problem. Moreover, and this is a key point, this story is explicitly framed as a story in search of a solution; the notion that there eventually will be such a solution is the draw. Solving the problem, as Mintz states, is the focus of both scholarly and corporate resources and of media attention. Significantly, it is a story for which “everyone has a theory, but no one has managed to attract many more women” (para. 1) This particular instance of the g/t story was widely distributed by the Associated Press not because it is a new or familiar story, but because it promises new hope for a resolution.20

The g/t story has, in some ways, remained surprisingly stable over the last three decades even as details of the story have changed significantly. In the early 1980s (the generally acknowledged starting point of the story), in education and engineering, assumptions, and beliefs about girls and women’s innate and lesser abilities in STEM fields provided the driving narrative (see for example, Collis, 1985; Hawkins, 1985; Kay, 1992; Lockheed, 1985; Morse & Daiute, 1992; Sanders, 2005; Turkle, 1988). By the 1990’s, the focus became more explicitly an attack on pervasive inequities as the liberal feminist

20 In quick Google search I found that the story ran on all major and local websites – perhaps 190 hits on Google in one search. I read it first in a local paper and thus presume that the article also ran in the print versions of other papers. I found the article online: Turkish Daily News, Canadian Business; salon.com; aol.com; cbs.com; yahoo.com; yahoo Singapore, Australia IT, and so on.
movement escalated the push for gender equity and parity. In this charged political climate, the ways in which inequities and gendered ideologies were thought to be embedded in software due to male biased designs, particularly in computer games, became a primary target (e.g. Gürer & Camp, 2002; Hawkins, 1985; Henwood, 2000). By around 2000, the emphasis had largely shifted to deficits and embedded inequities in the cultures where technology is used or created (e.g. AAUW, 2000; Henwood & Miller, 2001; Margolis & Fisher, 2002). In addition, race and class concerns became more prominent, but tend not to be significantly differentiated from gender. Generally, the idea has been that a triad of gender, race, and class deny or limit access to a power that is attributed to or located within technology and its culture.

Statistics are generally the way that the g/t problem (or race or class) is documented and traced over time and between populations. For example, the AAUW (2000) report characterize the extent of the problem:

Statistics on girls’ participation in the culture of computing are of increasing concern, from the point of view of education, economics, and culture. Girls are not well-represented in computer laboratories and clubs, and have taken dramatically fewer programming and computer science courses at the high school and postsecondary level. (p. x; bold in original)

Similarly, statistics drive the NSF’s agenda of identifying workable interventions, as seen in this excerpt from its 2007-2008 funding prospectus:

The Division of Human Resource Development (HRD) manages a portfolio of programs that aims to broaden the participation of traditionally underrepresented groups in science, technology, engineering, and mathematics (STEM) learning and in the STEM workforce. Programs are in place to address the learning, interest and participation of women, underrepresented minorities (African Americans, Alaska Natives, American Indians Hispanics, Native Hawaiians and other Pacific
Islanders), and people with disabilities, at all academic and professional levels. (2007, sec. 1)

Gender representation is the problem and the focus is always on the low numbers of women and girls in the field. My aim is not to question these numbers but rather, to highlight that it is a rare occasion indeed that any qualitative analyses of women’s influence on computing is discussed. Rather, foregrounded are programmatic interventions meant to eliminate the gender (as well as race, ethnicity, disability) divide. The NSF prospectus is an example of how research agendas are shaped to focus on causal factors. The factors in question are, broadly, specific characteristics of girls and women as these intersect with technology and its culture and characteristics. The NSF puts it this way:

**Research projects: investigate factors behind the underrepresentation** of girls and women in STEM education; societal, formal and informal educational systems' interaction with individuals that encourage or discourage interest and persistence in study or careers in certain STEM fields. (2007; par. 41; bold in italics)

Researchers have adopted this project of identifying causal factors and this has produced a vast store of micro stories—each elaborating a particular hypothesis about the relationship.

Examining this body of literature, Cohoon and Aspray, in their 2006 review, identified ten factors that have served to focus g/t research and, in their view, warrant further investigation.

Most extensively written about so far in the scholarly literature are experience, confidence, mentoring, and student-faculty interaction. Least extensively covered are entry barriers, role models, and culture. Somewhere in between are curriculum, peer support, and pedagogy. Regardless of the coverage, each of our ten categories includes important questions that still need investigation. (p. 171)
Gurér and Camp’s 2002 literature review identified a different set of factors, but showed a similar mindset:

It is imperative that we encourage and retain more women in computer science (CS) …Why are the numbers going down? and, how can we reverse this trend?...The information contained in the [ACM-W] database can be divided into 12 areas: early in the pipeline, attitudes, computer experience, computer games, mentoring and role models, self-confidence, computing environments, societal influences, teacher and family encouragement, all-female environment, graduate school, and balancing work and family. (p. 121)

An earlier, yet similar, framing may be seen in “Computer Fear,” published in 1983:

The results of a study conducted at Princeton High School showed that gender, grade, and the type and section of math class were all related to how much students learned. Males, younger students, students in sophomore and junior precollege math, and students in advanced math courses gained relatively more than females, seniors, and students enrolled in other math courses and levels. In general, access to and experience with computers were unrelated to gain in computer literacy. However, asking for help from the teacher benefited female students, and access to a computer outside of school affected the scores of ninth- and tenth-grade female students. (Bakon, Nielsen, & McKenzie, 1983, p. 27)

There is a consistency in these stories that spans two decades. The focus is always on identifying and narrowing probable causal factors of the gender gap and the ongoing aim has been to refine a set of predictive theories/accounts of how particular factors impact the g/t relationship, as Cohoon and Aspray explicitly state:

The extent of coverage for a topic does not necessarily indicate the quality or adequacy of evidence. The quality or adequacy rests more on whether the study demonstrates a reliable link between women’s participation and some preceding conditions. (2006b, p. 171)
The factors and variables identified to date are numerous, which is perhaps not surprising given the sheer number of studies.\textsuperscript{21} A New York Times op-ed piece from 2000, a variation on Mintz’s 2007 AP article, highlights some of these:

Why are there few women in these fields? One reason is that girls receive little encouragement to explore computers early in their schooling. Most computer games are male-oriented, and there are few female role models in technical industries. Women who perform well in high school math and science are often put off by male-dominated lecture halls in college. Women who do end up joining the technology work force have complained about a lack of opportunity for advancement and an absence of support and mentoring. (sec. A,”Technology’s gender gap,” p. 26)

The overarching g/t story is built from a vast landscape of small g/t stories; the above examples are only a representative selection. Notably, this landscape, despite its reach, is rather flat. The picture is composed of a large expanse of identified factors with a large pile of discarded or discredited factors still clouding the view or lurking in the background. The many micro-level instances of this story—empirical and speculative studies as well as summative reviews—highlight factors and causal relations that themselves are not independent of beliefs now broadly held about the g/t relationship. The stated intent is to identify specific causes of the gender divide and develop a predictive theory of g/t that will facilitate designing and implementing effective remedies.

A very recent concern is that theorizations of g/t have been insufficient or even missing. The argument is that better theory would produce more accurate explanations and

\textsuperscript{21} The meta g/t story is astoundingly huge, considering it essentially emerged in the early 1980s. Counting up the specific examples would be quite a challenge: Jo Sanders’ 2005 review of the g/t education research literature alone listed over 700 such studies. Her review was highly specific in its scope and thus, there are still more examples located in policy, media reports/commentary, along with those to be found in other disciplines and their venues.
thus, more effective interventions. This argument itself functions as a theory of g/t. In
other words, the theory of g/t in use appears to be that there is a problematic g/t
relationship due to specific characteristics in or of girls and women, technologies, or the
environments where they meet. This argument or theory functions to both hypothesize and
conceptualize the relationship by insisting that identifying particular, salient factors or
relations will make it possible to change the relationship and eliminate the problem. This
is the overarching framework of the g/t story and the theory of g/t in operation.

Befitting its alliance with the behavioral-cognitive-psychological sciences, this use of
theory is linked to what I suggest is another key characteristic of the meta story—its
recursiveness. The story is always looking back on itself for self-verification and continues
to circle back on itself by relying on a relatively stable set of overarching concepts and
theoretical frameworks. The story is a continuous loop of formulating a predictive
hypothesis, “testing” this new hypothesis, and eventually, discarding the older suspected
factor in favor of some new, more plausible, representative, or comprehensive factor. It is
hard to discern how the g/t problem can be other than a reiteration of previous studies
and thus, a contributor to the continuation of the problem.

That is, a micro-story resonates as true because it is prefaced by the long-standing
larger story that has become a truth of everyday life. Missing from this way of telling the

22 Hubert Blalock (1985) describes a recursive formula for explaining social phenomena or
relationships as one that focuses on “one-way causation” and tends to “focus on a single
dependent variable and a set of ‘predictors’...in effect it provides a set of rules for making
causal inferences on the basis of empirical relationships...they can give us a systematic way
of building block upon block, so that our theories can become cumulative and so that
alternative explanations that are not consistent with the data can be rejected” (p. 3).
story is any possibility of questioning what its underlying truth rests upon. There is no entry point that would allow asking whether there is really a truth to be relied upon. I am not trying to suggest that there is not a gender/technology disparity, but rather, that the ways in which the story is approached limit what can be known about the relationship as well as what is available to investigate. These limitations might be understood as a set of a priori beliefs, concepts, expectations, or ideologies through which we view the relationship.

It is said that seeing is believing, but often it’s the other way around. We do not form our beliefs on the basis of what we see; rather, what we see is determined by our beliefs. We see not what is there, but rather what we want to see or expect to see. (Morris, 2007, mid-page)

One such belief—expressed in Mintz’s AP story (2007)—is the story itself. This story is built from a collection of shared beliefs about a problematic relationship between gender and technology that presume that this pervasive, well-recognized problem is indeed a problem of equity and access. Mintz, using the phrase “For more than a decade...” relies on a cultural belief that this g/t gap is true and needs no elaboration because the problem is already so well known. Thus, by her third sentence she can get right to the main point—a new, potentially corrective solution is in the works that will address the diminishing participation of girls and women in computer science.

This type of social engineering or instrumental narrative is pervasive and, despite the quantity of examples, remains relatively consistent across these micro examples. As an illustration of this way of thinking, the chapter titles and subheadings used in specific texts show how the story is both organized around a set of beliefs yet relies on these beliefs to describe and explain itself. For example, Unlocking the Clubhouse (Margolis & Fisher, 2002) relies on headings such as: “The Magnetic Attraction”, “Middle and High School: A Room
of His Own”, “Computing with a Purpose”, and “Geek Mythology.” The AAUW report, TechSavvy (2000) is organized around the following headliners: “We Can, But I Don’t Want To,” “In the School”, “Educational Software and Games.” Another text, From Barbie to Mortal Kombat (Cassell & Jenkins, 1998, 1999b) focuses specifically on the girls’ games movement using titles such as: “Video Game Designs by Girls and Boys: Variability and Consistency of Gender Differences” and “Retooling Play: Dystopia, Dysphoria, and Difference.” Such examples highlight the ways in which these texts’ organizational strategies reflect the ways in which the story is oriented to examine highly specific causal factors that begin with a set of existing beliefs.

I have suggested two levels to the g/t story. The first is a macro level story (which I refer to as the meta story) that acknowledges the g/t problem as one of under-representation and inequity and tries to articulate ways of intervening in this problem. The micro stories are built from a vast quantity of studies or reports each describing or explaining some aspect of the g/t relationship. Despite the seeming clarity of the macro story, the wealth of micro stories suggests a complexity to the relationship and a murkiness that results from so much information coming from so many directions. In this stew, it is sometimes hard to discern the essential issues held to be at stake. The next section will sort through the stew to identify and characterize a set of eight meta-level concerns or problems.

**Meta-Level Concerns**

**Quantity.** Camp’s paper, “The incredible shrinking pipeline” (1997) is highly cited and commonly used to describe the extent and genesis of the g/t problem. The shrinking
pipeline describes the specific concern over the declining numbers of women in computing as they move through a career trajectory of K-16, masters’ and PhD degree programs, and careers. Figure 5 is Camp’s graph (p. 103):

![Graph showing the shrinking pipeline from high school to full professor.](image)

**Figure 5.** Camp’s shrinking pipeline.

The gap in women’s representation that Camp identified has deepened in the new millennium, as documented by the National Center for Education Statistics, illustrated in figure 6. (U.S. Department of Education Institute of Education Sciences; Digest of Education Statistics, 2005, p. 456)
Camp’s paper stated:

The percentage of bachelor’s degrees awarded in CS to women decreased almost every year over the last decade. In other words, not only does the pipeline shrink from high school to graduate school, but it also shrinks at the bachelor’s level). ... Furthermore, while the percentage of bachelor’s degrees awarded in CS to women decreased, corresponding percentages of other science and engineering disciplines increased. Since the number of women at the bachelor’s level affects the number of women at levels higher in the pipeline and in the job market, these facts are of great concern. (1997, p. 104)

This description represents the g/t story as primarily a problem of the numbers or percentage of girls and women studying or working in the field. The emphasis is the *quantity* of women rather than other, qualitative descriptors. This focus on under-representation thus frames the problem—at the outset—as one of quantity. This is probably due to the fact that primary story is intended to promote gender equity in computing fields and access to technology. Similarly, Margolis and Fisher have stated that while women are no longer a minority on the Internet,
In the nation’s research departments of computer science fewer than 20 percent of the graduates are female. Fewer still enroll in high school programming or advanced computer science classes....women have lost ground in the world of computing. (2002, p. 2)

Quantity is the overarching problem, and this emphasis on counting up the numbers now structures the story itself; the problem and potential solutions are always framed in quantitative terms. Quantity also underlies the characterization of a “leaky pipeline” that has been a central concern. Herman and Webster (2007) state that the problem, from a 2007 perspective, is that there has “been very little gender analysis apart from the superficial number crunching, dictated by targets and quotas” (p. 280).

**Difference.** Conceptualizing the g/t story as a problem of quantity—of numbers of kinds of bodies—highlights a second meta-problem of difference. When Mintz (2007) states, “For more than a decade academics and technology executives have been frowning at the widening gender gap in computer science” difference is the defining quality that makes measuring the gap possible (para. 1). Defining or contextualizing this difference has been an empirical focus of research yet is also a contested conceptual construct. For example, in the following, Cassell and Jenkins (1998, 1999a) want to trouble conventional assumptions about m-f difference and bring to the table a more nuanced notion of what it means to be feminine; also evident is the competing need for women to be classifiable as a cohesive group:

Feminism has struggled to break down univocal conceptions of gender and open a space for many ways of being masculine and feminine. The development of girls’ games needs to be careful to reflect the diversity of women’s lives and to foster acceptance of a range of different feminine styles and identities. Industry insiders, however, note that to do so would necessitate fragmenting an already small,
marginalized, and developing market, insisting that such specialization of interests will be possible only when the girls’ game industry is more firmly established. (p. 27)

The tension over what kinds of differences are most representative and useful is palpable. Despite this difficulty, the g/t story largely proceeds in categorizing girls and women as a unified group, with recognizable and consistent characteristics. This is masked however, by the ways in which these differences themselves are counted, but mostly in the ways that race and class are framed as complicating factors to gender. One version is evident in Cohoon and Aspray’s (2006a) analysis:

We have also glossed over the issue of differences among women. For example, we know that minority women’s representation in computing differs from white women’s. Likewise, students who interrupt their formal education for work or family reasons … often follow different career paths than those women who continue straight through all their schooling before entering the workforce. There may also be significant differences among women depending on their level of education, type of occupation, or employment setting planned. (p. 142)

For Cohoon and Aspray, identifying and explaining difference is the aim, but this is not the only way difference is manifest. Turkle, in 1988, argued that there is an innate and symbolic difference between the computer and woman. In her view, women’s future relationship to computers will not be phobic but rather, reticent, as “the computer becomes a personal and cultural symbol of what a woman is not” (p. 41). In making this claim, she located a difference between the nature of woman and the nature of the computer, inferred that the computer is masculine, reinscribed some innate differences between m-f and female-computer, and thus relied on an innate and intimate male-computer relationship. The meta-problem of difference is a constant and central concern in the g/t story, though the nature of that difference has never been settled.
Deficits. Difference has further been used to articulate or explain some kind of deficit, be it biological, psychological, or a product of socialization and education. An ongoing tension between these kinds of deficits is evident in the Mintz (2007) article:

Beckwith decided to investigate why women and men might interact so differently with the same software....One theory grabbed her attention: High confidence correlates with success....And most studies indicated that women—even ones who study computer science—have less confidence than men in their computer skills.... Beckwith wasn’t interested in changing women’s confidence levels. She was interested in whether changing the software could help women over this hurdle. (para. 5)

It is hard to separate discussions of difference from those of deficits, especially as the target of each shifted over the decades. Beckwith sees a lack of confidence in women, but further locates the deficit in a human-computer interaction—it becomes a deficit embedded in software design, but her project also seems to infer that it will be easier to change the software than to change women.

In the late 1990s, institutional and cultural deficits took center stage. Unlocking the Clubhouse (Margolis & Fisher, 2002) targeted the cultures of computing and computer science programs:

Despite doubts and uncertainties, women tend to persist in computer science when they reject and find alternatives to the dominant culture of the field. A larger question, though, is what institutions can and should do to eliminate the negative factors that lead students to leave computing programs. (p. 107)

Placing the deficit within men, software, or within institutional cultures superficially moved the focus away from deficits within women to deficits in cultures or more subtly, in men, as a group either too apt to show off, try to control, or narrowly focused on technology for technology’s sake.
As early as kindergarten, girls use the computer eagerly and skillfully for writing their stories, but boys race to the computers for free time and play....a remarkably consistent picture emerges: more boys than girls experience an early passionate attachment to computers, whereas for most girls attachment is muted and is ‘one interest among many.’ (p. 15-16)

Underlying all of these efforts is an implied and enduring deficit located in women’s lack of passion or interest in computers—an “interest deficit” caused by deficits in the dominant computing culture. The tension between these is explicit in the AAUW (2000) report:

In its inquiries into gender issues in computers and education, the commission found that girls are concerned about the passivity of their interactions with the computer as a ‘tool’; they reject the violence, redundancy, and tedium of computer games; and they dislike narrowly and technically focused programming classes. (p. ix)

Identity constructions. Somewhat under the radar, but inferred in this AAUW passage, is that the problems are not simply those of difference or deficits. Identity construction is another meta level concern, and identity formation might be fostered, tinkered with, or challenged by the computer. Turkle (1988) positioned the computer as a kind of force around which identities are understood:

This essay looks at the social construction of the computer as a male domain through the eyes of women who have come to see something important about themselves in terms of what computers are not. (p. 41)

She argued that keeping one’s identity as a woman necessitated differentiating oneself from the computer. For women, it might be fun to play around with one’s identity but, because women are not like men, they could not see themselves in a merger with the machine.
[Women] At the extreme...see the social world of the “hacker,” a culture of computer virtuosos. It is a world, predominantly male, that takes the machine as a partner in an intimate relationship. (p. 42)

Bryson and Castell’s (1996) work targeted this use of identity as part of the problem; it too rigidly defined woman.

Intervening at the level of gender-identity construction troubles the illusory naturalness of ‘differences between the sexes’ - differences whose function depends on those differences being seen as immutable and constant. (p. 240)

In their view, the problem is a normative construction of girls and women’s identity that plays out in classrooms in the notion that while girls should be able to use computers, they are not real girls if they become experts.

The tactic of ‘queering’ gender identity by intervening in terms of access to and uses of technologies in school is seen by many as simply unacceptable. It is one thing to propose that ‘you can be a girl and still use computers’ and quite another to work...to make girls the experts at computers. (p. 240) The very idea of the identity of the computer has also been an issue. In many pockets of the g/t story, the computer has been socially constituted as male, and this is the root of at least some of girls and women’s issues with computing.

As children see dads and brothers tinkering with the computer, being the computer experts in the family, playing games on the computer that obviously speaks to boys’ interests and not girls’, there is the likelihood that very young children will identify the computer as a ‘he’ object. The consequences for daughters and sons of identifying the computer as male and of seeing mothers as having low confidence and ability with technology are far-reaching. (Margolis & Fisher, 2002, p. 22)

The computer acquires a masculine identity through children’s observations of their mothers’ low confidence and ability and their fathers’ normative role as the technical go-to person. Family practices promote the social construction of the computer as male, and women as outsiders.
Sometimes a co-construction model of the g/t relationship is prominent. This model suggests that both gender and technology co-evolve and take shape through everyday, socio-political interaction. Computer and video games, for example, are often discussed in this way:

Video games provide a prime example of the social construction of gender. Women rarely appear in them, except as damsels requiring rescue, or rewards for successful completion of the mission. Most feminist analysis of gender and video games to date has been concerned with the proliferation of violent, aggressive, gory, and often overtly misogynistic images within the video game marketplace. (Cassell & Jenkins, 1998, 1999a, p. 7)

In these types of discourses, it is clear how the feminine is constructed but the fact that the computer itself is also constructed with a masculine identity is more transparent.

**The digital divide.** These problems of difference, deficits, and identity are constitutive elements in digital divide concerns. Inequities in various groups’ access to technology help sustain or create inequities in society and, thus, limit the opportunities and rewards available to those affected by this digital divide. This issue was at the heart of Turkle and Papert’s (1991) work on the epistemological frameworks that they saw dominating computer science programs:

The concerns that fuel the discussion of women and computers are best served by talking about more than women and more than computers. Women’s access to science and engineering has historically been blocked by prejudice and discrimination. Here we address sources of exclusion determined not by rules that keep women out, but by ways of thinking that make them reluctant to join in. Our central thesis is that equal access to even the most basic elements of computation requires an epistemological pluralism, accepting the validity of multiple ways of knowing and thinking. (para. 1)

The digital divide has many facets; it is manifested not only in epistemological terms but also refers to the realities of long-standing economic and social conventions or
disparities faced by individuals, groups, or countries. Margolis and Fisher (2002) characterize the gender divide within families:

While upper- and middle-income children in the digital generation are being introduced to the computer at home, long before kindergarten or even preschool, home access and use are far from universal or uniform....Many students recount a gender divide in their families....The computer impaired mother is a stock character in many students’ stories....Children are keen observers. They notice whether their mother or father gets into the driver’s seat or the passenger side, they notice who is called for the when the electric power goes out...and they notice who tinkers with the computer. (p. 20)

This divide manifests on a global level as UNESCO, in its report *Gender Issues in the Information Society* (Primo, 2003) notes:

Given the potential of ICTs in development and social transformation, it is essential that we address the gender digital divide. The aim is both to ensure women’s access to the benefits of ICTs, and to make ICTs into a central tool in women’s empowerment and the promotion of gender equality. (p. 15)

The digital divide is a way of talking about the structural barriers that women face and emphasizes interventions meant to break down these long-standing inequities that women (and other similarly marginalized populations) face.

**Techno-literacies and power.** The digital divide is of growing importance in a world where technological literacy (or new literacies) is viewed as essential for individuals in getting and retaining good jobs and to governments as they strive to keep, or gain a foothold, in the global competition for resources and wealth. Notions of what constitutes technological literacy range from literacies around being able to use technologies and literacies needed to design new kinds of technologies. The AAUW (2000) report makes this central tension between literacies a focal point:

A common alternative to computer science courses—and a common point of entry for girls into the computer world – has been courses on computer "tools," such as
databases, page layout programs, graphics, online publishing, and other
“productivity software.” The commission believes that while mastery of these tools
may be useful, it is not the same thing as true technological literacy. (p. x)

For the AAUW, the problem is creating a space for girls and women to achieve an
advanced and “real” technological literacy, one that would enable them to become creators.
The NSF’s (2007) concern is broader, in that literacies fostered on an individual level are
the building blocks of a technologically literate society:

One of the National Science Foundation’s (NSF) key strategic goals is to cultivate a
world-class, broadly inclusive science and engineering workforce, and expand the
scientific literacy of all citizens. Investments are directed at programs that
strengthen scientific and engineering (S&E) research potential and education
programs at all levels. These outcomes are essential to the U.S. as we progress
toward an increasingly technological job market and a scientifically complex society.
(p. 5)

The digital divide is the barrier to full technological literacy and the digital divide
and technological literacy are together significant because they are the gateway to
technology’s power. In the g/t story, access to this power is both the problem and the goal.

This plays out for individuals as well as countries, as this UNESCO (Primo, 2003) passage
illustrates:

Women’s capacity to exploit the potential of the new information and
communication technologies as tools for empowerment is constrained in different
ways in different regions...In regions with low teledensity, basic socio-structural
obstacles mean that the vast majority of women and men are effectively excluded
from the emerging Information Society. Yet in many cases these overall constraints
are filtered through specific gender-based determinants that cause women to be
particularly disadvantaged. (p. 10)

Focused on computer games, Cassell and Jenkins (1998, 1999a) both highlight and merge
the problems of literacy, access, and power:

The problem in the differential attraction to computer games stems from the fact
that here, as is often the case, the cultural constructions of gender are not separate
from those of power. It is not just that girls seem to like today’s computer games less than boys do, but that these differential preferences are associated with differential access to technological fields as the children grow older, and this differential access threatens to worsen as technological literacy increasingly becomes a general precondition for employment. (p. 11)

Power, transmitted or enforced by social structures, motivated Turkle and Papert’s (1991) research in Epistemological Pluralism:

*With this assertion we find ourselves at the meeting point of three epistemological challenges to the hegemony of the abstract, formal, and logical as the privileged canon in scientific thought....the canonical style, abstract and rule-driven, is associated with power and elitism, and with the social construction of science and objectivity as male. (para. 2)*

**Globalization & social change.** Concerns over access, literacy, and power are driven by desires to keep up in a world economy seemingly ever more dependent on technology and technologically skilled workers. At stake are both the individual’s ability to sustain her/himself in this technological world and a society’s self-interest that cannot be separated from the ways it supports or uses its citizens and workers. Some stakeholders are less concerned with jobs and instead foreground the potential of technology to foster—or at least support—social change. This notion is also evident in Epistemological Pluralism:

*We find that, besides being a lens through which personal styles can be seen, it is also a privileged medium for the growth of alternative voices in dealing with the world of formal systems....As a carrier for pluralistic ideas, the computer holds the promise of catalyzing change, not only within computation but in our culture at large. (1991)*

UNESCO’s (Primo, 2003) gender-ICT agenda is driven by this desire for social change and for fostering an international ethic of equity, harnessed through technological opportunities.
In regions with low teledensity, basic socio-structural obstacles mean that the vast majority of women and men are effectively excluded from the emerging Information Society. (p. 18-19)

Thus, literacy and access to technologies are the means of overcoming social and structural barriers within particular communities and across the globe. Access to technology means access to information, and information means not only having power but is the resource for acquiring power. This meta level concern meets at the intersection of globalization and desires for social transformation.

**Inadequate research or theory.** Another meta concern highlighted in the overarching g/t story is that research methods are found lacking in scientific rigor. A growing concern is that inadequate research methods are themselves causal factors in girls and women’s continuing underrepresentation. The problem is that insufficient methods are thought to deliver unreliable predictions and interventions, as Cohoon and Aspray (2006a) argue:

> Our review of the literature on women in postsecondary computer science leads us to the conclusion that two conditions contribute to the persistence of women’s underrepresentation. The first condition is an inadequate understanding of the underlying and immediate causes. Much of what has been published is based on personal experience or observation of a single case, rather than being grounded in empirical evidence that can be generalized. (p. 137)

Problematic methods suggest that theory-building is stymied. Cohoon and Aspray elaborate as follows:

> Potential influences on the gender composition of computing are seldom discussed in relation to any theoretical perspective....None of the studies we located were designed to test a particular theory. Still, movement toward more explicit consideration of theory might help advance empirical investigation of this issue. (p. 138-139)
The set of meta level concerns I have identified all meet in this problem of theory. For example, the NSF (2007) document highlights how good theory is essential in shaping testable and predictive hypotheses:

All research proposals should...include a discussion of the theory or theories grounding the research and outline testable hypotheses. Strong research designs will produce rigorous, cumulative, reproducible, and usable findings. (sec. C)

Conclusion

The g/t story, told as a progression of hunches about the factors that cause the gender gap in computing, is also a manifestation of what is communally believed to constitute a credible, researchable problem. I have identified eight meta concerns that the g/t story is explicitly concerned with: (a) quantity, (b) difference, (c) deficits, (d) identity construction, (e) digital divide issues, (f) literacies and power, (g) globalization and social transformation, and (h) inadequate research methods or theories. These are evident in policy papers, institutional reports, and the media. I have highlighted only a few examples, but the story derives its presence, stability, and authority from the multitudes of similarly grounded micro studies and reports available.

While these eight meta-level concerns are not the only way the g/t story could be characterized, these do represent the overarching concerns of the story as it has evolved since the early 1980s and that remain active concerns today, in some form. It is however, hard to separate these concerns into discrete units—each seems to rely heavily on others; separated from these other problems, a single problem would make little sense. This alone suggests some limitations in a research agenda built upon isolating causal variables.
These problems have generated sufficient concern to spawn what might now be described as a g/t research industry aimed at locating promising interventions. I am not out to evaluate these interventions, though it is generally acknowledged that most have produced little, if any, change in the numbers. The general, driving assumption has been that more explicitly defining and characterizing the g/t relationship and the constructs of gender and technology will bring some resolution. In articulating and supporting this narrative of a gender problem and the possibility of resolution, the macro g/t story has come to function as a kind of narrative social truth yet this “truth” of the story is not open to question, because the story itself seems so solid. Recursive and reductivist approaches make it more so. In some very important ways, this g/t story is functioning in ways analogous to a modern meta-narrative.23

The questions I pursue grapple with exactly this dilemma. That is, a meta-story of g/t either makes it seem like there are not other significant stories, or it effectively negates the possibility of other stories, voices, or lenses. This is not unlike Marco Polo’s subtractive exercise:

“I have also thought of a model city from which I deduce all the others,”... “It is a city made only of exceptions, exclusions, incongruities, contradictions...So I have only to subtract exceptions from my model, and in whatever direction I proceed, I will arrive at one of the cities which, always as an exception, exist.” (Calvino, 1972, 1974, p. 69, quoted in italics in orig.)

The question, in essence, is whether the mainstream g/t story warrants its narrative and conceptual dominance.

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23 Although I state that we ought to recognize the meta-narrative aspects of the g/t story, I am not also claiming that it is such a narrative.
Facet 4

The G/T Story as Meta-narrative

Over the course of this chapter, I will show how the g/t story is constituted through rules and practices of scientific discourse and associated research methodologies. I identify four sets of such rules and practices, which I describe as: (a) techniques for stabilizing objects, (b) discourse and a stealth technological determinism, (c) suppressing ambiguity, and (d) prescribing (good) knowledge. These rules and practices construct and enable the g/t story to function in ways analogous to a meta-narrative. The meta-narrative is in part a product of the way in which the story and its constructs are conceived in and through normalized linguistic practices of mainstream science. The question is not whether the g/t story is a meta-narrative—rather, of significance is how it comes to function as such a story. This functioning meta-narrative is the target of my third faceting.

A meta-narrative is understood, following Lyotard (1979, 1984), to be a grand, cultural-political narrative that presumes a universalizing perspective about the nature of knowledge and knowing. Such knowledge is self-legitimizing in that it takes its validation from appealing to Enlightenment meta-values of universal truth and justification. A meta-narrative, in offering a grand explanation, also tends to be durable. For example, Lyotard characterizes science and the stories that science self-generates about itself as such an Enlightenment meta-narrative:

[Science] produces a discourse of legitimation with respect to its own status...making an explicit appeal to some grand narrative, such as the dialectics of Spirit, the hermeneutics of meaning, the emancipation of the rational or working subject, or the creation of wealth ... This is the Enlightenment narrative, in which the hero of knowledge works toward a good ethico-political end. (p. C-6. xi-xxiv)
The way in which the g/t story is represented, circulated, and examined presupposes a
similar kind of narrative truth of a problem in need of some kind of heroic science to
provide an ethico-cognitive-political solution.

The g/t story has acquired the status of an Enlightenment meta-narrative in part, by
our insistence on framing the story through universalizing ideas about the nature of
knowledge, science, gender, women, men, technology, and equity, as well as a set of
assumptions about the stability of the story itself. If there is even a possibility that these
concepts have over-universalized, it is worth spending some time to consider whether these,
as Foucault (1972) puts it, are indeed as continuous, stable, and foundational as the story
represents them to be. That is, it is important to consider how rules and practices
transparently embed beliefs about what constitutes good scientific knowledge or “good
ethico-political end[s]” of this knowledge (Lyotard, 1979, 1984, p. xxiv). At stake are not
only the warrants behind assumptions of universalizing concepts but also, their usefulness;
to be examined is the ways in which they shape analyses and narratives about the g/t
relationship and problem. In short, how has a discourse of science helped to constitute the
subjects or objects of the g/t story over the past thirty years?

In *Archaeology of Knowledge* (1972), Foucault laid out a methodological position
from which to interrogate the rules and practices of discourse and showed how ideas about
the origin and stability of social phenomena are constituted and constituting. The g/t story
has escaped such analysis such that assumptions, rules, and practices that construct the g/t
story remain transparent. That is, there are a set of practices and ideas now so
commonplace that they are invisible actors in how we think about the story and its
components. My aim in this chapter is first to consider how rules and practices function as techniques for stabilizing the objects and constructs of the g/t story. Second, I examine how discursive practices support a stealth technological determinism despite surface level dismissals of such determinist thinking. The problem of a suppressed ambiguity is my third concern, which leads to the fourth, an examination of how these rules and practices prescribe what is “good” scientific knowledge, conceived as holding an unambiguous clarity.

It has seemed as though the g/t problem is about a straightforward dilemma of coming to terms with a set of problems (the eight meta-level problems I discussed in Chapter 3). However, there is reason to consider how thinking about the story only in this way (e.g. through these rules and practices) masks a broader set of assumptions that mask how the problems and constructs thought to adequately characterize the g/t relationship are themselves contributing to the problem as it has been laid out. That is, on the table is whether “reflexive categories, principles of classification, normative rules, institutionalize[d] types” function as if “they are ... intrinsic, autochthonous, and universally recognizable characteristics” (Foucault, 1972, p. 22). In order to consider this possibility, I chisel away at representative examples from the g/t story.

Techniques for Stabilizing Objects for Scientific Investigation

The g/t story’s power as a meta-narrative rests in part on the way in which it constitutes what are in fact dynamic and processual phenomena as if they are stable objects available for examining. Foucault (1972) describes this, in part, as a problem of assumed
unities that come to refer to and encompass individuals and their situations through practices of examination and representation—what he terms the disciplining sciences.

In the g/t story, there are many objects (e.g. women, girls, men, boys, masculinity, femininity, technology, equality, a digital divide, and knowledge) portrayed and positioned across statements, examples, and different kinds of sources that are used to infer a set of unified, stable, and durable objects and subjects. These unities are sustained by relying on “ready-made syntheses” and what we presume are “facts of discourse” such as Foucault’s aforementioned “reflexive categories, principles of classification, normative rules, institutionalized types.” (1972, p. 22). These rules and practices are the conventions (linguistic, discursive, and methodological) through which the g/t story, gender, and technology are rendered into concrete objects for investigation. The “gender gap” exemplifies this type of stabilized object, illustrated as follows:

For more than a decade, academics and technology executives have been frowning at the widening gender gap in computer science. (Mintz, 2007, p. 24)

The gender gap is discursively stabilized into a scientific object that is conceptually persistent over time. The size of the gap may fluctuate but what is significant is that the gap itself is construed as a stable and enduring object of analysis.

In another example, Camp, in The Incredible Shrinking Pipeline (1997) merges many kinds of women, at many different life stages, into a similarly singular and stable object:

Since the number of women at the bachelor’s level affects the number of women at levels higher in the pipeline and in the job market, these facts are of great concern. (p. 104)
There are potentially very different women and interests represented here, but within this well-cited article, the major issue is taken to be how the numbers at one level of the pipeline affect the numbers in subsequent levels. Grouping women into a stable, identifiable object facilitates this argument. Similarly, Mintz’s Associated Press article depends on similarly durable objects, as follows:

The level of confidence expressed by the participants in the questionnaire about debugging, however, played a much different role for the genders. (para. 15)

Distinguishing between genders relies on practices of neat stabilization, essentialization, and classification.

The problem to unpack is how gender becomes an “it” and how it is rendered into a stable and locatable object. In the following passage, from UNESCO’s Gender Issues in the Information Society (Primo, 2003) there are many stabilized and essentialized objects:

Given the potential of ICTs in development and social transformation, it is essential that we address the gender digital divide. The aim is both to ensure women’s access to the benefits of ICTs, and to make ICTs into a central tool in women’s empowerment and the promotion of gender equality. (p. 15)

Objects identified in the passage are ICTs, equality, and the gender digital divide. These objects are all fixed through their positioning into nouns (rather than practices) and thus are made available as objects of scientific investigation. Further, these objects are rendered easily categorizable, well suited for systems of classification that try to reduce ambiguities in trying to make sense of the experience of everyday life (Bowker & Star, 2000).

Nominalization, essentialization, and classification are common techniques for stabilizing objects into forms suitable for scientific examination. These techniques have stabilized, for
example, the “problem” of g/t, underrepresentation, gender, girls’ interests, or computing culture. In the next sections I more fully develop these three techniques.

**Nominalization practices.** Halliday and Martin (1993) go to some length in describing how nominalizations function in scientific writing. They argue that nominalization is the means by which scientific reasoning—the process of building knowledge—is elaborated and explained. A nominalized phrase turns a verb into a noun and thus serves to sum up and carry forward previously accumulated knowledge. Nominalization renders processes of knowledge making and the objects of knowledge static as well as passive. It is the way scientific argumentation has been practiced since Newton and facilitates the reporting and publishing of scientific research. The practice is not without controversy, as a 2008 debate between several critical discourse analysis (CDA) scholars in *Discourse and Society* (2008, Vol. 9:6) makes evident.24

Billig (2008) argues that CDA scholars, in trying to unmask nominalizations, themselves problematically engage in this same nominalizing enterprise in their own critical scholarship and writing. The paradox he pursues is that CDA scholars “investigate language, yet at the same time...use language in order to make our investigations. We have no separate tools to pursue our tasks. Discourse analysis does not, and cannot, exist outside of language” (p. 783). His argument is that CDA scholars need to become more self-reflexive in their language constructions and to refine their writing styles to better serve their critical position. What Billig helps brings to the foreground is the pervasiveness of

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24 The prominent scholars included are: Michael Billig, Teun A. Van Dijk, Norman Fairclough, and J.R. Martin
nominalization and the difficulty of thinking outside long-standing practices and conventions. That is to say, nominalization is not necessarily intentionally used as a strategy. Nonetheless, explicating nominalizations helps to illuminate the ways in which discursive conventions transparently promote ideologies through everyday or scientific discourses. One concern is that such practices become so transparent and pervasive that they infuse social discourse to become a kind of ideology or narrative.

Van Dijk (2008) disagrees with Billig’s analysis of nominalization with a counter argument that the contexts within which nominalization occurs are what ought to be of concern, not the writing practices of CDA scholars. In Van Dijk’s view the real concern is who does the nominalizing and with what kinds of motivation; the issue of CDA researchers’ writing styles is largely peripheral and only points to a need for greater reflexivity in writing. For Van Dijk, the import of identifying nominalization is that it locates “the details of discursive domination...by specific elite authors, and in specific contexts—that may be used to express and convey a distorted view of social events, namely the obfuscation of the problematic role of powerful actors in society” (p. 822). Contextual analysis makes evident that nominalization can be used as more than a grammatical convention. That is, in some contexts and practices nominalization “is especially problematic because it may influence the way citizens represent social events” (p. 822). When CDA scholars identify nominalization, their intention is “that citizens get the best possible information from the symbolic elites” (p. 822).
What this debate highlights is that nominalizations are on the one hand common practices and on the other hand, they indicate circles and contexts of influence by those doing the nominalizing. Thus, they are analytically significant. Van Dijk's concern is quite specific, which he states as follows:

A critical analysis should examine not only the syntactic structures of text or talk, but also its contexts, such as the relations between a right-wing newspaper and a political right that defends an ideology of law and order...analyses of the abuse of nominalizations should be based not on single examples, but should be shown to be a systematic practice. (p. 824)

Fowler is cited by Billig (2008) as a seminal scholar who brought nominalization and its partner, passivization to the foreground, building upon Halliday's earlier work. Fowler showed that “nominalization ‘turn[s] verbs into nouns’ (Fowler et al., 1979: 14)...[in] a ‘process of syntactic reduction’...and 'is a transformation which reduces a whole clause to its nucleus, the verb, and turns that into a noun”’ (Billig, p. 785). Concerns over nominalization are four-fold: it eliminates agency; reifies concepts; posits reified concepts as agents; and sustains unequal power relations (p. 785). Ideas abound as to what nominalizations accomplish. Through nominalization practices, “nominalized forms become the subjects of active sentences, appearing as the agents who do things. This is reified language: things and abstract entities, not people, perform actions.... Nominalization is presented as the actor that transforms processes into objects” (p. 793).

Within CDA, nominalizations are a critical target when an analyst is intent on showing how a political, journalistic, or media discourse promotes the passification of a marginalized group, in turn supporting a standing elite or hegemonic system. Nominalizing practices within the g/t story may not be as charged as CDA accounts of police action or
media distortion. Nonetheless, the ways in which groups and subjects are rendered into stable and passive objects—to be examined by benign yet invisible agents—is significant in that nominalization contributes to the g/t story’s allure as an encompassing narrative. It is the technique through which key constructs and relationships in the story are rendered static and passive (e.g. gender, technology, knowledge, and culture).

For the purposes of my thesis, it is not necessary to become sidetracked by a finely tuned debate about or analysis of nominalization. Sufficient is Billig’s (2008) characterization of five kinds of nominalizing processes: (a) linguistic nominalization, (b) etymological nominalization, (c) psychological nominalization, (d) between-text nominalization, and (e) within-text nominalization (p. 787-88). My analysis does not draw such a fine distinction, as I am more interested in broadly illuminating the pervasiveness of nominalization practices that provide seemingly static and passive objects for the g/t meta story.

In looking again at the opening quote of Mintz’s (2007) article, “For more than a decade, academics and technology executives have been frowning at the widening gender gap in computer science,” nominalization facilitates representing the gender gap as an object of investigation that precedes this particular article (para. 1). The grammar of the statement makes it possible to portray, without much explication, the idea that this gender gap is long-standing and ongoing. This gap is something we already know. The other purpose of nominalizing is to render the object of investigation stable as an object of scientific examination, by preparing it through the language of science, as Halliday and Martin (1993) explain:
The second reason for nominalizing has to do with the structure of scientific knowledge. While the argument has to be dynamic...the edifice that is constructed by it is a static one—or let us say that it embodies a synoptic rather than a dynamic representation of reality. Newtonian science has to hold the world still, to anaesthetize it so to speak, while dissecting it—if you are trying to understand something, then in the early stages of your inquiry it is helpful if it does not change while you are examining it. (p. 131-132)

The gender gap thus becomes an object of science, in part, through its representation in language. Language construes our human experience and shapes how we comprehend and reconcile external, in the world, and internal experiences (Halliday & Martin). The gender gap is linguistically shaped to be the problem of the g/t story—both are nominalized phrases—and both are built from this linguistic convention. The NSF (2007) prospectus also builds from this same set of nominalizing conventions:

**Research projects: investigate factors behind the underrepresentation** of girls and women in STEM education; societal, formal and informal educational systems' interaction with individuals that encourage or discourage interest and persistence in study or careers in certain STEM fields. (para. 41 bold in original)

In this short paragraph, multiple relationships and practices have been turned into stable nouns: “the underrepresentation of girls and women,” “STEM education,” “societal, formal, and informal educational systems' interaction,” “interest,” “persistence,” and “study.” Nominalizing confers a technical stability onto otherwise dynamic phenomena so that “they take on the semantic flavor of objects, on the model of the abstract objects of a technical taxonomy like radiation, equation, and mass” (Halliday & Martin, 1993, p. 15).

While this grammar construction has made it possible for scientific knowledge (in the Newtonian tradition) to proceed, this language of science has infiltrated everyday constructions. The problem, as Halliday puts it, is that nominalization “holds reality still,
to be kept under observation and experimented with; and in so doing, interprets it not as changing with time” (Halliday & Martin, 1993, p. 15).

The g/t story is not only fixed, it is also shaped into a form ready for experimental investigation. It can be dissected and taxonomized. The problem—this stabilized object—acquires an authority and presence; there is no arguing with a noun so there is no arguing with the story (Halliday & Martin, 1993).

Summarizing her essay, *Computational Reticence*, Turkle (1988) wrote: “This essay looks at the social construction of the computer as a male domain” (p. 41). “Social construction” has been nominalized, thus rendering a social process into a fixed entity where the computer is linguistically constituted into a stable male domain (e.g. Hacking 1999). Rendered into objects, neither the domain (computing), nor its construction, is contestable. Through such stabilizing practices, scientific, linguistic formations make elements of the g/t story available as objects of investigation.

The practice is evident in the NSF funding prospectus (2007) as it articulates a research agenda and the dissemination of STEM research. As it lays out these goals, knowing is conceptualized into the stable object “research knowledge”:

To integrate various findings about gender in science and engineering into a unified program of change or to facilitate the interpretation of research knowledge into practice. (Sec. B)

Processes of knowing are nominalized as both a goal and product and the emphasis is put wholly on knowledge, thus fixing into a concrete form products of the act of knowing. This discursive practice reflects both a disposition towards empirical science and the fact that gender (or race, class, and disability) has long been nominalized. Both the object and what
is known about that object and its condition are fixed, a practice that allows knowledge of
the object or problem to be widely disseminated.

Nominalization supports other discursive practices that allow linguistic biasing
devices to embed themselves in the descriptive language of the g/t story. For example,
computer gaming became the center of much gender-focused concern; this quote from
Cassell and Jenkins (1998, 1999a) is a representative example:

The problem in the **differential attraction** to computer games stems from the fact
that here, as is often the case, the **cultural constructions** of **gender** are not separate
from those of **power**. It is not just that girls seem to like today’s computer games
less than boys do, but that these **differential preferences** are associated with
**differential access** to technological fields as the children grow older, and this
differential access threatens to worsen as **technological literacy** increasingly
becomes a general precondition for employment. (p. 11)

The bold-face nominalized phrases (my addition) highlight the number of practices and
conditions that have been frozen into objects: **difference**, **attraction**, **cultural constructions**,
**gender**, **power**, **access**, **preferences**, and **literacy**. I do not mean to infer that the authors intend
or believe that gender, culture, and power are actually stable objects. Rather, my point is to
show how linguistic practices confer a fixedness to concepts and practices that subverts
these authors’ socio-political interests in challenging other conventions of the g/t story.
Rendering practices into objects functions as a linguistic limitation on the capacity of an
agent to counteract inferred structural limitations. As Halliday and Martin (1993) said, it is
hard to contest a noun.

**Essentializing practices.** Nominalization is also a key linguistic practice that
facilitates the essentialization of women, girls, boys, and men. Gender, constituted as an
object, precedes essentialized characterizations of women and girls or men and boys. The
problem—seemingly girls’ lesser interest in computer games—is wholly dependent on a deep essentialization of boys and men who are all grouped into a class that loves computers and video games. The g/t story is represented as a story of girls’ underrepresentation in computing, but it also constitutes all boys and men into an opposite position and group fully engaged and represented in technology. In this way, concerns over gender are largely framed around an essentialized male and masculinity. This idea crystallizes in Turkle’s *Computational Reticence* where “the computer becomes a personal and cultural symbol of what a woman is not” (1988, p. 14). In a mere fourteen words women and men have been essentialized by and in relation to the computer—woman explicitly, man by holding the default position.

Highlighting difference is also a means of essentializing. For example, Cohoon and Aspray (2006a) state: “We have also glossed over the issue of differences among women. For example, we know that minority women’s representation in computing differs from white women’s” (p. 142). While claiming to make room for multiple differences, the essentialization of women simply gets more specifically located, in this case as minority or white. This tendency towards essentialization feeds the ways that computer culture is described and explained. For example, in the AAUW (2000) report, researchers lay out two different computer cultures, one that reflects boys’ interests and a second that reflects girls’:

Girls describe gender differences most vividly in relation to the Internet and computer games....They tend to represent the Internet as a vice in the hands of boys, and a virtue in the hands of girls, because boys use it to play games and “fool around” while girls use it as a source of information. (p. 8)

Girls approach the computer as a “tool” useful primarily for what it can do; boys more often view the computer as a “toy” and/or an extension of the self....For boys,
the computer is inherently interesting. Girls are interested in its instrumental possibilities, which may include its use as an artistic medium. (p. 9)

Just as girls and boys, men and women are classified, so too are their computing cultures.

**Classification practices.** Nominalization, essentialization, and classification are techniques of representation that denote objects. However, there is more that representations accomplish. The following statement, made by Hawkins in 1985, uses difference, classification, and nominalization to great effect:

> It is a common concern that all children have equal opportunity and appropriate support for acquiring competence with the technology. These concerns derive from (1) the belief that, because many careers will require competence with computers, knowledge of information technology will be a source of power in the future; and (2) the fact that current differences among groups of people in their access to bodies of information may be exacerbated by unequal opportunities for learning about technology. Two important dimensions of difference are social class and sex. With respect to the latter—if current projections are accurate—girls are likely to learn less about and have less ability to control this increasingly important cultural tool.(p. 165-166)

In this passage, somewhat vague differences in social class and sex are not only determinant, they are taken to be predictive. Being able to classify groups is the means of predicting and cataloguing difference. The AAUW (2000) also articulates girls’ perceptions of computing as a tool to contrast these with boys’ interests in computers as toys. Hawkins however, seems to have little concern with a toy conception; the real issue for her is the tool and the power it represents. Classifying objects is also a way of neatly locating sites of power or its lack, even if an injustice is not explicit or overt. As the AAUW report notes “Girls...almost never report overt discrimination” (p. 7). In a sense, this is true of the g/t story as a whole—much of what this story does is not overt. Rather, it is a story whose surface intentions of equity and opening up a culture are organized into a seamless story of
a g/t problem that is made so through practices of nominalization, essentializing, and classification.

Essentialization, along with nominalization, positions actors as objects of scientific investigation and these practices facilitate classifying these actors or objects through a set of defining characteristics and attributes that may be isolated for further examination. The impetus to identify and separate these characteristics is quite strong. Descriptive techniques become increasingly sophisticated ways of organizing and classifying objects. Classification is such a commonplace practice that we accept premises such as those made in the following passage:

Socially projected stereotypes about who should be scientists and engineers pose artificial limits on the participation of talented students. Gender is only one of the characteristics that shape personal and group identity. Other characteristics such as race, ethnicity, economic status, religion, and disability also bear on whether students are encouraged, neglected, or discouraged from developing certain skills and ambitions. (National Science Foundation, 2007sec. A6)

On the one hand, we can find much to appreciate in this statement that wants to open science to a more diverse group. However, it might also be argued that this passage also relies quite heavily on a widely cast net of difference that inferentially includes as a kind of category, a quite disparate array of “identity” constructs. Because the category is so ill-defined it remains fuzzy as to how such categorization will translate to a more diverse group of scientists. Perhaps it helps discern ever more ways of documenting differences. The passage itself accomplishes such an objective and points to two concerns. First, there is no such thing as “innocent” classification—the practice actively constructs boundaries that may be too broad and at the same time, overly circumscribed, thus becoming self-reifying.
Second, the line between promoting equity and standing in the way of socio-political transformation is gray; what one construction provides, another may take away.

Bowker and Star (2000), discuss the ways classification is a means of excluding groups. One problem with essentialization and classification practices is that they create an assumption that categorizing is beneficial or necessary to the welfare of those being categorized. The taken-for-granted assumption, often, is that categories are both useful and benign descriptors. Glossed over are the ways in which such practices and techniques often become tools of exclusion. Essentialization and classification tend to infer that relying on some innate characteristic of an individual or group is adequate to the descriptive task at hand, yet these same practices are often not attentive enough to the ways in which aims of social justice may be sideswiped by well-intentioned projects framed around classificatory and essentializing narratives. Once marked as a category, it is quite difficult to be not of that category. For example, Cassell and Jenkins note that it is often difficult to sell a group on the idea that it is okay for women to be computer experts, because they are not commonly seen as such. Moreover, there are beliefs about sex roles and gender that often have strong cultural, experiential, or religious roots and merely identifying inequity or the characteristics of girls and women is rarely sufficient. In another example, focused on race, Reardon’s *Race to the Finish* (2005) explicates the ways in which the human genome project, despite lead scientists’ intentions towards social justice, was taken by others to open too many possibilities for extending colonializing practices or enabling new classificatory barriers to be put in place. Categorization has both positive and negative effects.
A Stealth Technological Determinism

There are probably few researchers, policy makers, media pundits, or even technologists, who believe in an uncomplicated technological determinism. However, an examination of the language used to tell the g/t story reveals a tendency to drift into such territory. The following statement is one such example:

Along with technology’s power come responsibilities to determine what computing is used for and how it is used. These concerns may not be on the minds of adolescent boys who get turned on to computing at an early age and go on to become the world’s computer wizards. (Margolis & Fisher, 2002, p. 3)

The second sentence is, by now, recognizable for its essentialization of boys into a predictable and narrowly conceptualized category of carefree players simply passionate about technology for its own sake. In the first sentence, however, technology and power have both been nominalized and linked as one object. There seems to be no particular subject or agent associated with this technological power or responsible for shaping either technology or its power. Moreover, the g/t story tells us that such concerns are most certainly not on the minds of the future wizards portrayed. This is not to say that these authors are making a case for technological determinism, but that the notion is embedded through language practices used in telling the story. These practices in effect leave out any responsible agent or subject, thus deferring to an agentless technology in charge. In another example, from TechSavvy (AAUW, 2000) a similar practice is visible:

In this report, we use the terms “computer culture” or “e-culture” to refer not only to the computer that does things for us but to the computer that does things to us as people, to our ways of relating to others and our ways of seeing the world.25 (p. 7)

25 (AAUW, 2000, p. 7) The authors cite Turkle’s The Second Self and Life on the Screen as the source of this distinction.
The computer does things to or for us, and thus, seems to hold a great deal of power; it is positioned to do this without any particular human input and agency. This may sound silly on the surface, but there is an implicit message about technological power embedded in these kinds of statements. An ominous sense of impending disaster is injected into the g/t story when human intentionality and agency are linguistically sidelined by a technological determinism. In the above quote, the computer is the agent that does things. The hardware and software engineers and designers are nowhere in sight; it is the “culture” of computing and the computer that does these things. Language practices portray an independent, agential computer, one that seemingly wields a great deal of power.

The link between technology and power is solidified when written through this kind of determinist language, as, for example, Cockburn put it: “Technology is a medium of power” (cited in Wajcman, 2004, p. 10). This notion pervades the g/t story. This example from UNESCO’s (Primo, 2003) report is a common version:

While ICTs and the Internet offer vast, new and unprecedented opportunities for human development and empowerment in areas ranging from education and the environment to healthcare and business, they are also one of the key contributing factors to social and economic disparities across different social and economic groups. The gender divide is one of the most significant inequalities to be amplified by the digital revolution, and cuts across all social and income groups. (p. 3)

The power that makes change (or continued oppression) possible is linguistically held by technologies (ICTs, the Internet), not by people, their policies, or governments. The gender divide is a product of these technologies so that in the power positions articulated in this passage there is no human agent. This is, at the least, an artifact of a technological determinism that positions power wholly within technology.
Turkle’s work prefaced many ideas subsequently taken up in the g/t story. Among these are the kinds of power and capabilities held by the computer, as she states in her introduction to *The Second Self* (1984):

> Technology catalyzes changes not only in what we do but in how we think. It changes people’s awareness of themselves, of one another, of their relationship with the world.

> Most considerations of the computer describe it as rational, uniform, constrained by logic. I look at the computer in a different light, not in terms of its nature as an “analytical engine,” but in terms of its “second nature” as an evocative object, an object that fascinates, disturbs equanimity, and precipitates thought. (p. 13)

The issue I want to raise here is not (yet) about the meaning of these changes or the role of the computer, but that technology is represented as a catalyzing force and an object. The machine precipitates the changing perceptions people have of themselves, to each other, and to the world, but it does this as both a force and as an independent and stable object. Technology is given a great deal of power when it is linguistically unattached to any human agent.

**Suppressing Ambiguity**

STEM fields are differentiated from other fields and feminist critiques of these fields as male sites of power and privilege are stronger to the extent that they eliminate ambiguity. Such constructions, along with essentializing and nominalizing, rely upon oppositional positions for clearly articulated arguments to take hold. The stronger the binary construction, the less ambiguity there is to cloud (or weaken) an argument. The
familiar binary is between men-women and girls-boys and this is evident in the way

Margolis and Fisher (2002) rely on the notion of “contrast” in the following quote:

For many male students, in contrast, the decision to major in computer science barely reaches the level of conscious consideration; it is a natural extension of their lifelong passion for computing. (p. 50)

Most women take a large number of factors into account: five of the seven categories we tabulated were mentioned by at least 30 percent of the women. In contrast, the only motivation listed by at least 30 percent of the men (in fact, by 70 percent) is the enjoyment of computing. (p. 51)

Again, I am not aiming to discredit these findings, but to highlight the rhetorical emphasis on contrasting positions that insist on a clear m-f separation. Any ambiguity would belie the essentialized male at the center of the g/t story.

As the g/t story progresses from the 1980s to the present, increasing attention is paid towards de-essentializing the m-f binary when talking about girls and boys or women and men, as Margolis and Fisher (2002) try to do in this quote:

It is all too easy to fall into thinking that “women are this way and men are that way” —to simplify the categories and underplay all the contradictions and differences within each individual and within each gender. (p. 9)

However, they reconstitute this binary in the next sentence: “At the same time, it is misleading to see women as sharing no unifying experiences” (p. 9). Two things may be going on here: (a) a discomfort with the ambiguities that the first statement opens up and, (b) an overt effort to paint women as complex and yet, still maintain a coherent binary by not eliminating a core difference.

While the m-f binary is often thought to be the primary locus of concern, there are additional binaries in play that remain stable across the story. For example, somewhat later in their text, Margolis and Fisher (2002) state that the computer is “a medium that
supports a powerful sense of mastery” (p. 42). To support this, they turn to a statement made by Turkle in The Second Self (1984) as she portrays the constraints of computer games as “those imposed by rule systems” (cited in Margolis & Fisher, p. 42). Turkle’s support for her thesis, re-emphasized by Margolis and Fisher, is Chodorow’s Freudian explanation of boys’ needs for separation from the mother that leaves them in a tumultuous state and seeking structure in a rule driven world (p. 42).

Importantly, there are inherent contradictions in how these arguments unfold and thus there is room to consider how seemingly incommensurable binaries make it quite difficult to conceptually navigate competing positions of difference. For example, after relying on Chodorow and Turkle’s rule driven binary, Margolis and Fisher (2002) immediately shift to Jenkins’ portrayal of computer games as “undefined open spaces” (albeit virtual) that support boy’s high risk, adventurous play styles that challenge (in a productive way) uniquely “male fears and anxieties” (1998, p. 43). Thus, although masculinity is at the core of their statements, I wonder if there are two somewhat incommensurable “accusations” made about the games and masculinity. On the one hand, boys are driven by a need for serious rules; yet, on the other, boys are driven by a desire for the high-risk adventure that games provide—“an untamed world for people who refuse to bow before the pressures of the civilizing process” (Jenkins, 1998, p. 279, cited in Margolis & Fisher, 2002, p. 43).²⁶

²⁶ I see this contradiction to be – at least in part – an outcome of a methodological need to unfold specific, separable characteristics or variables (I discuss this more fully later in the chapter). The focus has been on identifying a set of qualities that could function as descriptors of women, men, games, and computers as ‘researchable’ qualities and
Flanagan (2002) has a wholly different critique of these games, but one that is also dependent on a binary that eliminates ambiguity. She is an artist-scholar known for her criticisms of a masculinized computer gaming industry and she has made a mark by creating computer games meant to empower girls. In her 2002 book *Reload*, she states:

The layout of most 3-D software packages and virtual world-making software reinforces a reading of these products as useful, practical, and unbiased or objective....Through the simultaneity and variety of perspectives, however, the software packages used to create these virtual worlds and characters evoke complete omniscience rather than multiplicity, fostering instead an “old school,” white, masculinist epistemological model. Virtual environments are entirely mathematically based constructions that create the sense of a cohesive, seamless, scientific system, and a unified order of knowledge; 3-D graphics generation is a science perhaps even more than an art. (p. 427-428)

The usual concern in the g/t story, and the framing concept in this passage, is the gender binary, but these are not the only contrasts in play. Other, taken-for-granted binaries ground Flanagan’s argument. Her thesis that the 3-D software environment and the virtual worlds these produce are beholden to an objectivist, masculinist epistemology is seemingly dependent on a view that mathematics and science reflect an equally objectivist, masculinist epistemology. She views these as “a cohesive, seamless, scientific system, and a unified order of knowledge” (p. 427). One problem is that the notion of mathematics and science that she relies on has been seriously contested. For example, Lakatos elaborated that such formalist, objectivist notions of mathematics are a legacy of logical positivism but that this methodological position has little relation to the actual work of mathematicians

characteristics. This thinking makes it difficult to consider overlapping boundaries or incongruities.
Throughout her framework, Flanagan (2002) articulates strong binaries of science and art. As I read her essay, Flanagan is trying to counter what she sees as a masculinist, epistemological limitation within 3D software environments, interactions, and games while also aiming to show examples of women artists’ resistance to these limitations. The problem is that her reliance on these binary oppositions becomes a large limitation of her argument. She tries to articulate a position of resistance to a set of binaries (of mathematics, reason, science, and masculinity that are oppositional to intuition, art, contexts, and the feminine) that she also reifies in her argument. Thus, what she tries to promote in a visual medium, she negates in language as she reduces the possibility of ambiguity.

Lakoff & Núñez, in Where Mathematics Comes From: How the Embodied Mind Brings Mathematics into Being (New York: Basic Books, 2000) argue that mathematics is a product of human ideas that arise from embodied, human experience. Bertram (Chip) Bruce suggests these others as well: “Feyerabend’s Against Method, (that science proceeds on the basis of sociocultural, political, and economic factors rather than any consistent method (thus challenging Kuhn, whose paradigm shifting model still holds to a rationality); Keller’s critiques of math practice as hierarchic/patriarchical; that it is necessary to distinguish between math practices and various idealizations of it. After Gödel demolished the Russell-Whitehead program, mathematics as a “seamless, scientific system, and a unified order of knowledge” isn’t anything more than a straw figure. In addition, Tufte, Nightingale, Monmonier, and others emphasize the communicative role of math (as does the NCTM). Generally, there has been a shift from the early Wittgenstein view (picture theory of language, and consequently math) to the later Wittgenstein views (expressive, community-based).” (Quoted from an email communication with Bruce, 2008).

As the creator of one of the 3D artworks she uses as an illustration, I also take issue with the premise of her thesis, but that is a topic for another paper.
The Means of Producing Knowledge

Ideas about, and intersections of, theory and causality frame the way the g/t story can be told and in key ways, rely upon nominalization, essentialization, objective power, and the reduction of ambiguity to drive both the telling and the means of producing knowledge of the g/t relationship. This interplay is evident in the g/t story and I highlight a few examples over the next pages.

The NSF 2008 Program Solicitation for Research on Gender in Science and Engineering clearly takes a position on what constitutes appropriate scientific research:

Successful proposals will incorporate relevant advances in research methodologies and theoretical models. They should capitalize on the development of new instrumental, computational, or statistical methods, models, and tools of observation and analysis.

According to the National Research Council report, Scientific Research in Education, educational research projects should:

1. Pose significant questions that can be investigated empirically;
2. Link relevant research to theory;
3. Use methods that permit direct investigation of the questions posed;
4. Provide a coherent and explicit chain of reasoning;
5. Replicate and generalize across studies; and
6. Disclose research to encourage professional scrutiny and critique.


Clearly, in the view of the NSF, empirical research dominates because of its capacity to produce findings that are broadly generalizable. Such research, in turn, will add to the growing knowledge base of explanatory or causal theory. This model largely reflects that of the natural and psychological-behavioral-cognitive sciences, and to be clear, has provided many insights and continues to ground much of the democratic ideals behind U.S. educational research, policy, and pedagogies. However, reification of this model of knowledge production and/or of a particular kind of knowledge and thinking regarding
theory depends on a number of other assumptions and too easily dismisses still other ideas. In many ways the NSF statement reflects a naïve yet persistent separation of science from non-science or of the sciences from the humanities. It privileges a particular intersection of theory, objectivity, and methods that serve generalizability and a search for causal explanations that will ring true in the past, present, as well as the future. The “problem” is not so much with this way of doing science, but with policies or beliefs inferring that this is the way of doing science or producing knowledge. Such beliefs and practices preclude considering limitations or problems in this dominant science or the way in which, despite limitations, the model comes to dominate the construction and warranting of knowledge. Cast out in the margins are other perspectives regarding science, knowledge, and theory that challenge the dominance of this model in significant ways.

Making the limitations of normal science visible has driven much of the work of Barad, Wittgenstein, Foucault, Derrida, Gadamer, Harding, Haraway, and uncountable others. These scholars have challenged many of the underlying, transparent assumptions about doing science that the NSF relies on as the only means appropriate for researching the g/t gap. I draw on many of these alternate perspectives in subsequent chapters but here want to highlight an interplay between directives for doing “dominant science,” theory articulation, and the production of knowledge. The following excerpt from the NSF prospectus (2007) is worthy of some investigation, in light of these concerns. The bold type highlights particular phrases of interest.

All research proposals should, therefore, present the disciplinary and conceptual framework for the study. They should include a discussion of the theory or theories grounding the research and outline testable hypotheses. The proposal should discuss in detail the methods used to test the hypotheses, and if a
population sample is used, this should be described along with the rationale for sample selection, and the project’s access to the sample population. The proposal should address whether the design is premised on special needs and interests due to educational level, race, ethnicity, economic status, or disability, in addition to gender, and to what extent data will be disaggregated for multiple characteristics...

The effort should provide a research foundation for educational approaches, curriculum, and technological tools that are already developed or can be developed in the future, bridging research and educational practice in settings such as classrooms, informal learning sites, and technological learning environments. The research foundation is assumed to provide a strong base of support for sustained improvement in STEM educational practice. Strong research designs will produce rigorous, cumulative, reproducible, and usable findings. (p. 8)

In this passage, theory informs hypothesis formation but more significantly, grounds the testing of hypotheses in the quest for findings that are, as they state, “rigorous, cumulative, reproducible, and usable.” While these goals are laudable, they come with some complicating assumptions tied to the problems I have already outlined regarding the practices of nominalization, essentialization, and categorization that tend to solidify historical, dynamic, complex, and ambiguous subjects into fixed, simplified, and ahistorical objects. This practice makes possible the notion of predictive differences or explanatory theories that support broadly generalizable theory production.

The point of methods, in the NSF’s view, is to control ambiguities that would stand in the path of generating predictive theory. The NSF promotes experimentalism as the gold standard, with no significant attention paid to significant criticisms of these models and the idea that experimental methods will yield more certain knowledge (e.g. Dewey, 1929; Hickman & Alexander, 1998). Wittgenstein (1958) sums up the problem with this perceptive statement:
The existence of the experimental method makes us think we have the means of solving the problems that trouble us; though problem and method pass one another by. (p. xiv)

Funding calls, such as the 2007 NSF example, foster an exclusivity in research and in the means of producing knowledge. These policies are, in effect, not particularly “democratic” given the ways they push aside significant scholarly criticisms of the dominant approach that in turn eliminate compelling alternatives for thinking about theory and causality (e.g. Barad, 2007; Foucault, 1972, 1975, 1995, 1990; Haraway, 1991a, 1997; C. Taylor, 1995, 2002). These ideas focus much of the rest of this dissertation and thus my discussion here is quite limited.

For the purposes of thinking more about how knowledge is produced in g/t research, I first want to briefly highlight the significance of the discursive (or linguistic) turn in the social sciences that challenged the dominance of positivism (e.g. Schwandt, 2003). Foucault (1972, 1975, 1995, 1990) argued that empiricist science made the reflexive knowing subject the central agent in the production of knowledge, thereby missing the significant role of discursive practices in constructing not only knowledge but the subjects and objects of that knowledge. Empiricist models of social science have largely depended on factors of “resemblance” that classify and demarcate objects and their relationships. Foucault, in The Order of Things (1970, 1994), examined how thought itself (and thus discourse practices) “operate upon the entities of our world, to put them in order, to divide them into classes, to group them according to names that designate their similarities and their differences” (p. xvii). The NSF quote above is an illustration of this reliance on ordering and resemblances; gender constitutes an ordering practice without which a
reproducible and predictive theory of gender would be meaningless. Science, as promoted by the NSF, takes the object to be fixed and conceptually assures this through practices of science. In short, language, not science, prepares the research object to serve the production of this knowledge production practice.

Ideas about knowledge and science are in constant flux. Recent thinking by feminist new materialist scholars argues that an overreliance on discursive constructions is itself a limitation. In this section, I briefly introduce some of the motivations for feminists’ new embrace of the body and materiality, but return to this idea in Facet 9 with a more in depth analysis. One of the core precepts of feminist thinking has been, until recently, separating women’s potentiality and experience from the limitations of the material body. Alaimo and Hekman (2008) argue that this thinking has itself become confining:

Feminist theory is at an impasse caused by the contemporary linguistic turn in feminist thought....

The turn to the linguistic and discursive has been enormously productive for feminism. It has fostered complex analyses of the interconnections between power, knowledge, subjectivity, and language....It has allowed feminists to understand how gender has been articulated with other volatile markings, such as class, race, and sexuality, within cultural systems of difference that function like a language....The strength of postmodern feminism is to reveal that since its inception, Western thought has been structured by a series of gendered dichotomies...argu[ing that] the male/female dichotomy informs all the dichotomies that ground Western thought: culture/nature, mind/body, subject/object, rational/emotional, and countless others. (p. 2)

Feminists have long contested the determinist boxes that society and science have used to contain, explain, or predict women. Also, as Alaimo and Hekman (2008) argue, while Foucault (and Deleuze) engaged with the material world, postmodern and poststructuralist feminists have overemphasized the discursive aspects of this scholarship.
New materialist feminist thinking brings three major ideas to the foreground: (a) that bodies and materiality are both inescapable and meaningful sites of analysis, (b) that an overemphasis on “critique” is itself limiting, and (c) show a way of thinking past long-standing binaries—e.g. material-discursive, nature-culture, and m-f. New materialist feminism posits that discursive and constructivist lenses are theoretically insufficient, at least as total explanations. Judith Butler is one example cited as a scholar who has depended on too great a distancing from the material body (Alaimo & Hekman, 2008, p. 3).

Discursive and new materialist thinking highlights two issues relevant to my analysis of how knowledge of g/t is produced in mainstream research and policy. First, gender (and objects) are radically essentialized as an outcome of categorizing practices meant to constitute fixed, researchable objects in a way that others argue is itself an artifice of power and a hegemonizing, patriarchal science. Moreover, the work of Foucault and new materialist scholars suggests that there are significant and consequential alternatives or additional ways of approaching knowledge of women and technology.

Thus, the NSF’s (2007) view of science and of theory can be viewed as quite limited in some significant ways. The problem that the NSF renders invisible is the unlikelihood of a viable overarching and predictive theory of gender or women. Such a theory could not accommodate the ways in which social relations, bodies, nature, and the material world are always in process and in relationships that are also evolving. I will return to this idea in my last chapter. My point here is that the rules and practices framing the production of
knowledge about a g/t problem have become the limitation and I highlight one last example.

Cohoon and Aspray (2006a) argue that causality and predictive theory are a central and pressing aim of g/t research, but that these have been lacking to date:

Without theory, the research produces a collection of valuable observations that lack the context of a causal chain linking them to each other as well as to a meaningful outcome, such as women’s representation, retention, or progression to the next level ...Even when theory is invoked as a foundation for empirical research, study outcomes may not be tested against theoretical predictions, or the test can be less than convincing. Too much of the research into the gender composition of computing includes only formative evaluations...rather than summative evaluations that measure whether predicted outcomes and impact were achieved. (p. 143-144)

In emphasizing a triad of theory, testing, and prediction, Cohoon and Aspray appear to be relying on unities of “development and evolution” that Foucault argued, in Archaeology of Knowledge, falsely presume that it is “possible to group a succession of dispersed events, to link them to one and the same organizing principle...to discover...a principle of coherence and the outline of a future unity” (Foucault, 1972, pp. 21-22). If indeed these unities are not all that stable, why do we continue to think that reducing subjects or objects to an essence is so crucial?

**Conclusion**

Despite the multiplicity of objects, problems, and factors swirling around in the g/t stew, framing the meta story are a core set of suppositions made about identifiable, classifiable, and stable objects and relations that are presumed to progress on a predictable continuum and that are discoverable by making educated predictions from what is already
known. This however, is not the only position from which to think about and theorize the
g/t story/problem. Foucault’s (1972) interrogation of persistent and universalizing unities
was a direct challenge to this kind of predictive and prescriptive model for trying to
understand our social-political world:

We must question those ready-made syntheses, those groupings that we normally accept before examination, those links whose validity is recognized from the outset; ... instead of according them unqualified, spontaneous value, we must accept, in the name of methodological rigour, that, in the first instance, they concern a population of dispersed events...We must also question those divisions or groupings with which we have become so familiar. (p. 22)

Foucault (1972) saw that rather than persistent unities, the social and political narrative of history, and its portrayal, is one of discontinuities and ruptures. In his archaeologies he drew out the ways in which discourses are organized and the strategies from which they their draw authority. Subsequently, genealogic analysis moved to the foreground of Foucault’s work, and a new set of questions, focused around “thematiz[ing] the relationship between truth, theory, and values and the social institutions and practices in which they emerge” (p. xxv), emerged. In the next chapter, I continue on this genealogic path to examine further how assumptions about the g/t relationship are formed in discourse and practices and how these are constituted as distinct concepts that themselves are constitutive of—as well as constituted within—a set of social imaginaries. These imaginaries form the synthesizing and “pre-interpretive” foundations of knowing that, in many ways, directly and indirectly inform how the g/t story is researched, told, and interpreted.
Facet 5

Social Imaginaries of the G/T Story

In previous chapters, I examined the ways in which the g/t story is constructed and how it functions as a meta-narrative. In this chapter, I further deconstruct the story by examining a set of background social imaginaries that make it possible for the story to be told as it is and as well, to be readily understood as a believable representation of reality. The imaginaries I highlight coalesce around gender, technology, knowledge-technoscience-progress, education, human-machine subjectivities, and research. First I explain the concept of the social imaginary, particularly as it as been thought about in political science. Following this I analyze in some depth these particular social imaginaries and explain how they play out in the construction of the g/t meta story and support the constitutive work of the story.

Figure 7, below, is a graphic representation of the analytic model that is normally used to study the g/t relationship in education. It illustrates the ways in which prior literature and theory foreground the formulation of researchable questions that are investigated through a clearly articulated set of variables. A disengaged researcher-observer ensures an unbiased analytic field and the overarching aim is to produce a generalizable and provable theory that explains an aspect of the g/t relationship. In this model, replicating prior studies builds the credibility of a theory’s generalizability but it also depends on a recursivity that is both lauded and difficult to escape. That is, the ideal of replicability also constrains the kinds of research questions asked to within a genre of those already asked. At the very least, the conceptual framework behind the research questions is rarely itself questioned. This is the problem of this chapter: What does a social imaginary
analytic help to illuminate about the underlying beliefs or transparent assumptions that foreground the articulation of researchable questions?

![Analytic Model Diagram](image)

**Figure 7.** The dominant analytic model of g/t research.

The dominant analytic research framework is the result of a black-boxed epistemological worldview that, in its transparent reach and normativity, fits the definition of a social imaginary. Examining the meta story through as a multi-layered social imaginary opens up some new possibilities for further understanding how ideas about the g/t relationship are built and function. The g/t story itself has become part of the conceptual
background of Western society and because of this, many specifics of the story seem to be—
even if not acceptable—normal.

The g/t imaginary is a manifestation of the transparent notions we have about
gender, tool culture, identity, and the like, as well as ideas about social science research
conceived as empirical study of relationships among isolatable variables.\(^{29}\) Contained
within this imaginary is a seemingly normal set of beliefs and practices about research and
its use in producing knowledge of the story. Moreover, this g/t imaginary is entwined with,
and dependent on, a number of other imaginaries and this network of imaginaries is the
lens through which we think about the g/t relationship. The questions I consider in this
chapter are: (a) what are these imaginaries and (b) what beliefs and ideas are functioning in
the background that allow these imaginaries to pass unnoticed in such seemingly everyday
practices as representation, education, education research, and policy making?\(^{30}\)

Defining the Social Imaginary

Gaonkar describes social imaginaries as “ways of understanding the social that
become social entities themselves, mediating collective life” (2002, p. 4). Imaginaries have
been understood variously, in terms of ideas, theories, and philosophies, but also as

First-person subjectivities that build upon implicit understandings that underlie
and make possible common practices. They are embedded in the habitus of a
population or are carried in modes of address, stories, symbols, and the like. They

\(^{29}\) Here I am using ideas about the social imaginary from Gaonkar, Taylor, and Appadurai
and will explain this more as the chapter unfolds.

\(^{30}\) I cannot undertake what Taylor does, which seems to me to be in part, a genealogy of the
modern social imaginary. For this dissertation, it will have to suffice that I identify and
deconstruct the imaginaries rather than provide a ‘history’ of how they have evolved.
are imaginary in a double sense: they exist by virtue of representation or implicit understandings, even when they acquire immense institutional force; and they are the means by which individuals understand their identities and their place in the world. (p. 4)

Notably, there is not one all-encompassing social imaginary, nor are social imaginaries fixed. Rather, there are multiple social imaginaries within which peoples live and through which society, social actors, and social movements are conceived and enacted. Some imaginaries that Gaonkar points to are “the ethnos, the mainstream, the public, and humanity”; some are “articulated as a we”; and others are “third-person objectifications of society ... the market, the mainstream, and ethnic and census categories” (p. 5).31

Social imaginaries are also central to the way Taylor (Gaonkar, 2002) unfolds a collectivity of modernities through which social life is imagined and proceeds, such that,

Within the folds of a social imaginary, we see ourselves as agents who traverse a social space and inhabit a temporal horizon, entertain certain beliefs and norms, engage in and make sense of our practices in terms of purpose, timing, and appropriateness, and exist among other agents. The social imaginary is something more than an immediate practical understanding of how to do particular things...It involves a form of understanding that has a wider grasp of our history and social existence...what some contemporary philosophers call the background. It is a complex, unstructured, and not fully articulated “understanding of our whole situation, within which particular features of our world become evident”....It gives us a sense of who we are, how we fit together, how we got where we are, and what we might expect from each other in carrying out collective practices that are constitutive of our way of life. (p. 10)

31 The social imaginary seems to overlap with Bourdieu’s notion of habitus in the sense that the imaginary describes a set of transparent organizing beliefs and assumptions held by a society and that precede the way a society understands itself as a particular kind of society, whereas the habitus refers more to the beliefs and societal structures that are translated into transparent rules and practices that individuals subscribe to in their everyday life. Gaonkar sees imaginaries as embedded into a society's habitus, thus rendering rules and practices logical and meaningful.
The social imaginary is not a theory that shapes the way we comprehend the world but rather, an imaginary is collectively shared, confers legitimacy on practices and beliefs, and confers a normative aura on these collectively embraced stories and “modes of address that constitute a symbolic matrix that cannot be reduced to theoretical terms....[it] carries within it an image of moral order, which imbues embodied practices and the accompanying cultural forms with meaning and legitimacy” (p. 10-11).

Taylor’s modern social imaginary helps us understand the modern, moral compass that has framed how we have come to think about how society ought to function. The ways a social imaginary “comes to be socially constituted and politically utilized,” is Rizvi’s (2006) concern as he argues that social imaginaries ground the ways policies are given broad legitimacy and authority (p. 195).

This social imaginary is the background understanding through which we envision the g/t relationship; it is what we transparently navigate when trying to counter or resist recognized social, professional, economic, intellectual, or creative inequities presented by perceived or real gender differences that are believed to manifest in the context or use of technology. Appadurai (1999, 2000) illuminates how the imaginary is a location as well as the means for agency. Social imaginaries are the collective workings of a communal moral aesthetic, and organizing rationale that envisions, frames, and models the ways in which social lives and social relations can be perceived and imagined.

The first step in trying to characterize the g/t imaginary is to recognize that it functions at once as a holistic understanding and as a network of interconnected other imaginaries. The imaginaries of the g/t story that I will focus on (there may be others and I
do not mean to infer that my list is complete) reflect how we understand and engage with gender, the technological sphere, a knowledge-technoscience-progress triad, education, human-machine subjectivities, and research as these play out in a socio-political arena. These imaginaries co-exist as the moral, intellectual, perceptual, and affective facets through which the anchoring objects and ideas of the g/t story are articulated and sustained. Figure 8 is an illustration of this background:

![Figure 8. Selected social imaginaries of the g/t story.](image)

Over the next several pages, I describe these specific imaginaries, give some examples of their influence in the g/t story, and discuss what kinds of understandings have become taken-for-granted as a result of the strength of the imaginary. However, while these imaginaries are powerful, they too are constructed, and this aspect is my primary interest—the construction of underlying beliefs and concepts that precede and shape the kind of imaginaries that a group comes to rely on. In the following chapters, I diffract these
imaginaries and the g/t story, largely by facetting technology as a concept, tool, and way of being and interacting in the world.

A Gender Imaginary

In 1975, in education, humans’ biology was the essential limitation to be overcome, but the greatest limitations seemed to be in girls and women. This limitation backgrounded a focus on m-f differences, as seen in this quote from the *Journal of Teacher Education*:

> Human cultures are aggregates of inventions designed to mediate between the constants of human nature on the one hand and the demands of human environment on the other. One such human constant is the biological difference between the sexes. (Lee, 1975, p. 135)

What biology determines has gone through numerous articulations and revisions and eventually lost ground as a reliable predictor or explanation of women’s abilities or futures. Largely, one’s biologically determined sex is no longer presumed to be the natural and constant marker of difference, at least cognitively. For the most part, this kind of biological essentialism is off the table, although it rears its head every now and again (the Lawrence Sumner controversy at Harvard is one example (e.g. Healy & Rimer, 2005). Nonetheless, in the g/t story, it now appears to be de rigueur to explicitly distance oneself from any biologically determined essentialism, as the following two quotes suggest:

> We are reasonably sure ... that most of sex role culture is open to re-invention free of biological constraints. (Lee, 1975, p. 339)

> The use of the word “gender” among feminists in the 1970s was meant to underline the fundamentally social or cultural quality of distinctions based on sex.
The word denoted a rejection of the biological determinism underlying the earlier term “sexual difference.” (Cassell & Jenkins, 1998, 1999b, p. 5)

Over the years, biological sex difference was differentiated from gender, and both culture and gender were understood to be socially constructed. Nonetheless, g/t researchers continued and continue to rely on an essentialism that is the legacy of much of second wave feminism. This essentialism is evident in Gilligan’s (1982, 1993) portrayal of different moral inclinations of girls and boys. Girls and women are characterized as beings driven by a need for connection and an innate drive to care for others, whereas men, quite differently, have a far more independent and abstracted relationship to society. It is not our biologies that determine our desires and interests, but rather, our psyches. Thus, the shift away from biological determinism has not diminished the notion of a regulatory difference but seemingly, just relocated the ontology. As the g/t story distanced itself from biology and our psyches became more prominent, the idea that m-f difference was socially constructed became the standard discourse. “Sex” as a marker of innate difference was largely eliminated yet an idea of significant m-f difference seems to have become more important, as the following illustrates:

What it means to be male or female is culturally and situationally variable; it is neither genetically inherent in an individual nor defined or enacted in the same way across all social groups....Gender identity varies within particular contexts and forms, is reinforced within relationships and situations, and interacts with other types of identities in ways that influence beliefs about who takes on those identities. (Barker & Aspray, 2006, p. 9)

Specific attention to conceptual nuances of gender within the g/t story are not always evident, but commonly a writer will stake out her or his feminist position in noting the importance of difference, as in the following:
It is misleading to see women as sharing no unifying experiences. Feminist Ruth Behar (1993) warns that the “opposite tendencies to see women as not all that different from one another or as all too different” can lead one to go to far in either direction and then end up indifferent...Wendy Luttrell (1997) adds that going too far in either direction can lead one to disconnect, to be “unconnected to the lives of other women”....Throughout our study, we have worked hard to capture both gender differences and also the wide range of often contradictory experiences women have. (Margolis & Fisher, 2002, p. 10)

While the concept of gender in use here might be said to be experiential, it is important to understand the underlying persistence of liberal feminism in the story, on three counts. First is an emphasis on equity; second is the unreflexive assumption that what is relevant for white, middle class, Western women is relevant to all women; and third is the notion that girls, in particular, are driven, distinctly more so than boys, by an ethic of care and community. This idea is manifest in the ways women are said to have a different set of interests in computing:

Besides having a broader set of criteria for majoring in computer science, many women have interests in computing that go beyond the technical aspects. Connecting computing to other fields and working within its human and social contexts make the study of computer science compelling and meaningful to them. (Margolis & Fisher, 2002, p. 52)

Gilligan’s *In a Different Voice* (1982, 1993), had little to do with computers or technology per se, but its influence on how gender has been conceptualized in the g/t story cannot be overstated. Turkle’s “Computational reticence” (1988) built upon Gilligan’s concept of gender:

In *In a Different Voice*, Carol Gilligan talks about the “hierarchy and the web” as metaphors to describe the different ways in which men and women see their worlds. Men see a hierarchy of autonomous positions. Women see a web of

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32 The nods to race and class in the g/t story, in the ways in which these are largely merged into the concept of gender, are a reflection of this liberal feminist bias. I examine this later.
interconnections between people....Men can be with the computer and still be alone, separate and autonomous. When women perceive this technology as demanding separation, it is experienced as alien and dangerous. (p. 51)

Here the gender imaginary is what makes it possible to conceptualize two different worldviews in regards to computers and the web. This imaginary infuses Margolis and Fisher’s reflection on the importance of bringing more women into technology:

Feminist theorist Carol Gilligan foresees women’s participation this way: “To bring women in is not just to rectify an inequity... it means to change the whole conversation.” (2002, p. 143)

Ten years after the publication of “Computational reticence,” Cassell and Jenkins published From Barbie to Mortal Kombat (1998, 1999b) but the concept of illuminating gender differences by examining the relationship between girls and computers was already solidified:

This study will lead us further in the understanding of what computer games can be, and what girls are (and are not). It also leads us to examine the hidden gendered assumptions that have existed in the design of computer games, which in turn leads us to understand better what boys are and are not. (p. 5)

Also embedded in this focus on the culture of technology is a reference back to Barbara McClintock’s approach to science and Fox Keller’s work on the gendering of scientific laboratory culture (1983, 1985). These kinds of statements look something like this: 33

According to F. Wilson (2003), “In science the masculine is associated with objectivist, rationalist, emotional detachment, coupled with abstract theoretical and reductionist approaches to problem solving” (p. 128). Whereas a feminine

33 I am using the term ‘statement’ in the way that Foucault does in his Archaeology of Knowledge. In analyzing discursive statements, he bracketed both the credibility of a statement and its deep meaning. Thus, “statements are performances which can be taken at face value regardless of both the possible ambiguity of the sentences used in their formulation...and the causal factors involved in their utterance” (Dreyfus & Rabinow, 1982, 1983, p. 46).
approach to science is associated with a more holistic approach to problem solving, one in which scientists are engaged with the social world. (Singh, et al., 2007, p. 508)

All of these kinds of statements depend on reductivist or universalizing notions of masculinity and femininity, gender, and women’s experience. In their repetition and circulation, such statements come to constitute a social imaginary of gender. This gender imaginary has expanded in recent years to encompass race and class in a way that Chanter (2006) says simply adds constructs of sexuality, race, class, and gender—taken to represent multiple locations of difference, identity, influence—in a way that continues the dominance of white feminism as a dominant schema. Chanter suggests that this additive model reflects the continuing practice of creating space for race and class, but only as these fit within feminism’s narrow articulation of gender in an alliance with white, middle class women. That model keeps gender, sexuality, race, and class apart, as separable characteristics.

Third wave and poststructuralist feminists’ problem with this additive model is that it “envisage[s] race, gender, class, and sexuality as if they were separable strands or segments of social life that develop independently of one another, which can be added together, or subtracted from one another, as if they had integrity in and of themselves” (p. 11). The

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34 Additionally, the digital divide has also been used to characterize inequities between first world and other populations and nations, which in turn cannot be separated from gender, race, and class.

35 As an example of ongoing deliberation on the relationship of gender to sex, race, class, and so on, Linda Martin Alcoff argues that sex is significantly biological & metaphysical, whereas race is not. Sex (as do age, disability) represents a biological difference of the capacity to reproduce that is more than physical appearance subjected to cultural interpretation and valuations “the variable of reproductive role provides a material
problem, as Chanter articulates it, is that these different categories are then played off one another, reinforcing the drive to “ascertain which aspect of identity is more important” (p. 11). It is just this kind of structural thinking that focuses the NSF’s approach:

Gender is only one of the characteristics that shape personal and group identity. Other characteristics such as race, ethnicity, economic status, religion, and disability also bear on whether students are encouraged, neglected, or discouraged from developing certain skills and ambitions. (2007, p. 10)

In Barker and Aspray’s review of girls and IT (2006), these gender-race-class categories seem to function a little differently:

We recognize that gender and race/ethnicity are inextricably linked... Still, because relatively little research has been conducted on girls who are members of minority groups, or because the representation of minority girls in samples is too small to measure difference, we have chosen a broad focus on girls in this chapter. (p. 4)

In their estimation, each category represents exclusion in some way. However, because they are not easily separable and not sufficiently measurable given current data, race and ethnicity are easily merged into the bigger category of gender. Gender is not simply a category of women or privileged whiteness; the category of gender is also used as a placeholder of difference or inequity across multiple categories. The problem is not at all that race and class do not matter, but that the g/t story conceptualizes gender-race-class through a “whitefeminist” worldview (Armour, 1999) and too easily just adds these together. Thus, gender, race, and class are terms fraught with contested meaning, yet they function as the primary means of measuring the rate at which members of these categories participate in the dominant techno-culture. Because computing is culturally male and infrastructure for sexual difference that is qualitatively different from the surface differences of racial categories” (2006, p.165).
white, a sweeping gender imaginary makes it possible to include within this culture—in the
g/t story—what is in fact, a large diversity of male computer scientists (or geeks, hackers,
gamers), that includes Americans, Chinese, Russians, Koreans, Indians, and so on. The
gender imaginary itself is so strong that it supersedes ethnic, race, or class concerns (except
in immigration debates) and thus is used to describe and mark a set of outsiders to a
dominant and seemingly “pure” masculine computing culture.

Chanter (2006) characterizes a growing feminist unease with relying on category
distinctions. She argues that poststructuralist feminists understand that the project is not
to “simply get rid of these categories” but instead to recognize that each attempt at
universal categorization “tends to oversimplify a complex field of phenomena” (p. 11).
However, in the g/t story, the categories of gender, race, class, disability, and so on are
glossed into a broadly encompassing category. Discursively, because of insufficient data
measuring how these various categories have fared in the project of achieving technological
parity or competency, gender has become a broadly useful construct for addressing
problems in computing’s culture. While there is a growing interest in research that more
explicitly attends to these categorizations, one idea remains coherent and durable: the
imaginary of gender, in the g/t story, is strong enough to include difference and inequity
across multiple categories such that differences of gender are taken to be useful in
attending to differences more specifically or comprehensively. In addition, difference itself
is conceived as something that can be isolated, measured, and catalogued.

Through the strength of the gender imaginary, gender functions not merely as an
analytic construct. The notion of gender as a key signifier of difference is one of the
primary lenses through which we understand and conceive of how girls, women, boys, and men act or understand themselves and others in the world. The specific ways in which ideas of gender, sex, men, and women are approached and conceptualized have shifted over the years, particularly in feminist thinking. However, the dominant model of the g/t story reflects an imaginary wherein locating precise difference and categorization is assumed possible and desirable. This extends from beliefs that generalizable theoretical models and interventions are the Holy Grail to pursue. This pursuit however, relies on a belief that gender is a static category, meaning that, even as race and class intermingle with gender, there remains a desire to predict based on these classifications. This thinking in turn depends on these categories remaining stable. The g/t story reflects the holding power of a gender imaginary that has been grounded in notions built from second wave feminism and psychology. This imaginary is taken to be fluid enough to be useful across gender, race, class, and other markers of difference while at the same time the gender imaginary holds together as a central, internally stable, organizing strategy of Western society.  

36 Here I have indeed alluded quite broadly, and without due detail to several important ideas: the progression in feminist theory (often referred to as first, second, third wave feminisms, now moving towards post-feminism); what some view as paradigm shift as Hillary Clinton became a serious contender for the US presidency, even as others claim that hers was an opportunity available through a particularly and politically convenient marriage; and the fact that feminism, if not the g/t literature, is particularly sensitive to global feminisms and tries to steer clear of what might be described as a persistent colonial notion of global gender.
A Technological Imaginary

As the gender imaginary percolates behind the scenes, so to speak, the g/t story also depends on a specific imaginary of technology. In this section I unpack some of the ideologies and beliefs about technology commonly circulated and that function as our technological imaginary. In the two quotes below, UNESCO articulates how access to ICTs is connected with social and economic power:

While ICTs and the Internet offer vast, new and unprecedented opportunities for human development and empowerment in areas ranging from education and the environment to healthcare and business, they are also one of the key contributing factors to social and economic disparities across different social and economic groups. The gender divide is one of the most significant inequalities to be amplified by the digital revolution, and cuts across all social and income groups. Throughout the world, women face serious challenges that are not only economic but social as well as cultural—obstacles that limit or prevent their access to, use of, and benefits from ICTs. (Primo, 2003, p. 5)

The Fourth World Conference on Women in Beijing in 1995 is generally regarded as a watershed in understanding of information technology as a powerful tool that women could use for mobilization, information exchange, and empowerment. (p. 11)

In the following example, the National Research Council (2007) similarly connects technology tools with social and economic progress:

Since the Industrial Revolution, the growth of economies throughout the world has been driven largely by the pursuit of scientific understanding, the application of engineering solutions, and continual technological innovation. ... To many of us, that universe of products and services defines modern life, freeing most of us from the harsh manual labor, infectious diseases, and threats to life and property that our forebears routinely faced. ... Maintaining that vast and complex enterprise during an age of competition and globalization is challenging, but it is essential to the future of the United States.37 (p. 4143)

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37 The Research Council, in this chapter, also nods to an alternative point of view on technology by including a short, boxed statement: “For all the practical devices and
In these various descriptions of technology—whether referring to computers or technology more broadly—we see technology at its best, positioned as a tool and means of improving human life in general; and, in particular, as the means through which marginalized groups will achieve equity. Technology, in these kinds of statements, is a tool of democracy and brings progress. This belief relies upon what is commonly called the technological fix thesis.

This notion is also evident in the following excerpt from the AAUW (2000) report:

In contemporary culture, the computer is no longer an isolated machine: It is a centerpiece of science, the arts, media, industry, commerce, and civic life. Information technology is transforming every field, and few citizens are unaffected by it....The question is no longer whether computers will be in the classroom, but how computers can be used to enhance teaching and learning—ideally, in ways that promote the full involvement by girls and other groups currently underrepresented in many computer-related endeavors. The commission’s themes and recommendations, while focused on girls in schools, would, if addressed, improve the quality of the computer culture for all students. (p. ix)

Burbules (2007) articulates rather concisely, what an idea of a transformative role of technology—in education—might look like:

Questions of teacher authority, “coverage” of material, and the isolation of school activities from learning that takes place in other contexts (and vice versa) are all impediments to realizing the transformative potential presented by new learning technologies. (p. 207)

He sees a set of new tools that themselves hold the power to transform schools.

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wonders that science and technology have brought to society, it has also created its share of problems. Researchers have had to reapply their skills to create solutions to unintended consequences of many innovations” (National Research Council, 2007, p. 42). The interesting thing here is how strong is the technological determinist language—technology has not only brought wonders, but also created problems. Researchers, in this kind of statement, are seemingly the discursive white knights to save us, but responsibility for the bad technology remains within the technology itself.
The dominant idea throughout is that technological tools represent the possibility of progress; they open the door to new, more democratic practices and outcomes, particularly in education. The “question regarding technology” here is not concerned with technology in any cultural, ontological, or practice-based sense. Instead, the question is reduced to how everyone can be brought into technology’s fold so that the benefits promised by these new tools will be equitably distributed. This is the dominant and visible social imaginary of technology in education and the imaginary central to the meta g/t story. Cassell and Jenkins (1998, 1999a), for example, rely on the pervasiveness of this imaginary to explain why computer games are an important site for feminist activism:

The second sense in which we are feminist researchers comes from our belief that equity between boys and girls, men and women, is a laudable goal....In this context we examine the different ways in which we might strive for equity: equity through separate but equal computer games, equity through equal access to the same computer games, equity through games that encourage new visions of equity itself.” (p. 4-5)

Similarly, Barker and Aspray (2006) explain why it is important to expand the number of women in IT by offering, as one of several reasons, “applying computing as a tool for solving big problems is considered critical to the U.S. future and economy” (p. 14).

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39 Here is one place where the education g/t story is quite different from that told in feminist technoscience or Science & Technology Studies (STS), fields where technology itself is more critically examined.
Dede (2007), at Harvard’s Graduate School of Education, also relies on this instrumental technological imaginary to advocate for the role of computing technologies as the means of transforming education:

To prepare students for 21st-century work and citizenship, the usage of sophisticated ICT based on a complementary pedagogical theory, situated learning, is a vital supplement to current educational technologies. (p. 22)

Fortunately, emerging ICT that enable immersive, collaborative simulation now offer the capability to implement situated learning environments in classroom settings. (p. 23)

Similarly, in the following UNESCO statement (Primo, 2003), the technological imaginary of “tools for transformation” foregrounds concerns over gender equity:

Information and communication technologies could give a major boost to the economic, political and social empowerment of women, and the promotion of gender equality. But that potential will only be realized if the gender dimensions of the Information Society—in terms of users’ needs, conditions of access, policies, applications and regulatory frameworks—are properly understood and adequately addressed by all stakeholders.

UNESCO believes that unless gender issues are fully integrated into technology analyses, policy development and programme design, women and men will not benefit equally from ICTs and their applications. (p. 9)

Gender matters, in the technological imaginary, but the locus of transformation is centered in technology itself; women have needs, but technology has the power. Thus, the technological imaginary includes technology’s power to transform society (or conversely, its power to thwart transformation). In this imaginary, technology is an enormously powerful tool for social transformation. Lost is the way in which responsibility for the inequities
wrought by technology are ascribed to tools—not the creators or handlers of these tools or the socio-economic-political milieus within which technologies are conceived.\(^40\)

Sometimes this imaginary expands to include the *culture* of computing. In the following quote from *Unlocking the Clubhouse* (Margolis & Fisher, 2002) the power to limit social change is located in an inventing that is determined by culture; thus, the masculine culture of technology is the target factor that determines what kinds of technologies we get:

> If *boys invent things, and girls use things boys invent*, a cyberspace culture will inevitably reflect the desires and sensibilities of males to the exclusion and often denigration of females. (p. 12)

It is in these kinds of statements that a radical technological determinism is embedded into the technological imaginary. In conceiving of technology through its instrumental aspects, tools, or the culture that contains them, two ideologies persist. One is that it is sufficient to talk merely about tools and the second, that tools and their culture hold a power that determines social relations. Politics, agendas, and other human involvements are not particularly visible, except as they are to be manipulated by technology.

**A Knowledge-Technoscience-Progress Imaginary**

The dominant technological imaginary of Western society is that technology itself will fix—or provide the means of fixing—many ills of society and the imperfections of humans. This imaginary acquires its cache through another that extols expert, abstract,

\(^{40}\) This is an idea that Langdon Winner takes up at great length in his essay *Do artifacts have politics* (1986).
scientific, and rationally acquired knowledge. In 1993, an NSF solicitation stated the following:

The amount of information generated by science and engineering has grown dramatically. The increased use of technologies has enabled us to expand our capacity to solve certain problems that were thought intractable only a short time ago... If society is to continue to benefit from the rapid production of new knowledge, new and better ways must be devised to expand human capacity to deal with the increased information, multiply the power of human reasoning to deal with the increasing complexity of science, develop ways to compensate for human limitations, and expand the power of human skills through collaboration to convert data into information, information into knowledge, and knowledge into practice. If these innovations are to affect education, new institutional innovations and infrastructures may be needed to cope with and speed their adoption in a timely manner....

... The program urges proposers to anticipate what new knowledge will be available in 5 to 10 years and to show how best to articulate and represent it through the use of advanced technologies—in the laboratory and classrooms as well as to decision makers. (Section: Basic and applied research)

The technological imaginary is again evident, particularly in the intertwining of technological determinism and the exponential growth of knowledge. Implicit is the connection between knowledge and progress, and the idea that humans are limited in their capacities to produce and sort through this knowledge, as well as seemingly powerless in any attempt to contain it, whether or not such containment might be warranted. In fact, humans themselves are to be “improved” by techno-science, to become better equipped to use and produce ever more knowledge, in turn made possible through technological progress.41

41 Another distinction lost in these kinds of documents is the difference between science, technology, and engineering. In this NSF passage, these seem to be rather interchangeable, but this strategy ignores the important distinctions as well as the debates over what each of these fields represents. One of these debates is over whether technology is the tool of science or conversely, is something bigger that contains science. I will not attempt to
The new knowledge of technoscience—and the “progress” it promises—is the background good by which humans and their activities and abilities are to be evaluated and modified. The pre-eminence of this technoscience-knowledge-progress imaginary frames how literacy itself is now conceived and measured. For example, the 2002 National Science Foundation Reauthorization Act frames technology and engineering as the primary literacy needed by citizens:

A literate citizen is one that understands the world around her. Engineering offers an excellent platform for project problem-based engineering and helps children integrate knowledge from all disciplines including math, science, social science, language art and art. (Statement of Dr. Ioannis (Yannis) Miaoulis, page 58)

Margolis and Fisher (2002) also foreground this scientific and technical literacy as they argue for a broader relevance for computer science in education:

Many computer science teachers argue that computer science involves developing higher-order critical thinking skills and problem-solving skills important for all students, not just those who intend to make a career of computing. (p. 37)

Foreshadowing these ideas was Turkle and Papert’s (1990) work on epistemological styles and a rigidity they perceived in programming classes that negated what they argued were alternative, stylistic differences in approaches rather than differences in student abilities or programming outcomes. In the passage below, Turkle and Papert argue that a top-down, formal, and rule driven process was not the only way that programming could proceed or be taught:

resolve, nor even enter this debate (Dewey and Heidegger would be good places to begin to understand this complex issue.) While I think technology is more than the tools of science (or learning), my analyses of particular statements only reflect the language or ideas embedded in a particular text. Here the term techno-science reflects the general blurred boundary I observe in these texts.
The computer has emerged as an important actor in the revaluation of the concrete, a privileged medium for the growth of alternative voices in dealing with the world of formal systems. The conventional route into formal systems, through the manipulation of abstract symbols, closes doors that the computer can open. The computer...can provide a port of entry for people whose chief ways of relating to the world are through movement, intuition, and visual impression. At the heart of the new possibilities for the appropriation of formal systems is the computational object, on the border between an abstract idea and concrete physical object....The computer has a theoretical vocation: it can make the abstract concrete; it can bring formality down-to-earth. (p. 131)

In this excerpt, the technological imaginary is in full view, as the computer will “fix” problems in how formal systems and abstract knowledge are understood and acquired.

More importantly, the acquisition of concrete, formal, and abstract knowledge is the ultimate goal. The “tweak in the system” that Turkle and Papert propose concerns only the styles of interacting with knowledge and artifacts, not the kind of knowledge produced, nor what is to be done with it. We might say that their major interest lies in the methods of production, as the following suggests:

For some people in our study, what is exciting about computers is working within a rule-driven system that can be mastered in a top-down, divide and conquer way. (p. 136)

Formal reasoning is not a stage, but a style....Thus, observation of programmers at work calls into question deeply entrenched assumptions about the classification and value of different ways of knowing....It supports a perspective that encourages looking for psychological and intellectual development within rather than beyond the concrete and suggests the need for closer investigation of the diversity of ways in which the mind can think with objects rather than the rules of logic. (p. 143)

Linking the technological and the knowledge-progress imaginary is this idea of “thinking with objects” and something that Dede (2007) builds on to position expert thinking in the 21st century as requiring different knowledges and problem solving skills than those needed in an earlier, less technological time. As he articulates it, what is needed
is a new kind of knowing, problem solving ability, and cognitive disposition. Globalization and the emerging knowledge economy require new kinds of thinking and these rely heavily on information and communication technologies (ICTs). Expertise is not within individuals, but is a product of the ways individuals, groups, and communication technologies are brought together. In short, 21st century expertise—which he portrays as a particularly (and new) complex approach to thinking and problem solving—is not possible without a strong ICT presence and capacity.

In the new world that Dede (2007) locates, expertise is grounded in a fundamental fluency in cognitive processing skills but this is no longer the end goal or final expert knowledge. The new expertise supports knowledge building that is distributed and mediated across groups of people and through technologies. However, achieving this distributed expertise is dependent upon individuals’ expertise with ICTs. This is made clear in the following:

Education should prepare students for a world in which computers do almost all types of routine cognitive tasks and in which expert thinking and complex communications are based on fundamental knowledge about how to do simpler tasks, so the shift needed is not about removing the learning of routine cognitive performances from the curriculum. Rather, the fundamental change involves deemphasizing fluency in simple procedures as an endgoal of preparation for work and life, instead using these routine skills as a substrate for mastering complex mental performances. (p. 13)

The vision of 21st century expertise envisioned by Dede is impossible to visualize outside the technological imaginary; technologies are not only called upon to repair a lack in human processing capacity, computers (and insufficient pedagogies) apparently create this new cognitive disability.
Unfortunately, the interrelated 21st-century skills delineated earlier are largely absent in current pedagogical assessment practices. The following section then delineates how emerging technologies such as multiuser virtual environments (MUVEs) and augmented realities enable new types of pedagogical strategies that meet a broader spectrum of learning styles and enable mastery of more sophisticated kinds of skills, complementing current teaching methods to more effectively prepare students for the 21st century. (p. 17)

Expertise, and what or who counts as an expert, is given a great deal of significance in differentiating users from experts, the technologically literate from the non-literate, and within these demarcations, men from women. This plays out in not only what kinds of programming strategies are deemed acceptable or who is given access to technology, but also delineates a boundary that promotes self-exclusion, as this quote from Margolis and Fisher (2002) shows:

School computers and computing centers have been claimed as the territory of a subset of male students who are the school's computing experts. And girls, as “outsiders,” do not see how they and what they value can fit into the computer culture and curriculum. (p. 33)

Central is an idea that knowledge and power are intimately connected and that technology plays a central role in this power hierarchy:

The domination of communication by a small powerful elite, mostly males, who use the existing communication technologies to coordinate and reinforce social/cultural dominance, is a very real threat for women. (Primo, 2003, p. 21)

In this technological-knowledge imaginary, even when technology is a hegemonic tool or force, certain kinds of knowledge and information are given greater social capital. In the

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following passage, UNESCO (Primo, 2003) argues that indigenous knowledge has been undervalued, yet must be protected from exploitation. Largely Western notions about intellectual property become the driving concepts through which to understand knowledge, ownership, and the distribution rights to this knowledge:

The critical issue for women in indigenous communities...involves their control over, access to, and potential compensation for the knowledge they have acquired. The fact that most of their knowledge is considered “old” places it outside the scope of protection by industrial property laws. Under current international legal mechanisms, local and indigenous women’s knowledge are at increasing risk of exploitation in the race for genetic resources...In the information or knowledge society, a new legal instrument is needed that would recognize and protect knowledge created, developed and enhanced by communities of people, and which acknowledges that men and women have differential access to the structures that shape knowledge systems. Such an instrument needs to be developed with the full participation of all parties who hold such knowledge, including men and women. (p. 51-52)

While this recognition of indigenous and women’s knowledge is important, the stated goal is to find an appropriate legal instrument that protects and accommodates these indigenous rights and needs. Not on the table is the possibility that the knowledge-science-progress triad might be re-envisioned or contained. Knowledge still acquires its social capital to the extent it can be framed within a Western model of expertise and progress.

An Education Imaginary

It is difficult to separate characterizations of the gender/technology problem from (a) concerns over a nation’s need for skilled and technically literate workers; (b) educational policies charged with ensuring measurable outcomes (intellectual, economic, attitudinal) so that its products (students) may become productive workers; or, (c) the competitive realities of an increasingly globalized marketplace that both requires newly skilled workers and
simultaneously socially and economically devalues them. Aspects of this state of affairs are both evident and invisible in the following excerpt from the 2007 NSF Program Solicitation for Research on Gender in Science and Engineering:

One of the National Science Foundation's (NSF) key strategic goals is to cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens. Investments are directed at programs that strengthen scientific and engineering (S&E) research potential and education programs at all levels. These outcomes are essential to the U.S. as we progress toward an increasingly technological job market and a scientifically complex society.

(p. 5)

It is largely in this socio-economic-political intersection that national educational policies are shaped and enacted. Prefacing these policies, education is understood as a central, mediating factor in developing workers’ technological competencies. However, taken-for-granted in all this is the working definition of education itself. What is meant by education and who will be educated in these various sectors? What we need to be clearer on is how the social imaginary of education is construed and enacted, and further, why this matters.

Dede (2007) provides an answer:

A crucial challenge for U.S. education is to align curriculum and learning to a whole new economic model based on an emerging global, knowledge-based workplace.... Linking economic development, educational evolution, workforce development, and strengthened social services is essential to meeting this challenge.

(p. 15)

In a footnote Dede explains that he is not dismissing those who believe education should include other objectives, “e.g., equity, moral citizenship, self-realization” (p. 35). He does, however, position the economic model as the primary model. Similar emphases are evident in the 2007 NSF prospectus:

The program for Research on Gender in Science and Engineering (GSE) seeks to build resources - developing the nation's knowledge capital, social capital, and
human capital – toward the goal of broadening the participation of girls and young women in STEM education from kindergarten through undergraduate education. (p. 5)

In the g/t story, constructs of gender and technology tend to be defined or explicated in at least some minimal way. Often one is more defined than the other, and the understandings reflect transparent assumptions of the imaginaries already described. The education imaginary is perhaps the most black-boxed of all simply because education tends to be one of the generally agreed upon values of society. Specific goals and practices may be debated but few oppose the idea of education as a social good. However, the ideals driving societal beliefs in education have themselves shifted, increasingly driven by market and technocratic values. Education has become more of a market good rather than a citizen good.

**Education and human capital theory.** In the passages quoted above, the generally agreed upon understanding that makes these statements both plausible and expected is a human capital theory of education. Livingstone (1997) explains how this theory framed mainstream thinking about education during the post WWII years. It equated “workers’ knowledge levels with their levels of schooling” where these would reliably insure “higher productivity and macroeconomic growth” and both individuals and society would gain, economically, from higher levels of schooling (p. 9). In the 1970s, the theory was found lacking, given that people’s salaries and employment levels were falling despite their
increasing educational credentials. The theory was then revamped in two ways: First, it made the quality of education the problem and the focus turned to raising standards, starting children in school earlier, making schooling more relevant or specialized; second, it shifted the focus from schooling to life-long learning (p. 9).

Evidence of a reliance on human capital theory is strong in the g/t story as this example from TechSavvy (AAUW, 2000) illustrates:

Girls were less likely to take high level computing classes in high school, and comprised just 17 percent of those taking Advanced Placement computer science exams. Girls outnumbered boys only in their enrollment in word processing classes, arguably the 1990s version of typing. In 1995, at the postsecondary level, women received one in four of the computer/information science bachelor's degrees and only 11 percent of the doctorates in engineering-related technologies. These educational gaps reverberate in the workplace, where by most estimates women today occupy only 20 percent of the jobs in information technology. (p. 3)

The instrumentality is palpable. Girls, women, and society will gain if they can be convinced to stick with technology in their education careers thus plugging the “leaky pipeline.” This leaky pipeline is one of the driving story lines of the g/t narrative, but it is important to recognize how this metaphor relies on thinking about education through human capital theory. Camp’s 1997 article, “The incredible shrinking pipeline” not only makes this connection clear, but also positions it as a fundamental, human capital concern.

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43 For example, the recent economic downturn has hit the well-educated. In addition, a particularly well-educated and undervalued group is the ever increasing adjunct faculty of higher education, most with expensive PhDs.

44 It might be useful to consider this pipeline concern in the context of a proportionally miniscule discourse of concern over a long-standing low percentage of men studying to be K-12 teachers.
The percentage of bachelor’s degrees awarded in CS to women decreased almost every year over the last decade. In other words, not only does the pipeline shrink from high school to graduate school, but it also shrinks at the bachelor’s level. Furthermore, while the percentage of bachelor’s degrees awarded in CS to women decreased, corresponding percentages of other science and engineering disciplines increased. In short, there is a critical labor shortage in CS and, although women are more than half the population, they are a significantly underrepresented percentage of the population earning CS degrees. (p. 104)

Human capital theory is also a foundational concept in Unlocking the Clubhouse, as seen in the following:

Girls and women who have the necessary talent and inclination but do not become engaged in the technology are missing the educational and economic opportunities that are falling into the laps of computer-savvy young men. Computing salaries are high, jobs plentiful, and entrepreneurship opportunities unbounded. Furthermore, a command of information technology is an asset in many contexts outside the field itself. (Margolis & Fisher, 2002, p. 2)

**The technocratization of education.** Thorndike’s behaviorist theories of education have also been enormously influential in how technology has been brought to education. Tomlinson (1997) describes Thorndike’s educational position as reflecting a notion of education that relies exclusively on the “tools of behavioral psychology, mental testing, and scientific management” (p. 366). He explains that Thorndike also advocated a technocratic and scientific role for education that became a “most effective argument for undermining the traditional humanist curriculum” (p. 372). Thorndike also insisted that there is little or no transfer of learning between domain specific tasks and that no subject is more effective than any other in developing a child’s intelligence. One outcome of Thorndike’s ideas is the notion that education and teaching should focus on the acquisition of skills and that these skills should be tested, measured, and tracked. The technocratic shift in education is
not merely about bringing computers to the classroom, it reflects an overall theory of education that the computer facilitates.

Gibboney (2006, October) also returns to the tensions between Deweyian and Thorndikian conceptions of education to understand current debates in education over testing and what kinds of learning matter. As he illuminates, Thorndike’s view of transfer promoted the idea that learning can (and must) be measured and it conjoined transfer and testing so that the only relevant learning is that which can be measured, visibly and quantitatively. Gibboney explains that Dewey argued a wholly different notion of education.45

Dewey’s ideas on the transfer of learning were fundamentally more humanistic than Thorndike’s. Dewey believed subject matter in schools exists to make the quality of democratic life as good as it can be under given conditions....In other words, what is transferred when a student learns something that is truly important is intangible and immeasurable by tests. It is an attitude, the desire to learn. Subject matter is but one among many means used to attain this central objective, which is sadly overlooked in today's race for higher test scores. (p. 170)

In the early 1980s, education started to view the computer as a new tool for learning that would transform schooling. The debates on this are extensive and I will not delve into them.46 Of greater significance here is that the g/t problem has historically been linked, at least since Hawkins’s 1985 article, “Computers and Girls: Rethinking the Issues,” to how education conceives of and deals with both girls and technology. Early on it was understood that girls do not receive the same educational support that boys do, from

45 Dewey’s oeuvre also reflects a substantively different, and experiential, view of technology that I do not have space to fully acknowledge.

46 Some key scholars who have weighed in this are Bertram (Chip) Bruce, Larry Cuban, Robert Taylor, and Robert McClintock.
teachers or parents, and that technology is but the latest manifestation of this gender (and later, race and class) inequity. From this base, Margolis and Fisher (2002) viewed the educational cultures wherein computing is taught and view these as much of the problem.

In this book, we lay out the blueprints—the doors, walls, and windows—of the “boys’ clubhouse” of computing education. We show how rarely girls’ interest in computing is kindled and how women who do develop and interest in computing often have it extinguished in school. We discuss what is necessary to remodel education so that girls and women who are or could be interested in computing can find a home in the discipline.

Curriculum, teacher’s expectations, and culture reflect boys’ pathways into computing, accepting assumptions of male excellence and women’s deficiencies in the field. (p. 3-4)

Across the g/t story, inadequate and male-centric pedagogies are quite often isolated as the problem. An example of this is evident in the AAUW (2000) report:

The AAUW Technology Commission also found computer science classes often to be “bastions of poor pedagogy” (p. 41). Assignments and teaching examples often embed male-dominated interests and activities, such as sports statistics and card and number tricks. There is often little in computer science instructional materials to draw in girls...Although computing is integrally linked to critical investigations in medicine, environmental science, famine control, art, and music, computer science textbooks focus primarily on technical detail, with little attention paid to the application and impact of the technology in meaningful interdisciplinary problem-solving assignments. (p. 37)

Besides the broad inference that girls and techné do not mix well, this way of thinking about computing education seems to be an extension of Turkle and Papert’s “Epistemological pluralism” (1990; 1991) in which they focused attention on boys preferences for formal, abstract, and rule-driven logic and girls’, for the intuitive and contextual. A similar idea is found in Kay’s 1992 essay concerned with associating cognitive abilities with technological skills.
By assuming that all knowledge is acquired in a similar fashion, researchers ignore potentially important differences that are illuminated by investigating specific cognitive tasks such as programming, word processing, spreadsheet software, or computer terminology. Yet even in these studies, we are still at the general learning level. By testing general programming skills, for example, we obscure factors such as language features or syntax, design skills, program reading, and procedural skills. (p. 165)

The attention, in these kinds of statements, has been on the cognitive and psychological abilities of girls and boys. However, is this all that is going on? In thinking that these abilities can be tested and measured, they become the most important factors and abilities and other approaches and ways of thinking about education move to the margins. Transparent in this kind of education climate is the dominant imaginary of a Thorndikian inspired technocratic view of learning and education.

My aim here is not to get embroiled in the Dewey versus Thorndike debates over education; however, the technocratic turn in education is of great significance. I want to suggest that the g/t story—in statements like those made in Margolis and Fisher and in the AAUW report—frames preferences for humanistic, experiential, or holistic pedagogies or motivations to be an outcome of one’s gender. That is, the battleground laid out is a curriculum that privileges boys’ ways of learning and ignores what and how girls want to learn. Invisible is the ways in which skill-driven and task-based pedagogies and assessments have come to dominate in schooling. This reality can be black-boxed to the extent that the gender imaginary is available to act as a counter-balance even if its surface use is to articulate difference.

The underlying analytic framework is a response to a dominant, yet transparent, Thorndikian conception of education. That is, the g/t story construes contextual and
experiential preferences in education to be gendered preferences, yet doing this masks a longer-standing debate over what education is to be and how it should be conceived and practiced. This suggests the import of recognizing how technocratic and human capital ideals of education have merged and together have become the transparent beliefs underpinning the education imaginary.

A Human and Machine Subjectivity-Identity Imaginary

Another legacy of Thorndike’s influence on education is the overarching influence of the psychological, cognitive, and behavioral sciences as the primary model for conceptualizing students in terms of their subjectivities and identities. This tendency can be traced within the g/t story and because this practice seems so normal, it functions as another layer in the g/t social imaginary. It might not be a stretch to state that the subjectivity-identity imaginary is the primary means through which we understand and try to make sense of the g/t relationship. It denotes a picture of persons wherein psychological-behavioral-cognitive traits are taken to be either innate or socially ingrained and taken to be determinant, in some fashion, of a person’s identity or capacities. Moreover, these traits may be catalogued and measured. This social sciences tradition grounds the g/t meta story; for example, girls’ and women’s subjectivities or identities tend to be viewed as fixed rather than in flux. Arguably, studies on online identities query this very question, but within education’s g/t story, identity research remains within the psychological-behavioral-cognitivist conceptions that depend on enduring notions that subjectivities can be
objectively observed and thus, catalogued. This subjectivity-identity imaginary is evident in
statements such as the following:

At each step from early childhood through college, computing is both actively
claimed as “guy stuff” by boys and men and passively ceded by girls and women....
Curriculum, teachers’ expectations, and culture reflect boys’ pathways into
computing, accepting assumptions of male excellence and women’s deficiencies in
the field. There is also a subset of boys and men who burn with a passion for
computers and computing. Through the intensity of their interest, they both mark
the field as male and enshrine in its culture their preferences for single-minded
intensity and a focus on technology. (Margolis & Fisher, 2002, p. 4)

In this passage, boys and men’s subjectivity is described as active and girls and women’s is
one of passivity. Margolis and Fisher’s concern seems to be focused on how boys’
excellence in computing is misconstrued because girls’ competencies go unnoticed, masked
by their passive natures. The subjectivity-identity imaginary transparently enables these
assumptions. Thus, boys and men’s passion and intensity for computing becomes a
subjectivity ready to be measured and investigated in contrast to girls and women’s
dispassion. The underlying assumptions that assign these subjectivities and identities
however, pass as norms.

In many ways, the g/t imaginary is built upon two beliefs: (a) identifying and
understanding psychological, cognitive, and behavioral subjectivities will provide a
substantive and sufficient explanation of girls and women’s experiences with technology
and (b) we can observe, measure, and compare subjectivities or identities. Framing the
subjectivity-identity imaginary is the dominant lenses of the psychological-cognitive-
behavioral sciences. Some readers may be skeptical that a set of ideas so infused and
evident in the story are “transparent.” However, the very fact that the g/t story-imaginary is
so heavily and unreflexively dependent on the exposition and examination of subjectivities-

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identities is sufficient reason to further investigate the black-boxed nature of these assumptions.

While Thorndike’s influence cannot be underestimated, Turkle’s *The Second Self* (1984) has also been influential. Using a psycho-anthropological analytic lens, she described human subjectivities and psychologies as they intersected with the computer—an object with its own subjectivities and psychologies. In the following two passages, she deftly connects human psychology with the computer in a way that makes subjective understandings of both central and formative:

Most considerations of the computer concentrate on the “instrumental computer,” on what work the computer will do. But my focus here is on something different, on the “subjective computer.” This is the machine as it enters into social life and psychological development, the computer as it affects the way that we think, especially the way that we think about ourselves. (p. 13)

People are thinking of themselves in computational terms....Their language carries an implicit psychology that equates the processes that take place in people to those that take place in machines. It suggests that we are information systems. (p. 17)

Turkle takes subjectivity in a new direction and extends it to the machine. The computer here is not simply a tool; it offers a new kind of subjective experience through which to understand human identity.

Turkle’s (1984, 1988, 1995; Turkle & Papert, 1990) analyses of computer culture have been immeasurably influential in describing the ways identity formation and computers may be linked. This conception followed in the wake of Turing’s (1950) infamous tests of whether a machine was capable of thinking or learning. Turkle’s narratives depend on psychological-behaviorist-cognitivist lenses that in turn both support and are supported by a model of artificial intelligence that understands the mind as a
processing machine (e.g. Minsky, 1985; Moravec, 1988). Significant is that an idea of mind as information processor was the dominant model of AI and learning in the early 1980s when education began its relationship with computing. Therefore, it seems important to consider the import of linking human psychology, machine psychology, and human thinking to computational processing. Reflecting the ongoing strength of a link between these, Dede (2007) has stated:

[Observing] the impact of ICT on society...cognition is now distributed across human minds, tools/media, groups of people, and space/time....Because of sophisticated computers and telecommunications, the process of individual and collective thought in civilization is increasingly dispersed symbolically, socially, and physically. (p. 12)

More so than human ingenuity or agency, ICTs are seen to be the articulation points in a triad of communication, thinking, and information processing. Turkle’s ideas, along with those of Papert (1980), were somewhat revolutionary during this time when computers were emerging as a new force in society. For Turkle and Papert, the bond between human and machine was significant, but Dede’s statement reveals how widely much of this human-machine subjectivity has been embraced and the ways in which human cognition is now nearly inseparable from the computer, particularly in STEM education circles.

The ideas promoted by Turkle and Papert were probably not attributable to Thorndike specifically but to the close professional association at the Massachusetts Institute of Technology (MIT) between Turkle, Papert, and Minsky, where artificial intelligence was the driving paradigm. This paradigm had a major influence on how the

47 Quoted from Minsky’s website at M.I.T.: “Marvin Minsky has made many contributions to AI, cognitive psychology, mathematics, computational linguistics, robotics, and optics.
computer, from within education, would be understood. For example, Hawkins’ (1985) research explicitly reflected Thorndike’s influence, as seen when she describes a tight interplay of psychological-behavioral-cognitive factors:

Some studies indicate that particular characteristics of children's learning tasks may be an important factor in the development of sex differences. For example, Licht and Dweck (1982) suggest that achievement orientations may be different for the two sexes in various subject areas. Girls and boys interpret failure feedback differently: Girls are more likely to attribute difficulty in solving problems to their own lack of ability; boys are more likely to attribute failure to other situational factors. (p. 169)

This psychological-behaviorist-cognitive lens is the basis upon which attributions of particular and identifiable traits, dispositions, abilities, and so on, become claims for objectively understanding and explaining individual and gender-dependent factors that influence STEM outcomes.

Gender biases are still evident in gender gaps at many stages of the STEM educational continuum. While both boys and girls now enroll in elective and advanced high school courses to prepare for college at about the same frequency, girls are less likely to report liking math or science. (National Science Foundation, 2007, p. 6)

A Thorndikian subjectivity is behind the experiential, explanatory narratives of who can or cannot, wants or does not want, to engage with the computers or its culture. In 1985, this narrative took the form of “we can, but I can’t,” framed as a “paradox” (Collis, 2011).

In recent years, he has worked chiefly on imparting to machines the human capacity for commonsense reasoning. His conception of human intellectual structure and function is presented in The Society of Mind (CDROM, book) which is also the title of the course he teaches at MIT.” [http://web.media.mit.edu/~minsky/](http://web.media.mit.edu/~minsky/)

48 A case could be made (though I do not have space here to make that argument) that Thorndike’s influence reaches to the way in which cognitive science and AI now permeate educational models of learning. For example, the dominant approaches of the learning sciences and IES projects on educational technology.
1985, cited in Kay 1992, p. 167). By 2000 the narrative had morphed into “we can, but don’t want to” (AAUW, 2000, p. 6). Another recurring theme around subjectivities in the g/t story is that of a tool-toy divide that is repeatedly used to distinguish girls and boys interests in computing. The contrast derives its authority from a reliance on Thorndikian behavioral psychology:

The focus groups support a recurrent theme in research on gender and technology: Girls approach the computer as a “tool” useful primarily for what it can do; boys more often view the computer as a “toy” and/or an extension of the self (what Turkle has called the projective qualities of the computer, the computer as “Rorschach” or “second self”). For boys, the computer is inherently interesting. Girls are interested in its instrumental possibilities, which may include its use as an artistic medium. They express scorn toward boys who confuse “real” power and power on a screen. “I see a computer as a tool,” a high school girl declares. (p. 9)

Although I do not want to dismiss out-of-hand the importance of people’s experience and perceptions in learning and interacting with computers or other technologies, the degree to which this subjectivity frames the g/t conversation is striking, so much so that it might be hard to separate the story from this way of understanding. The question is whether this perspective warrants the ways in which it has become a totalizing lens and whether it has the explanatory reach that it has been given. The list of psychological, cognitive, and behavioral characteristics that have been used as explanatory traits in the g/t story is quite extensive. For example, girls and women’s confidence levels or various fears of computing are repeatedly discussed in the literature, and the following are but two highlights.49

Most studies indicated that women—even ones who study computer science—have less confidence than men in their computer skills. (Margolis & Fisher, 2002, pp. 38-39)

One of the more pervasive but intractable problems is “technophobia,” or fear of technology. Women often have complex relationships with technology and machines as a result of being socialized over time to believe that machines and technology are a man’s domain and not for women and girls, thus generating a gender bias in attitudes towards studying or using information technology. (Primo, 2003, p. 38)

Often, ideas about women’s relationship with computers refers back to Turkle’s work on women’s fears of the intimate machine.

The central issue for these competent and talented women is not phobia or lack of ability, but a reticence to become more deeply involved with an object experienced as threatening. (Turkle, 1988, p. 42)

Building from these ideas of essential psychological-cognitive-behavioral differences, the NSF 2007 prospectus highlights these as key factors worthy of investigation and funding:

Proposals in the research area may seek to enhance the multidisciplinary understanding of STEM learning to the extent that differences are evident based on gender. Behavioral, cognitive, affective, and social differences may be investigated using methods of sociology, psychology, anthropology, economics, statistics, and other social and behavioral science and education disciplines. (p. 7)

There is also evidence that differences in m-f subjectivities do not only reflect “objective” measures of perceived difference; they are also rhetorically enforced.

“Dreaming in code” has become one of our working metaphors, emblematic of a male standard of behavior in this computer-oriented world. (Margolis & Fisher, 2002, p. 5)
The role of computers and computing culture in identity formation is another way that subjectivity is approached and dissected in the g/t story:  50

Computers become particularly seductive at a certain moment in psychological development: the moment of adolescence. (Turkle, 1988, p. 43)

There is not room here to show how extensively this notion of identity formation permeates the gender and computing story. However, the following quote from Wajcman (2007), one of the most prominent feminist scholars of gender and technology, illustrates the pervasiveness of this idea across various sectors of the g/t story:

The literature on gender and technology has grown to become a broad and diverse field. It foregrounds the need to investigate the ways in which women's identities, needs, and priorities are being reconfigured together with digital technologies. (p. 295)

The subjectivity-objectivity imaginary, framed as it is through the psychological-cognitive-behaviorist triad, supports a quite narrow and exclusionary conceptual framework for understanding the modern social-technological world or girls and women’s interactions with technology. This imaginary has become, through many intersecting facets, normative yet transparent as an explanatory lens—dominant, and itself constitutive.

A Research Imaginary

According to many scholars, mainstream educational research remains too dependent on positivism, experimentalism, and measurement (Rizvi, 2006; St. Pierre, 2006). Appadurai (1999) describes this dominant model as the modern research imaginary

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and argues that it is marked by a valorization of method. In the following passage, he
highlights some of the beliefs driving this imaginary:

The most serious problems are not those to be found at the level of theories or
models but those involving method: data-gathering, sampling bias, reliability of
large numerical data-sets...method, translated into research design, is taken to be a
reliable machine for producing ideas with the appropriate shelf-life. (p. 236)

Appadurai’s concern is a dominant research ethic that supports or reflects the tendency of
Western ideologies to dominate in knowledge building. It also refers to the “ubiquitous,
taken-for-granted and axiomatic quality of research” (p. 233). That is, there is a
transparently accepted way of thinking about research that on the one hand has become
normal and expected, yet on the other, brings with it an ethical orientation towards
knowledge and inquiry that is imbued with its own set of ideologies. This “modern
research ethic” emphasizes “systematicity, prior citational contexts and specialized modes of
inquiry” and “the issue of replicability...not search but research” is foremost. At the heart of
this dominant research imaginary is replicability, which Appadurai argues has become a
kind of moral authority that most worships a values-independent rationality (p. 199).

The belief in replicability sustains the idea of value-free research and notions that
only professionals connected through “a professionally defined field of prior knowledge...a
specialized, usually technical, body of readers and judges” are warranted to do this research
(Appadurai, 1999, p. 236). There are many scholars and researchers working to reign in the
dominance of this research imaginary (e.g. Helga Nowotny, 2003; Schwandt, 1996, 2004;
Wallerstein, 1997; Wallerstein & Gulbenkian Commission, 1996) but nonetheless, in g/t
research in education, this imaginary remains quite strong. Driving criticisms of this
imaginary is a concern that its ideologies are so pervasive and transparent that the notion
of “research” not only carries the weight of authority, it claims a flawed assumption of
neutrality and at the same time a kind of omniscience. Examples of the strength of this
imaginary are pervasive in the g/t meta story. In Cohoon and Aspray’s 2006 literature
review the gender gap in computing is attributed, at least in part, to flawed research
methods—research that does not meet the criteria of the dominant research imaginary. This
is explicit in the following statements:

Our review of the literature on women in postsecondary computer science leads us
to the conclusion that two conditions contribute to the persistence of women’s
underrepresentation. The first condition is an inadequate understanding of the
underlying and immediate causes. (Cohoon & Aspray, 2006a, p. 137)

Too much of the research into the gender composition of computing includes only
formative evaluations (participant satisfaction with aspects of the program) rather
than summative evaluations that measure whether predicted outcomes and impact
were achieved. When summative evaluation is attempted, it must still meet several
criteria if it is to be credible. (Cohoon & Aspray, 2006a, p. 144)

This same research imaginary and ethic dominates the NSF calls for g/t research funding
proposals—perhaps the primary funder of STEM education research in the U.S.:

Successful proposals will incorporate relevant advances in research methodologies
and theoretical models. They should capitalize on the development of new
instrumental, computational, or statistical methods, models, and tools of
observation and analysis. (National Science Foundation, 2007, p. 7)

The NSF is not merely setting a standard of research; it is wholly engulfed within a kind of
value system where the research imaginary functions as a kind of gatekeeper to the kinds of
knowledge that may be pursued.

Sometimes this research imaginary that is built around a strong belief in
replicability is dressed in less explicit language. When Cohoon and Aspray (2006a) focus
attention on the lack of causal theory, their underlying concern is the gap in replicable
studies that would produce such theory. They state: “Without theory, the research produces a collection of valuable observations that lack the context of a causal chain linking them to each other as well as to a meaningful outcome” (p. 144).

Concerns about methods are, ultimately, meant to bring research more in line with the research imaginary. That is, the reason that solid methods are thought to be so crucial is that they are the means to producing first, good results and second, replicable studies that move findings up the ladder towards becoming proven theory. This ladder is evident in how Cohoon and Aspray (2006a) draw on the NSF position on methods (highlighted below) to pinpoint a perceived flaw in g/t research that limits this kind of theory building:

The criteria considered most important by an NSF evaluation of research on programs for women and girls in STEM were:
- A cogent means of measuring outcomes;
- Data from a sample set larger than ten;
- Appropriate measures of outcomes;
- A study design employing pre- and postassessments, a control group, or comparison;
- one or more data points;
... We found few examples of published research on computing’s gender composition that was tied to theory and met these criteria. (Cohoon & Aspray, 2006a, pp. 144-145)

The NSF program solicitation however derives its criteria from the National Research Council report, “Scientific Research in Education” (2002) which argues that educational research projects should reflect scientific principles based on the following standards and ideals:

- Pose significant questions that can be investigated empirically...
- Link relevant research to theory...
- Use methods that permit direct investigation of the questions posed...
- Provide a coherent and explicit chain of reasoning...
- Replicate and generalize across studies... (p. 3-4)
The explicitly stated belief amongst g/t researchers is that methods lacking in “scientific” rigor are a primary contributing factor to the persistence of the g/t problem. This idea, that methods are the root problem, emanates from the research imaginary that Appadurai identifies. Research, in the g/t meta story, means exactly what Appadurai refers to when he characterizes contemporary educational research as holding an ethical stand towards knowledge as “research.” The “re” in research confers a moral authority to “redoing” in the search for causal relations. Replicability both validates knowledge and moves it up the chain of authority but it also both depends on and confers a stasis of phenomena, subjectivities, or relationships that is blind to cultures, geographies, politics, and to any shifts in or between these.

The problem with the research imaginary is both its transparency and its grandiosity, by which I mean the moral authority it claims, through methods that are marketed as passive and neutral, but in actuality, carry the ethos of a very specific Western epistemological orientation to the world. The belief is that knowledge produced according the norms of the imaginary is promotable to become generalizable theory. Appadurai’s argument is that this research imaginary is a barrier to understanding in a globalized world. The research ethic is so circumscribed that it has become a major constraint for researchers and policy makers.

Wittgenstein’s (1958) criticisms of the experimental method, the model behind this dominant research imaginary, takes the argument a bit further: “The existence of the experimental method makes us think we have the means of solving the problems which trouble us – the problem and method pass one another by” (p. 232).
It is crucial to understand the strength of the research imaginary across the g/t story in order to understand the moral authority attributed to a triad of method, replicability, and the value neutrality of re-search. Researchers functioning within this research imaginary tend to negate criticisms of its ethical authority, positing such criticisms as non-science (the extreme example is Sokal’s hoax (Ross, 1996, Spring-Summer), which I discuss in chapter 9. Debates over the efficacy or ethic of this imaginary continue. The problem of the g/t meta story however, is that it so wholly embraces the research imaginary and rarely considers what is being constituted in the process.

Conclusion

By now it might be evident that it is difficult to talk about these multiple imaginaries independently—each is connected to a larger set of ideas and practices and is dependent on a set of long-standing beliefs, even if the source of these beliefs or practices have been forgotten. These imaginaries both constitute and continually promote the understandings we have of the g/t relationship. They inform the ways in which we normatively imagine how gender sits and is studied in relation to technology. Moreover, the ways that we imagine this relationship are also constitutive. Taylor, in Modern Social Imaginaries (2004), illuminates the intimate interplay between background social practices, the social imaginary, and a social theory. “What is originally just an idealization grows into a complex imaginary through being taken up and associated with social practices” (p. 29). Our sense of the social order, of our place within this order, and the explanations we construe of this order evolve as they come in contact. However, Taylor suggests that theory
is quite influential in the ways it “penetrates and transforms the social imaginary” (p. 29).

This is the process, as he describes it:

For the most part, people take up, improvise, or are inducted into new practices. These are made sense of by the new outlook, the one first articulated in the theory; this outlook is the context that gives sense to the practices. Hence the new understanding comes to be accessible to the participants in a way it wasn’t before. It begins to define the contours of their world and can eventually come to count as the taken-for-granted shape of things, too obvious to mention.

But this process isn’t just one sided, a theory making over a social imaginary. In coming to make sense of the action the theory is glossed, as it were, given a particular shape as the context of these practices...the theory is schematized in the dense sphere of common practice. (p. 29-30)

This interplay of practices, background understandings, and theory building is a hermeneutic one—each processually transformed in the interaction. This suggests that, contrary to how the g/t meta story views theory as an explanatory scheme to be discovered, the interplay between theory and practices is far more complex, each mutually constitutive of the other.

Moreover, an imaginary holds within it a particular set of concepts that give it a normative authority. These concepts promote or reflect a particular worldview or orientation to the empirical world. In the imaginaries I described, some of the most instrumental concepts are determinist thinking, an instrumental orientation to the world, the primacy of essentializing and cataloguing difference, and reductivist thinking that make our imaginaries seem as if they are our ontological condition. It is through the exclusive, wholehearted, or unreflective embrace of these concepts, and the near exclusion of others, that these imaginaries function transparently and with such influence. The flawed notion is that a theory is descriptive of an observed phenomenon (for example, that gendered
experiences shape an interest in computers) rather than a constitutive element in producing the practices, beliefs, or relationships that are taken to be causal or most significant. In the following chapter, I explore this notion further by reading the g/t story as a reflection of a four-faceted enframing.
Facet 6

A Story Enframed

Despite the rapid changes in technology and some fifteen years of literature covering the era of the ubiquitous personal computer, a remarkably consistent picture emerges: more boys than girls experience an early passionate attachment to computers. (Margolis & Fisher, 2002, p. 16)

The question is twofold: How should we read the g/t story and how can we read it, given the imaginaries, traditions, or lenses through which we have been conditioned to read and interpret? There is an assumption embedded in the g/t story that we will eventually, once the right causes are identified—be able to intervene in and “finally” redress the underrepresentation of women in computer science. Sometimes the idea promoted is a “fix” of either women or the cultures of computing technology. In this chapter I argue that the “should” or “can” aspect of reading and interpreting is inextricably tied to four ways of being in and reading the world: (a) a representational and radically reflexive epistemology (e.g. Taylor), (b) a technological understanding of being (e.g. Heidegger), (c) a far-reaching set of rules over what denotes gender difference (e.g. Cornell), and (d) a limited yet powerfully exclusionary organizing perception of subjects and objects (e.g. Haraway). This four-faceted enframing grounds the g/t story’s aura of a meta-narrative that gains its credibility through an accumulation of similarly conceptualized micro stories all bent on describing and explaining girls and women’s experiences, interests, and abilities as these intersect with “technology.”

A story is regarded as “true” because it is recognized to be an appropriate and familiar kind of narrative that is at once descriptive, encompassing, and objective in explicating a subjectively experienced empirical world that seems natural in the way it has
been represented. In their various ways, Heidegger, Gadamer, Foucault, Taylor, Bowker and Star, Haraway, and Barad (to list but a few) have taken issue with presumptions made about the innate authority or necessity of this epistemology. In earlier chapters I unpacked the ways the g/t story is put together and characterized some of the transparent ideas or practices that have made this story plausible in its current forms. Beyond these constructions and imaginaries however, are concepts and beliefs about epistemology, technology, difference, and perception that act as a foundational glue in the story. Viewing the world through ideals filtered through a pervasive instrumentalism, reductivist epistemology, a limited conceptual framework of difference, and an objectivity located outside the knower, the constitutive outsider (CO) is delineated. This outsider foregrounds the scientific basis and descriptive power of the g/t story and makes it possible to see women and girls as the outsiders to technology. The problem lies in how women are construed as outsiders and that the category of women is essentialized to all women, in part by not recognizing those women who sit outside the norms of our enframing.

Enframing, as explained by Heidegger is

The mind-set that underlies the rise of technology and that permeates our daily habits of speech and thought...a way of objectifying our world and our experience (including our experience of ourselves) in such a way as to make what is enframed available for our use, manipulable and transformable in the service of designated goals and purposes.” (Pattison, 2000, p. 2)

Enframing is not merely a way of describing the human drive towards mastery over nature. Rather, it reflects how we understand ourselves to be in the world. It is a kind of narrowed perceptual disposition wherein the beliefs-lenses-dispositions that we rely on to navigate,
understand, and attempt to control the world are themselves already constrained by our technological disposition to, and understanding of being in the world.\textsuperscript{51}

I facet enframing through the following four lenses: First is our epistemological enframing: Taylor’s (1995) tracing of our modern epistemology illuminates the ways that, for example, reductivist and representational practices have come to shape how we are in and understand the social world through knowledge formulations. Second is our technological enframing: Heidegger’s (1977) discussion of technology as our modern enframing (Gestell) characterizes our self-understanding and ways of being in the world in a modern mindset where humans, nature, and society are normatively thought about in wholly instrumental terms. Third is an enframing in difference: By articulating an ethically drawn re-visioning of sex difference and gendered identity, Cornell (1999) challenges us to consider the possibilities of différance that Derrida (1978; Wood & Bernasconi, 1988) introduced. Along with Irigaray’s (1985) re-imagining of sex difference as something other than opposition, a re-imagining of difference opens the possibility of moving beyond taking the masculine position as the norm. Fourth is a perceptual enframing: Focused on how an observer’s perceptual position shapes the production of scientific knowledge and subject-

\textsuperscript{51} Heidegger’s concept of Being is quite complicated but Hubert Dreyfus’s explanation is both useful and illuminating: Briefly, the shared practices into which we are socialized provide a background understanding of what counts as things, what counts as human beings and what it makes sense to do, on the basis of which we can direct our actions towards particular things and people. Thus the understanding of being creates what Heidegger calls a clearing (Lichtung). Heidegger calls the unnoticed way that the clearing both limits and opens up what can show up and what can be done, its "unobtrusive governance (Waltens)." (Dreyfus, Being and Power: Heidegger and Foucault; http://socrates.berkeley.edu/~hdreyfus/html/paper_being.html) Thus, Being is tied in with Heidegger’s concept of technology.
object relations, Haraway (1991a, 1997) takes on the problem of a disembodied objectivity, for the ways it produces not only an exclusionary field of observation and objects, but it is also improbable. I bring these four positions together to portray a four-faceted enframing through which the observational field of the g/t story, as well as its interpretation, are shaped and regulated. Faceting (as a process of diffracting) is one step in re-imagining some of the assumptions embedded within this widely disseminated story. As part of a deconstructive re-imagining, I consider how our enframing designates the constituted outsider and from this, show how the g/t story functions as a kind of socio-political technology.

On the one hand, highlighting a four-faceted enframing as epistemological and technological and that is driven by a specific orientation to difference, and perception helps to make evident an underlying and dominant conceptual framework through which we are conditioned to see and make sense of the social-scientific world and the g/t story. On the other hand, faceting also brings new theories, realities, networks, and perspectives into the mainstream circle of knowledge and understanding that has heretofore shaped the g/t story. This makes it easier to see how, through a complex and largely invisible enframing, the g/t imaginary is functioning as another technology of contemporary society.

**Epistemological Enframing**

The g/t story is a product of modern science and our modernist epistemology. As Taylor (1995) showed, this epistemology is not itself “natural.” Instead, it reflects and shapes how we are in and understand the world and in turn, proscribes the norms for
producing and validating knowledge claims and interpretations. An ongoing dispute is whether social scientific knowledge can, in effect, be disembodied or value-neutral given that it reflects and shapes understandings of social phenomena that themselves are fully immersed within the messy contexts of being, politics, history, or intersubjective interpretation. Taylor (and Heidegger, Gadamer, Castoriadis, among others) argues that our modernist epistemology, which claims to be neutral and disengaged, in reality depends on deeply embedded beliefs that perceive social contexts or human subjects as reducible and independent units that can be instrumentally prepared for scientific investigation. Contrary to its aura of neutrality and disengagement, beliefs about knowledge building construe and situate agents in relation to other agents, contexts, and knowledge. Taylor suggests that a scientifically drawn epistemology is not a problem when trying to understand the natural world but that it leads us wholly astray in trying to conceptualize, document, and interpret humans in what are actually highly contextual social-political actions, interpretations, and relations. There are multiple facets to Taylor’s explication of epistemology and I focus on these: representationalism, reflexivity, atomism, and the punctual self. The following passages from an NSF prospectus (2007) soliciting research proposals that investigate the causes of the g/t gap are useful to consider.

The GSE program supports activities that address the following types of objectives. ...To discover and describe gender-based differences and preferences in learning science, engineering, technology and mathematics in K-16 and factors that affect interest, performance, and choice of STEM study and careers in fields where there are significant gender gaps. (p. 6)

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52 Others, including Haraway, Nowotny & Gibbons, and Barad also question whether knowledge of the natural world should be opened up, but this controversy is beyond the scope of my project.
There is a familiarity in this NSF statement, itself based on a notion that differences between subjects and objects can be scientifically documented and investigated; we are so comfortable with this idea that it seems wholly normal.

Through modern epistemology, the scientific basis of knowledge, subjects, or even science are not themselves viewed as problematic; instead, schools, teachers, parents, game cultures, and so on become analytic targets wherein behaviors and beliefs can be examined and perhaps corrected. This model is inferred in the NSF’s prospectus.

Our society as experienced in education through parents, the media, K-12 educators, post-secondary faculty and others tends to reinforce traditional assumptions about the capabilities, interests, and career options for girls and women, steering them away from STEM classes, majors and careers. (p. 5)

On the one hand, the notion that research and policy can facilitate social and educational change is both necessary and somewhat unremarkable (yet also quite extraordinary when accomplished). On the other, there is reason for caution because of the ways in which the locus of and responsibility for knowledge is located and dispersed (notably, away from science and scientists and onto their research objects or products) and for what this knowledge sets out to accomplish. The instrumentalism embedded in the following quote makes it seem laudable and natural that citizens can be repurposed to fit the needs of a domestic workforce in need of more human capital.

At the same time, the demand for science and technology literacy on the part of all citizens has never been higher, and the demand for domestic workforce capacity in engineering and computer fields is projected to exceed supply. (p. 5)

This example broadly illustrates aspects of our modern epistemological enframing, a technological understanding of humans and society, and the ways in which this is facilitated by bounding the perceptual field in the name of objective science. The normalcy,
neutrality, and necessity of these beliefs and practices is a kind of black-boxed conceptions of knowing that transparently surrounds the g/t story.

Representationalism & reflexivity. A created—not innate—understanding of both knowledge and being is at the heart of our epistemological enframing. That is, our view of knowledge reflects a modern, Western orientation toward both self and the world. In “Overcoming Epistemology,” Taylor (1995) traces the underlying principles that evolved from Enlightenment natural science to become the dominant model of knowledge in modern social science. He identifies several characteristics of this epistemological model and the most significant aspect in his estimation is the dominance of the representational view of knowledge, as he states here:

If I had to sum up this understanding in a single formula, it would be that knowledge is to be seen as a correct representation of an independent reality. In its original form, it saw knowledge as the inner depiction of an outer reality. (p. 3)

One of the features of representationalism is that external observations and interpretations of others’ (e.g. their experiences, actions, or accounts of these) are deemed to be accurate and objective portrayals of empirical reality, as long as correct procedures are followed. Moreover, in producing representations, we take on two roles. As disengaged observers (researchers) we receive impressions emanating from the external world but “fix experience in order to deprive it of its power” (C. Taylor, 1989, p. 163). As objects of knowledge, we are ready and available not merely to be examined but also, to be instrumentally altered. Social research is a form of self-disciplining where we cooperate in the quest to improve ourselves to better fit various social, political, or economic roles (Foucault, 1975, 1995; C.
Taylor, 1989). The following passages highlight Taylor’s understanding of our modern, disengaged and instrumentally driven epistemology:

Knowledge then hangs on a certain relation holding between what is “out there” and certain inner states that this external reality causes in us....The epistemological construal is...an understanding of knowledge that fits well with modern mechanistic science. (1995, p. 4)

What one finds running through all the aspects of this constellation...is the growing ideal of a human agent who is able to remake himself by methodological and disciplined action. What this calls for is the ability to take an instrumental stance to one’s given properties, desires, inclinations, tendencies, habits of thought and feeling, so that they can be worked on, doing away with some and strengthening others, until one meets the desired specifications. (1989 p. 159-160)

This epistemology is the invisible glue of the g/t story. The belief in representationalism is expressed through statements such as the following, where representing sets the stage for a subsequent re-imagining.

We have worked to listen carefully to students’ accounts of their experiences and translate them in ways that are both accurate and useful for conveying how the gender gap in computer science perpetuates itself. (Margolis & Fisher, 2002, p. 9)

The interplay between representationalism and the disciplining intention of g/t research is evident in the following two excerpts concerned with the problem of girls’ instrumental attitudes towards computers.

The focus groups support a recurrent theme in research on gender and technology: Girls approach the computer as a “tool” useful primarily for what it can do; boys more often view the computer as a “toy” and/or an extension of the self....For boys, the computer is inherently interesting. Girls are interested in its instrumental possibilities.

These girls’ descriptions of what boys are doing with technology are missing some very important elements. There is strong value in boys’ activities that girls are quick to denigrate....But it is also clear that getting girls involved with computing will require overcoming resistance based on their negative feelings about getting involved with the machine “for itself.” (AAUW, 2000, pp. 9-10)
A neutral observer registers what is going on but the assumption carried along is that girl’s interests and motivations are available to be modified both for their own benefit and to benefit society.

Representationalist epistemology equates real (i.e. “objective”) knowledge to scientific knowledge, i.e. knowledge obtained through the judicious application of method (whether that is the method of reason or the method of empiricist investigation). Objectivity depends on a radical reflexivity whereby the researcher “rids” his observational perspective of unwanted subjectivities, “ordering ... thoughts correctly” to observe reality without bias or prejudice (C. Taylor, 1995, p. 5). Taylor calls this a stance of “disengagement.”

It is essential to our scientific practice, to what we understand as the correct search for knowledge, that we set ourselves the goal of making an accurate representation of things. And this has meant shaking ourselves free from earlier view in which the demands of connection, communion, or attunement with the cosmos were still intricately with those of attaining an adequate picture of the true state of affairs. (cited in Abbey, 2000, p. 176)

When representationalism drives the rules for producing objective knowledge, rational disengagement is the only stance allowed in producing scientific knowledge. In the following excerpts, Margolis and Fisher explain that subjects’ accounts of their experience shift over time.

Our subjects—being the live creatures they are—change and transform in response to their own inner workings and to their environment....By the fourth interview she may announce to us that she is leaving the program, having concluded that she just isn’t interested in computer science. At any point along the way, had we drawn conclusions prematurely about this student, we would have an incomplete and possibly a misleading story. (2002, pp. 7-8)
This passage highlights that although these researchers explicitly acknowledge the shifting nature of their subjects’ accounts as something fundamental to the analysis, the researchers themselves are so outside the analytic field they get no mention. There is no account of the researchers’ understandings evolving in tune with their subjects’. Moreover, there is nothing else complicating the field.

Representationalism relies on a specific form of reflexivity for its validation. For example, in illustrating how systematic analysis is used to disengage the researcher, Margolis and Fisher justify that interview narratives are not merely “anecdotal” but qualify as external, scientific data.

Accounts which are gathered and analyzed in a systematic manner allow the investigator to discover things that cannot easily be discovered by any other means. In complex human affairs, noticing the patterns in the independent accounts of expert witnesses plays the same role as laboratory observations in the formation of hypotheses. (p. 8)

These “accounts” are discovered independent of the discoverer. Discovery is made possible by a radical reflexivity that may be described as a kind of distancing and disengaging built on the notion that socially situated “data” are independent and available to be discovered. Radical reflexivity accomplishes this separation of the researcher’s perspective from the analytic field, as the following example highlights:

Completed by 76% of the females and 88% of the males, the questionnaires were first analyzed for (a) word counts, (b) average-length responses, and (c) evidence of personalization...We then studied the responses and developed descriptive categories...which emerged from the data. (Morse & Daiute, 1992, p. 13; italics added)

The belief that categories emerge from the data themselves, rather than from a researcher’s input or interpretation, depends on this radical reflexivity. Reflexivity in this sense refers to
a process whereby a scientist’s biases or a priori beliefs are procedurally eliminated from the scientific field.

The problem with this epistemology, in Taylor’s estimation, is that it has become the dominant model of knowledge yet it is not a particularly suitable model for developing knowledge of humans or the social world. It discounts the self-interpreting nature of being human as well as the dynamic contextual backgrounds within which selves and self-interpretation unfold (e.g. H.-G. Gadamer, 1976; C. Taylor, 1989).

**Atomism, disengagement, & the punctual self.** An atomized society is one where “the ideal of self-responsibility is foundational... and linked to the modern ideal of freedom as self-autonomy” (C. Taylor, 1995, p. 7); objectified, punctual selves become the instruments of this society. The punctual self describes the individual tuned to treat self and the world instrumentally as a “subject [ready] to change and reorganize...the better to secure the welfare of himself and others” (p. 7). It reflects a modern “radical stance of disengagement to himself or herself with a view to remaking” that self and contributes to what Foucault characterizes as the disciplining technologies of the self (C. Taylor, 1989, p. 171).

The g/t story may be read as an instance where this atomizing and disciplining is carried out. The scenario, broadly, looks like this. The disengaged researcher reflexively locates, without biases of experience, beliefs, or instincts, a set of atomistic objects (in this case, girls and women) with the full intention (and presumed cooperation of these objects) of reshaping and reconstituting individuals to fit a desired result. This model is reflected in the AAUW report:
One of the values in getting more girls and women interested in the computer pipeline is that their greater presence may transform the computer culture overall; by the same token, changes in the e-culture itself—the ways technology is discussed, valued, and applied—would invite more girls and women to participate fully in that culture. (2000, p. 3)

Behind this passage is an explicitly stated instrumental train of reasoning. Transforming the culture is the rationale for bringing more women (re-engineered to become more interested) into computing fields. At the root is the modern subject available to be remolded to fit external circumstances and purposes. However, this process of disciplining depends on a black-boxed and “external” observer—the disengaged, neutral researcher.

In the following statement, the researcher remains outside the field, a disengaged, radically reflexive observer. Disentanglement ensures that the researcher and any values or ideologies are not influencing the field of observation. This interplay depends on a group of punctual selves (girls and women) who even when they do not have the right self-descriptions, are willing to search for an appropriate language to help facilitate both research and societal aims.

In focus groups, most girls took offense at any suggestion that there may be differences in how boys and girls interact with computers....we found that girls observe and describe strong gender differences but do not have a language with which to talk about them. The result is that girls are likely to express bewilderment and confusion about how they are different in their attitudes and abilities than boys. In girls’ efforts to find a perspective from which to talk about gender differences, they often position themselves as morally or socially more evolved than boys who, they tell us, enjoy “taking things apart” and interacting with “machines.” (AAUW, 2000, pp. 7-8)

Girls and women are examined by researchers operating within a set of transparent, instrumental technologies that depend on and promote a particular strain of disengagement that construes selves as separable from others, from their own experience and bodies, and malleable so as to be self-disciplining. Thus, the self sees itself, so to speak,
through an instrumental understanding of the social world that articulates the normal in institutions, social science research, and individuals or groups of people. Foucault’s project in such texts as *Discipline and Punish* (1975, 1995), *Birth of the Clinic* (1963, 1989), and *The History of Sexuality* (1990) was examining how this normalizing process unfolds.

Framed within a Cartesian mind-body separation, the knower is disengaged from corporeal messiness or affective biases. Scientific knowledge maintains an abstract distance from responsibility for the outcomes of knowing or its procedures, as long as these follow epistemological conventions. Taylor’s characterization of an atomistic society, disengaged knowledge, and the punctual self would be difficult to conceptualize without Heidegger’s explication of our technological enframing. Epistemology is itself a kind of instrumental technology, another way of characterizing our technological enframing. With a nod to Heidegger, Taylor explains that he “notoriously treats the rise of the modern epistemological standpoint as a stage in the development of a stance of domination to the world, which culminates in contemporary technological society” (1995, p. 8).

One reason that the instrumental project appears to be logical, appropriate, and wholly democratic is that it is carried along with conceptions of an atomistic society. For Taylor, this society is infused with a particular ethical disposition to being in the world wherein not only is knowing disengaged, freedom is similarly decontextualized and disassociated. This promotes a radical individualism that negates ideals of collectivity and promotes “the belief that humans...are free to develop their own goals and purposes rather than having to bend to preordained ones” (Abbey, 2000, p. 177). Self-regulation and self-
autonomy are key markers of successful and responsible personhood in the atomized society.

Within this worldview, it seems epistemologically logical to scientifically ferret out factors that get in the way of girls and women’s participation in computing. Factors within girls and women—such as their beliefs or interests—will no longer stand in the way of their pursuit of individual freedom to achieve a self-determination that serves society’s needs. Computing is conceived as one such path to economic (and thus social and political) freedom for both the individual and for society. Thus, the instrumentalism that frames the g/t story reflects more than an agenda of helping women to achieve parity. There is also an instrumentality driving this gender equity project that is “democratized” through the ways in which selves are disengaged from their experience and disciplined, as malleable selves, to better fit the social norms and needs of a technocratic society.\(^{53}\)

**Technological Enframing**

I resisted articulating, at the outset, a specific definition of technology, instead suggesting that how technology will be defined remains an important and open question in reading the g/t story. How we think about technology has a great deal to do with how we think about the processes and products of knowing, about our relation to tools and their culture, and not so visibly, our relation to ourselves and to each other. The g/t story largely relies on a tools-culture definition of technology (largely focused on computers), but this

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\(^{53}\) Brown (2005) develops these ideas and I return to her work later.
definition does not adequately describe the interweavings of ideas about technology, knowledge, or being within the g/t story. Common understandings of technology, in the g/t story, have emphasized (a) applied definitions (e.g. Dede, 2007; Papert, 1980) rather than the philosophical or ontological (e.g. Heidegger, 1977; Hickman, 1990; Mitcham, 1994); (b) a natural and self-determining view of knowledge rather than the ways knowledge (and tools) are socially constructed (e.g. Law, 2000; Oudshoorn & Pinch, 2003, 2005; Wajcman, 2004), and (c) an enforced separation of scientific knowledge from politics and values (contested by scholars such as Pacey (1983, 1989), Franklin (1990, 1999), Winner (1986), or Bruce (1996; Bruce & Hogan, 1998)). Overwhelmingly, the g/t story has been framed through an engineering, determinist, and epistemological definition of technology, whether talking about technology in a broad sense, more specifically about computers, or in characterizing the cultures and environments within which technologies are produced and used. Following Heidegger, it is easier to see that our technological enframing is dual: first is the enframing that he describes, and second, more specific to the g/t story, are the conceptual boundaries that function as a technology to frame a working definition of technology.

Heidegger’s explication of a far more comprehensive notion of technology was meant to move us away from a dominant and highly essentializing and determinist view of technology. A flawed definition of technology, in his estimation, was perhaps more problematic than technology itself. A misdirected view of technology interferes with our ability to think better about the intersection between technology, nature, and culture. The character of modern technology that he unfolds resonates with Taylor’s work on
Briefly, Heidegger’s thesis is that our modern relation to technology is wholly instrumental, but he means this in a much larger way than an overreliance on machines. The core problem is that humans are (as wholly part of the natural world that technologies are increasingly used to control) in danger of being subsumed by technology in part because we misunderstand what technology is as well as our own ontological relationship to technology.

Using Heidegger’s notion of technology, I recast the g/t story as a functioning technology rather than simply a descriptive or explanatory narrative. That is, in significant ways, the g/t story is wholly bound up in, as well as promotes, an instrumentalization that is technologically and epistemologically facilitated. Conceptualizing the g/t story as a social imaginary in chapter four made it possible to illuminate a set of background imaginaries upon which the g/t story depends. Drawing on enframing as the essence of modern technology, as well as Taylor’s deconstruction of our epistemological enframing it becomes easier to see that the g/t story mirrors a contemporary epistemological and technological enframing. Thus, this g/t story is more than a descriptive narrative of women, technology, and equity. The story both depends upon and builds the subjects, objects, and beliefs through which we are able to perceive the techno-social world, and it

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54 It is not possible for me, in this dissertation, to characterize the ways in which Heidegger’s ideas are foundational to the range of scholars that I draw on, but his work is at the core of most of this work that steps outside the dominant Western notions of knowing and understanding. Some feminist scholarship may situate itself outside this framework, but this is not an argument that I will pursue or defend in this dissertation.

55 This analysis has some connection as well to Foucault’s work on disciplines and technologies of the self and I will discuss this further in a subsequent chapter.
does this in part, through an instrumentalizing conception of technology, of which we are a part.

Throughout the story are statements that distinguish between gendered, tool, and play orientations to technology and the tool-toy divide is a common focus. The AAUW (2000) states: “Girls approach the computer as a ‘tool’ useful primarily for what it can do; boys more often view the computer as a ‘toy’” (p. 9). This tool-toy orientation is taken to reflect how boys and girls relate differently to computers such that girls are described as having a more instrumental, and thus limited, relationship to technology. This attribution has two features. First is a framework that defines technology quite narrowly as tools and second, a failure to recognize the ways in which an instrumental epistemology reflects our broad enframing within a technological understanding of being that allows the tool-toy description to function, credibly, in the story.

The underlying instrumentality of the g/t story itself remains below the surface, as when the AAUW uses this tool-toy framework to distinguish between girls and boys and their interests and abilities.

These girls’ descriptions of what boys are doing with technology are missing some very important elements. There is strong value in boys’ activities that girls are quick to denigrate. For example, there is intellectual importance to getting to understand computers from the “inside out” and developing skills and an intuitive feel for programming. There is intellectual value in tinkering with technology... it is also clear that getting girls involved with computing will require overcoming resistance based on their negative feelings about getting involved with the machine “for itself.” (2000, p. 9)

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56 This is in part, Turkle’s conception in "Computer Reticence" and is an idea expanded on in various g/t micro stories.
This toy-tinkering orientation is taken to reflect a condition of clearly delineated gendered differences in development or dispositions, but this misses the ways that such beliefs act as a functioning technology to reflect an underlying, instrumentalizing human capital model. These kinds of narratives reveal how means-ends rationality permeates how we think about not only technology, but also each other. The idea promoted in the above passage is that even if girls have different interests, there is reason to reshape these interests to facilitate the greater project of getting girls interested in computing. Preceding this argument is the punctual self, available to be re-molded.

The problem of the underrepresentation of girls and women in computing is constructed to be a problem of human capital development; the idea that passes as normal is that persons can be revised to better serve national interests—as capital rather than as a community of citizens. Girls and women are one of the available resources to be harnessed for a particular purpose. Once the “technology” is found that will more predictably engage girls in computing, these human “resources” can be placed into service. This is one way the g/t story functions as a technology. It is one expression of the ways in which we are all resources in a larger instrumental project.57 Within the story, this relationship is also taken to be normal.

Nationwide movements...seek to identify, pilot, and spread promising and effective practices. This new approach asks what works, rather than why it works. Mirroring the distinction between scientific efforts to know or understand, and engineering efforts to make or do, we see a shift away from the science and toward the engineering of computing’s gender balance. (Cohoon & Aspray, 2006b, p. 471)

57 Scholars in various ways describe this “project.” Some, such as Wendy Brown (2005, 2006) hone in on neoliberalism whereas Ulrich Beck (1992; Beck, Gibbons, & Lash, 1994) characterizes a risk society and I discuss both in chapter 8.
When humans are conceived as resources—capital—this reflects the kind of relationship that Heidegger was concerned with. This was his way of characterizing the dominance of a means-end and value-neutral understanding of technology (and of humanity) as our modern, primary relation to technology (and again, humanity). Our self-understanding is, in essence, technological.

Presented in this way, the instrumental use of humans may seem a bit disconcerting; why do we not protest? The following passage suggests how the relationship is blurred to intimately connect technological and social progress:

Information and communication technologies could give a major boost to the economic, political and social empowerment of women, and the promotion of gender equality....Socially and culturally constructed gender roles and relationships remain a cross-cutting element in shaping (and in this case, limiting) the capacity of women and men to participate on equal terms in the Information Society. (Primo, 2003, p. 9)

There is a conflation of technologies and social liberation and empowerment, as if this connection is itself going to reshape society. Technology is promoted as the new hope for achieving equality in the Age of Information. However, this democratic optimism is only a partial view. A somewhat different picture is evident in the NSF 2007 funding prospectus:

The program seeks to broaden the participation of girls and women in all fields of science, technology, engineering, and mathematics (STEM) education...that will lead to a larger and more diverse domestic science and engineering workforce. (p. 2)

This passage has a different tone and emphasis. Increasing the numbers of women in STEM fields is not simply about bettering some women’s opportunities, it must also be read more specifically as fulfilling a national need. Much of the engineering forecasted is of women rather than technological tools and this is rather explicit in the NSF’s narrative:
“The program for Research on Gender in Science and Engineering (GSE) seeks to build resources—developing the nation's knowledge capital, social capital, and human capital” (p. 8). Here, women are explicitly described as capital and resources, illustrating the ways in which humans become “normally” constituted in the same instrumental terms as oil and other tradable or usable resources. This thinking is also evident in The National Academy of Sciences report *Rising Above the Gathering Storm* (National Research Council, 2007):

> An educated, innovative, motivated workforce—human capital—is the most precious resource of any country in this new, flat world. Yet there is widespread concern about our K-12 science and mathematics education system, the foundation of that human capital in today’s global economy. (p. 30)

This idea, that girls and women are available as resources to be controlled and reshaped is but an instance of our larger technological enframing. Yet, it is through such “discursive” technologies that a technological relationship to the world and to each other has become our “truth of the world.” We are bound up in this technological story (itself a kind of imaginary) and this is the relationship that Heidegger calls our enframing (1977).

**Enframed in Difference**

Without some significance attached to differences between genders, there would be little reason to worry about the g/t relationship. Difference is a key lens through which we see the world around us—men from women, black from white, western from eastern, geek from jock, and so on. The question is what to make of these differences. Within the g/t

58 Dewey (and Bruce, Pacey, Franklin, among others) has a different ontological perspective on technology that I will reserve for a later chapter. These views are not incompatible with what Heidegger lays out, but they do seem to head in a different direction that is not particularly useful here.
story, differences denote well-bounded categories such as girls-women, boys-men, tools-toys, and gender-race-class and a somewhat more transparent and ambiguous us-them when global competitiveness is factored in women’s underrepresentation. The problem normally of concern is how to better identify, articulate, qualify, and quantify these differences.

What is it about this notion of difference that has us thinking that sifting and sorting based on oppositions is the appropriate path of inquiry? Moreover, what challenges follow this way of thinking, given that one of the great debates of late modernism has been over this question of difference? Despite such long-present concerns, g/t researchers tend to stay clear of the kinds of ambiguities that such questions provoke and instead view the problem of locating and explaining differences as a methods problem—it is a conception enframed by a singular, dominant notion of difference. What follows is a simplified exposition of the kinds of questions that Derrida, Irigaray, and Cornell have grappled with, the latter two more specifically concerned with sex and gender. Interpreting Derrida (and somewhat less so, Irigaray) is a path fraught with controversy and uncertainty; my interpretation borrows from Cornell’s Beyond Accommodation (1999). Culling from Derrida and Irigaray, she states “Woman, the feminine, is what cannot be captured” (p. 141). Her argument is with both MacKinnon and Gilligan, but my concern is the latter because Gilligan’s book, In a Different Voice (1982, 1993) has been so central to the meta g/t story. Gilligan’s thesis was that women have a different moral compass than do men. Importantly, she argued that it is not inferior, merely (but significantly) different. Equal status for this different view of justice and ethics was Gilligan’s aim.
The g/t story has always been about difference and—on the surface—it appears that the story has been theoretically sensitive in articulating differences by shifting over the years from a focus on biological sex to refocus on gender, and more recently, open to adding to the mix race, class, ethnicity, and disability (to name the most prominent categories). Gilligan’s work has grounded these conceptions and thus, the g/t story is ultimately modeled on an understanding of difference as an essential and largely static subjectivity or identity trait. While not always explicitly cited, Gilligan’s influence is evident in the ways researchers pursue, use, and interpret girls and women’s perspectives on computing.

We found that girls observe and describe strong gender differences but do not have a language with which to talk about them. The result is that girls are likely to express bewilderment and confusion about how they are different in their attitudes and abilities than boys. In girls’ efforts to find a perspective from which to talk about gender differences, they often position themselves as morally or socially more evolved than boys who, they tell us, enjoy “taking things apart” and interacting with “machines.” (AAUW, 2000, pp. 7-8)

If there is a background assumption driving this statement, it is descended from Gilligan.

The problem is not difference per se, it is finding the right way of describing that difference.

According to Cornell (1999), Derrida’s understanding of différance is that of “a ‘general economy’ [that] can only be demonstrated within the particular context” (p. 140). This primacy of context situates and problematizes any idea of “the male and the female as unshakable biological entities” that can be used to systematize a universality of difference (p. 140). The problem of sex and gender difference is manifest in the way either is used to

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59 Cornell’s concern was MacKinnon’s framing of a legal argument and how she defines the terms of debate by focusing on the problem of a masculinized norm.
paint a reality of women’s experience and identity quite broadly, without regard to individual women. Irigaray (Cornell, 1999; Irigaray, 1985), drawing from Derrida, made this problem her target, arguing that articulations of these kinds of sex or gender differences become just another way of setting up the rules of belonging or not belonging—in essence fostering new hierarchies by conceiving difference as a fixed condition.

Cornell (1999) explains Derrida’s contribution as follows: “Différance...is not reducible to either an empirical or a normative concept of relational difference. Nor is a différance meant to indicate the empirical difference between the sexes as they are now defined by the gender divide” (p. 139). Cornell’s interest is whether, and in what form, difference matters. For MacKinnon, Gilligan, and the g/t story, difference describes a fixed set of differences between sexes and genders where equalizing the values ascribed to differences is the aim.

This is what Cornell and Irigaray resist. In returning to a kind of biological essentialism that had been superseded by cultural feminisms’ focus on gender, Cornell and Irigaray want to recognize relationality, where neither the masculine nor the feminine can signify an independent essence or lack. Any lack is only in relation to the other.

The intertwinement of the masculine and the feminine belies the very structure that would define one apart from the other as an ontological truth or one against the other, so that the masculine is privileged as the self-determining term that unites the pair. The feminine as Other remains. (Cornell, 1999, p. 143)

Differences, yes, but in Irigaray’s re-imagining this does not end in oppositions that always seem to reduce the woman to an inferior position. Irigaray imagines the feminine as significant but in an “alliance beyond the master/slave dichotomy...as the threshold located in the specificity of our desire for peace” (p. 145). The meta g/t story relies on women as
the other who will bring a more humanizing set of values to technology. In the g/t story, women’s value orientation is what sets them apart.

The drive to identify and accommodate a clear m-f difference becomes a hurdle within the g/t story. For example, as the AAUW (2000) tries to come to terms with gendered approaches to software or computer games, they trace a number of conflicting positions. Should more games be like Barbie Fashion Designer, be more gender neutral, or model particular gendered characteristics? Each option builds on a deep belief that difference itself is of great significance, and thus, none of these stances towards gendered games is significantly different from the others. Interviews conducted by the AAUW commissioners also yielded some differing opinions from teachers.

It is not enough to make “token gestures” in software—as one teacher surveyed put it, “tossing a token female or black” into science software. As a solution to the problem, some teachers advocate the use of “neuter” characters...What’s wrong with making the main character in these software packages be neuter?” (p. 31)

Another teacher has a different take on difference:

_The problem with most gender issues within educational software is that they are gender-neutral. I teach eighth grade. [My students] are at an age when gender is something they are thinking about and confused about. The software should be addressing their needs instead of utilizing non-gendered beings such as animals and other animated creatures. Gender differences are not being given their just due. The students appreciate discussing the differences and negotiating roles. Even math programs can address differences._

_teacher survey, on gender and software._ (p. 31; italics in original)

It is less important how the AAUW commissioners use these reports (to argue that software selections in schools should serve multiple learning styles and promote learners as

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60 Mattel published this software “game” in 1996. It was the first entertainment software to be widely successful with girls. It was however, controversial amongst women and educators.
designers). More significant is the way these interviews with teachers (and the AAUW commissioners) display a deep belief that gender difference is on the one hand phenomenally important and on the other hand, is connected with software in often incommensurable ways. However, in all these configurations, computing software is expected to fix a problem with gender.

Is the difference that Irigaray and Cornell imagine the same as that promoted by the g/t story? In the latter, difference reflects a view wherein women can be reduced to an idea or a set of attitudes and dispositions. The g/t story has, since Gilligan, fully separated itself from a dependence on biological sex difference yet has instead wholly embraced an idea of gender difference that is often grounded in social constructivism. However, there remains an embedded psychological and behavioral essentialism so that even what is socially constructed is given a determinist character. In part, this is because gendered subjectivities socially constructed in girlhood tend to be portrayed as endpoints in a woman’s trajectory. On the one hand, gender is argued to be socially constructed and on the other, girls and women are broadly differentiated from boys and men by explicating psychologies and behaviors that are characterized as static and innately different. Moreover, the aim of the g/t story is really to make the girls more like the boys, even if the specifics of what is to be realigned shifts. Across the meta story there is an “appeal to what women are as the basis for feminine difference” that derives from Gilligan (Cornell, 1999, p. 146). Irigaray and Cornell have a completely different vision where “What the feminine ‘is,’ is not the question” (p. 146). For both, the feminine is evoked in writing that itself must not be determining or merely delineating a fixed reality. However, this is just what the g/t story
does. The significant limitation of the g/t story is that it continues our enframing through thinking and writing within a prescriptive and fixed idea of difference.

**Perceptual Enframing**

Haraway (1991b) argues that women put themselves at risk, and misconstrue science and technology, distancing themselves from either, by believing that they do not belong because science is for men.\(^61\) The predominance of Western, white, masculine epistemology and technoscience is due to the ways in which Enlightenment derived science has constituted “non-scientists” so far outside the field of relevance that they became invisible. The problem as Haraway sees it is an ideal of objectivity promoted by Enlightenment science. She does however remain in favor of a strong objectivity, conceived from a different perspective. While she believes in science, she argues that the kinds of knowledge that mainstream science’s objectivity has promoted are faulty. The problem is not technoscience or objectivity *per se*, but the hegemonic, masculinist, objectivist, and disengaged lens through which mainstream science has privileged a god-like position of the knower.\(^62\) Moreover, this knower has been ordained through privileging practices and positions that render other knowers as not possibly reliable or relevant (Haraway, 1997). The epistemological problem of objectivity that Haraway (1991a, 1997) takes to task suggests another facet relevant to understanding the depth of our enframing. Through

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\(^61\) She does not seem to make a clear distinction between science and technology, as do others, and I am not going to make that distinction for her, nor is it particularly relevant to my thesis.

\(^62\) Some other scholars who have written, variously, on these kinds of ideas include Sandra Harding, Evelyn Fox-Keller, Knorr-Cetina, Dorothy Smith, and Bruno Latour.
her articulation of situated knowledges, Haraway identifies a perspective that reconnects knowledge and the knower and posits a more objective objectivity. Situated knowledge (1991a) was in part an argument with feminist thinking that wanted to debunk objectivity by arguing for a highly relativist social constructivism. Instead, she relocated objectivity in an alternative epistemological position, within the feminine and more aligned with the body, concern for community, and respectful of the localized contexts of meaning and experience.63 I do not want to get caught up here in the debates over what technoscience knowledge should or could look like. My interest is much more contained—to identify some theoretical lenses useful for understanding something about the ways the g/t story itself is framed and what sneaks in under the radar (or is left out) because of epistemological assumptions made by various stakeholders about what we observe.

Situated knowledge (Haraway, 1991a) repositions scientific knowledge and objectivity, as well as feminist critiques of science, to challenge beliefs that women should stand aloof from technoscience. Rethinking objectivity itself and the positions from which we can objectively know the world, Haraway challenged feminist technoscience scholars’ reticence and their notions of a highly localized objectivity by arguing that objectivity and the knower’s position are intimately interconnected and inseparable. Notably, Haraway’s

63 See Sandra Harding or Nancy Hartsock (for example) for some of the work that Haraway was challenging. Maria Mies insisted that women—to ensure their own well-being and the feminine itself—should stay clear of an always exploitive and domineering technology, and eco-feminism views technology as violent and patriarchal. Arguing a polar opposite, Sadie Plant’s 1998 essay, Zeros and Ones: Digital Women and the New Technoculture, proposed that the new digital technologies were far more aligned with women’s innate abilities, and therefore, women could (and should) take these over as their own; the computer offered a way out of patriarchal domination.
portrayal of what falls under the domain of “science” is more expansive than is Taylor’s (1995), in that she explicitly includes the social sciences. Whereas Taylor’s project was, in part, to distinguish the social sciences from the natural, Haraway’s call for “some enforceable, reliable accounts of things not reducible to power moves and agonistic [sic], high status games of rhetoric or to scientistic, positivist arrogance” was intended as a criticism of how normalized, scientific ways of knowledge building about “genes, social classes, elementary particles, genders, races, or texts” have given us a misconceived construal of objectivity (1991a, p. 188), even in the natural sciences.

Haraway’s criticisms of feminist anti-epistemology and anti-science or technology discourses highlighted the ways these aimed to have it both ways: a radical constructivist notion of reality and a feminist version of objectivity. I am not going to attempt to sort through her “unifying” the social and human sciences and the natural sciences. Instead, her ideas about what constitutes objective knowledge and the ontological positions from whence we know are sufficiently interesting to be of use here without getting diverted by these other debates. Haraway’s argument is that the originating locus of the knower’s perception must be integral to any scientifically useful notion of objectivity. In her words, “feminist objectivity means quite simply situated knowledges” (1991a, p. 188). The core idea is that what we know is dependent upon what we “see,” which in turn frames what we can know. Hence, vision is always partial and “only partial perspective promises objective vision” (p. 190). Normal science’s god-like, all-seeing and all-knowing perceptual position that insists on disengagement is a false epistemological position, producing a flawed objectivity.
One of the emerging notions in the g/t story, particularly in recent literature reviews is that the relationship between gender and technology is “under theorized.” One of the things that slips by, however, is a notion of theory that itself is heavily bound to our epistemological, instrumental, differentiated, and perceptual enframing. Heidegger (1977), Taylor (1995, 2004), Cornell (1999), and Haraway (1991a, 1997) each articulate an aspect of enframing that is bound to a technocratic disposition fed by representationalism and a value-neutral objectivity. Taylor and Heidegger’s analyses remain in many ways cerebral, abstracted arguments, largely framed around the centrality of language as the locus of human experience and knowing. Irigaray and Cornell take issue with a fixed and oppositional difference. Taking a different angle, Haraway draws out a metaphor of human vision (particularly as it is enhanced by technological extensions to our human sensory faculties) to show how knowledge is always partial and linked to a particular sensory lens, and in this way, the knower—as the objective lens—is responsible for the production of knowledge; this knowledge can only be situated and thus, partial. Continuing a myth that the knower is independent of perceptions and knowledge produces knowledge that is more than limited. As she explains it, this vision is destructively aggressive in its reach and power.

Vision in this technological feast becomes unregulated gluttony; all perspective gives way to infinitely mobile vision, which no longer seems just mythically about the god-trick of seeing everything from nowhere, but to have put the myth into ordinary practice. And like the god-trick, this eye fucks the world to make techno-monsters. (Haraway, 1991a, p. 189)

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64 This is an explicit argument made by Cohoon & Aspray (2006) and Singh, Allen, Scheckler, & Darlington (2007).
Concerns over representationalism, atomism, and morally neutral objectivity focus both Haraway and Taylor’s work, although Haraway’s critique is less measured and more far-reaching in the ways she explicitly moves beyond the mind and language as a center of knowledge production to highlight the significance of localized sight for the construction of knowledge. As she states, “Objectivity turns out to be about particular and specific embodiment, and definitely not about the false vision promising transcendence of all limits and responsibility” (p. 189-190).

Disembodied vision is a view from nowhere that claims an “infinite vision” to transcend any limits or responsibility for the knowledge it produces or disseminates (Haraway, 1991a, p. 189). Some might argue that the g/t story does something different when it attends to the personal experiences of girls and women as they navigate computer cultures. The question is whether these subjective, experiential accounts are a kind of situated knowledge or just another incarnation of a god’s eye view and its false (insufficient, limiting) objectivity. The problem in these kinds of g/t stories is that subjective reports are an aspect of representationalism. However, these subjective accounts are not at all what Haraway is getting at with her situated knowledge. On the contrary, I think she is focused on the researcher’s lens and the knower as producer of scientific knowledge. Taking a situated perspective exposes empirical, subjective accounts to be problematically logged and analyzed by a disengaged and far too distant observer; this is what yields a false objectivity.

The extent of the g/t story’s perceptual enframing is evident in Cohoon and Aspray’s (2006a) claim that “much of what has been published is based on personal
experience or observation of a single case, rather than being grounded in empirical
evidence that can be generalized” (p. 137). This statement illustrates a common tension.
On the one hand is a belief in empirical evidence, but this evidence, to be useful and true,
must be bigger than it is. Local knowledge and experience must be filtered through the
disengaged-disembodied-diffuse observer to be promotable to a god’s eye, scientific
objectivity, a move that both reflects and molds knowledge through a wide-ranging belief in
representationalism and instrumentalized knowledge.

The Constituted Outsider

Haraway’s (1991a, 1997) claim is that certain subjects are set outside the visual
range of mainstream scientific epistemologies. Some knowledges or bodies remain outside
these privileged spaces, and Haraway argues that this alterity is an outcome of the ways that
the observational field is populated with objects that are seen and counted—or not seen
and not counted—through a limiting and biased gaze. An Enlightenment derived modest
witness is the idealized scientist-observer that promotes an idealizing objectivity and
hegemonic epistemology. Modest witnessing in turn delineates the constituted outsider
(CO). 65

65 Judith Butler describes the CO in Bodies that Matter (1993). For her, any meanings
ascribed to bodies are constructions. However, constructions are not benign and within a
construction are other “domain[s] of unthinkable, abject, unlivable bodies” that are the
“excluded and illegible domain”(p. xi). The constitutive outside is unintelligible because it
exists outside what has been constituted the legible terms within which to read or see
subjects and their domains. Derrida also develops this idea, which Bowker & Star (2000)
use to explain the way in which an “other’ category”—while invisible—is what makes
possible the “whole social architecture”(p. 301). Thus, the very category of gender and
The gaze that mythically inscribes all the marked bodies, that makes the unmarked category claim the power to see and not be seen, to represent while escaping representation. This gaze signifies the unmarked positions of Man and White, one of the many nasty tones of the world [sic] objectivity to feminist ears in scientific and technological, late industrial, militarized, racist and male dominant societies. (Haraway, 1991a, p. 188)

This powerful gaze has long staked a claim as apolitical and non-judgmental: the foundation of independent science. The Enlightenment witness is modest in its stance as outside the scientific field; it is, however, immodest in its claims made for objectivity, representational knowledge, and the reach of this science and knowledge. By now this “neutral” position has faced significant challenges from a host of prominent scholars across the social sciences and humanities. Why is it then that this gaze persists so strongly in the g/t story? As an example, the following passage describes a common focus in the literature:

By middle and high school years, many boys have spent endless hours, alone or with their friends, playing games, manipulating the games so that they do what they want them to do, and in some cases delving into the programming behind the games. Many girls are also interested in games but not generally with the same focus. (Margolis & Fisher, 2002, p. 40)

On the surface, this example relates a particular case of girls having a different experience with computer gaming, and this seems to make sense within the larger, encompassing meta g/t story. Not explicitly evident, but ultimately essential, is the gaze that recognizes appropriate objects of study. Where does this gaze emanate from? The third person voice suggests that it relies on a culling of some girls’ statements, but it is not readily apparent which girls are under the lens. We also do not know which boys, but there is a lot of detail about what, where, and with whom the boys’ game play unfolds. A description of the girls’ technology reflects the way that we normatively segment society into classifications rather than a wealth of intersectional and constantly moving plurality.
playing lacks a similar richness. Who decides that the boys get good details whereas the
girls are merely noted as outside this male norm? It does not really matter for the moment
whether the boys or the girls might have promoted either description, in subjective
accounts or even, whether the researchers are male or female. More significant is that what
is represented has been filtered by an independent observer who lays claim on the one
hand to a “modesty” and on the other, acts as the sole, thus immodest, filtering agent.
What is assumed is that this observer is appropriately distant and disengaged (apart from
an interest in getting girls into computing). However, despite a presumption of modesty,
this is not a weak gaze; it quite clearly lays out some parameters for measuring and
positioning subjects. An individual or groups’ degree of focus (which may also infer
passion) is one, but being part of the norm is the important signifier and the gaze
articulates this norm. In the above quote, “many girls” are located outside the normal field.
What happened to the other girls?\textsuperscript{66} The CO refers to those objects that remain outside the
observational field, not of their own accord, but as an outcome of exclusionary knowledge
building practices.

The CO is an important position and production of the g/t story, and thus bears
some elaboration. Beauvoir’s argument that women are always cast as an other to the male
norm brought the “woman as outsider” problem to the table. Haraway (1997), building on
her own earlier criticisms of disengaged objectivity, uses the notion of “modest witnessing”
to illuminate two differently valued and positioned modest witnesses in Enlightenment

\textsuperscript{66} Google is less of a modest witness: A search for girl gamers gives a different story. One I
particularly liked describes “The top 10 myths about girl gamers” at
science practices. At the top were the scientists: “transparent, self-invisible, legitimate witnesses to matters of fact” and below, the rest of us—men and women who are “made simply invisible, removed from the scene of action” (p. 29). Modest witnessing, as a core practice of Enlightenment technoscience, eliminates from the scientific arena any potential other or complicating witnesses, especially common knowledge. In particular, gender and race were easy to exclude from the field because women and non-whites were not scientists and thus, had no right to witness; in being absent, these also were fixed into categories and identities:

The effect of the missing analysis is to treat race and gender, at best, as a question of empirical, preformed beings who are present or absent at the scene of action but are not generically constituted in the practices choreographed in the new theaters of persuasion.” (p. 29)

Within the boundaries of official technoscience practices and spaces: “modest men were to be self-invisible, transparent, so that their reports would not be polluted by the body” thus providing “credibility to their descriptions of other bodies and minimiz[ing] critical attention to their own. This is a crucial epistemological move in the grounding of several centuries of race, sex, and class discourses as objective scientific reports” (p. 32).

Of what significance is this constituted outsider in reading the g/t story? Thirty years of research and stories have relied on a vast array of constructions wherein women have been described outside a male norm. First, it was that women were thought to be differently constituted in math and science abilities, in their competitive drive, and so on.

A version of this persists, as seen in this quote:

Almost every woman in our study was enthusiastic about learning computer science. ... Yet most came to computer science later, in high school, through being “math and science” students who enjoyed problem solving, doing puzzles,
exercising logical thinking skills, or taking a high school programming class. Most did not have the same experience of falling in love at an early age that many boys did. Early exploration into the computer is the exception among the women. (Margolis & Fisher, 2002, p. 18).

More recently, a schema built around ontologically different m-f values orientations frames conceptions of women and men’s relationships to computing and to society, and this is articulated in ways such as the following:

Yet even among these computing-oriented women, we heard about values and preferences that were distinct from those of most male computer science students. (p. 49)

Often, boys and men are described as ruling a computing culture that makes it uncomfortable for women to participate.

The study of computer science education can be seen as a microcosm of how a realm of power can be claimed by one group of people, relegating others to outsiders. (p. 6)

Beginning around 2007, researchers started to argue that the category of woman has overly generalized women. Singh, Allen, Scheckler, and Darlington (2007) make this argument in the following:

The literature on women’s enrollment and retention in computer science majors begs the question of ‘which women’...Thus, women in computer-related fields are not a monolithic group, do not bring the same kinds of economic and social resources to the academic arena, and do not face the same kinds of pressures to succeed. (p. 517)

On the one hand, there is opportunity in this intent to open up the group of women by opening up the gaze, but even Singh et al. shoot themselves in the proverbial foot when they later argue that “small, nonrandom samples and single-site case studies...do not yet present in-depth analyses of the complex interplay of forces that affect women’s decisions.” (p. 518) The contradiction escalates when they argue for methodologies that ultimately rely
on long-standing methods of the modest witness, which, as I have argued, can only reify
some version of the CO.

Methodological triangulation of data allows for in-depth theorizing and the
generation of new concepts...
...Quantitative research that is explanatory and tests a priori hypotheses will allow
for theory development and greater generalizability of results. (p. 518)

Another conflict is evident in terms of which women and which fields are considered
significant and in debates over whether progress has been made in bridging the gender gap.
A 2008 column in the New York Times (Stross) suggests some dilemmas. Citing a
conversation with Justine Cassell (a professor of computer science and communications at
Northwestern and a prominent thinker on g/t), Stross explains competing conceptions of
the state of g/t research.

Some people in the field still believed that the answer to reversing declining
enrollment was building the right game. Another school of thought is what she
calls the “we won” claim because women have entered computer-related fields like
Web site design that are not traditional computer science. Ms. Cassell points out
that it’s not much of a victory, however. The pay is considerably less than in
software engineering and the work has less influence on how computers are used,
and whether this actually accounts for the diminishing numbers of female
computer science majors remains unproved. (para. 9)

The first idea, focused around games as an intervention, holds on to the notion that the
gap is an artifact of computing experiences that have kept women out of the game, so to
speak. Cassell’s second, alternative thesis recognizes that Web designers and other applied
computing professionals have made significant inroads, but she clearly dismisses these as
less significant activities than computer science careers. Hers is a position not unlike the
exclusionary modest witness who discounts not only certain types of subjects, but also their
meaning and significance.\(^{67}\)

What makes telling the g/t story possible is a pervasive and black-boxed constituted
outsider. Certainly there is some value in highlighting the various inequities that different
groups or individuals face, but it is also true that the CO position just as easily makes it
possible to discount and displace objects who have been marginalized through scientific
methods and lenses that make broad claims based on a highly constructed form of
objectivity and knowing. An exclusionary objectivity and epistemology enhance the
technological character of the g/t story, for both good and less desirable outcomes and
understandings. That is, the lenses of our enframing(s) are also the tools of constituting
subjects and objects in ways that do not merely mirror reality; they allow and disallow
selected subjects, objects, lenses, or knowledges.

On the one hand is an epistemology and perceptual lens that claims to depend on a
neutral and broadly encompassing objectivity; on the other, this objectivity is instrumental
and marks some subjects as outsiders. In this way, the epistemological tradition of modest
witnessing casts not only the objects of research but also, non-standard observers, so far
outside the scientific field that they and their knowledge, experiences, and perceptual
lenses are not only considered second tier, they are negated through a lack of presence.

\(^{67}\) Arguments that users are more central than has been recognized are found in, for
construction of users and technology*. Cambridge, MA & London: MIT Press; Oldenziel, R.
(2001). Man the maker, woman the consumer: The consumption junction revisited. In A.
N. H. Creager, E. Lunbeck & L. Schiebinger (Eds.), *Feminism in twentieth century science,
Conclusion (A Technological Story)

Heidegger, Taylor, Derrida, Cornell, Irigaray, and Haraway, in their various arguments, each provide a lens useful for illuminating the ways in which our theoretical and conceptual enframing precedes and infuses the g/t story. If the g/t story is a descriptive story, what it describes is filtered through a four-faceted enframing wherein our technological, epistemological, differentiating, and perceptual orientation to the world both shapes how the g/t story is constructed and why it takes this particular form. A technocratic understanding of being and knowing promotes an epistemology reliant on a separation of mind and body where knowledge and knowing have a bi-directional instrumentality (that is, they are meant to shape and mirror an objective reality).

Gender-technology researchers and scholars argue that a more robust objectivity, better theory, and better adherence to experimental and rigorous scientific methods will help solve the gender gap in computing. However, upon closer examination it becomes increasingly apparent that the problem is instead the extent of our epistemological and technological enframing. The meta g/t story is limited in and through its epistemological and technological foundations. There is then, a kind of paradox that unfolds in the way the g/t story—meant to describe and overcome perceived problems of subjects, objects, or opportunities—is itself trapped within a more transparent set of technical, epistemological, differentiating, and perceptual boundaries.

I have belabored these points of methodology, epistemology, and conceptualization schemas, for which there is no easy solution (which is the point of attending to them) to ultimately question the prudence and value of reductivism. The reason to pursue more
complexity is to see what else is going on in the g/t story, beyond what appears in conventional readings. When read as more than a story about inequity and access to opportunity, what “value” does this so-called objective story offer to girls, women, and society? Is objectivity as an end in itself, or are there additional implications in telling—and retelling—the g/t story as one of underrepresentation and its effects?

Objectivity, in the g/t story, has an instrumental function such that the meta story, constructed within the limitations of our epistemological and technological enframing is, ultimately, a technology that both reflects and promotes an instrumental understanding of technology as well as of girls and women as technological resources. Epistemology and the constituted outsider are transparent technologies of a four-faceted enframing.

This g/t story reflects the underlying conceptual frameworks through which we imagine our world and our subjective positions within this world or our experiences. In this enframing, an embodied imagination is stifled; it is “disabled” in attempts to transform social inequities that have been shaped by deeply held and black-boxed beliefs about scientific truth, progress, the workings of social and intellectual hierarchies, and by subscribing to a reductivist epistemology and exclusionary witnessing in producing knowledge and thus bounding possibilities. In the next chapter, I delve into some additional subliminal technologies that feed a contemporary state of anxiety and examine how the g/t story is positioned to manage these anxieties.
Facet 7

Subliminal Social-Political Technologies

No social, human, or spiritual fact is so important as the fact of technique in the modern world. (The Technological Society, Ellul, 1964, p. 3)

The g/t story is strategically positioned and unreflexively used to manage a set of modern anxieties such that gender or women are co-opted to stand between traditions and values and a generalized societal malaise prompted by a seemingly unfettered, and oftentimes frightening, technological progress. Mediating both a fear and fascination with technological innovation, the meta g/t story functions as a technology that reinforces a number of expected norms regarding societal expectations of women or men, the use and value of education and disciplines, of research, and what scientific, educational research should look like and accomplish. To see how the story functions in this way requires bringing to the surface several social-political-intellectual practices that themselves function as “technologies” that both consciously and subliminally define, construct, and constrain objects, subjects, knowledge, and relationships.68

These subliminal technologies are largely taken-for-granted, yet they ground the central conceptual, organizing, and representational premises of the meta g/t story. Through these hidden technologies, the constructs of gender, technology, knowledge, research, and education are normalized and embedded as themselves a kind of technology that educational research and related policy agendas have come to rely on. In addition, these fundamental technologies and organizing constructs serve a number of competing

68 Although I will deconstruct ‘technology’ in depth as the chapter unfolds, I am using it here to refer both to tools (particularly the computer) and to a cultural practice and system that reflects the dominant, modern, Western, mindset.
interests regarding the role of women and technology in education and in society more broadly. The transparency, ubiquity, and taken-for-granted character of these transparent technologies subliminally grounds and amplifies our contemporary culture of anxiety. While the g/t story is a technology used to mediate anxieties over the encroaching technorationality of society and its social institutions, these anxieties derive from the very technologies we have idealized and promoted as the best ways to think about our situations in the world.

Reflecting more than simply concerns over equity or a diverse workforce, a (post)modern anxiety drives much of the g/t story, such that this story may be understood as a particular response to the uniquely disruptive emergence of the personal computer in the latter quarter of the 20th century. This was the computer—a new and wholly different kind of machine—as it has been articulated in and bound to multiple agendas and discourses that became increasingly important to education, markets, states, and individuals beginning in the early 1980s (e.g. Beck, 1992; Bowers, 1988; Brown, 2005; Sennett, 2004, October 23; Turkle, 1984, 1995).

Conventional approaches to studying the intersection of the computer, society, women, and education have largely focused on specific tools to understand their influence on social interactions, individual or group identities, learning, and so on. While these approaches have given us new and helpful insights, exclusively focusing on tools offers only a partial picture. In what follows, I largely leave aside material tools to instead examine a set of abstract subliminal technologies manifest as common, conceptual, discursive practices that in turn have shaped Western social-political-intellectual life through their
transparency. They frame the expected parameters of what is normal across a range of practices and beliefs. These “non-tool” technologies preface notions of how we think about and interact with our tangible tools.

Given the ways that the g/t story has been built via these subliminal socio-political-intellectual technologies over the last thirty years or so, the story may be seen as a product of and response to a set of anxieties, seemingly specific to computing, but that in reality mirror a greater and more profound anxiety that emanates from an unease with the increasingly techno-rational character of modern society. These anxieties reflect our extensive yet conflicted cultural relationship with the computer and technology that carries over into education and weaves back into society (e.g. Bromley & Apple, 1998; Franklin, 1990, 1999; Hickman, 2001; Illich, 1973; Pacey, 1983, 1989). I situate the g/t story within this socio-technological-policy-education complex and in this chapter examine three primary technologies: (a) a conceptual technology of binary thinking, (b) reductive conceptualizations of technology, and (c) the political technologies of neoliberalism and techno-rationality.69

A Conceptual Technology of Binary Thinking

Western epistemology is a technology for thinking in and through binary constructions (e.g. Derrida, 1978, 1997; Foucault, 1970, 1994, 1972, 1975, 1995; C.

69 In the next chapter I tackle disciplining technologies; constructing gendered objects; objectively constituting outsiders to technology; constituting objectivity as a technology; and uncovering a better objectivity. There may be others that are significant and I do not mean my list to be comprehensive.
Taylor, 1995; Wood & Bernasconi, 1988). This epistemology insists that we think through oppositions, reductions, representationalism, and a radical reflexivity. It is also a technology that insists on and provides the means for scientific objectivity, by keeping biases and beliefs of the observer out of knowledge constructions. In essence, Western epistemology is a technology that presumes disengagement is a normal state and that a thinker is independent of the knowledge she/he thinks. Fundamental to this technology of thinking is a conceptual separation of mind and body (understood as the legacy of Descartes).

The conceptual technology of binary thinking has sustained such primary oppositions as nature-culture, male-female, reason-affect, and more recently, sex-gender. Even as the possibility of such dichotomization has been hotly debated and deconstructed (Barad, Bowker & Star, Cornell, Colebrook, Derrida, Dewey, Foucault, etc.), these dichotomizing practices retain a broad intellectual and cultural cache. Standard thinking about g/t is transparently caught up in the web of this binary thinking. It seeds the dominant social imaginaries through which the g/t story is understood and circulated, yet mainstream epistemology offers little help for understanding how this happens or the significance of these formations, because the epistemology itself seems so normal and necessary.

Examining binarism to question this normal epistemology in turn makes it possible to re-examine essentializing classification practices that foreground the g/t story. These practices produce what have become, even if not intentionally so, reliable and stable
constructs of gender and technology. Deconstructing the binary layer illuminates how gender and technology tend to be conceptualized as if they are independent constructs, easily traced or measured (even if they are argued to be co-constructed). Moreover, reduction and opposition prepare gender and technology to be used in the intersections of knowledge and power. Binary reductions found across the g/t story are women-men; women-computing; rationality-interpretation; STEM-humanities; affect-reason; and so on.

Binary thinking is the dominant social-intellectual technology of the modern West. It is one of the transparent technologies through which the g/t story acquires the stature of a modern meta-narrative, as I suggested in Chapter 3. To reiterate, Lyotard (1979, 1984) argued that a narrative gains the aura of a meta-narrative when it is accepted as the carrier of important and universal perspectives regarding knowledge, truth, and social relations. A meta-narrative, taken to represent a significant and enduring truth, is embedded into the social-scientific library of explanations and understandings of the world.

The g/t story has taken on the character of a meta-narrative in the ways that it draws upon and promotes a set of conceptual unities around knowledge, science, difference, gender, technology, equity, and related concepts and constructs that have been essential in characterizing the persistence and import of the g/t relationship. In what follows, I extend and refine my analysis of this meta story by highlighting a number of other transparent and pervasive technologies that function to normalize practices and

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70 I do not mean to dismiss other studies or papers that have considered alternative and complicating ideas or positions (Lockheed, 1985). However, these do not reflect the thinking that drives the mainstream story and in fact, these alternatives seem to remain marginal in the larger dominant g/t story, an idea I return to later.

71 Other technologies will be explained later in the chapter.
beliefs and that in turn function as a kind of discursive or conceptual glue in making the g/t story appear coherent. These other technologies manifest as thinking or practices built from our social imaginaries and enframings.

Explicating Technology

Articulating “concepts” as social or intellectual technologies suggests that a more expansive yet precise consideration of technology is needed than the reductivist tool construct relied upon in the g/t story. Heidegger’s (1977) articulation of our modern technological enframing is a useful starting point for the ways that it characterizes our background understanding of being, but this too is only one lens onto how technology might be more thoroughly understood and situated as a complex social-cultural-political-cognitive-affective practice. Over the next pages, I discuss the problem of reducing technology to its instrumental nature and pursue other ideas for thinking about technology that better reflect the multiple and often conflicted ways in which we think about and are situated in relation to “technology.”
Conceptual reductions of technology. Reducing technology to only its tool and tool culture aspects is epistemologically useful—it provides something tangible to analyze and measure. This conceptual pruning makes it possible, for example, to quantify the underrepresentation of women in computing fields, thereby avoiding the messiness that a more complex rendering of technology would inflict. By confining technology to its instrumental essence, an illusion of control is maintained so that in a given g/t study, the variables of technology and gender are seemingly contained and constructs are neatly defined, making it possible to easily locate the technology. Expectations are for something akin to “the PC, the I-pod, mainframe computers, computer games,” and so on. However, in accommodating such demands for neat and precise definitions, much is lost—specifically, the highly nuanced character and reach of technology as well as a richness of concepts otherwise available for understanding how technology is implicated within the g/t story and infused in society on a grand social-political-experiential-existential scale.

More complex explication of the essence and workings of technology are essential if we are to move beyond the instrumental or constructivist explanations that have helped to sustain the working assumptions and frameworks of the g/t story. Bruce (1996; 1998), Foucault (1975, 1995, 1990), Franklin (1990, 1999), Heidegger (1977), Pacey (1983, 1989) and others have already done this, yet this kind of exposition is excluded from the meta g/t story. Expanding the “definition” of technology necessitates expanding the disciplinary bases from which we theorize or classify our interactions with technology. Needed is a way to think beyond technology as an isolatable construct with its own culture and mores. One way to do this is through philosophical and critical theory lenses that counter or
complicate the dominant psychological-behavioral-cognitive approaches taken by g/t researchers.

Expanding notions of how to think about technology opens up new kinds of questions. For example, it becomes more pressing to understand why is it that technology, in the g/t story, has been reduced to tools and tool culture. From this it becomes more evident that thinking about technology as something separate and distinct from our shared human experience and being-in-the-world is quite pervasive, yet also a flawed notion. There are multiple influences that serve to delimit conceptions of technology to its instrumental aspects, but once this is recognized, we more easily notice that other philosophical or cultural-sociological conceptions of technology have been rendered invisible (or marginalized).

The instrumental understanding of technology is the product of three phenomena: (a) a separation of science and technology from the humanities (e.g. Heidegger, 1977; Kuhn, 1962, 1996; Mitcham, 1994; Snow, 1965); (b) a reliance on an epistemological model of knowing that overly values reductivist practices and the expert knower (e.g. Appadurai, 1999, 2000; Klein, 2004; Helga Nowotny, 2003; C. Taylor, 1995; Wallerstein, 1997; Wallerstein & Gulbenkian Commission, 1996); and (c) a totalizing tool-focused notion of technology that mirrors the inherently instrumental nature and intentions of the g/t story. The construct of gender and this instrumentalized notion of technology intersect as the g/t story takes on an aura of a meta-narrative that aims to be broadly descriptive and explanatory. Instrumental conceptualizations of technology easily accommodate arguments that the descriptive and explanatory methods of g/t research have been insufficiently
rigorous. Tools, their culture, and procedural concerns over methods—rather than self-limiting conceptions of technology or methodology as technique—are argued to be the problems to fix.

When technology is articulated only as tools, this makes it seem as if the g/t story is a neutral and merely descriptive or explanatory narrative. Black-boxed is the way the meta story is constructed by promoting some beliefs or practices about technology while rendering others invisible, unwarrantable, or more emphatically, absent. One reason the workings of the meta story seem so natural is its conceptual blindness. We have become so comfortable with engineering, psychological, cognitive, and behaviorist driven conceptions of technology that this has made it seem most appropriate to similarly reduce other concepts and constructs that play out in the g/t story.

Reductivist definitions and concepts mask the ways in which technology could be better understood as something both concrete and quite mysterious, more cultural-intellectual-existential practice than artifact. For many scholars, technology is a difficult term to pin down and any agreement on how to do so remains elusive. Philosophers and cultural theorists of technology have been pursuing such questions for quite some time, producing a vast store of scholarship that this study cannot do justice to in more than a cursory way. That said, in the following paragraphs I draw upon some key ideas, fully recognizing that this, too, is a bit reductivist and a simplification of a complex body of thinking that considers technology as it intersects with humans and their practices.

**Engineering views of technology.**

An individual relates himself in action to his society through the use of tools that he actively masters, or by which he is passively acted upon. To the degree that he
masters his tools, he can invest the world with his meaning; to the degree that he is mastered by his tools, the shape of the tool determines his own self-image. (Illich, 1973, p. 17)

Although quite critical of our technology driven, capitalist society, Illich’s criticisms of technology remain tied to a tool-based definition of technology. Mitcham (1994) tells us that engineering grounded the first philosophy of technology. This view frames technology within a mechanist model but it also extends this technological model as an emancipatory model for human thinking and society, for moving beyond the distractions and biases attached to bodies, emotions, and other non-technological processes. The engineering definition of technology is not limited to machines but extends to theories of knowledge and mind and is far too complex to elaborate here. For the purposes of my thesis, it suffices to note that within the fields of philosophy of technology, one of the ongoing controversies is whether, or to what degree, the mechanistic model should extend to humans, their activities and production, society, and nature. Technology is argued to be both the key to a humanizing, democratic society (Bacca cited in Mitcham, 1994, p. 34) or the antithesis of humanism and democracy. Advocating the former, Bunge’s definition is that “‘technosophy’ is only an aspect of a larger effort to explain reality in scientific-technological terms and to reformulate the humanities (philosophy and ethics) along scientific and technical lines” (cited in Mitcham, 1994, p. 37).

Conversely, Ellul (1964) argued that a dominance of mechanistic technique has expanded to become the driving conception of society across political, social, economic, and cognitive activities. Dewey’s thinking was more experiential and pragmatic and held that tools and instruments are “are the methods and means by which technological inquiry
takes place” (Dewey, cited in Hickman, 1990, p. 4). Perhaps the primary controversy is to what degree, and in what form, technology functions as an appropriate metaphor for human social, political, and economic relations or as a viable model of the human mind.

**Social constructivist & actor-network views of technology.**

“Technology [is] a culture that expresses and consolidates relations amongst men.” (Wajcman, 1991, p. 22)

Scholars across the humanities and sciences have argued two positions on how technologies unfold: (a) technologies and persons are social constructions and co-constructed or (b) humans and non-human organic actors, as well as non-organic actors (e.g. tools, artifacts in the physical world, and concepts), evolve in concert in a networked relationship that is both material and semiotic. Without getting deep into either position, the idea is that technologies do not blossom independently from a technological ether, but are an outcome of human input, thinking, and social-political-cultural relations that both frame and are changed through specific technologies (e.g. Bijker, Hughes, & Pinch, 1989; Latour, 2005; Latour & Woolgar, 1979; Suchman, 1999; Wajcman, 1991, 2004, 2007).

Social constructivists argue that the practices through which technologies are conceived and used are inseparable from these technologies. Although the social constructivist model is vastly influential (and underlies much of the scholarship of science and technology studies) it tends to focus attention on specific technologies and the formation of technology cultures as sites of inclusion, exclusion, identity formation, and so
Social constructivist views have also been criticized for their tendency to leave aside the possibility of a social agent’s responsibility within the interaction. More problematic is the turn to a radical social constructivism that claims a totalitarian explanatory position (Haraway, 1991a) or the tendency to focus on language and culture to the exclusion of materiality. For example, Barad’s (2007) criticism is that social constructivist approaches depend on a belief in representationalism and “the power of words to mirror preexisting phenomena...perpetuating the endless recycling of untenable options” (p. 133).

**Philosophical & political perspectives of technology.**

Technology, like democracy, includes ideas and practices; it includes myths and various models of reality. And like democracy, technology changes the social and individual relationships between us. It has forced us to examine and redefine our notions of power and of accountability. (Franklin, 1990, 1999, p. 2)

Philosophical examinations of technology often have followed two distinct paths in considering values and ethics: engineering or humanities perspectives. The broad aim, amongst humanities-focused philosophers of technology has been to articulate how technology might be conceptualized as a complex social, cultural, and political practice.

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72 Both social constructivist and actor-network-theory are more complex than my discussion suggests. My intention is to briefly note some of the ways technology is discussed.

73 Carl Mitcham (1994) and more recent works on the ethical and philosophical aspects of technology are explored at such conferences as the International Association for Computing and Philosophy (IACAP). Some prominent scholars are Luciano Floridi, Charles Ess, Philip Brey, and Gordana Dodig-Crnkovic.

74 See Mitcham, Pacey, or Franklin, for example. This aspect of technology has been used by Bruce, etc to redirect the focus on technology in education and learning from an overreliance on technology as fix. The intent is to refocus attention on the fact that technologies and social relations are co-constructed and moreover, that technology has always been part of education (even as the specific types of tools have evolved). (Bruce, 1996)
Driving these inquiries is often a broad interest in the ethical or political dimensions of technology (e.g. Castell & Bryson, 1998; Foucault, 1975, 1995, 1990; Franklin, 1990, 1999; Winner, 1995). Concerns also frequently focus around the consequences of the Enlightenment project that idealized technological progress (e.g. Balsamo, 1995; Haraway, 1997; Heidegger, 1977; Postman, 1993). The argument often made is that the modernist project, in the ways that it dichotomizes science and art, reason and affect, mind and body, also reflects a stratified society that promotes and distinguishes experts and the technical sphere as the privileged domains of society while casting users or non-experts as relatively insignificant (e.g. Helga Nowotny, 2003; H. Nowotny, Scott, & Gibbons, 2001; Oldenziel, 2001). Similarly, the primacy of a tools and tool culture conception of technology is, according to Pacey (1983, 1989), a reflection of the dominance of the expert-technical sphere of technology. In humanistic philosophical and cultural analyses, the significant issues are said to revolve around values (e.g. political, moral, ethical, social, or user-centered) especially as these are deemed to have been artificially separated from the technical realm. Criticisms of the expert-nonexpert hierarchy highlight how privileging the expert domain has diminished the cultural and organizational spheres of influence regarding technology, and in doing so, promoted a false sense of a structural divide between technological progress and the politics, values, and human agency driving this progress.\textsuperscript{75}

\textsuperscript{75} Arnold Pacey portrayed somewhat distinct spheres, each weighted heavily towards either users or experts’ interests and positions, and noted that co-constructivist models blur these boundaries. However, what persists is that the technical aspects lie wholly in the technical/expert sphere, while the cultural and organizational aspects (including values,
Definitions of technology tend to reflect their context of use. It makes some sense then, that philosophers pursue fine-tuning how we might conceive of technology, and educational researchers pursue how technologies are used in learning. In this separation, however, something essential is lost. Specifically, when g/t researchers focus only the computer’s instrumental aspects, it becomes quite difficult to see what the conceptual reduction of technology supports or masks.

That is, opening up technology so that it is not merely understood as tools that we manipulate, or as a hegemonic culture where tools are conceived and developed, also supports more nuanced thinking about the g/t relationship. For example, it complicates epistemological assumptions about a totalizing objectivity; because the g/t story has relied only on a singular notion of technology it must be understood as only a partial story and thus, its objectivity can also be questioned. The key point is that objectivity can never be totalizing nor wholly impartial in its perspective. As Haraway (1991a) frames it, knowing is goals) are more dispersed. Because of this cultural hierarchy, experts are able to ignore much of the cultural and organizational effects of their technologies or the ways they negatively influence the user sphere. Similarly, Franklin (1990, 1999), a noted experimental physicist, characterizes technology as a practice, but she also describes a system of activities and a body of knowledge that is both structured and structuring (p. 2 & 5). This act of structuring is particularly significant and refers to how technology initiates “a different way of doing something, a different tool for the same task, [that] separates the outsider from the insider” (p. 6-7). Thus, the structuring nature of technology functionally categorizes groups according to their practices, knowledge, skills, and tools. Moreover, technology alters or even eliminates reciprocity in human activities and relationships by constructing physical distances between parties and because of this, she argued, the fundamental quality of reciprocity—is distorted, reduced, or even eliminated and this enacts a “form of technologically executed inequality” (p. 42-43).

76 Some, such as Burbules and Bruce do try to bridge this gap; still, these crossovers are not much in evidence in the g/t story
inevitably situated, necessitating a more limited, yet also more robust, notion of objectivity. How we think about objectivity impacts how we understand the g/t story.

In addition, given the prominence of the psychological, cognitive, and behavioral sciences in grounding the g/t story, it is crucial to understand how a limited disciplinary range delineates the dominant and instrumental construct of technology in use. The meta g/t story is conceptually disciplined as an instrumental story in part because other perspectives are absent. Rethinking the concept of technology makes it possible to more fully consider how the g/t story reflects, explains, and creates our technological and epistemological enframing. The problem is in recognizing how we are disciplined in how to think about gender and technology and to cooperate with the meta story as its disciplining unfolds. Reconceptualizing technology is, therefore, a first step out of what has been a No Exit endeavor of recursively describing and explaining inequities.77 There is much more to the meta g/t story.

Thinking through the “question concerning technology” creates a space for ideas heretofore missing from the g/t story to be re-engaged. The goal is a more encompassing understanding of technology as a complex cultural-political-intellectual-affective system through which humans normally live, learn, and relate (e.g. Pacey, Franklin, Dewey, Heidegger). In the next section, I look at the separation of technology from its values, which prefaces a discussion later in the chapter of two political technologies—neoliberalism and the techno-rationality that increasingly drives society, fueled by technoscience.

77 This is the title of Jean-Paul Sartre’s 1944 existentialist play.
Separating technology from its values. When it became less possible to argue that women are ontologically less capable than men as mathematicians, logical thinkers, or scientists; the focus of g/t research was re-directed. This shift simply brought to the table a new version of the deficit model—it changed the problem to a lack of social or humanistic values in the dominant computing culture, specifically in computer science programs and in their main cohort of boys and men. Women were no longer lacking; instead the culture and boys-men show a deficit in their ethical connection to technology. Despite this shift, concerns over equity did not go away, thus putting two desires in play. First, is an ongoing desire to increase the technological labor pool by bringing in more women that expanded to include a desire to diversify the ethnic, racial, and class representation in technology. These diversity and equity concerns coexist with the idea that more women are needed in computing because women, specifically, will bring a wholly different values orientation and reshape computing as a discipline and in ways that will better serve society’s interests. Two additional ideas are carried along. One is that the impact of women’s values is itself conceived in the singular, reflecting the ways in which the gendered position is framed as a

78 There has been such a large focus on women’s different subjective experiences to explain underrepresentation that this has masked possibilities of seeing that some studies are focused on women working as “line programmers,” technical laborers, or K-12 teachers (needing to be made more technologically literate), while other studies focus on women at the creative center (e.g. Carnegie Mellon computer science majors). Because these studies blend together to seemingly focus on representation statistics, somewhat lost in the ether is that often these studies are examining fundamentally different positions that are about class, race, mentoring, opportunity, and a host of other factors more related to a universal glass ceiling and other social or economic class disparities than to any specialness of computing. Moreover, there just is not as much financial or social capital expended in trying to increase women’s representations in the creative fields or in the higher echelons of business, politics, academe, medicine, or law, as there is in STEM fields and most particularly, computing.
universal, not local, subjectivity of women rather than of any particular woman. Women, essentially, become a unitary construct in terms of their techno-social values and dispositions. The other embedded feature is that this values reorientation is predominantly expressed in the future tense—it is hard to find an example in the meta story that discusses how women have changed computing. The examples used tend to be from medical fields, where women have brought new insights and respect for women’s bodies or from the legal profession, where women have altered the law, particularly in thinking about women’s rights and bodies.

In short, g/t research and policy agendas have been too willing to blend three notions: (a) increasing women’s representation in computing will increase women’s economic well-being, (b) doing so will also enhance the country’s technological workforce and competitiveness, and (c) women’s greater presence will make computing cultures and society more humanistic and values-driven. There is a black-boxed assumption that these are easily compatible desires or outcomes. One way that such assumptions pass is that technology itself has been separated from its values, which in turn have been relocated in women, seemingly exclusively. In essence, over the life of the meta g/t story, as computers facilitated a growing instrumentalization of humans and society, gender and women became increasingly useful constructs as political ideologies increasingly construe humans (and non-humans) in terms of their production-consumption value.

This shift is evident in the ways that the NSF language changed from 1993 to 2008 in publications of the Division of Research, Evaluation, and Dissemination. In 1993, the following language is found:
This agenda recognizes that our greatest assets are students of all ages...and citizens who want to know more about the world we live in—and who want to be knowledgeably involved in the many critical, scientific choices we make each day...

Our ultimate goal is to create and sustain a national atmosphere that values and encourages scientific thinking and scientific endeavors by all of our citizens. When we succeed, every student will be able to study mathematics and science and become knowledgeable in these vital areas. (1993, Luther S. Williams, Assistant Director for Education and Human Resources, introductory letter)

Contrast this with the 2008 language in the same directorate:

One of the National Science Foundation's (NSF) key strategic goals is to cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens.

The program for Research on Gender in Science and Engineering (GSE) seeks to build resources—developing the nation's knowledge capital, social capital, and human capital—toward the goal of broadening the participation of girls and young women in STEM education from kindergarten through undergraduate education.

The demand for science and technology literacy on the part of all citizens has never been higher, and the demand for domestic workforce capacity in engineering and computer fields is projected to exceed supply. (National Science Foundation, 2007, pp. 5-6)

The NSF started its Program for Women and Girls in 1993, and the first example above emphasizes engaged, citizen-centered knowing. Its language is of helping a broad range of students and citizens become more knowledgeable about science, because these learners are themselves interested and moreover, are valued as citizens. By 2007, the NSF shifts to rather explicit language that talks in terms of human capital development rather than of a citizenry broadly knowledgeable and critically literate. We are described not as citizens but as resources. Arguably, the reasons for increasing women’s participation in computing shifted on a national, visionary, and policy level.
Once we recognize this shift of vision, our understanding of g/t research and the meta story requires reevaluation. For example, the AAUW (2000) report appears to be reporting girls’ disinterest in computing noting that girls feel they are not incapable, they just are not that interested.

Most [...] girls do not predict that they will want to learn more about or become more involved with computers in the future. In Turkle’s terms, these girls are not computer-phobic; they are “computer reticent.” They say that they are not afraid but simply do not want to get involved. They express a “we can, but I don’t want to” philosophy. (p. 7)

We can read this, first, through a national policy agenda that has become more explicitly interested in humans as capital rather than as participatory citizens. The problem becomes how to get girls interested because they are untapped resources. Moreover, since girls and women’s intellectual deficits are no longer viable as an explanation for the computing gender gap, the focus easily shifts to girls’ subjectivities. In both narratives, subjectivities are made available for re-engineering. Through these shifts, the g/t story steers attention to the notion that reducing the gap is both the best way to increase the labor pool and to bring a greater sense of values into computing. Largely glossed over is how these two quite different notions fit together.

This thinking is bound to approaches that view proper methods as the arbiter of quality research findings. A tight focus on the gender gap keeps our attention from other more problematic gaps, such as those between, on the one hand, desires to promote more humanistic techno-social values and on the other hand, funding agendas shaped around human capital theory and neoliberal market values. The incommensurable problem is one of hoping to lessen the instrumentalization of humans and society while at the same time
thinking in terms of policies and language that themselves facilitate this
instrumentalization. Foucault (1975, 1995, 1990) and DeLauretis (1987) have showed how
this proceeds through the disciplining technologies of the self and gender (which I will
explain in greater detail in chapter 8).

There is a kind of co-dependence in the persistent focus on statistics showing girls
and women’s underrepresentation and the growing numbers of micro-stories focused on
girls and women’s values-driven ethical orientations to technology. Throughout g/t micro
stories, women not only are said to bring a different orientation to computing, this
difference is stated to have the potential to reshape the society-technology relationship.
Increasingly these narratives infer that women have an ethical responsibility to become
more interested in technology. For example, Margolis and Fisher (2002) state: “In the long
run, the greatest impact may be on the health of computing as a discipline and its
influence on society. The near absence of women’s voices at the drawing board has
pervasive effects” (p. 2). These kinds of discourses do not merely describe a universal,
gendered ethical subject. They also help to discipline women into this subject who must fit
herself to these kinds of expectations. The following example further illustrates how
women’s subjectivities are located and used:

Another first-year student, Louise, describes a difference she felt between herself
and her male peers when she saw her peers’ nonchalant response to a lecture on
ways that computers can be nonproductive in society:
Everyone just said how boring it was: “Who cares that computers did not
benefit anyone? We like computers! We love computers! We know
computers! And who cares about the rest of the world”
She describes herself, on the other hand, as someone who scrutinizes the worth of
each computing project in terms of what it is doing to change and help the world.
...
Jessica, a woman student who has always done well in math and science, feels deeply that computer science must “make a contribution”: “just...making video games” is not “worth the energy and talent that it takes.” She relates her interest in computer science to her concern for her grandmother’s medical condition. (p. 53)

It is not the expectations inferred about women’s presence in computing that are so intriguing but instead, how these women’s self-accounts consistently seem to support this expectation. That is, within this g/t story, women’s technology narratives are first, represented as constant and dependable and second, easily cataloged to be available for objective analysis. Self-reports are reasonably expected to depict women’s seemingly universal and predictable social-ethical dispositions and interests in technology. The notion that women will bring a new values orientation to technology, which is in fact a quite powerful idea, largely skirts by as both expectation and fact. Women, in the g/t story, have become a singular entity and in this discursive merger, they signify, broadly, the right kind of “subject” on which we pin our hopes for bringing social values to computing and technology.

What has happened in the g/t story is that technology and its values and politics have been artificially separated, just as boys and men have been put into another technological box. Technology on its own is value free and boys and men’s values are driven only by their fascination for technology and how far it can be pushed. This separation happens through discursive practices that locate and essentialize men and boys within a technological realm devoid of humanistic values and that articulate women as wholly driven by these otherwise missing values. A closer look reveals different twists and turns over the years. For example, although Turkle’s The Second Self (1984) is most cited for
her portrayal of hacker culture, she also devoted a chapter to PC hobbyists, another
subculture that emerged when the PC first became available to home users in the early
1980s. The desktop machine was perceived by these hobbyists to be a major opportunity to
subvert the drone-like activity of programming for corporate mainframe computers. The
PC offered a new affordability and one no longer needed to have a warehouse to park the
thing; its desktop size and price shifted everything. What, however, did it shift? The
dominant g/t story has had us focus on hackers and a masculinized computer gaming
culture, thus lessening the visibility of other practices and interests. One missing actor is
the PC hobbyist. In 1984, Turkle described this culture in the following terms:

What is most striking in the story of the revolution that began with the Altair
personal computer is that for many people the computer at home becomes a tool
that compensates for the ravages of the machine at work.

... They came on the scene at a time of dashed hopes for making politics open and
participatory. Personal computers were small, individually owned, and when linked
through networks over phone lines they could be used to bring people together.

... Computers, long a symbol of depersonalization, were recast as “tools for
conviviality” and “dream machines.” Computers, long a symbol of the power of the
“big”—big corporations, big institutions, big money—began to acquire an image as
instruments for decentralization, community, and personal autonomy. (1984, p.
170-172)

In its singular focus on hacker culture, the g/t story was able to lose this other narrative of
socio-political engagement, where gender does not mark whether one thinks about
computers in relation to societal concerns.79 We see instead that early on the PC was

79 This aspect of computing, however, continues in community informatics (e.g. Chip
(Bertram) Bruce and Anne Bishop) and in texts such Beyond Resistance!: Youth activism
and community change; Ginwright, S., Noguera, P., Cammarota, J. (Eds); New York :
viewed, in some circles, as the hope for a new engaged, political economy. It would provide the harried worker and citizen an outlet and hope for creative, self-directed, and fulfilling work, independent of the corporation. Similarly, artists (both men and women) adopted the computer to explore a radically new creative terrain, often blurring the boundaries of artist-programmer, artist-social activist, or art-technology. Kept out of the g/t story are these other stories where engagement with the computer has been driven by a host of values-driven interactions, such as community-building, facilitating social-political change, and quests for new aesthetic values. In the dominant g/t story, however, these values are expressed almost exclusively as the domain of women, framed within a liberal feminist ethic of care.

Winner (1995) has shown how Western moral philosophy separates technology from politics and in so doing, ignores the significant role that citizens should hold in articulating policy and in making choices about technological projects. As a result, citizens have been “isolated from the realities of technical practice and technical change” (p. 67). Furthering this separation has been modern liberalism, which emphasizes individual enterprise, the accumulation of wealth, and technological progress as a driving rationale of society and human knowledge building (p. 72). Through such social-political practices, the political domain of technology has been kept separate from the technical domain,

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80 See for example, Char Davies, Lynn Hershmann-Leeson, or Anne-Sarah Le Meur.
81 Winner attributes this divide to two sets of ideas – the ancient Greek idea of techné as a lesser form of knowledge-practice and to our modern understanding of “megatechnics” (p. 67)
82 This criticism is reminiscent of Taylor’s modern social imaginaries (although Winner and Taylor seem to cover different disciplinary terrain), wherein atomism and punctualism are highlighted as key aspects of our epistemological orientation to the world.
leaving the citizen marginalized from both. Winner (1986) deconstructs the ways in which
the separation of technology from its political dimension masks an unreflexive
technological determinism. He also argues that technologies sometimes contain or
promote particular kinds of power independent of the political system from which they
emerged. Thinking about technology and power in this way leads back to Foucault and
grounds how I think about the g/t story as a disciplining technology. This technology not
only describes girls and women (and technology), but also construes these actors for
specific ends, in large part, by separating values from technology. Practices of separation
make it possible to locate technology’s values in the feminine, rather than in philosophy,
society, or in citizens of multiple persuasions and identities.

The computer as a metaphor of mind. As sociological, philosophical, or political
perspectives of technology unfolded in response to the computer, it was given numerous
characterizations. Some saw it as a radically new psychological, subjective, thinking
machine (Papert, 1980; Turing, 1950; Turkle, 1984). The emergence of the computer,
according to other scholars, was a major rupture to long-standing human-machine,
technology-society, and human-society conceptions. For some, as the computer entered
mainstream social consciousness, its tool nature intertwined with and promoted an
information processing model of the human mind (Mazlish, 1967, 1989; Minsky, 1985;
Moravec, 1988). This model became one of the dominant metaphors to emerge from
computer science and AI research. Initially separating logic and reasoning from emotions
and affect, the model also facilitated a separation of men’s rationality and disengaged “tinkering” from women’s embodied ways of knowing and interacting with the world.\textsuperscript{83}

In some circles, AI provoked deep philosophical reflection and debates (that continue today) over the meaning of the computer and whether we were (or are) at the precipice of a new human-machine relationship.\textsuperscript{84} One of these thinkers, Colburn (2000), argued that the computer and AI force a new encounter between science and philosophy, in that AI challenges long-standing traditional philosophical concerns over what it means to equate computational processing with the human mind and to represent this mind as separated from its body (hence, nature).

The point is that AI instigated a profound conceptual rupture to a social imaginary that had long presumed a fundamental and enduring distinction between machines and the human mind, be this in terms of intelligence or psychology. Minsky’s \textit{Society of Mind} (1985) is a highlight of this period that promoted a computational model of mind and a belief in computers as the new hope of the school reform movement. In this milieu, a technological euphoria (Winner, 2005) presaged the new field of the learning sciences in education. This field pursued strong alliances with the cognitive, psychological, and behavioral sciences, far less so with philosophy or the arts. Building from an initial, instrumental understanding of technology, the computer, as it became part of the modern social imaginary and the new hope for education reform, facilitated a powerful human-

\textsuperscript{83} I do not want to dismiss the work being done with affective computing (e.g. Phoebe Sengers at Cornell), but discussing this work would diverge from my thesis.
machine metaphor that fostered an instrumental understanding of not only technology, but also, of humans and their social institutions.

The g/t story is built on transparent intellectual-social-political technologies that have made it possible to separate technology from its values and in turn, relocates these values within a universalized construct of woman. Built from these technologies and practices, the g/t story itself functions as a kind of technology. Through the meta story, women have been shaped into appropriate research objects and cultural subjects, becoming not only the holders of socio-technical values, but a subject who comes to see herself as this subject. In chapter 8, I delve deeper into how the g/t story itself is functioning as a kind of discursive, social and political technology that works in concert with a technology of gender. This technology of gender is both a product of, and a facilitator to, a technorational political mindset complicit with the neoliberal project, as described by Brown (2005, 2006). The rest of this chapter discusses these two political technologies and their intersection with the g/t story.

Two Political Technologies: Neoliberalism & Techno-Rationality

The g/t story conceives technology as tools and tool culture and this shapes the conceptual tenor of the story. It becomes a story that offers little opportunity for characterizing the techno-rational tenor of contemporary society and institutions or even, of technology. I have already characterized Heidegger’s (1977) analysis of our technological

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84 For example, the July 26, 2009 edition of the New York Times reported that in February 2009, a group of prominent computer scientists met to discuss the potential consequences of AI advances (Markoff, 2009).
enframing and here focus more explicitly on some political dimensions of this enframing. I draw on two thinkers, recognizing that there are many others who could be considered. I first consider Wendy Brown’s analyses of a neoliberal political rationality that infuses social life to create new kinds of political subjects. Second, I focus on the techno-rational character of modern society as one driven wholly by technique (Ellul, 1964) from two perspectives. On one side is a society increasingly managed and justified through the primacy and efficacy of technique and instrumental rationality as a social-political ethic. On the other side is an emergent postmodernist mindset that remains beholden to industrial modernity yet has set in motion the nascent reflexive modernization of the risk society as characterized by Beck (1992; 1994). The risk society describes an emergent new relationship between individuals and institutions and between the politics of governing and the growth of technoscientific knowledge. It is characterized by the ways that (a) technological innovation and technoscientific knowledge become the driving rationale of society and (b) the fact that managing risks—as outcomes of techno-innovation culture—becomes the dominant political-economic concern as the consequences of these innovations become increasingly unknowable. Reflexive modernization is Beck’s term for characterizing how an older, industrial form of modernity is being remodeled to a new stage of modernity.

**Neoliberalism.** Brown (2005) is particularly helpful for the ways she locates our technological enframing in political terms. She explains how political governance in the West has shifted from liberal democracy to a neoliberal political rationality that shifts “subjects, forms of citizenship and behavior, and a new organization of the social” not
merely to produce economic subjects, but also, new types of political subjects (p. 37).

Neoliberalism describes a social relationship that, when deployed as a form of governmentality, reaches from the soul of the citizen-subject to education policy and practices of empire. Governmentality is a term coined by Foucault (Burchell, Gordon, & Miller, 1991; Foucault, 1975, 1995, 1990) to describe the shift to a form of power meant to govern populations economically by bringing the governed subjects into a kind of self-compliance with the needs of the state. Technique, bio-power, and a new knowledge-power relationship characterize this political form (Burchell, et al., 1991). Neoliberal rationality, while foregrounding markets, is not only focused on economics, it also involves extending and disseminating market values to all institutions and social actions (Brown, 2005, pp. 39-40).

Neoliberal political rationality, in Brown’s (2005) estimation, is not unintended. It is a constructed outcome, aimed at producing a particular kind of human subject as well as institutions that promote instrumental rationality and facilitate its growth. Individuals, practices, and institutions are re-shaped to become facilitators of a market rationality that in turn, requires a particular kind of atomized and entrepreneurial citizen who reasons instrumentally. The state must facilitate the production of this neoliberal subject. This subject is not, however, one that simply complies because of rules; neoliberal governmentality “orchestrates the subject’s conduct toward him or herself...[and] convenes a ‘free’ subject who rationally deliberates about alternative courses of action, makes choices, and bears responsibility for the consequences of these choices” (p. 43).
“Freedom” becomes a means of control “because of neoliberalism’s moralization of the consequences of this freedom” (p. 44).

Brown’s analysis builds from Foucault’s technologies of the self (1975, 1995, 1990; Martin, et al., 1988), where she characterizes a political technique that transparently “molds and folds” individuals and groups into the neoliberal project by orchestrating these subjects into politically appropriate norms and practices that, although disciplined into compliance, appear to be outcomes of individual choices. Neoliberal governmentality has us thinking of ourselves as political-economic subjects and objects.

The political rationale of technique. Beck (1992; 1994) explains post-industrial society from a different perspective and argues that a new form of modernity is emerging. The risk society he articulates shifts the relationship of individuals and institutions, but does so based on relationships that diffuse or re-negotiate responsibility for these risks from their locus of production to their points of receipt. The production and management of, and responsibility for, risks of unknowable reach and consequence are mediated based on negotiators’ access to knowledge about potential risks. In this society, knowledge with the most argumentative, economic, and political power is techno-scientific, mirroring the shift to a techno-rational society. The quest for technological innovation, in search of better health, medical treatments, agricultural techniques, weapons, and so on, has reshaped society such that STEM knowledge is deemed the most respected and useful knowledge, yet the consequences of this knowledge and its innovations are themselves largely unknowable.

Risk and access to knowledge frames this new phase of modernity, but these risks are of a heretofore unknown scale, are multi-dimensional, and shared globally and across
generations. Ever-present, incalculable risk shapes political power, agency, and the value attributed to bodies of knowledge. It brings with it a new concept of being where the self and society are thought about through relationships conceived around dimensions of risk. The locus of power or agency shifts from a consciousness focused on control, rights, or wealth to a consciousness that “determines being” (Beck, 1992, p. 23). In the risk society, “knowledge gains a new political significance” and having “knowledge about risks” is the primary source of power, because techno-scientific knowledge is accepted as the basis for reasoned argument concerning the management and distribution of risk (p. 24-25). Beck (1994) calls this reflexive modernization “a radicalization of modernity that breaks up the premises and contours of industrial society and opens paths to another modernity” (p. 3).

Political disputes shift from trying to mediate distribution of wealth and resources to instead weighing in on negotiations over the management and assignment of rights that are held in the private sector but hold immeasurable risk for the public sector. Beck’s thesis is that this shift requires new approaches because the political and conceptual tools of modernity are inadequate for thinking about the scale or complexity that these risks represent. Thinking in terms of “perpetrator and victim” merely masks the subtle interplay of social, political, and cultural factors that should have a prominent voice in technoscientific project and policy deliberations.

Paradoxically, modernist epistemology is inadequate to the task of considering the multi-dimensional character and consequences of mega-scale risk and yet we continue to depend on and idolize modernist epistemologies as the best way of building, evaluating, and justifying technoscience knowledge. This epistemology supports a political economy
that calculates risk through the concept of “the average” (Beck, 1992, p. 25). The problem Beck illuminates is that averaging diffuses two oppositions—no risk and high risk—depends on a concept of averaged risk. The problem of averaged risk is that it conceptually diminishes the scale of extreme risks as it diffuses these to a more moderate middle. Moreover, averaging makes much more invisible any consequences experienced in these margins because they too, are diffused into an average. By managing knowledge through such practices, power in the risk society becomes about access to and control of knowledge. The high status of economic, scientific, and technological knowledge keeps the focus on a logic of distribution even as understanding and evaluating these risks also requires social, cultural, and political knowledge for fruitful discussion.

The sublimation of social knowledge and social-humanities disciplines becomes a political limitation. Beck (1994) argues that technoscientific knowledge is insufficient for assessing risk. Specifically, when consequences themselves are likely to be widely dispersed, large scale, or ongoing (e.g. nuclear plant failures, global economic meltdowns), trying to isolate causes is ineffectual when causes are “substantively-objective, spatially and temporally disparate...brought into a social and legal context of responsibility...[where] causality always remains more or less uncertain and tentative” (p. 28). Beck argues from an optimism that he locates in an alternative political relationship no longer bound to “old certainties of the industrial epoch” (p. 35). He finds hope by distinguishing between “rule-directed and rule-altering politics” (p. 35).

Essentially, Beck (1994) explains how sticking to an old, industrial era nation-state model of politics—dependent on highly structured knowledge and rule driven, top down
politics—is itself the limitation. In arguing for a re-imagination of the political as a kind of sub-politics, he is advocating for less hierarchy and trying to envision a ground level dissolution of enforced epistemological, social, and political structures. Long-standing political oppositions such as that framed by a right-left political metaphor shape how problems and their resolution are conceptualized as “safe-unsafe, inside-outside and political-unpolitical” (p. 42). The real problem becomes, at least in part, the endless disputes wrought by this model but more problematic is that the problems of post-industrial society are of such magnitude and reach that they require not only a new metaphor, but new kinds of questions. The three that he highlights are: “What is your attitude towards, first, uncertainty, second, towards strangers and, third, towards the possibility of shaping society?” (p. 42). The problem Beck makes central is that of continuing to think in techno-rational terms when the problems we face extend far beyond the merely technical.

**Political technologies and the g/t story.** Neoliberalism and techno-rationality function as political technologies that collaborate in shaping our political and technoscience driven metaphors and relationships that in turn, become dominant conceptual metaphors for thinking about subjects, objects, power, knowledge, and technological-political progress. Neoliberalism depends upon techno-rationality and together these have enframed modern social-political-institutional relationships and conceptions of how we are expected to be or think in these relationships, as subjects or objects. These technologies also shape and manage the g/t relationship as it is articulated in and through the meta g/t story. One way to observe how this happens is by reading
across multiple micro g/t stories, particularly those with more of a policy bent. Over the next several paragraphs, I highlight sections of three texts to illustrate some ways that political technologies underlie the construction and articulation of girls-women, boys-men, and technoscience in a complex relationship that nonetheless is framed only through the knowledges of technoscience, to ultimately play into the neoliberal political agenda. Given the status accorded increasing girls and women’s representation in computing, there is also a great deal of risk—economic and societal-moral—insinuated into girls or women’s disinterest in signing on to techno-culture.

The examples I highlight in the following paragraphs struggle with the problem of girls-women’s representation in computing as a kind of risk situation, but they do so through the political agendas and metaphors of neoliberalism and techno-rationality. The Executive Summary of TechSavvy (AAUW, 2000) outlines a set of key themes we ought to be concerned about regarding girls and women’s participation in computing.

Girls are not well-represented in computer laboratories and clubs, and have taken dramatically fewer programming and computer science courses at the high school and postsecondary level. Therefore, girls and women have been labeled as computer-phobic. The commission sees it differently: It interprets such behavior not as phobia but as a choice that invites a critique of the computing culture. We need a more inclusive computer culture that embraces multiple interests and backgrounds and that reflects the current ubiquity of technology in all aspects of life. (p. x)

In this passage, the AAUW depends on techno-rational thinking to tackle the problem of an overly technocratic computing culture. They also deftly shift the problem locus from girls’ interests and history of non-technoscience course taking to problems within computing culture itself. Girls are portrayed as the canary in the mine; they have sniffed a problem with computing culture that is bigger than just girls’ interests—the culture itself is
quite unfriendly to outsiders. However, in the passage immediately following, the
responsibility again falls to girls, who really do need to acquire a solid technological
literacy, which is defined within specific parameters, as follows:

**Girls’ current ways of participating in the computer culture are a cause for concern.** A common alternative to computer science courses—and a common point
of entry for girls into the computer world—has been courses on computer “tools,”
such as databases, page layout programs, graphics, online publishing, and other
“productivity software.” The commission believes that while mastery of these tools
may be useful, it is not the same thing as true technological literacy. To be
“technologically literate” requires a set of critical skills, concepts, and problem
solving abilities that permit full citizenship in contemporary e-culture. (p. x, bold in
original)

What constitutes sufficient involvement in technology is the driving question across the g/t
story but the specifics of an appropriate techno-literacy varies somewhat depending on the
focus of a given micro story. They tend to revolve around two core competencies: (a)
technological literacy that would enhance workers’ skills that are seen as fundamental to
sustaining the state’s economic competitiveness in producing technoscientific knowledge
and innovation and (b) developing technological literacies that would mediate the cultural
impact of technoscience. While the first literacy is broadly hoped for all citizens, subjects,
and workers, the second is on the one hand still construed from within technoscience and
on the other hand, is discussed through girls and women, themselves outsiders to
mainstream technoscience in these discourses. Neoliberal governmentality disciplines girls
and women to absorb an obligation to refit their interests and dispositions to serve the
market. To be a good citizen nowadays is to become a usefully, techno-scientifically literate
subject.
The AAUW (2000) articulates a view of technological literacy that reflects the growing concern over worker skills and technological literacies in national science policy.

As described by a National Research Council report, fluency with information technology requires the acquisition of three kinds of interdependent knowledge that must be taught in concert: skills, concepts, and capabilities. Skills are necessary for job preparedness, productivity, and other aspects of fluency. They include such things as using the Internet to find information, or setting up a personal computer. Skills change as technology advances: Using the Internet became essential in the past five years, and designing a home page will be essential soon. Concepts explain how and why information technology works. Capabilities, essential for problem solving, include managing complex systems as well as testing solutions. (p. xi)

Evident here is that being fluent with technology also means being able to use it in multiple fields, to study languages as well as science. This way of thinking, however, makes it seem that the significant knowledge of technology lies entirely within the field of technology. Achieving computational mastery is the dominant literacy, although it might be applied in vastly different fields. Absent in this hierarchy of knowledge is thinking that other kinds of knowledge have something to contribute to understanding how technology “works” or what it does or means.

While the AAUW’s thinking helps illustrate the techno-rational tenor of the debates, Rising Above the Gathering Storm (National Research Council, 2007) reveals a finely-tuned neoliberal political agenda wherein to be good citizen-subjects we must become more techno-literate students and workers.

The United States takes deserved pride in the vitality of its economy, which forms the foundation of our high quality of life, our national security, and our hope that our children and grandchildren will inherit ever-greater opportunities. That vitality is derived in large part from the production of well-trained people and the steady stream of scientific and technical innovations they produce. Without high-quality, knowledge intensive jobs and the innovative enterprises that lead to discovery and new technology, our economy will suffer and our people will face a lower standard of living. (p. 2)
The foundational notion embedded is that above all, the economy must thrive, and from this, so too might the people. The neoliberal subject is expected to comply and the consequences of not doing so are strongly articulated. More diffuse however, is the distribution of risk. There is no promise that all workers will prosper; instead, a political averaging of risk and benefit keeps those at the bottom of the political-social-economic hierarchy from visibly complicating the arguments for single-minded pursuits of technoscientific innovation. Economic and technological conceptions of society ground these political arguments as purely questions of a techno-rational nature.

- The committee found that multinational companies use such criteria as the following in determining where to locate their facilities and the jobs that result:
  - Cost of labor (professional and general workforce).
  - Availability and cost of capital.
  - Availability and quality of research and innovation talent.
  - Availability of qualified workforce.
  - Taxation environment.
  - Indirect costs (litigation, employee benefits such as healthcare, pensions, vacations).
  - Quality of research universities.
  - Convenience of transportation and communication (including language).
  - Fraction of national research and development supported by government.

(UNESCO, 2003) also depends on these two political technologies to locate technological literacy and access to ICTs at the center of the political quest to improve women’s lives across the globe.

Information and communication technologies could give a major boost to the economic, political and social empowerment of women, and the promotion of gender equality. But that potential will only be realized if the gender dimensions of the Information Society—in terms of users’ needs, conditions of access, policies, applications and regulatory frameworks—are properly understood and adequately addressed by all stakeholders. Poverty, illiteracy, lack of computer literacy and language barriers are among the factors impeding access to the ICT infrastructure,
especially in developing countries, and these problems are particularly acute for women. But women’s access to ICTs is constrained by factors that go beyond issues of technological infrastructure and socio-economic environment. Socially and culturally constructed gender roles and relationships remain a cross-cutting element in shaping (and in this case, limiting) the capacity of women and men to participate on equal terms in the Information Society. (p. 9)

I do not mean to suggest that computers and ICTs are irrelevant in trying to improve communities and people’s lives. Rather, there is an idea promoted that these are the primary solutions, thus continuing the idea that technoscience is the solution to all sorts of social-cultural-political problems and inequities. Subjects, and their agency and power, are to be bettered to the degree that they achieve this technoscientific literacy or storehouse of technological skills. The social-cultural-political dimensions of communities and people’s lives or agency are folded into the technoscientific dimensions of progress.

Conclusion

The g/t story is a particularly useful technology for the ways it sits between the two political technologies of neoliberalism and techno-rationality, both dependent on Western epistemological conventions and binary thinking. Women are called upon to become kinds of subjects, who (a) in becoming appropriate political subjects will better serve a neoliberal political rationality, (b) carry within them the ethical dimensions able to monitor motivations or responsibility—of some subjects—in this technocratic risk society, and (c) function as a kind of mediating agent to an otherwise unknowable dimension of risk that technological progress is likely to unleash. That is, sometimes women are called upon to shore up the technological workforce and sometimes the rationale for more women in computing is that their values will intervene in technology-facilitated ruptures to our
human-centered social institutions. Women’s role is to mediate potential risk, but to do this, they must first “fit” as appropriate subjects—both the technologically literate subject and the gendered, ethical subject. Women are stretched to fit two different needs, in part, because technological knowledge is the only knowledge of significant value in the risk society. In the process of serving these two political technologies, women’s subjectivities, whether innate or re-molded, become a kind of substitute for other knowledges or philosophical reflections on techno-culture and the risk society. Technologies of the self and of gender facilitate the blossoming of this politically strategic subject, the argument I develop in the next chapter.
Facet 8

Disciplining the Constituted Outsider to Technology

The meta g/t story is an interpellative social-political-intellectual disciplining technology through which women become subjects who take on, as their own, specific perceptions of and attitudes towards computing. The gendered subject sees herself in and through a specifically articulated relationship with computing and computing culture that has been tweaked and nurtured over thirty years. The meta g/t story not only facilitates a fully functioning technology of gender, it effectively and instrumentally disciplines the gendered constituted outsider to technology.

My first aim in this chapter is to provide some substance to the claim that women and gender do not necessarily have to be described through the very limited construct of gender that the g/t story promotes (e.g. through an overreliance on Gilligan or continuing to draw on cultural-liberal feminism as its conceptual base). To use gender in this way is to lay the grounds for a technology of gender that depends on an instrumental understanding and use of difference as well as researchers’ limited view of that difference as their objective lenses are disciplined into a position of disengagement to meet the criteria of scientific value-neutrality. These disciplining technologies of difference, gender, and objectivity in turn demarcate the constituted outsider, which is the key interpellative production of the g/t story.

Girls and women, shaped and disciplined into a useful and universalized subject, in turn serve a construct of gender positioned to act as a conceptual salve to smooth the raw edges where society and technological progress meet. Understanding this is central to grasping how gender functions as a technology that stands between anxieties over vanishing
traditions of industrial society and new anxieties surrounding the shift to a postmodern risk and techno-rational, scientific society (Beck, 1992). In the new risk society, technological progress itself has taken on a new tenor as it serves various and often competing institutional, political, or social interests. While technoscientific progress tends to be managed by technoscientific knowledge and experts, leaving aside philosophy and the humanities, the gendered other is used to fill the conceptual and ethical gap.

Cast as outsiders in the techno-rational drive for progress, women’s values, dispositions, and priorities are available to intervene in the less humanistic aspects of this progress. Within our dominant enframings and disciplining technologies, this positioning of gender and women easily passes as a norm to the degree it fits within Western epistemological and technoscience conventions. Looking at the g/t relationship through the disciplining technologies of the self and gender, we see how women are discursively disciplined as a techno-ethical and socially concerned subject. In order to see this disciplining however, we need resources that extend beyond Gilligan’s (1982, 1993) differentiation of male-female ethics, wherein girls and women are said to have a fundamentally different kind of ethical orientation to the world and to technology.

In the first part of this chapter, I discuss the concepts of discipline and difference. Following this, I draw on Foucault’s technologies of the self (1975, 1995, 1990; Martin, et al., 1988) and Lauretis’ technologies of gender (1987) to examine how gender is disciplined in the g/t story, in part through a disciplining of objectivity that in turn makes possible the constituted outsider. I show how this outsider is constituted as a particular, gendered-
ethical outsider who is strategically positioned to intervene in the dominant techno-culture and to mediate anxieties arising from the postmodern risk society.

**Discipline**

An assumption made in the empirical study of subjects and objects—particularly in the meta g/t story—is that this research approach is fundamentally a problem of discovery and explication, dependent on techniques to ensure objective analysis and representation. Foucault shows, however, that these techniques are far more active than they appear and that the social sciences must be seen as harboring a set of practices that discipline subjects to better fit the norms and needs of society (1975, 1995, 1990). The sciences of education, psychology, and psychiatry (for example) are a disciplining “technology of the ‘soul’” (1975, 1995, p. 30).

Disciplining (Foucault, 1975, 1995) is a form of power that draws the body into its web in a kind of political compliance. Disciplining technologies reflect a bio-power that depends on a “multiplicity of often minor processes...[that] converge and gradually produce the blueprint of a general method” (p. 138) through which humans are studied in order to be improved. Foucault helps us see the less-than-benign aspects of these human sciences.

The human sciences...have been able to be formed and to produce so many profound changes in the episteme...because they have been conveyed by a specific and new modality of power: a certain policy of the body, a certain way of rendering the group of men docile and useful. This policy required the involvement of definite relations of knowledge in relations of power; it called for a technique of overlapping subjection and objectification; it brought with it new procedures of individualization....Knowable man (soul, individuality, consciousness, conduct, whatever it is called) is the object-effect of this analytical investment, of this domination-observation. (p. 305)
These disciplines are an “apparatus of production” whereby humans become “objects for discourses that are in themselves elements for this strategy” and disciplines exercise “the power of normalization” that is integral to “the formation of knowledge in modern society” (p. 308).

Techniques of generating, analyzing, and reproducing subjects’ accounts of their experiences, thoughts, and actions transparently enforce society’s expectations of women that in turn become women’s own self-understandings of how they are to be and think. This process of disciplining, whereby subjects fit themselves into a discursively disciplined mold, appears rather innocuous and looks something like the following:

While rejecting generalizations about gender in the abstract, girls reveal a highly developed set of beliefs about how boys and girls differ in their relationship to computer technology. In other words, we found that girls observe and describe strong gender differences but do not have a language with which to talk about them. (AAUW, 2000, p. 7)

There is a kind of black-boxed negotiation evident where girls are said to distance themselves from abstract gender essentializing, yet in many ways g/t researchers suggest the “missing language” that would make it more possible to articulate stable gender differences. These suggestions reflect and help to mold gender norms and expectations. Even the practice of asking for descriptions of gender difference subliminally infers that there is a difference that can be identified. Thus, ongoing dissections of girls and women’s different relationships to the computer become a kind of self-fulfilling prophecy or effectively support a transparent need for these kinds of differences to exist. Discursive repetitions of the idea that women have a different relationship to technology become internalized by
women, thus building a rationale for women to believe that their technology orientation or interest is different.

The g/t story, dependent as it is on essentializing m-f differences, is a disciplining technology through which gendered differences towards technology both construct, and are constructed by, a belief in foundational difference and this belief grounds the excavation of women’s subjectivities. However, through techniques of articulation, gendered subjectivities or identities are not merely described and analyzed; they are molded and sustained through repetitions across narratives that are eventually normalized and embedded as typical and expected gendered identities and subjectivities (Lauretis, 1987).

The analytic problem that is masked in the g/t story is an unresolved tension between desires to distance from one kind of gender stereotyping and the ways in which discursive constructions themselves participate in another form of gender disciplining, by monitoring what gendered subjectivities “normally” look like. Distinguishing and maintaining notions of normal, gendered subjectivities has some accrued value, as I will explain later.

What is being disciplined? What, exactly, is being disciplined is often hard to discern because there appears to be two different ways that women’s subjective accounts are thought about within the g/t story. Sometimes individual subjectivities form the basis of broader accounts of girls or women’s experience and their “outsiderness” to computing, a
position reflected in the AAUW passage above. In other instances, methodological practices are criticized for the ways in which these same subjectively derived accounts or analyses exhibit a lack of objective rigor, as Cohoon and Aspray (2006a) suggest:

The first condition is an inadequate understanding of the underlying and immediate causes. Much of what has been published is based on personal experience or observation of a single case, rather than being grounded in empirical evidence that can be generalized. (p. 137)

The meta g/t story navigates three intersecting desires: (a) a desire to understand social phenomena or relationships through narratives of individual experience; (b) a desire for a broadly applied concept of gender difference sufficient to “explain” computing experiences and culture; and (c) a methological desire that the gathering and analyses of subjects’ accounts and experiences themselves be rigorously objective to in turn produce warrantable and broadly generalizable theory. Concerns framed around a perceived lack of objectivity or scientific rigor in turn assign a fundamentally benign authority to these techniques. The focus on the rigor of methods helps to mask the disciplining and constituting nature of these methods.

An interpellative technology. Disciplining refers to the ways in which discourses and practices—in defining, classifying, representing, or locating human agents—function as interpellative technologies. Relationships and conceptions that are circulated through discourses are internalized by subjects and in turn become core self-understandings such that these subjects take on the self-understanding and responsibility of remaking

My intent is not to dismiss a long tradition of interviewing and observing human subjects in order to better understand their perspectives and the social world, but to note that these practices are themselves constitutive in some fashion.
themselves to fit a set of societal norms or needs that discourse promotes (Foucault, 1975, 1995, 1990; C. Taylor, 1989, p. 159). These discursive and disciplining technologies have a number of nodes of influence. They facilitate the shaping of selves into acceptable socio-political-instrumental subjects and they provide the means of subjugating some knowledges while privileging others. Through the interplay of selves, social norms, and discursive technologies, subjectivities and the self are shaped through a relational, interweaving power that circulates through social discourse and other practices. One of these sites of power and discourse is the constructed story of gender and technology.

Technologies of Difference, Gender, & Objectivity

With the publication of The Second Sex in 1952 in the U.S. (1949 in France), Beauvoir skewered the idea of an ontological woman born into her nature; woman could no longer be understood as a being fully knowable through biology or sexual difference. Stating “One is not born but becomes a woman,” she took on the nature-nurture binary, arguing that nurture-culture constructs the feminine as the “other” to an also culturally conceived neutral and preferred masculine position (p. 267). This primary subject—male—requires the feminine Other for its own articulation, but is itself never put in the position of the Other. Her radical insight was that this m-f difference is not innate. Women become Woman through culture, historical conditions, and education—nurture not nature.

Subsequently, the notion of gender and femininity as social constructions entered mainstream discourse, embraced by the liberal feminist movement. However, it is difficult, if not impossible, to divest from some form of binary thinking in conceiving of social
relations, actors, and difference. Thus, upon dismissing the biological sex binary, other kinds of oppositions filled the void and these have often focused around cognitive, psychological, and behavioral differences between men and women. As concerns about a g/t divide grew, so did articulations of the premises and locations of clearly bounded differences. Gilligan’s (1982, 1993) work has been used by g/t researchers in this way, to characterize two oppositional, gendered orientations to ethics and social values in the context of technology. This model grounds most of the g/t research produced since the 1980s.86 Transparently functioning technologies of difference, gender, and objectivity work in concert to sustain certain kinds of differences for social or political ends.

The problem of difference. The g/t story depends on a core belief in difference of a particular stripe. It predominantly construes the world through easily definable oppositions and otherness (even if these are socially constructed), rather than as interconnected interweavings of relational and contextual exigencies (as, for example, Derrida or Cornell suggest). This commonplace and starkly oppositional framing of difference is built on the conceptual technology of binary thinking. That is to say, through normal practices of dichotomizing society and persons, filtered through an imaginary of gender, it has become common practice in the g/t story to use gender to characterize two oppositional orientations to technology—the value-rational and the value-neutral. However, these depend upon a conceptual clarity in distinguishing gendered roles and beliefs, as in the following example, taken from “Girl Games and Technological Desire” (Brunner, Bennett, & Honey, 1999):

86 Gilligan however, did not herself specifically use this to characterize the g/t relationship.
Our analysis of the adult fantasies [of men’s and women’s feelings about technology] focused on five major topics: 1) the role of technology in integrating people’s home and work lives; and technology’s relationship to 2) nature, 3) the human body, 4) the process of creation, and 5) the process of communication.

...For the women in our sample, technology is a fellow creature of the earth, a child of humanity, promising but problematic...needing care and guidance to grow...The women wrote stories about tools that allow us to integrate our personal and professional lives and to facilitate creativity and communication.

...In contrast, men’s fantasies were about mind-melds and bionic implants that allow their owners to create whole cities with the blink of an eye, or to have instant access to the greatest minds in history, to...see...what Ghandi might have thought about a problem they are facing in the office that day. In their stories, technology frees us from the earth, from social problems, possibly from humanity itself. (p. 74-75)

Through stories such as this, broad portrayals of women’s beliefs, dispositions, and fantasies express and locate conflicting desires and fears at the intersection of society and technology. First, these beliefs are separated based upon previously agreed upon concepts that suggest women and men are easily distinguishable. Second, it facilitates the composition of a discourse that articulates a mediatory function for gender, albeit invisible. Discourses are both constituted and constituting, but the processes of discourse make the oppositions articulated in the above passage seem inherently logical, even as they are products of our imaginaries and epistemologies.

Differentiating difference. The meta g/t story makes it seem as if difference merely points to some fundamental otherness through which systemic, social inequities play out. Derrida’s work is most useful in this regard, to disrupt a complacency in thinking that a notion of difference is fully agreed on so as to be foundational. Portraying the diversity of thought regarding difference, Wood and Bernasconi (1988) posit an imaginary society of Heraclitus, Nietzsche, Saussure, Freud, Adorno, Heidegger, Levinas, Deleuze, and Lyotard to suggest that these “members are divided not only among themselves, but perhaps within
themselves too. United by their affection for difference, nothing ensures it is the same
difference that counts for each, or that it counts in the same way” (p. ix). The problem they
lay out is that difference itself is hard to pin down.

Derrida coined the word “différance” to bring into one concept a number of
competing ideas about difference and to include a range of “logical, ontological, and
(transcendental) aesthetic values” (Wood & Bernasconi, 1988, p. x). Différance pursues
two parallel aims: (a) it brings together, without “exhaustively capturing” conceptions of
difference articulated in Nietzsche, Saussure, Freud, Levinas, and Heidegger and (b) it
accommodates reading and interpretation as non-reductive acts, where reading is never
final or all-encompassing (p. xi). For my purposes, without delving into the controversies
surrounding the interpretation of Derrida, this short deconstruction of difference suggests
that women, men, and genders are not so easily or neatly differentiated as they are assumed
within the g/t story.

**Difference in the g/t story.** Difference, as it is conceived in the g/t story, makes it
possible to locate a definable subject, who is differentiated through the conceptual
conventions of psychology and related social sciences. Difference signifies what appears to
be a kind of natural binary that is, on the one hand, not based on biology, but on the other
hand, still depends on reductivist thinking about subjects or objects. Enframed in this
worldview, the g/t story is built around a concern over the statistically documented trend
that women’s representation in computing fields is, and remains, at a far lesser percentage
than men’s. My argument, to be clear, is not the reality of underrepresentation, but rather,
with (a) what we make of “it”—this it that is both a constructed number and a constructed
relationship between objects and subjects and (b) the facilitating practices that are said to be most significant in the persistence (or import) of this g/t gap.

Reductive methodologies of the psychological-behavioral-cognitive sciences have provided the most consistent approaches to examining the g/t relationship. They appear to be objectively reductive and thus, analytically appropriate to the task they have been assigned. However, the ways in which these epistemologies actively construe a set of reduced, gendered, objects and subjects is more complicated because what difference is used to signify, or is able to signify, is far more nuanced than has been assumed in the meta story.

Similarly, in the dominant epistemology of the meta story, theory is also a kind of object (albeit conceptual) and is taken to be an outcome of accurately defining, discerning, and explaining differences between subjects or objects. Theory should be explanatory and is therefore largely dependent on differences that can be conceptually and methodologically pinned down. The question that might be asked is “What or who is being measured and theorized in the g/t story, how, and why?”

**Difference & second wave feminist theory.** Reading through the meta g/t story, the influence of Carol Gilligan (1982, 1993) and second wave feminism is remarkably persistent twenty-five years later. From these ideas, there emerged a compelling picture of women ontologically driven by a unique and stable ethic of care, values, and community that bears some scrutiny in 2009. A particular idea of difference is behind this ethic that describes a dichotomous moral-ethical orientation to the world. Difference demarcates a
universal, yet binary, ethical sphere that is used to explain girls and women’s relationship to technology.

One significant characteristic of gender theorizing in the g/t story is that it is done from within a largely singular, conceptual, and disciplinary base where psychology, behaviorism, and cognitivism intersect. Because of this, a conceptual gap is left, thus underutilizing recent, more philosophical, political, or cultural studies perspectives. This gap helps to explain the perennial presence of Gilligan’s or other liberal feminist derived gender conceptions. The problem that this limited lens manifests is that gender too easily becomes a reductivist construct used to simplify and condense girls and women (as well as boys and men) in relation to technology. Another problem (discussed earlier) is that liberal, second wave feminism, outside its continued influence in the g/t story, has been heavily criticized by numerous scholars for the ways it has unreflexively relied upon a conception of women and their experiences that is largely articulated through a lens of white, Western, and middle or upper class women.

**Gilligan’s influence.** The following example illustrates what this looks like when the AAUW relies on this kind of differentiation as a rationale for attending to gender differences in computing classrooms:

Additionally, computer science courses would do well to discuss the interplay between computers and people in real-life situations, an aspect of the computer culture that girls say they value. Studies have shown that when teachers have tried to demonstrate how programming applied to real life, their classroom examples gravitated toward sports statistics, even when the programming task at hand was open-ended. (2000, p. 43)

In this passage, sports are targeted as being a poor pedagogical example if girls are to be interested in the computing classroom. However this characterization depends on a
particular gender conception that ignores the debates that resulted in the 1972 Title IX education amendments addressing sex discrimination in the U.S. The amendments, in part, responded to girls’ demands for greater access to sports in school.\textsuperscript{87}

Relying on difference to characterize gender attributes, gender/technology narratives broadly blend culture, biology, and social roles, such that an abstracted universal woman is made available in both local and global terms as the holder of a society’s ethical values in a technological world. It is not within the scope of this dissertation to fully examine the veracity or possibility of this kind of statement. My aim is more focused, to point to the limitations of static, inconsistent, or dated constructions of gender and women. When difference is painted in black and white, it becomes quite difficult to accommodate other differences, e.g. those within groups or individuals, shifts in the beliefs or identities that mark such differences, or the grayness of differences.

Additive differences in gender/technology research. In more recent gender/technology research, attempts to transcend a tendency to frame difference through a Western, white conception of women have largely embraced an additive approach wherein race and class (for example) are to be added to the identity mix. The aim is to promote research that better addresses intersectional race-class-gender (and so on) differences. This additive approach is described by Chanter (2006) as one that seems to create space for race and class analyses, but only as these fit within feminism’s narrow articulation of gender in a white, middle class conception. This model also keeps gender, sexuality, race, and class apart as separate

\add\footnote{See \url{http://www.dol.gov/oasam/regs/statutes/titleIX.htm} for the Title IX, Education Amendments of 1972.}
differences. This model characterizes how the meta story tries to accommodate race and class as other analytic variables that, while separate, can be added together. These efforts remain bound to the same psychological-cognitive-behaviorist foundations of second wave feminism and its conception of difference. They adhere to a model that is ill suited to developing a more nuanced and contextually sensitive intersectional complexity. While these attempts at promoting diversity have noble goals, in effect, they simply build on current limitations in how the g/t relationship is construed, remaining theoretically insufficient.

To be fair, substantive, ongoing debates over what a feminist theory should look like, accomplish, or represent complicates any attempt at ultimately defining gender or women. One of the ongoing debates within feminism is whether, and through what dimensions, women can or should be pinned to a definition. There is an inherent contradiction between stated goals of g/t research in education and those driving postmodern and poststructuralist feminist approaches as these challenge the reductivist practices so pervasive in the former.

** Alternative lenses in theorizing gender difference.** Contrary to assumptions made in the G/T story, there is no universal agreement on what “difference” construes or how it is to be noted. In what follows, I highlight several views of difference because understanding the contested nature and potentiality of difference is crucial to understanding what a theory of difference means for the g/t story. I offer a necessarily limited rendering of a few particularly salient ideas because it is not possible to go into the kind of depth and richness that current feminist thought deserves.
**Irigaray on difference.** Irigaray (1985) examines psychology’s penchant for “econom[ies] of representation” (p. 22) and argues that constituting difference in this way reflects an organizing system wherein masculine subjects determine the “paradigms and units of value” that constitute women. Drawing from Derrida’s extensive work on différance, she suggests that subjectivity itself must be reconceptualized so that it includes both nature and culture, to accommodate a reality where men and women are equally present in both. It is not a masculinized transcendence that women need to aim for, but an embodied subjectivity. In Irigaray’s view, both philosophy and psychology have been complicit in theorizing negative views of women, lacking in subjectivity. Neither are the truth of women’s nature.

**Haraway’s cyborgian challenge to binaries.** The cyborg is another concept through which scholars have tinkered with gendered and human-machine binaries for the way the cyborg, metaphorically at least, renders biology problematic or irrelevant. Haraway’s use of the cyborg (1991b) suppressed the biological body in order to challenge a Western subjectivity constituted through oppositions of nature-culture, m-f, and mind-body. The target was dominant Cartesian and essentialist models of knowing and her intention was to reposition knowing as a product of experience that is inseparable from the social and political position of the knower. One of Haraway’s targets was liberal feminism, which she saw as delineating a false unity of “women’s experience” or female subjectivity (p. 149). A key problem for her was how feminists had promoted women’s opposition to science through a strategy of resistance that itself depended on a separation of body-machine and nature-culture. This strategy was meant to dismantle oppressive regimes of white male
capitalism and its blind drive for progress through the appropriation of nature, which Haraway argued is a misunderstanding of science. Her cyborg was a plea to merge nature and culture and to dissolve the basis of a false gender binary that was limiting both women and science. It was a metaphor for a new vision of nature-culture-science and expressed the potential of women’s release from the self-imposed constraints of women’s own representation of their experience. Haraway’s cyborg was, metaphorically, a rupturing technology and what it ruptured, in part, was a particular concept of difference. Haraway negated the separatist notions of difference that themselves become determinist rationales and that Irigaray had identified as the problem.

**Alcoff & a metaphysics of difference.** As it turns out, the intersection of essentialism with feminism is quite complex, intensely debated, but ultimately, the concern is how some beliefs about sex, gender, their intersection, and a theory of differences promote determinist thinking. Alcoff (2006) argues for a metaphysics of sexual difference that recognizes the natural, inescapable, reality of biological reproductive capacities, but she also believes that recognizing sex as a significant marker of difference should not lead to, in itself, pre-determined assumptions about roles, beliefs, or practices.

**Butler & performativity.** Despite controversies over whether Judith Butler’s notion of gender as performance remains useful (see Alcoff (2006) for one criticism), her ideas are helpful in articulating how certain bodies are articulated “within the productive constraints of certain highly gendered regulatory schemas” (1993, p. xi). The g/t story can be viewed as one of these schemas. In essence, thinking about gender as something
performed rather than innate is a way of highlighting how some performances are cast to the margins of society.

Theorizing difference to reduce gender & women. Running parallel to cyborgian challenges to a universalizing, gendered difference is the g/t story that seems to have been, and remains, blind to the possibility that m-f difference as it has been conceived in the story is itself a reductivist construction. I think it fair to characterize this conceptual gap as a blindness given that much of feminist technoscience has been left out. Thus, g/t researchers have themselves practiced a version of constituting the outsider to a dominant, perceptual norm.

The problem is to decipher why the meta g/t story, which is both a gendered and gendering technology, remains so pervasive and seemingly useful. Gender-technology micro-stories support a meta g/t story that in turn has become the conceptual and productive space wherein a technology of gender blossoms. Given that there are other ways of thinking about gender and technology available, it becomes even more important to examine why the dominant story persists despite evidence of serious limitations. One alternative might be Halberstam’s (1991) use of the cyborg and AI to locate a postmodern incarnation of the technology of gender. Her cyborg dismantles the Woman = nature construct by locating a commonality in how gender and AI are processed and performed, as similarly functioning technologies:

88If the g/t story were not so useful it would not be so persistent. After all, similar amounts of money, time, and research effort are not spent in trying to intervene (at least not to the same degree) in other long-standing gender gaps in the arts, academe, or the professions.
Learned, imitative behavior[is]...processed so well that it comes to look natural. Indeed, the work of culture in the former and of science in the latter is perhaps to transform the artificial into a function so smooth that it seems organic. (p. 443)

Outside the meta g/t story, intersectional, multicultural, transnational, transgender, postcolonial (and so on) feminisms take issue with universalizing Western, white, Eurocentric theories or approaches to conceptualizing difference, gender, or women but they do so from across a number of disciplines. This wealth of alternative theorizing suggests another problem. The subtle alliances and underlying epistemologies of the meta story do not announce how they sustain specific practices of theorizing gender and women,

**Circumscribing gender.** The following passage from Barker and Aspray’s *Women and Information Technology* (2006) illustrates how they navigate the problem of gender essentializing:

Males and females may share many more similarities than research suggests, but authors frequently privilege statistical difference in reporting rather than not finding any variation.

... Bennett, Brunner, and Honey (1999) argue that one should not be trying to reinforce existing gender stereotypes or be looking for the gender-neutral solution but rather should seek ways to validate both masculine and feminine views of technology. (2006, p. 10)

Evident, in the first sentence, is a desire to accommodate a reality where it is difficult to classify all men or all women based on gender rules or expectations. The authors first offer a moderate criticism of research methods that emphasize difference for the sake of producing findings. However, in the second sentence their intentions are less clear. They want a language or gender theory that is better equipped to accommodate m-f difference but that does not merely reinforce common stereotypes. What they do not appear to have
is a theory that is sufficiently sophisticated. Instead, Barker and Aspray rely on Kenneth Howe and Nel Noddings’ theories as I explain in the next paragraphs.

For Howe, the problem of gender theory in education is that it has overly emphasized equity. He posits that a better approach would be to focus on environments and how these may be “foreign or hostile to who they [girls or women] are” (Barker & Aspray, 2006, p. 11). Similarly, as explained by Barker and Aspray, Noddings’ sees a more gender friendly classroom as one that “would be broadened and customized to the particular set of students” and become less driven by the mechanics of computing (p. 13). What happens is that gender essentializing is not ultimately subverted in these approaches; instead, it is subsumed into a problem of teaching methodology and learning environments. Thus, the methodological problem to be “fixed” in solving the underrepresentation problem is more differentiated teaching methods and settings. I do not mean to suggest that this approach is of no pedagogical value; however, this strategy does not seem to escape an ongoing tendency towards reducing subjects to the degree they fit an explanatory theory. Moreover, these attempts to differentiate pedagogies are stymied as they meet up with other methodological disputes.

This methods problem is illustrated by looking at another essay in the same edited volume, where Cohoon and Aspray (2006) argue that there are two highly significant contributing factors to ongoing gender underrepresentation.

Our review of the literature on women in postsecondary computer science leads us to the conclusion that two conditions contribute to the persistence of women’s underrepresentation. The first condition is an inadequate understanding of the underlying and immediate causes. Much of what has been published is based on personal experience or observation of a single case, rather than being grounded in empirical evidence that can be generalized. (2006a, p. 137)
There is an underlying contradiction between the first essay’s criticisms of determinist or enforced gender stereotyping and this second essay’s criticism that g/t research has not produced broadly generalizable findings. It is hard to reconcile this latter concern with statements such as “what it means to be male or female is culturally and situationally variable” with the ongoing quest for generalizable interventions (2006, p. 9).

A Theory of Difference vs. Theorizing Differences

When theorizing gender and women in the meta g/t story, there is an ongoing paradox: on one hand are intentions to be open to specificity, and on the other, a methodological insistence on locating explanations that facilitate generalizable interventions. Standards for producing these explanations are often borrowed from the NSF. The following, among those cited by Cohoon and Aspray (2006), are the most relevant for making my point:

- a cogent means of measuring outcomes
- data from a sample larger than ten
- a study design employing pre- and post assessments, a control group, or comparison (p. 144)

A methodological conflict emerges on two levels. First is the barrier set up between a contextual or individualized practice of gender and the methodological requirements for a quantifiable set of research objects and a control group to facilitate comparison. If gender is highly specific, what is to be controlled? A further conflict becomes evident in looking more closely at the two understandings of “theory.” In discussing feminist theory, “theorizing” represents a lens onto the world that is not fixed nor proscriptive—it is interpretive. However, theory when used to argue for generalizability means something
quite different: “theoretical underpinnings are seldom articulated, and none of the studies we located were designed to test a particular theory. Still, movement toward more explicit consideration of theory might help advance empirical investigation” (p. 139). Here, theory refers to a testable explanation.

In the g/t story, theorizing typically refers to causal, explanatory theory. This use of theory suggests a reactive feminism that is organized around prediction and interventions conceived globally. Other scholars, working in other disciplinary homes, view feminist theorizing in a substantively different light. For example, Ella Shohat (2002) argues for a “relational feminism” that builds “a kind of kaleidoscope framework of communities-in-relation without ever suggesting that their positionings are identical” (p. 69). Her vision is for a feminism that is not about difference per se, but a “multicultural feminism” that expresses difference through “a situated practice in which histories and communities are mutually coimplicated and constitutively related, open to mutual illumination” (p. 75).

In general, this latter notion of feminist theorizing might be broadly characterized by its commitment to rigorous and ongoing critique regarding the conceptualization and study of persons and their cultural-political positions, voices, and significance. Such a practice suggests, however, a high degree of reflexivity about not only women, but of the intersection of feminism with knowledge, methodology, and socio-political contexts. Joan Wallach Scott (2008) describes this feminism as

Not a set of prescriptions but as a critical stance, one that seeks to interrogate and disrupt prevailing systems of gender, one that assumes that what worked in the 1980s might not work in the early years of the new millennium, one that is committed to self-scrutiny as well as to denunciations of domination and oppression, one that is never satisfied with simply transmitting bodies of knowledge
but that seeks instead to produce new knowledge. This is feminism not as the perpetuation and protection of orthodoxy but feminism as critique. (p. 6)

“Feminism as critique” describes a critical stance from which to consider social reality where both subjects and objects are hard to pin down, thus interrupting at a fundamental level the methodological “finesse” of a reductivist and empiricist model of knowledge production. Theoretical limitation characterizes much of the g/t story that is written through methodological and disciplinary terms initially constructed back in the 1970s-80s. Early on, the meta g/t story defined women and gender through a clearly defined difference. Complicating recent efforts to move beyond this circumscribed concept of woman is a methodological proscription that depends on stable and controllable objects and that has, in many ways, worked against its own transformative aims. This model makes it difficult to accommodate the ways in which the social-political-intellectual situation has shifted and thus, how feminism and women (and men) continue to evolve. These kinds of static formations are what Appadurai and Rizvi are responding to when they locate a research imaginary built upon an empiricist model of knowing (Appadurai, 1999, 2000; Rizvi, 2006). In a recent conference paper and thought experiment, Corneliussen (2009) plays with a similar notion, that g/t research has been quite static, even as computing technologies have been rapidly advancing. She suggests a focus on “change” in looking at the connection between gender and technology.

The g/t story, on the surface, seems positioned to ‘produce’ equity and to accommodate differences or at least create the conditions for attaining these, but this is not all that it accomplishes. This g/t story persists in using old and limiting ideas about women and this begs the question of why this model remains so popular. In particular, I am
interested in two questions: Why are these limited notions of gender, women, and technology so enduring and what sorts of social or epistemological relationships and g/t futures do they value and promote?

Scott (2008), in highlighting feminism’s “most potent weapon” to be critique, suggests that the essential motivation for feminism is “the exposure of the contradictions and inadequacies of any system of thought” (p. 7). I rely on this feminist stance with the specific intention of critically analyzing the ways in which a particular stripe of feminism has, in effect, been co-opted by a neoliberal politics. The twist is that the g/t story, in its conception or use of gender, also tries to stand between society and the increasingly instrumental quality of everyday life, in work, politics, health care, education, and social relations that neoliberalism promotes.

The Disciplining of Gender & Women

The conceptual disciplining of difference facilitates a fully functioning technology of gender, through which groups of “researched and reported on” women adopt the self-understanding of being outsiders to technology, as the g/t story consistently suggests. This technology of gender depends on two key conditions: (a) a demarcation of women as outsiders to a masculine technological norm and (b) a set of practices through which that technology is put into play. Analyzing the technology of gender makes it possible to see that gender is used to differentiate and constitute a “normal” subject or object, and in turn, consider what that accomplishes. In order to understand the technology of gender, we
must first understand what Foucault’s technology of the self was intended to address and make visible.

**Technologies of the self.** Foucault’s argument was that technologies of the self are interpellative practices “designed to confirm the behavioral norms of the society at large”; through these practices humans “construct...modes of discourse and...action through which we shape our conception of human nature” (Hutton, 1988, p. 25). His technologies of the self “are a kind of currency through which power over the mind is defined and extended” (p. 135). For example, in *The History of Sexuality, Volume I* (1990), the reader is witness to how desires, transgressions, thoughts, and actions are transformed through social and institutional practices into discourses that in turn function as technologies of the self. Subjects fit themselves into social-political norms by self-monitoring their desires, actions, and transgressive practices. Foucault identifies the social and psychological sciences as perpetrators of a set of technologies that promote and facilitate the transformation of the individual (Martin, et al., 1988). Through genealogic analyses of discourses and social practices (e.g. madness, sex, prison, and disciplines), Foucault (1975, 1995, 1990; Martin, et al., 1988) brought to light the interworkings of how a human subject is constituted and transformed in and through social scientific discourses and practices.

**A technology of gender.** Gender, as it is used in the g/t story, is a technology in ways that are reminiscent of Foucault’s technology of the self. The connection between technologies of the self and those of gender was drawn by Lauretis (1987). The technology of gender, problematically for women, too often “translat[es] women into metaphor” (Braidotti, 1985 cited in Lauretis, 1987, p. 24). Through discursive practices, the
technology of gender has become a stable, reliable, organizing concept as it disperses expectations of gender through cultural markers and metaphors that are in turn, interpellated by women as they become “right” kinds of women (Lauretis). This technology of gender invisibly shapes women’s self-understandings of themselves in relation to computing and technology. A technological interplay between concrete, material and intangible, or socio-political technologies foregrounds the construction of a unifying theory of girls and women’s relationship to computing.

Women become the subject represented by the g/t story. As Lauretis (1987) states it, the “representation of gender is constructed by the given technology...and is absorbed subjectively by each individual whom that technology addresses” (1987, p. 13). Moreover, “gender is not a property of bodies or something originally existent in human beings, but ‘the set of effects produced in bodies, behaviors, and social relations,’...by the deployment of a complex political technology” (p. 3). The technology of gender is also a revisiting of Beauvoir’s (1952, 1989) proposition that to become “Woman” is to be constituted without subjectivity, without the valued traits associated with masculinity, left with only the less valuable traits marking femininity. However, rather than understanding women as a social production constituted without masculine attributes (a deficit model), the technology of gender makes something else possible. It both recognizes yet skirts a biological difference that is redirected to psychology, behaviors, or cognitive capacities such that discussing this difference becomes a means for instilling cultural and political agendas as norms, based upon membership in a well-defined category of gender. This creates a social-discursive interplay in which representations of women serve as a facilitating technology through
which women are brought into a kind of gender compliance, thus fitting themselves into a cultural expectation or norm of how women are in relation to technology. The questions should be what this technology of gender is for and what role it serves. Why is the g/t story so compelling as a “proxy for a bigger concern” (phrase borrowed from Stolberg, 2009; sec. Week in Review, p. 1)

The technology of gender is not unique to the g/t story. However, in this story, the technology of gender facilitates something specific, namely, girls and women’s self-understanding and subjectivity expressed as a particular orientation towards computers or computing as well as the wide dispersion of this self-understanding and subjectivity. Thus, the g/t story is more than a description or explanation of women’s underrepresentation in computing. It is also a significant cultural story about how mainstream society, education, and engineering think about technology, women, and the society-technology intersection in terms of progress, values, and ethics in this technological era. It is, as well, a constituting story, one that promotes some kinds of relationships and subjectivities and marginalizes others.

Over the last thirty years, the g/t story has emerged as a disciplining story that both creates and monitors a normal picture of women and their relationship with the computer. It does not matter that we find this relationship problematic for numerous reasons. What does matter is how women themselves are disciplined into a kind of subject through the very techniques used to observe and explain their intents, behaviors, and interests.

One way to see how this disciplining proceeds is to look at the picture of women and computing prior to the rise of the contemporary meta g/t story. Ada Lovelace is
considered the “prophet of the computer age” based on her work, around 1843, with Charles Babbage on the forerunner to the modern computer. According to the Computer History Museum (2008), Lovelace, in creating the technical and explanatory notes for Babbage’s engine, was the first to articulate “the idea of a machine that could manipulate symbols in accordance with rules and that number could represent entities other than quantity mark[ing] the fundamental transition from calculation to computation” (website 2008). About a hundred years later, Grace Hopper’s contribution to computing was the first machine compiler, an invention that makes advanced computer programming possible. There are also the numerous women who worked as human computers during WWII, contributing their extensive mathematical reasoning skills to the war effort.

By the early 1980s, the mainstream narrative of women and computing began to shift, emphasizing instead of women’s innovation and accomplishment, their computer reticence (Turkle, 1988), deficits (e.g. Hawkins, 1985; Kay, 1992; Sanders, 2005), or disinterest (e.g. Huber & Schofield, 1998; Morse & Daiute, 1992). By 2002, this updated g/t story was so well formed that Margolis and Fisher were able to convincingly articulate a set of seemingly normal or expected gender differences in students at Carnegie Mellon, one of the most elite computer science schools in the world. How was it that women’s subjectivities and self-accounts shifted so remarkably, such that women, who were, in fact, creators of the intelligence of the new thinking-psychological machine, could be so thoroughly, discursively and conceptually, located to the sidelines? This shift in women’s subjectivities and technological identities reveals the ways in which the g/t story itself has functioned as a disciplining technology such that women have learned to see themselves
through a set of norms that serve shifting societal expectations and concerns. The new norm serves a need for an intermediary to sit between our increasingly tenuous traditions and technological progress that quite often seems out of control.

There are other, radical or resistive g/t stories that tell a different story than the dominant g/t narrative portrays. However, these too, remain marginalized. Some scholars have argued that the discourses of g/t and technology have themselves promoted a social construction of women as outsiders to computing. Henwood (2000), for example, aims to discredit the idea that mainstream g/t narratives are representations of an objective reality:

In dominant cultural representations, men and women are constructed in oppositional terms: men as “good” with technology, women as technically “incompetent.” These representations, rather than being accepted as reflective of some “reality” or “truth” about men’s and women’s attributes, need to be understood as part of the broader picture of gendered discourse that surrounds technology relations and that positions men and women so differently. (p. 222)

Bryson and Castell, in 1998, argued from a Marxist perspective to characterize gendered portrayals as expressions of adults’ wishes that girls become good consumers or commodities.

We ought not to be surprised that it is in pink boxes that girls have learned to package their desire in our culture. But such desires surely have far more to do with the gender-identities developed by adult males than with those of children themselves, since it is masculinity that has always been the desired response to the question of what girls and women want....We suggest that girls’ desires have far less to do with what girls want than with what kind of girl adults, whether in education or in the marketplace, want to produce. Reenacting the ancient Greek myth, they eagerly create and then consume their own children as commodities, hungrily introjecting adult fears and desires onto their children, in the name of satisfying the children’s own wants and fantasies.

...Most importantly, are we producing tools for girls, or are we producing girls themselves by, as Althusser (1984) would put it, “interpellating” the desire to become the girl? (1998, p. 251)
The fact that these kinds of analytic approaches remain rare and quite marginal to the mainstream g/t story suggests how the disciplining sciences also monitor the kinds of discourses let in to the discursive circle. Alternative narratives tinker too much with the dominant story that we, as a society, need in some way. Looking back to the early years of the computer, the picture is of women positioned at the forefront of technological innovation. Beginning in the mid 1980s, there was something new in the air that foregrounded a revving up of concerns about girls and women’s participation in computing. The computer was no longer simply a calculating machine—it emerged as a radical new kind of machine with the potential to radically shift the fundamental human-machine separation and differences that had so long distinguished humanity from the rest of the world, most especially from the inorganic. Supporting this transparently functioning technology of gender is another technology—objectivity. I mean objectivity in the ways that it understood and invoked as a perceptual technology that makes the non-compliant or marginal subject (or story) invisible because these are taken to be irrelevant to the central story.

A Technology of Objectivity

We can think about the g/t story as having (at least) two nodes—a first node that is visibly promoted and a second node that is marginalized and relatively invisible. The first

89 Phipps (2006) is an example of these resistive interventions to the dominant g/t story. These kinds of approaches are more visible in the U.K. and Europe than in the U.S., but regardless of the location, this strand is not actively taken up or recognized in the mainstream story.
node is the meta g/t story and it is here that the technology of gender does most of its work. The second, marginalized, node is made up of those stories that resist, do not serve the right agendas, or are not visible within the scripted lens of the meta g/t story.

The range of documents already discussed throughout this dissertation represents the first node. The second and far less visible story node is less cohesive and is told from a number of perspectives and intentions that might be corrective, resistive, oppositional, reconstructive, or aesthetic. In size (measured in terms of the number of studies, articles, and citations), the first story is impressively immense; the second story is dwarfed by the first. I describe some examples of the second story in the following paragraphs. These examples characterize significant strands and highlight many of the locations where this second story may be found. Within these stories, it is possible to locate what might be characterized as a grassroots movement or gathering around localized or special interests quite marginal to the mainstream story.⁹⁰

**Outside the dominant & objective field of vision.** I began writing this section on the first ever worldwide “Ada Lovelace Day” on March 24, 2009. Artifacts of the event may be found on blogs such as this: http://www.pledgebank.com/AdaLovelaceDay. The day was instigated by Suw Charman-Anderson as “an international day of blogging to draw attention to women excelling in technology. Women’s contributions often go unacknowledged, their innovations seldom mentioned, their faces rarely recognised” (pledgebank.com). One of these contributions hidden under the social radar is that made

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⁹⁰ Some others that I do not have room to go into detail about, or whom I have mentioned earlier, are: Flanagan, Plant, Oldenziel, Wacjman, and earlier, Lockheed offered some insightful ideas.
by the women “computers” who provided a mathematical and computing prowess prior to (and later with) the ENIAC (the Electronic Numerical Integrator and Computer). These women were engaged as top secret computational workers and many went on to become the first women programmers. As were many women, these top secret “Rosies” were pivotal to the WWII effort. The women are documented in a movie, currently in production, directed by LeAnn Erickson (see http://topsecretrosies.wordpress.com/ for details).

Other examples include de Castell and Bryson’s (1998) resistance to the material co-optation of girls for the consumer game industry and Flanagan’s “Hyperbodies, Hyperknowledge” (2002) that interwove feminist cyberpunk fiction writing and feminist technoscience theory to argue that the cyberworld is not as wholly masculine as it has been represented. Taking a different tack, Abbiss’ (2008) scholarship deconstructs the idea of a stable gender problem and problematizes the underlying reliance on essentializing ideas about both IT and gender. There are also a number of active list serves and online communities of female digital artists or gamers with regular refutations of the dominant g/t narratives. Also noteworthy are other locations and practices of resistance that often interweave interests in art, technology, and social justice.

These examples of a far less visible g/t story are arguably, a stronger “feminist” story. The other dominant and highly visible g/t story reflects a weaker feminism, not in its intentions for equality, but in the ways it transparently combines women into a unity that remains rather fixed in time and thought, which in turn continues to articulate women in

\[\text{FACEs list serve: } \text{http://facesl.net; womengamers.com; girl gamers, for example.}\]

\[\text{Again, the FACEs discussions often focus this way. Another example of youth-based social justice projects is Beyond Resistance (Ginwright, Noguera, & Cammarota, 2006).}\]
rather limiting ways. Distinguishing a strong versus weak feminism makes it possible to account for the ways a contemporary feminist backlash often influences the kind and quality of feminist theorizing and practices that in turn influence research and policy making (e.g. Oakley & Mitchell, 1997). Specifically, an overly strong feminism has met some measure of resistance, and this is perhaps one reason for the second story’s marginal status. These more activist projects and positions have an explicit intention to visibly and vocally disrupt a dominant social norm that has been justified or organized around clearly defined gender roles. This norm has kept women and technology separate and disciplines women within a certain conceptual and social boundary. The technology of gender depends on a stable tradition or theory of gender.

Phipps (2006) uncovers one aspect of a backlash in her study where she interviewed women scientists and technology professionals in England, who, despite their professional success, tended to intentionally distance themselves from any kind of overt feminism. Her argument is that women successful in STEM fields appear reluctant to do much more than reform an existing environment so that it becomes a better “fit,” maintaining a neutral relationship to feminism. The problem is that, even though women STEM practitioners may express some feminist ideals and be engaged in some form of activism, they specifically situate themselves outside of any identity with a more radical feminist project, instead holding to the idea that individual “excellence” will help them succeed. Phipps argues that these women reflect contemporary neoliberal politics as well as the neoconservative backlash against feminism. This state of affairs mirrors the trend towards greater government involvement in STEM issues in pursuit of national market competitiveness in
a global economy. Phipps portrays women in technology as situated within dominant
“symbolic, cultural, and structural masculinities” that frame and characterize STEM fields
as a whole. (p. 127) She argues that a dominant habitus (citing Bourdieu) “‘tends to
reproduce the system of objective conditions of which it is the product’ and...this helps us
to understand why there has been so little progress on the issue of women in SET [STEM]”
(p. 133).

In 1990, Perry and Greber argued that educating girls in computing is paramount
to bringing feminist values to technology because advanced computer work is so often
linked with the U.S. Department of Defense. The suggestion was that women might
mount a radical feminist pacifist resistance to this co-joining of the military and
computing. Women would counter the increasingly popular model that views the human
mind as an information processor, albeit one that is highly complex. This model left us
without a recognizable purpose as “social relations, artistic creativity, whimsical invention,
imagination, faith, humor—all these drop away” (p. 96).93 The idea promoted was that an
overly masculinized culture of computing, itself militarily focused, has cast more
conventionally feminine traits to the margins, e.g. “the ability to care, to feel, and to
connect with other human beings” (p. 97). Perry and Greber’s essay was resistive in two
ways. It brought to light the early yet hidden formative contributions by women to the field

93 Hayles describes one organizing opposition that is emerging in the twenty-first century as
the tension between the “Computational Universe” and Mother Nature, where
computational universe refers to the belief that “the universe is generated through
computational processes running on a vast computational mechanism underlying all of
physical reality” (p. 3). Thus, “my mother was a computer” functions, for Hayles, as a
metaphor for “the displacement of “Mother Nature by the Universal Computer” (p. 3).
of computing and it argued an intriguing idea at the time, that bringing more women to computing would help to restructure work roles and thus, societal values.

The idea promoted in the meta g/t story is that it is (or could be, if its techniques were more scientific) an objective story. That is, despite individual or potential flaws in its micro stories, the meta story itself represents itself as an objective and accurate rendering of the state of the gender-computing relationship. When marginal or resistive stories are acknowledged, it is to point to a gap in the explanatory reach of current g/t theory. Mostly however, these stories are relegated to the margins because they rely on an overly expansive notion of gender and women than the story can accommodate, given its epistemological foundations. These marginal stories are evidence of how gender and women are disciplined, but these stories themselves do not explain how women have been transparently reshaped and envisioned to accommodate the neoliberal project of subject formation and compliance, nor why this female subjective position is useful. One way this happens is through the disciplining of what constitutes a relevant perceptual field.

Observing, as Haraway (1991a, 1997) suggested, is itself a limiting and constituting technology.

**An alternative objectivity.** An empirical study—to meet criteria for objectivity—should ensure a certain degree of neutrality in the observer-researcher as well as a high degree of honesty and reliability in respondents. What passes unnoticed or unaddressed is the way that objectivity (or its pursuit) functions as a technology in the way it closely guards the observational field from two perspectives. First, observers must adhere to prescriptive
methods that supposedly keep biases or preconceptions out of the research field and second, the research field itself must clearly delineate who or what is a relevant subject.

In the following example found in *From Barbie to Mortal Kombat* (Cassell & Jenkins, 1998, 1999b), there is an inferred objectivity to findings but this is in part dependent upon how one understands the sample of girls and women implied in a specific study. While the researchers do not claim these are attributes of all women, there is also no attention to other women who think otherwise. The perceptual lens only sees these women, with these characteristics.

Women and girls are much more likely to be concerned with how new technologies can fit into the social and environmental surroundings, whereas men are much more likely to be preoccupied with doing things faster, more powerfully, and more efficiently regardless of social and environmental consequences. Women are also far less likely to push the technological envelope and tend to be willing to make do with available tools. Men, in contrast, tend to draw upon their technological imaginations to extend the capabilities of technologies and to attempt to ‘go where no man has ever gone before.’ (Brunner, et al., 1999, pp. 77-79)

This observational boundary-making plays out across the g/t story. In the next example, women themselves are said to mirror what has been observed, yet the narrative strength of these self-reports is built from a lack of alternative narratives.

Women students’ descriptions of why they are majoring in computer science are a “counternarrative” to the stereotype of computer scientists who are narrowly focused on their machines and are hacking for hacking’s sake. Instead, these women tell us about their multiple interests and their desire to link computer science to social concerns and caring for people. (Margolis & Fisher, 2002, p. 54)

Criticisms of methods that rely on self-reports tend to put the focus on whether self-reports are reliable data rather than how the perceptual field has limited what kinds of subjects or practices were visible. The arguments appear to be over methodology, masking how certain practices of objectivity come to define what is available to be seen or what kind
of observing is scientifically appropriate. Debates about objectivity continue to be debates over whether subjective accounts are sufficiently objective. Unquestioned is what objectivity enables or disables when it broadly paints the picture of “normal.” Objectivity, in the meta g/t story, refers to the disengaged, birds-eye lens of normal science that Haraway (1991a, 1997) deconstructs. She sees a highly limited objectivity that bounds the perceptual field in a way that enables the production of the constituted outsider—a product of a biased objectivity.

An aura of expertise separating the higher echelons of computing from the rest of society is built on stories of a mystical convergence of passion, techno-virtuosity, and exclusivity (of interests, attributes, goals) in the masculine world of computing that in turn are made that much more exclusive through a strategic deployment of the constituted outsider. A bird’s-eye objectivity effectively separates women from technology in multiple ways. First, it locates the majority of women outside technology (e.g. maintaining the invisibility or otherness of users, artists, applied technologists, and so on), thus closely guarding the borders of what counts as “significant” participation. Even when occupying an insider position, computer science women are still constituted outside the male norm. Specifically, within the 0.3% of women who are identified as computer science majors, their different interests and values are always highlighted to characterize them as outside the dominant norm. In the g/t story, women’s significance looms large but its importance is framed around absence and otherness. Women are strategically located as outsiders to technology, most often based on their social natures and higher moral values. Women’s
continuing underrepresentation makes it possible to promote these values as the basis for intervening in techno-culture.

The need to locate significant differences between men and women has remained a top priority, but the specific loci of concerns regarding differences remain in flux. That is, even though the specifics of difference have changed, the value and position of the constituted outsider to technology continues to hold steady or increase in value. In some sense, the constituted outsider is a prediction come true. For example, in 1985, Hawkins argued that computers would contribute to an already existing gender/STEM divide:

The issue of equity of access to computers and learning about computers has become an important topic in education. It is a common concern that all children have equal opportunity and appropriate support for acquiring competence with the technology...Two important dimensions of difference are social class and sex. With respect to the latter—if current projections are accurate—girls are likely to learn less about and have less ability to control this increasingly important cultural tool. (Hawkins, 1985p. 165-166, bold added)

For Hawkins, the problem was not just computers, but the ways their use in schools revolved around STEM interests. This would, in Hawkins view, lead to a continuing gender inequity in schools because girls already had shown less interest and or capacity in those STEM fields. Thus, the argument went, the computer had to be disconnected from math and science to be welcoming to girls. Notably, recent statistics indicate that girls and women’s participation in many STEM fields has increased substantially—except, specifically, in computing. The constituted outsider has, ultimately, remained one of the most stable ideologies of the meta g/t story, even as the specific conditions for this outsiderness change. The mystery is why.
Women’s rejection of the computer as an “intimate machine” was an idea popularized by Turkle in her 1988 essay that stated:

The issue for the future is not computerphobia, needing to stay away because of fear and panic, but rather computer reticence, wanting to stay away because the computer becomes a personal and cultural symbol of what a woman is not. (p. 41)

Both the computer and woman take on symbolic purposes that suggest an ontological ground for the constituted outsider—the preservation of the feminine, as something other than technological.

The persistence of the constituted outsider in computing builds from these kinds of 1980s configurations. For example, in 1999, Mörtberg (a computer scientist and g/t scholar in Sweden) wrote:

Feminist researchers should therefore utilize the potential of feminist epistemological programmes in order to achieve a revision of the foundations of science and to intervene in knowledge processes and epistemological discussions. (p. 47)

Mörtberg’s argument mirrors others that similarly aim to resituate women in relation to computing. In essence, these arguments reflect attempts to renegotiate and reposition the constituted outsider. Instead of emphasizing exclusion, underrepresentation, or ontological discomfort, Mörtberg’s and similar propositions arguing that women represent a different kind of opportunity or hope for technology are dependent on the constituted outsider to delineate a space for a feminine alternative ethics and values. Margolis and Fisher (2002) also rely on this outsider.

In the long run, the greatest impact may be on the health of computing as a discipline and its influence on society. The near absence of women’s voices at the drawing board has pervasive effects....
Along with technology’s power come responsibilities to determine what computing is used for and how it is used. These concerns may not be on the minds of adolescent boys who get turned on to computing at an early age and go on to become the world’s computer wizards. (pp. 2-3)

This idea—that women are motivated by higher values or utilitarian ideals, and will thus shift the values and aims of computing—has become a dominant thread in the story.

A November 2008 article featured in the NY Times Sunday Business Section sums up the contested terrain of a g/t story where researchers still search for explanations of the gap.

Justine Cassell, director of Northwestern University’s Center for Technology & Social Behavior…said…some people in the field still believed that the answer to reversing declining enrollment was building the right [computer] game. Another school of thought is what she calls the “we won” claim because women have entered computer-related fields like Web site design that are not traditional computer science. Ms. Cassell points out that it’s not much of a victory, however. The pay is considerably less than in software engineering and the work has less influence on how computers are used, and whether this actually accounts for the diminishing numbers of female computer science majors remains unproved.

Ms. Cassell identifies another explanation for the drop in interest, which is linked to the pejorative figure of the “nerd” or “geek.” She said that this school of thought was: ‘Girls and young women don’t want to be that person.’ (Stross, 2008, par. 1)

This 2008 article, while it does not offer new numbers, research, or ideas for intervening in the continuing g/t gap, does make clear a number of continuing assumptions or concerns: 
(a) the g/t gap is a problem of numbers of women such that there are few discussions of the quality of women’s contributions to computing; 
(b) computing careers will bring greater material rewards; 
(c) a continuing stratification that places traditional computer science and engineering at the top; and 
(d) a continuing focus on m-f difference and identities as explanations. These continuing concerns reveal how common it is to believe that we can clearly separate men from women, users from the technological sphere, and our materially
derived investments from our perceptions. From these practices, the position of the constituted outsider is marked and “scientifically” marginalized. This scientific construction, however, is itself a limitation. As Haraway (1991a) put it, limited perception constitutes a false objectivity.

Disciplining Objectivity

There are other, more robust ways to think about objectivity. Postmodern and poststructuralist scholars argue that the dominance of an empiricist, disengaged notion of objectivity keeps some subjects, objects, or ideas outside the observational field because they are, as data, invisible. This invisibility describes the position and effect of the constituted outsider (e.g. Haraway, Derrida, Butler, Bowker & Star). Haraway’s (1991) deconstruction of a god trick objectivity highlights the epistemological premises that define practices of dominant science criticized by, for example, Harding or Fox Keller. Portraying mainstream science as beholden to a disembodied, bird’s eye view of knowledge, Haraway argues that this is a view from nowhere that also makes it too easy for scientists to dissociate from any responsibility for knowledge created. Perceptual practices and the ideologies behind them leave some subjects outside the scientific field but also falsely construe the scientific observer as having no influence or perspective on science. Outsiders are only outsiders because they are made to be invisible—outliers, if you will, to, or because of, the dominant perceptual field.
Foucault also grapples with the problem of objectivity, but from a genealogic distancing. Dreyfus and Rabinow (1982, 1983) characterize this objectivity as one that “when viewed from the right distance and with the right vision, [...] ensures] a profound visibility to everything” (p. 107). Foucault argues for a kind of perceptual distance that makes it more possible to “see” patterns and discontinuities where temporal distance makes it possible to discern patterns that reveal assumptions of great meaning, which from a greater distance turn out to about something other than had been understood up close.

The problem in essence, is that over-attention to hermeneutic depth makes a mountain out of a molehill, never really grasping the mountain or molehill’s intentions or meaning, all the while missing significant patterns in the mountain range and what these patterns illuminate. Foucault’s distinction between objectivity and objectification is useful in stepping back to reconsider the problem of g/t.

In a sense, Foucault’s genealogy might be said to be a re-envisioning of objectivity. He articulates knowledge as a kind of objective truth that is at once rational and objective, rigorously analytic, pragmatic, historically and contextually situated, and embodied (Foucault, 1975, 1995, p. 166). This view of objective knowledge is not independent of, but rather reflects, an interplay of power and contexts as they play out in discourse and social practices. One of these practices is a disciplining of the subject. For Foucault, the disciplining of subjectivities and the processes of objectification are inseparable interpellative practices that intersect as a technology of the self. This technology is enabled in an interaction of social scientific practices, the disciplines, objectifying methodologies, and discourse practices.
Constituting the Gendered-Ethical Outsider to Technology

The g/t story articulates two cultures of computing, one comprised of technological experts and insiders who are by-and-large male. The other culture is one of outsiders, whose natures or circumstances of gender, race, class, ethnicity, and so on pre-determine technological interests, access, or abilities and because of these, these groups are articulated outside the elite culture. Figure 9 illustrates the division.

Disciplined via technologies of difference, gender, and objectivity, the g/t story describes—but not “objectively”—a conceptual space of oppositional domains and interests. This separation produces the constituted outsider.

The constituted outsider. As I explained earlier, constituted outsiders are those objects-subjects who sit outside the observational or knowledge field because practices of scientific, disengaged observation have no other perspectives from which to see or account for those objects. The constituted outsider remains invisible because it is usefully so.
Through the technologies of difference, gender, and objectivity, the g/t story reduces constructs such as femininity, gender, and technology to their simplest, most accessible, or methodologically useful significations or relationships. These constructs, in turn, are meant to be studied from a neutral distance, without bias or involvement. This research convention became the objective glue through which the meta g/t story portrays computing culture as an independent culture, one that excludes not only women, but other disciplines, social groups, marginalized stories, and so on. In what follows, I show how this g/t story instead ultimately—and actively—constitutes women outside an insufficiently imagined culture of technology and that it does so by relying on a particular and limited notion of objectivity.

**A gendered-ethical outsider to reshape computing.** The meta g/t story is taken to be a descriptive representation of reality, an assumption that needs to be queried. In the following passage, written in 1985, it is possible to discern a point where the g/t story began to take shape.

The concept of the computer hacker or ‘Turing Man’ permeates our conception of computer users as insensitive rule-oriented males with a lust for winning. While this profile may characterize computer hackers, it does not characterize all computer users, and Turing’s men are not the only people who use computers. Writers, scientists, secretaries, choreographers, artists—to name but a few—use computers; many computer users remain sensitive to deep human motives, and many of them are women. So too are many computer programmers. Yet recent data on sex differences in computer use at home and at school support the idea that our culture is defining computers as preeminently male machines. What accounts for this, and what are the consequences? (Lockheed, 1985, p. 116)

The author highlights an emerging paradox in how gender and technology were characterized in different domains in the early 1980s. Noting a wide diversity of computer users across professions, she emphasizes that across these fields, many are concerned with
human values, many are women, and many are programmers. Computing culture was not merely a hacker culture. However, studies focused on school versus home computing tended to foster a notion of computers as masculine. Lockheed’s questions make apparent how some kinds of users and creators are left out of the computing picture and how a singular picture is constructed by limiting the field of reference. By 1985, school-based studies of computing use (where home access and use was an indicator of school use and success) had articulated computing as male. We get a sense from Lockheed’s study that this two cultures divide was created by not attending to a more diverse reality.

Lockheed (1985) raised an important question, thus it is pertinent to ask why the practice of characterizing computers, computing culture, and users based on their degree of separation from a narrowly conceived male hacker norm proliferated and became the gold standard. This standard became the measure of girls, women, and computing, defined by what became, essentially, the default vision of computing culture. An enforced separation of kinds of users and creators has helped to produce, in effect, a manufactured divide. Lockheed did not pursue this line of reasoning but instead suggested that the ways in which computers were described and located was a large reason for the emerging sex disparity. The computer was overly conceptualized as a “unitary object”—a singular kind of machine and site for programming and playing computer games (p. 118). Her idea was that if computers were viewed more expansively, “from the perspective of function (e.g. object of study, recreation, tool)” the g/t picture would be different. Looking back at the early 1980s, two things are evident: (a) computing was a relatively diverse practice and (b)
techniques of observation and representation constructed computing as a masculine domain or limited who could be seen in computing.

By the mid 1980s, women’s participation in computing began a three-decade decline and two additional phenomena should be noted. First, this decline was new, since women previously had been relatively significant persons in computing and second, the new female outsider to computing was an effect of emphasizing specific functions of the computer that in turn privileged different interests and interactions by construing these as pre-determined m-f differences (rather than differences tied to professional practices, for example). By limiting the observational lens onto computing culture, one specific role of the computer and computer hackers came to dominate. All other practices and actors were seemingly cast to the margins as inconsequential. In this way, other users and uses of the computer were constituted outside an exclusive and predominantly masculine hacker norm, even as this norm itself was never really an objective or all-encompassing representation of masculinity or computing.

The g/t gap itself became a kind of social imaginary and Lockheed (1985) as well became caught up in the tangle of explaining sex differences as they were correlated with different functions of the computer. This kind of cataloguing began the project of marking and measuring evidence of differences in m-f interactions with the computer and predicting their effects. Lockheed’s essay appeared as the frontispiece to a special issue devoted to girls and computers. Although intended to be cautionary, it ultimately helped to introduce an agenda that focused the blossoming of g/t research. Although insightful, Lockheed could not separate from the dominant research imaginary or our four-
dimensional enframing and thus, the problem of a limited objectivity itself escaped analysis.

**Conclusion**

The idea that gender can be separated from technology seems inherently logical within the dominant research and epistemological imaginary. To make this possible, the g/t story depends upon four core oppositions: (a) femininity versus masculinity, (b) value-rationality versus value-neutrality, (c) technology versus women, and (d) scientific knowledge versus politics. In relying on these oppositions, the meta g/t story acts as a constituting technology in creating two separate cultures, one organized around the feminine, where social, political, and ethical values may be brought to technology, and the other around the masculine, where the social realm and societal values are separated from both men and technology. The dominant technology of objectivity facilitates the continuance of these oppositions, but the underlying political technologies of neoliberalism and the knowledge economy of the risk society need this constituted outsider, both to accomplish certain aims and to mask their effects or offer some hope of respite.

The constituted outsider accomplishes two things: (a) through such technologies as discipline, it emphasizes difference, gender, and objectivity and it forcefully yet artificially situates gender and women outside techno-culture and (b) the g/t story depends on this outsider for the conceptual viability of the idea that women’s higher ethical values will reshape not merely some specific technologies, but the field of computing writ large. A
question remains as to why it is so enticing to cast women as the agents who will reshape computing or society’s relation to technological progress.
Facet 9

Techno Anxieties, Passions, & Values

Women’s interpellated subjectivity—managed through the technology of gender—is one major product of the g/t story. This story, however, sits within a transparent melding of discourses, social and methodological imaginaries, assumptions, and practices that reflect a four-tiered enframing of Western, modern society. On the one hand, the meta g/t story is a remarkably reductivist story, and yet on the other, it is also an enormously complex story that can be understood as one response to a host of anxieties pervading modern society. These anxieties may be traced through Beck’s (1992) characterization of the modern risk society as we increasingly face risks of a heretofore-unknown scale, where ecological and human survival may be sustained or annihilated through technological advances. As the potential consequences of techno-scientifically initiated risks have escalated, so have disputes over how these risks are to be calculated, monitored, or understood. In some circles, STEM knowledge is promoted as the primary literacy within this risk society. It becomes the only recognized knowledge for understanding and evaluating the products and effects of techno-science. In other circles, there is a pervasive suspicion that the knowledge and practices of technoscience are not the best (and must not be the only) lenses in assessing and mediating technological innovations or progress. The meta g/t story is situated in this complex milieu of explicit and implicit anxieties and controversies. The g/t story itself has become useful as a kind of intermediary between human-centered values and another set of values that put most value on techno-rationally derived progress. At the center is a tension between the modernist quest for certainty and
an alternative practice of ambiguity that many argue is essential to any sustainable 21st century posthumanist ethic.

As the meta g/t story increasingly focused on the problem of girls and women’s underrepresentation in computing, an assumption embedded itself that the problem of gender and technology was always about what we currently think about it. In this chapter I argue that the g/t meta story is about more than we have assumed. Specifically, it is a story that builds from—and uses—a technology of gender to position women as a kind of intermediary in a cultural climate of shifting and large-scale anxieties, many of which are linked to the rise of the computer. In this technology, girls and women’s play, passions, or desires become the ethical locus of attempts at mediation.

I first unpack a trio of meta-anxieties to which the meta g/t story responds and argue that our concerns over the gender and technology relationship shift in relationship to other economic, cultural, intellectual, and political tensions and transformations. Following this, I show how portrayals of girls and women’s play, passions and ethics-values become strategies for mediating the techno-anxieties arising from the range of social, class, and work centered transformations that characterize either real or imagined effects of the computer’s growing influence in our lives.

A Contemporary Milieu of Anxieties

The g/t story unfolds in a contemporary milieu that has been characterized by a number of scholars as an era of anxiety (e.g. Jacoby, Sennett, Stone, Heidegger, or the National Research Council). This era is characterizable as a set of responses to significant
ruptures in long-standing beliefs and unities that heretofore have held modern Western society together. One way of thinking about these anxieties is by cataloguing lists of binary tensions across a host of concerns such as old-new, tradition-progress, mind-body, and so on. This approach has some merit, but it further entangles us in a project of counting trees, missing the proverbial forest. It is more useful to think in terms of three “meta-level” anxieties.

The first meta-anxiety reflects a continuing tension where fears and fascinations with technological progress reflect incompatible desires to maintain long-comfortable traditions that butt up against desires to move forward with techno-scientific progress. This plays out as we are faced with advances in reproductive and medical technologies, genetic engineering, robotics, and so on, where all of these have been made possible by the entrance of the computer and AI into nearly all aspects of modern life. A second meta-anxiety is a response to a significant crack in what qualifies as reliable scientific knowledge as long-held ideas about knowers, their locations, and ideas about truth claims and methods are probed from numerous directions, in turn destabilizing traditional beliefs about predictable identities, subjectivities, and knowledge. As the humanities, social sciences, and natural science disciplines increasingly intersect, new ways of thinking challenge older assumptions and structures. A third meta anxiety reflects ongoing tensions of a social-political-economic nature; for example, in tensions between ideals of freedom and equity that often run counter to desires for material wealth, status, and control that technology promises. This is an anxiety emanating from the rising emphasis on technocratic market values at the same time these contradict our desires for and belief in
social democratic values (Muthuchidambaram, 1989, p. 227). These three meta-anxieties reflect what are often diffuse or seemingly irresolvable responses to significant shifts in our understandings of what it means to be rational, concerned, responsible, knowing, human subjects in an era of intellectual, political, social, economic, and technologically facilitated instabilities and risk.

The meta g/t story, as it is conceived and constructed, is a technology that unfolds in this milieu of meta-anxieties. This is portrayed in Figure 10.

![Figure 10. A story surrounded by anxieties.](image-url)
The graphic begins on the left with statistics that suggest the significant g/t problem is a quantitative representation problem. This is a reasonable approach when the aim is to redress inequities and if the g/t story was really about this, its enframing in western epistemologies and concepts might not be a problem. However, the g/t meta story argues much more than this—girls and women’s ethics or values bring something new and necessary to the modern technological table. That is, an absence of feminine ethics and values in computing is used to forecast dire consequences for women, society, and computing, which sets in motion a different set of anxieties. These anxieties in turn multiply because the foundational epistemologies and conceptions driving the meta story are insufficient for dealing with the kinds of anxieties the g/t story itself identifies, nor is it conceptually able to recognize or address the backgrounded meta-anxieties that feed quite powerful notions that more women in technology is going to radically change things.

**Three meta anxieties.** Within the active spheres of the meta g/t story—education, engineering, policy, and the popular media—the idea holding the most currency in recent years is that women hold the key to a future of more social and ethical or “values-sensitive” technologies. The belief tends to be carried along in discourse as a kind of meta-truth of women (in opposition to other “truths” of men and their technologies), needing little further analysis or justification. The idea plays out in rather explicit warnings suggesting that if more women do not get into the heart of computing, society will remain at the mercy of adolescent minded boy-men-hackers who will merely perpetrate whatever playful technological whim has captured their values-free attention. Two assumptions are at work here: (a) women alone have the necessary social values and commitments that boys-men do
not and (b) the future of computing, and society more generally, depends on women’s participation. This idea is strongly promoted in *Unlocking the Clubhouse* (Margolis & Fisher, 2002):

In the long run, the greatest impact may be on the health of computing as a discipline and its influence on society. The near absence of women’s voices at the drawing board has pervasive effects....

Along with technology’s power come responsibilities to determine what computing is used for and how it is used. These concerns may not be on the minds of adolescent boys who get turned on to computing at an early age and go on to become the world’s computer wizards. (p. 2)

Similar formulations are to be found across the g/t story. For example, the Executive Summary of *TechSavvy* (AAUW, 2000) states it this way: “In some important ways, the computer culture would do well to catch up with the girls. In other words, girls are pointing to important deficits in the technology and the culture in which it is embedded” (p. ix). Similarly embedded in UNESCO’s *Gender Issues in the Information Society* (Primo, 2003) is the following: “This resistance of policy-makers to considering issues related to the gendered digital divide underscores the need for gender practitioners and researchers, NGOs and a range of stake-holders” (p. 25). The authors of *TechSavvy* locate a values deficient computing culture that girls are expected to “fix,” similar to the underlying argument made by UNESCO’s report, which is that “gendered” practitioners and researchers will solve a problem that policy makers and governments cannot, or at least, have not.

In order for this g/t narrative to be cohesive, much has been left out. Excluded are extensive historical contributions of women in computing, many of which were military based or who show no particular evidence of being driven by social values in the way the
g/t story currently predicts. Also discounted is the work of contemporary women who hold or have held major roles in the field of computing (e.g. Carleton Fiorina, former CEO of Hewlett Packard, Barbara Liskov, recipient of the 2008 ACM A.M. Turing Award, and others, most of whom are not noted for specifically humanistic contributions to computing). Also missing from view and mainstream discourse is the work of women artists who have built international careers (and those who are less visible, though not less technologically inclined or innovative) by pushing the boundaries of technology and its aesthetics (e.g. Laurie Anderson, Char Davies, Coco Fusco, and Lynn Hershmann). Missing too, are the active online discussions that women artists or gamers engage in to ponder how to gain wider acceptance of the idea of women normatively engaged in advanced computing (see for example: http://faces-l.net/, http://www.girlgamer.com/, http://genderchangers.org/). Also absent are examples of women’s bullying of other women in the workplace (e.g. Klaus, 2009) that complicate the meta story’s portrayal of women’s ethic of care and community.

94 For example, those I discussed in Chapter 6, although there are many others who could be cited.

95 Lynn Hershmann Leeson was awarded the ACM SIGGRAPH 2009 Distinguished Artist Award for Lifetime Achievement in Digital Art. Also left out are the male computer scientists who, arguably, have displayed or promoted extensive concern with social, aesthetic, and utilitarian uses and values of computers. Bill Gates is famous for having stated that a founding intention of Microsoft was to get a PC on every desk. While we could read this as a fascination with technology for its own sake, the statement also reflects a highly tool-driven motivation as well as an economic drive. Steve Jobs and Apple have given us the I-pod, I-phone – along with an entire culture of community building applications. And speaking of communication—a value largely ascribed as female—the early web was envisioned by scientists specifically to facilitate communication between scientists, globally.
It seems timely to ask why these stories, women, and their practices are shunted to the margins, rendered nearly invisible. How is it that a singular g/t narrative has acquired such a following, across educators, researchers, policy makers, and the public? As a story positioned as an intermediary to competing values and agendas, the meta g/t story and society have no pressing need for other hidden or alternative stories.

**Has it always been this way?** The idea promoted by the g/t story is that a quantitative problem regarding women’s representation in computing has always been what we currently make of it. One way this belief is sustained is through a negation or absence of alternative evidence, examples, exceptions, or of incomplete analyses of what historical facts signify. Since I have already discussed how the g/t story is a disciplining story, through a technology of gender, I will just reiterate the following point: there are significant gaps in how the g/t story dichotomizes a social and values orientation to computing by locating it as women’s domain. Thus, this story is limited not only in its conception of gender and technology, but also, in how it considers the intersection of computing, values, learning, work, and the social realm. A major reason for this exclusion is that there has been little room, methodologically or conceptually, to accommodate the historical and emotional contexts of the computer’s emergence into society. Looking more closely at this cultural moment shows the g/t intersection to be more complex than g/t research or STEM approaches have made it out to be. The g/t story is itself a response to and manifestation of complex and competing anxieties about the increasing influence of technology across society that intersect with other political changes in both society at large and within the academy.
The next sections broadly characterize three meta-anxieties in play. Meta-anxiety #1 responds to the ramping up of technological progress and reflects our fears of, yet desires for, this progress. Meta-anxiety #2 surrounds the controversies emanating from ruptures to long-standing stabilities in our understandings of what constitutes good science and knowledge. Meta-anxiety #3 describes the tensions arising from conflicting notions of what social transformation entails and oppositional drives for market rational policies and democratic values. I explain each in more depth in the following sections.

**Meta-anxiety #1: The ramping up of technological progress.** The 1950s to 1980s might be cast as an era that signaled a new phase of intellectual and psychological ferment regarding what it means to be human. This was driven by some key technological advances, particularly as the personal computer (PC) and artificial intelligence (AI) captured both researchers and the public’s imagination in numerous ways. Many have argued that this era of the computer was a rupture to society because of the ways the computer shook long-standing conceptions of the human subject as a unique thinking, feeling, and reflexive agent. This was the argument behind Turkle’s *The Second Self* (1984).

> It [the computer] changes people's awareness of themselves, of one another, of their relationship with the world. The new machine...is a machine that 'thinks.' It challenges our notions not only of time and distance, but of mind.

> The ‘subjective computer’ is 'the machine as it enters into social life and psychological development.' (p. 13)
Turkle’s text articulated the computer as a wholly new kind of machine, one that instigated a major challenge to the human-machine binary and to a long-held notion that only living, breathing, biological (and primarily human subjects) could think, learn, and feel.6

The book examined how the computer had, by the early 1980s, captured the imaginations of seemingly everyone including preschoolers, teens, PC hobbyists (who were also computing professionals), and hackers, although in retrospect artists and mothers seem to be missing. She captured a sense, that at least in some circles, the computer was a new kind of mirror into the self and that it opened possibilities for selves to be re-envisioned.

Turkle’s anthropological-psychological research was based at MIT, an epicenter of cutting-edge work being done in artificial intelligence (notably by Marvin Minsky, Seymour Papert, and Joseph Weizenbaum). When she described the computer as a subjective and intelligent machine and second self, Turkle (1984) articulated, for a more general audience, a way of talking about an immanent rupture to the heretofore uniquely human traits of thinking and learning. With the introduction of the computer, humans seemingly lost their fundamental distinction from machines and the hacker became the public image of the perpetrator of this rupture. Putting the primary focus on the nerdy, anti-social hacker allowed us to “forget” the early contributions of Ada Lovelace, Grace Hopper, and WWII’s women computers who paved the way in helping to create the computer’s intelligence, or

6 I am sidestepping any discussion of what kinds of animals (or plants) are able to think or feel as this is (a) too large an issue for my project, and (b) not particularly significant for the discussion at hand, although it is increasingly discussed in science studies (e.g. Haraway, 2003).
to remember that men were more influential in creating its hardware. The era was more complicated than the hacker narratives infer. Thus, it is necessary to unpack some of the competing interests and depictions to understand not only the magnitude of the shift, but also the depth of anxieties as these played out (and continue) in the intersections of techno-science, education, and social life.

Three characterizations help capture the extent and significance of the public discourse and reception of the computer and AI that often centered on how the computer would impact children’s identities and education. The most dominant ideas about AI can be traced through the work of three researchers. The rupture could be said to have begun with Turing’s famous AI test (1950) intended to prove that a machine can be made to learn. A second would be Weizenbaum’s ELIZA (1966) program that illustrated a natural language processing system by simulating a psychotherapist and an aspect of the therapeutic process, as a real person would spill their troubles to the virtual computer therapist. Third was Minsky’s (1985) work on AI that became the dominant model for machine intelligence research from 1969 to the mid 1980s (Wilson, 1998). This work conceived of minds, whether machine or human, as information processers, composed of discrete processes. Working with Papert, Minsky’s model was brought to education, through cognitive science, later initiating the new field of the learning sciences. The influential conception was the model of mind as machine and machine as mind, one mirroring the other. The human mind was not much different from the computer and this made the computer a potential competitor to human capacities for thinking, learning, and
Minsky’s work in AI upended longstanding beliefs in the supremacy of human thinking and feeling, as he stated:

Most people still believe that no machine could ever be conscious, or feel ambition, jealousy, humor, or have any other mental life - experience. To be sure, we are still far from being able to create machines that do all the things people do. But this only means that we need better theories about how thinking works. (Minsky, 1985, p. 19)

There were other models of machine intelligence, e.g. neural networks and parallel processing models, but according to Wilson (1998), Minsky and Papert’s success in suppressing these derailed the development of alternative models of cognition.

Responding to this radical unfolding of a computer-human parallel, Simon (1977, 1989) stated that the key question regarding the computer is that of “what it has done and will do to man’s view of himself and his place in the universe” (p. 455). He viewed the intimate connection of the human and the machine as the most controversial of the arguments over how the computer revolution will change culture:

There is a more fundamental question...the question that was raised by Darwinism, and by the Copernican revolution centuries earlier ... whether the dignity of man, his sense of worth and self-respect depends upon his being something special and unique in the universe. (p. 456)

The computer brought a new existential dimension to the question of who we are and who will we become.

A second idea crossed into somewhat new territory by connecting human desires and fantasies with the computer in a way that some found exhilarating and others either

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97 This was not the only possible model. There was another model – neural networks – that Minsky fought for funding and prominence. This latter model is only now making a significant re-entry in a number of fields, e.g. neurobiology, sparking new ideas in political, feminist, and cultural thought.
threatening or just bizarre. Heim (1993) describes a technological eros different from Turkle’s focus on a new psychological and thinking machine:

> The computer’s allure is more than utilitarian or aesthetic; it is erotic. Instead of a refreshing play with surfaces, as with toys or amusements, our affair with information machines announces a symbiotic relationship and ultimately a mental marriage to technology. Rightly perceived, the atmosphere of cyberspace carries the scent that once surrounded Wisdom....Our hearts beat in the machines. This is Eros. (p. 84)

Boys and their fascination with computer games was another way of talking about machine-human desire. Brunner, Bennett, and Honey (1999) drew from this idea to design a study of men’s and women’s fantasies about the computer. What they found was a distinct gender difference. The women portrayed “technology as a fellow creature on the earth, a child of humanity, promising but problematic...needing care and guidance to grow to its best potential within the balance of things surrounding it” (p. 74). Brunner et al. emphasized these fantasies as about women’s focus on tools that “allow us to integrate our personal and professional lives...to facilitate creativity and communication” but the strong anthromorphizing, which is itself a dimension of techno-desire was seemingly overlooked.

It appears that the women wanted the machine to become “merely” a more instrumental version of a human.

Brunner, Bennett, and Honey (1999) saw a different kind of fantasy in the men’s reports. These were of “mind-melds and bionic implants that allow their owners to create whole cities with the blink of an eye...In their stories, technologies free us from the earth, from social problems, possibly from humanity itself” (p. 74-75). The significant phenomena
to note are that fantasies and desires of various kinds of human-machine crossovers became part of social and academic discourse.

A third idea was a sense that technological progress was challenging some longstanding structures and metaphors of modernity. Cyborgian science fiction began to blur borders of fiction and modern realities in virtual space rather than in real space. Moreover, the idea of the body itself was morphing in a “reconceptualization of the human body as a ‘techno-body,’ a boundary figure belonging simultaneously to at least two previously incompatible systems of meaning—‘the organic/natural’ and the ‘technological/cultural’” (Balsamo, 1995, p. 5).

The Internet inspired more disruptive narratives. For example, Stone’s War of Desire and Technology (1995) identified a new kind of multiplicity arising from the emergent phenomena of cyberspace and virtuality.

Irruptively constituting identities that are simultaneously technological and social, a catastrophic emergence of the ludic and the unpredictable...the technosocial, the social mode of the computer nets, evokes unruly multiplicity as an integral part of social identity. (p. 42)

No longer could we think about identities, the spaces they inhabit, or social-intellectual interactions as unitary or even “real.” The shift from the mechanical age to the digital brings a new kind of complexity and intersectionality where the real and the virtual interweave. The struggle that Stone notes is of “older structures stubbornly trying to reassert themselves in a techno-social milieu that to them seems to have gone berserk. These are the structures of individual caring, love, and perhaps most poignant, desire” (p. 36). The transition to virtuality portends something radical as humans shift from the laws of the physical world to those of cyberspace. The radical shift was in part the blurring of
the machine-human dichotomy but more than this, it also facilitated the fracturing of homogeneity and mono-identities.

Responding to this techno-cultural moment, the special feature essay in *Time* Magazine's "Machine of the Year" issue (Friedrich, Moritz, Nash, & Stoler, 1983) delved into the various ways the computer was expected to change social and work lives in fundamental ways. Computerization was expected to promote certain kinds of advances and yet also produce large-scale unemployment in some sectors. While some put great stock in how computers could transform schools and learning, others worried about the long-term effects of shifting thinking to the computer. The following summarizes the kinds of anxieties in the air regarding the future of the human in the era of the computer, at the start of 1983.

Will the computer's ability to do routine work mean that human thinking will shift to a higher level? Will IQs rise? Will there be more intellectuals? The computer may make a lot of learning as unnecessary as memorizing the multiplication tables. But if a dictionary stored in the computer's memory can easily correct any spelling mistakes, what is the point of learning to spell? And if the mind is freed from intellectual routine, will it race off in pursuit of important ideas or lazily spend its time on more video games? (p. 14)

With the computer and AI, humans faced a serious challenge to a self-understanding that had been based on a supposedly unique intelligence and psyches.98

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98 Some key scholars in the philosophy of technology to write on the computer are: Colburn, recognized as one of the formative scholars in the emergent field of the philosophy of computing, argued that the computer signaled a new encounter between science and philosophy; AI presented a challenge to long-standing philosophic concerns about logic, philosophy of mind, and epistemology (2000). Penrose is another central figure, and in the introduction to *The Emperor's New Mind*, he wrote: “We have long been accustomed to machinery which easily out-performs us in physical ways. That causes us no distress....But to be able to think—that has been a very human prerogative. It has, after all,
Truths, fictions, and speculations blossomed. The g/t story must be understood as one facet of this larger cultural moment—a story built around, and a response to, a seemingly unprecedented mix of anxieties. By 1983, research on gender and computing in education, focused through psychology and cognitive learning theory, started to emerge as did, albeit separately, philosophical examinations of technology writ large. The latter pondered the implications of computing and AI to society and education, whereas the former tended to embrace the notion that computers would positively reform and reshape learning and schooling as long as it was fairly distributed and used in pedagogically sound ways. Notably, these two threads of inquiry run parallel but rarely, if ever, engage within the g/t story. Outside the story, a few more cautious voices have included Apple (1989), Bowers (1988), and Cuban (2001).

Within learning sciences and educational technology circles, the computer is largely viewed as a tool that facilitates learning. While there is undoubtedly some value to this line of thinking, there is reason to think more broadly and philosophically about technology. Bringing philosophical reflection to an otherwise largely psychological-behavioral g/t story is more than an academic exercise. It helps in sorting out some of the assorted passions, emotions, and fears that accompanied the introduction of the PC and to understand these in a bigger context of social-political-intellectual anxieties that have troubled scholars,

been that ability to think which, when translated to physical terms, has enabled us to transcend our physical limitations and which has seemed to set us above our fellow creatures in achievement.” For Penrose, the questions were more profound than whether a machine could think or feel: “The question touches upon deep issues of philosophy. What does it mean to think or to feel? What is a mind? Do minds really exist? Assuming that they do, to what extent are minds functionally dependent upon the physical structures with which they are associated?” (p. 3).
politicians, executives, workers, and educators as society has navigated the challenges of industrial modernization and now, the digital era.

Technology has been at the center of both revolutions, but the tenor and locus of concerns has shifted with the turn to the digital. Common to both has been a fascination with technological progress and tools. Dewey (Hickman, 1990) and Heidegger (1977) identified an aspect of an ontological human-technology connection, each revealing that there is no getting around the fact that as humans we are intimately connected to technology. As Dewey explained, human intelligence, inquiry, and technology are so intertwined that “thinking is a technological task” reflecting a “process of extraction, refinement, and manufacturing” (Hickman, 1990, p. 50). Such an intimate connection to technology also has a dark side, which focused much of Heidegger’s thinking. Some examples are the atom bomb, the punch-time clock (and surveillance technologies more broadly), the 24/7 phenomenon, global outsourcing of jobs facilitated by technology, and so on. It also has positive effects as evident in the ways it has helped to reconstruct “deficits” of the physical or mental body (e.g. prostheses and assistive technologies).

The computer however, escalated the tensions between our desires, ontologies (e.g. how m-f differences fit in this new landscape), and fears. Its introduction ruptured the boundaries between man and machine, stabilities of m-f identity, virtuality (simulation) became equally as real as reality (e.g. Baudrillard, 1981, 1994; Benjamin, 1973 [1936]), and it challenged our historical sense and experience of time and space. Franklin (1990, 1999), for example, argues that technology “changed our realities of time and space ... planning and forecasting” (p. 3-4). Focused specifically on the Internet, Youngs (2001) brought to
light a hidden political economy of time as a way of understanding the inequalities that are embedded in the interaction of technology and globalization. It is not just access to technologies, but access to time itself that technology reshapes in complex ways. Agascinski (2000, 2003) argues that technological development has unfolded largely through Western paradigms of time and that in this era of globalization,

Henceforth, technical advances alone will determine the hierarchy of societies, which, by means of the global establishment of that same imperative for development, are integrated into a world and a unique time. Globalization is the unification of the world’s rhythms, all adjusted to the Western clock, that is, to contemporary chronotechnology. (p. 5)

That is, our way of being in the world shifts in relation to the dominant technologies we create and which become a kind of temporal-cognitive-psychological paradigm.

Computing meshed, collided with, or reshaped human experience and perception in multiple and complex ways. Our relationship with technology was at best, rendered ambiguous and the notion that the computer might indeed overtake the human mind, exhibiting ever greater capacities for independent thinking, stirred a number of philosophical, moral, technical, and pedagogical anxieties. In philosophy and the humanities more generally, scholarship on this interplay is vast. However, the psychological-engineering bias of the meta g/t story in large part pushes this additional analytic lens to the sidelines. In this very partial picture, women’s psychological distancing from the machine makes it seem that we can hold on to a kind of hope that the computer will not overtake humans and society.

Nonetheless, techno-anxieties persist. After Weizenbaum created ELIZA (1966) he became disturbed by what people, among them computer scientists, were claiming it
foreshadowed. His subsequent book, *Computer Power and Human Reason* (1976), pondered what he saw as the central question of the time—not whether computers can or could be made to think, but whether this *ought* to happen. In essence, the question of significance shifts: “Should man be the instigator of his own automation?” In a recent example of this kind of reflection, the July 26, 2009 issue of the New York Times (Markoff) reported on a meeting of scientists concerned about the degree to which computers are taking over so much of what was formerly the domain of humans in terms of their workload and responsibilities.

Impressed and alarmed by advances in artificial intelligence, a group of computer scientists is debating whether there should be limits on research that might lead to loss of human control over computer-based systems that carry a growing share of society’s workload, from waging war to chatting with customers on the phone.

Their concern is that further advances could create profound social disruptions and even have dangerous consequences. (para. 1-2)

It is probably reasonable to surmise that this group of scientists was at a minimum composed of a number of men, suggesting that maybe it is not just women who have been concerned over the changing dimensions of human and machine capabilities. Regardless, anxieties over this shift of human capabilities to the machine persist.

**Meta-anxiety #2: Controversies over science & knowledge.** Weizenbaum’s (1976) reflections on what science ought to pursue, rather than what is possible to pursue foreshadowed a growing concern over the reach of knowledge and science. These concerns were expressed in a number of ways. One concern focused around what constitutes warrantable scientific knowledge and the role of methods in producing this knowledge. These were debates over whether science should be left to self-monitor its ethics and
consequences of its knowledge, but also, over what kinds of knowledge would be good to pursue. Weizenbaum attributes his heightened awareness of the issues to being “deeply involved in a concentrate of technological society as a teacher in the temple of technology that is the Massachusetts Institute of Technology...There I live and work with colleagues, many of whom trust only modern science to deliver reliable knowledge of the world” (p. 10). Concurrent with the emerging work in computer intelligence at MIT was a parallel re-examination of whether there ought to be limits to the pursuits of scientific research, which challenged the dominant model of science as a sole pursuit of expanding science.

The debates over knowledge have since taken many twists and turns. One target has been the role of academic disciplines for the ways they separate the natural sciences from the humanities or the behavioral sciences from philosophy and the more politically and culturally oriented disciplines. The extent and significance of these disciplinary separations has been argued by scholars such as Bateson (1972, 2000), C.P. Snow (1965), Kuhn (1962, 1996), Dewey (Hickman & Alexander, 1998), Wallerstein (1997; Wallerstein & Gulbenkian Commission, 1996), and so many more. Advocates of a transdisciplinary approach (for example Nowotny & Gibbons, Klein, Lawrence, or Barad) argue that the structures of academe have effectively limited scholars’ resources for thinking and understanding, effecting a distancing of the ethics-politics of knowledge from the production of that knowledge. The concern has been that in keeping science and philosophy separate, knowledge of the world becomes overly compartmentalized. The separation has fostered a climate where technical rationality becomes the driving
justification for techno-science such that human-centered concerns and values become, at best, secondary.

Some argue that when techno-scientific knowledge is privileged, so too are techno-science experts. This is Winner’s (1995) concern when he examines the ways in which citizens are effectively distanced from participating in discussions over the socio-political dimensions of technological production. Similarly, Gibbons et al. (1994) argue that Mode-2 knowledge is replacing Mode-1. Mode-2 knowledge is much more application oriented and socially grounded, whereas Mode-1 knowledge has long been the domain of experts. Mode-2 knowledge is more responsive to real world concerns of the lay populace and strives for reflexivity, transdisciplinarity, and heterogeneity. In a follow-up book, Re-Thinking Science: Knowledge and the Public in an Age of Uncertainty (2001), Nowotny, Scott, and Gibbons suggest that society and science are themselves in flux, and therefore are “transgressive arenas” (p. 4). The new society-science relationship is a radical break from the culture of science that drove industrial modernity.

Nineteen ninety six was the year that the journal Social Text published a special issue on the “Science Wars.” The issue put itself at the center of escalating controversies regarding the dominance of technoscience and its exclusive and hegemonic methodologies and practices. Ross, in the issue’s introduction, located these new concerns through Beck’s articulation of the modern risk society that offered a “radical critique of the very scientific rationality that served as the vehicle of industrial society” (1996, Spring-Summer, p. 2).

Rose (1996, Spring-Summer) in the same issue, characterizes some of the tenor and tensions of the time.
In these wars, the self-appointed defenders of Science are seeking to police the boundaries of knowledge and to resurrect canonical knowledge of nature, against the attempts of the Others (including feminists, antiracists, psychoanalysts, post-colonialists, leftists, multiculturalists, relativists, postmodernists, etc., etc., in all our bewildering diversity) to extend, transform, or maybe even dissolve the boundaries between the privileged truth claims of science and other knowledges. But first, just because any of us may find ourselves among the Others under attack, I must emphasize that this commonality may not automatically generate bonds of solidarity between this ‘us.’ My enemy’s enemy is—only perhaps—my friend. (p. 61)

Rose reveals that the debates were not limited to oppositions of Us versus the Others, because there was also dissension within the ranks of the Others in taking a position on technoscience. Similarly, Weizenbaum’s (1976) reflections indicate that within the ranks of hard-core scientists there were similar disputes.

Not everyone saw this postmodern shift or critical-linguistic turn as productive or even reasonable. Published in Social Text’s science wars issue was Sokal’s “Transgressing the Boundaries: Towards a Transformative Hermeneutics of Quantum Gravity” (1996, Spring-Summer). The article itself is now famously known as “Sokal’s hoax” and became a kind of marker to the rising tenor of the methodological debates across the academy. The essay presented itself as sympathetic to postmodern, interdisciplinary, and hermeneutic approaches. Sokal portrayed these as reasonable criticisms of positivism, Cartesian-Newtonian metaphysics, and other dominant, Western epistemologies but did so with the specific hidden intent to parody and intellectually embarrass the journal and castigate the academic left and humanities-science critics or scholars. The day the issue was published, May 18, the front page of the New York Times announced the hoax. In a recent re-examination its impact, the editors of The Sokal Hoax: The Sham that Shook the Academy
(Editors of Lingua Franca, 2000) summarize Sokal’s political-intellectual motivations as follows:

By his own account, physicist Alan Sokal was inspired to submit such a piece of writing out of a growing concern over the state of the political left. He felt that a number of leftists (mostly academics in the humanities) were betraying their cause by challenging standards of logic, truth, and intellectual inquiry, in general, and the role of these concepts in the natural sciences in particular. (p. 1)

The debates are complex but the key point for my argument is that the science wars were (a) quite charged and (b) reached farther than science or the academy. They reflect a deep and growing unease with a hegemonic technoscience that touched the natural and social sciences as well as the humanities. The anxieties permeated into the popular press to heighten a contemporary climate of uncertainty.

The intellectual debates over knowledge extended to concerns over methodology in the social sciences and educational research, where they are often framed as a qualitative-quantitative opposition (Schwandt, 2006). Arguing for an alternative to a dominant empiricist model of normal science, Denzin and Lincoln (2003) suggest “a profound rupture occurred in the mid-1980s...[which was] the crisis of representation” (p. 25). This crisis was in part due to the rising influence of qualitative inquiry in the academy that broadly characterized those scholars searching for “new models of truth, method, and representation” (p. 26).

Schwandt (2003) locates qualitative inquiry as “a reformist movement that began in the early 1970s in the academy” that represented more than a set of alternative
methodologies (p. 293). It is also conceived as a major site of intellectual and political struggles within the academy regarding “what constitutes the appropriate goals and means of human inquiry” (p. 293). Schwandt’s argument is that doing qualitative inquiry is not simply a gathering and analyzing of data; it requires a convergence of “acting and thinking, practice and theory” where theory is not something static and given, but intertwined with evolving understandings of “what constitutes knowledge and how it is to be justified” (p. 295).

While computer scientists were busy breaking down the boundaries between humans and machines, putting out into the world a model of human thinking as not much different than an information processor, other scholars were arguing something wholly different, that human meaning making and contexts are inseparable from the production, understanding, or value of scientific knowledge.

Some years earlier, Foucault (1972, 1975, 1995, 1980a, 1990) argued that the methodologies of the social sciences were complicit in shaping selves, social relations, and institutions, not merely describing them. For him, the emergent, significant questions were quite fundamental: “What is a science? What is an oeuvre? What is a theory? What is a concept? What is a text?” (1972, p. 5). Foucault’s work characterizes how the rules of language and discourse themselves came to be viewed as non-neutral and key constituting
practices. Scholars could no longer understand the sciences or human social life without implicating discourse and related social practices.99

It might be said that the science wars represented different takes on the significance or durability of the Cartesian separation of mind and body. Controversies heightened over whether the Enlightenment had given us a flawed conception of mind-body, reason-affect, and thus, of science itself. James (1997) argues that the problem is not so much Cartesian science, but what has been left out, forgotten, or misinterpreted about that era over time. In *Passion and Action: The Emotions in Seventeenth-Century Philosophy*, she suggests that twentieth century philosophy has misconstrued the role of the passions in Enlightenment thought. In her view, the twentieth century separation of science from philosophy is a manifestation of a flawed understanding of Cartesianism and thus, the reason-affect or mind-body division of modern science is itself built on a misreading of seventeenth century philosophy. The ensuing mind-body separation has dissociated scientific rationality from the passions but this depends on an opposition that she argues was not true in the seventeenth century.

The meta g/t story must be seen as situated at the center of these disruptions and tensions regarding how to think about and produce science, knowledge, truth, or minds and bodies. The story is fundamentally one that cannot be separated from how we locate the intersection of humans with technoscientific knowledge and its production. James (1997) helps illuminate a significant problem—in the g/t story, psychology has dominated

99 Other scholars were working in this area, particularly in STS fields (e.g. Latour, Harding, Fox-Keller, Suchman, Bruce, and so on) and I do not want to dismiss their contributions nor the complexity of ideas in circulation.
the conversation, to the exclusion of philosophy. The g/t story self-organizes around two threads—techno-scientific methods and objectivity and a gap in locating a sufficient theory of subjectivities—both examined independently of philosophy and the humanities. The story misses some big-picture anxieties emanating from the science wars or presumes they have little to do with its own narratives.

The meta g/t story depends on a host of practices or assumptions regarding the nature, location, monitoring, and production of science, learning, work, and social interactions. As the story tries to manage a stew of desires and anxieties seemingly about access to technology, it does this by holding on to beliefs about knowledge, technoscience, subjects, and representations that have been contested elsewhere. The resulting anxieties are twofold. On the one hand are those due to the extent and longevity of the science wars and on the other hand—within the meta g/t story—anxieties stem from an inability to connect the meta g/t story to these other anxieties. The problem and anxieties escalate because of a too narrow store of resources for thinking.

The controversies in the academy over what constitutes rational, scientific truth or knowledge continue in the “anti-rationality” argument that Jacoby (2008) partially associates with the political right and an overly influential and anti-intellectual popular culture. However, she also takes on a contingent of cultural studies in the academy as well as other pursuits that disparage logic and reason. The problem in America, in Jacoby’s estimation, is a contemporary populace without the intellectual tools to do or judge good thinking. Hers is also a complex argument, and I highlight only two ideas. One is America’s overvaluation of technocratization: It is “a culture...with an endemic predilection
for technological answers to nontechnological questions and an endemic suspicion of anything that smacks of intellectual elitism” (p. xvii) A second is that this ignorance reflects and serves “as both cause and effect...an absence of curiosity about other points of view” (p. xix).

Thus, the second meta-anxiety reflects an uncertainty about knowledge and knowing, both battered from a number of sides. On one side, scientific-technical rationality is lauded, on another side, a dominance of “over-rationality” is severely criticized from a number of intellectual positions, and from a third side, science, reason, and intellectualism are disparaged by a large percentage of Americans. In this milieu, there is little consensus on what to know or how to justify it.

**Meta-anxiety #3: Radical social change.** The meta g/t story is also, in part, a response to the stirrings of social ferment that began in 1968 and culminated in the feminist and civil rights movements. Student riots that began in France set off an era of intellectual and social disruption that contested long-standing norms and socio-political structures that are still being debated. The result was a number of challenges to long-standing beliefs about what constitutes history, knowledge, power, and the state but also to expectations about rights and privilege. The g/t story is situated in this larger cultural context and its intentions to transform a number of social inequities reflect two influences. One is the social-political effects of the civil rights and feminist movements and the second is tied to expectations that the computer would facilitate radical social transformation or conversely, stand in its way.
Time Magazine (Rosenblatt, 1983) named the computer its “Machine of the Year” in 1983—giving the computer its traditional, annual Man of the Year honor. It recognized the PC’s enormous intellectual, economic, and political impact on society. The magazine’s cover image showed an active computer screen but seated in front of it was a pale gray and seemingly inert, nondescript (except for his whiteness and maleness), expressionless male. The cover story portrayed the computer as evocative, ironic, hopeful, or cautionary, depending on the reader’s circumstances:

This sweetheart here, this little baby, looks like any ordinary machine, isn't that so? A mess of screws and buttons, a whole heap of plastic. Comes with new words too: RAMS and ROMS....The computer is made of you, lady. It's got you all inside it. You wished it here. No, not to do your taxes or to teach you German or to whip you in Pac-Man four out of five. You wished it here because the country was running low on dream time.

Which provides equal time. I'm talking social equality. I'm talking freedom with a capital F, like when the railroad first rolled in 150 years ago, roaring and puffing over the countryside, scaring the chickens and the cows, but offering everyone a ride all the same, that's everyone, I say, giving the Republic to the people. Just like the computer. (p. 12)

In 2009, it is hard to know whether this was a tongue-in-cheek rendering, but that is not so important to sort out here. More importantly—at least in some circles—the computer brought with it hope for a new communitarian and egalitarian future (e.g. Turkle’s (1984) discussion of PC hobbyists). Rosenblatt’s words portray an explicitly anti-instrumentalist vision. He describes a machine for dreams, not word processing or calculating. Despite this glorious honor and evidence of great hopes for social-political renewal, other narratives provoked a different kind of awe, fear, or potential for abuse by special interests by emphasizing the hacker or relentless automation, outsourcing, timestamping, and new forms of surveillance.
As the computer entered the public arena in the mid 1980s, it portended a merger of the human mind with a new, heretofore unrealized intelligent psychologizing machine. Happening alongside this turn of events and unfolding new relationships were other cultural and political reshapings of existing gender-race-class structures that in turn collided with a host of other embedded practices, hierarchies, or beliefs.\textsuperscript{100} Taken together, these realignments manifest as major changes to the character of society, many of which may be attributed to the digital revolution.

On the one hand, the g/t story, claims to be motivated by gaining equity for girls and women in schools and jobs and thus, the important event would seem to be the feminist movement. However, too much focus on this aspect has given insufficient attention to the significance of the digital transformation of society and introduction of the personal computer (PC) in education and as the locus of school reform initiatives. As the PC became increasingly visible as a radically new and intelligent machine, educators also adopted it as the promising new tool for transforming education and schooling.

Since its introduction to mainstream society, the computer has become a symbol and tool for a number of competing agendas, desires, and interests. In education, the computer has been embraced as the tool that will finally transform education, learning, and the social-economic standing of anyone who can harness its power and potential. However, this tool also became the locus and personification of continuing inequities and

\textsuperscript{100} One of these is the glass ceiling used to denote the difficulty women have reaching top management levels in organizations. Similar limitations continue in academia and in the arts. Others to note are controversies over theories of intelligence and abilities, classified by gender or race and others, shifts in ideas of what constitutes family, and so on.
injustices marked by gender, race, class, or other categories of difference. Largely because of a meta story focused around equity, g/t research has only peripherally acknowledged other significant challenges that the computer portended for a large swath of human activities and relationships. Moreover, these challenges were (and are) not universally experienced. For some, the computer held the promise of great wealth, power, and new forms of intellectual or playful fascination (iconic examples are Bill Gates (Microsoft founder), Steve Jobs (Apple founder), and Marc Andreessen (Netscape founder). For others, the computer augured new forms of compliance, domination, marginalization, or tedium (e.g. those noted by Postman (1993) and Illich (1973)). Running parallel to discourses of computers enhancing learning are others concerned with how it will deskill teachers (e.g. Apple (1989); these latter discourses compete with promises of new opportunities for active and engaged learning experiences, where the computer is the newly relevant and qualified teacher.101

An ambiguous relationship to technologies and technologically driven progress accompanies a belief that it is possible to demarcate a clear border between the computer as tool and the rest of society. In the actual practices of everyday life and being, this supposed boundary is more a manifestation of our modern enframings and social imaginaries and apparent blindness to the ontological connection between humans and technology. In our modern, Western epistemologies the intersection of gender and

101 Relevant research on this focuses on cognitive tutors, where an intelligent computer becomes either the tutor or tutee (e.g. Brophy, Biswas, Katzberger, Bransford, & Schwartz, 1999; R. P. Taylor, 1980). Sometimes computer games are discussed in a similar way (for example, if schools and teachers were more like games, students would pay attention and learn (e.g. Gee, 2003; Kafai, 2006; Squire, 2006).
computing is oversimplified and thus, it has become too easy to focus on the statistics of underrepresentation rather than the complicated and shifting social-political milieu within which the g/t problem is narrated.

This complex and disruptive background of computers and technological progress is a significant contributor to what Beck (1992; 1994) understands as the modern risk society. Intersecting anxieties and desires backdrop the meta g/t story and its facilitating technology of gender, which in turn functions as a kind of technology to stand between unresolved (and perhaps irresolvable) anxieties that manifest in response to complex and competing expectations, roles, and interests that meet in the intersections of the vast social, political, and economic changes that accompany the computer.

In October 2004, Sennett’s “The Age of Anxiety” was published in the Guardian in the U.K. It was billed as a taking stock of the cultural and political temperature of New York City, post 9/11. The article was written during the time the Patriot Act II was under debate in the U.S., which Sennett saw as signaling a new era where American citizens as well as non-nationals could be stripped of their rights. 102 A good deal of this political shift was facilitated by technology. The Patriot Act was not only intent on setting rules for dealing with political transgressions, but also, setting rules for preventing what might happen or policing what individuals or groups might be thinking. It represented a shift from

102 This act was the February 2003 response to terrorism by the U.S. Department of Justice and Homeland Security. Some sense of the expected impact was discussed on the PBS website: http://www.pbs.org/now/politics/lewis.html; the act itself may be found here: http://www.pbs.org/now/politics/patriot2-low.pdf.
monitoring the actual to monitoring (and sometimes punishing) the possible that Sennett describes as a kind of emergent soft fascism:

Soft fascism is not so much a velvet glove as an invisible hand, the operations of control hidden from scrutiny as Patriot Act II, and more, internal repression presented to the public as merely preventive action against threats that have yet to materialise. The Bush administration acted in this preventive way, for instance, by shutting three of the larger Muslim charities in America, not for anything they had done, but for what might happen, some time, somewhere. In hard fascism the state exploits concrete fear, in soft fascism the state exploits diffuse anxiety. (para. 8)

Sennett draws a parallel influence in reality TV, through which the boundaries between public and private are increasingly disassembled. Similarly, high technology and corporations are complicit in culling and selling citizens’ private data for corporate profit.

Government destruction of private rights thus become ‘naturalised’: the public already enjoys the act of stripping people naked, and this intrusion is just an extension of how business gets done in the computer age.

Diffuse anxieties only add further fuel to this ‘naturalized’ process. Insecurity about what might happen, some time, somewhere, becomes an ongoing state of mind; it co-habits with preventive measures, but these draconian measures do not erase unease. Indeed, as the state machine acts stealthily to prevent things happening, as its technologies become built into the fabric of everyday business practice, there can be no defining moment when an ordinary citizen could declare, ‘now I am more secure.’ (para. 9-10)

Sennett's argument is that terrorism provoked a pervasive anxiety but also, the intersection of domestic politics, corporate profit motives, and high technology converge to produce a general state of diffuse anxiety. The focus on terrorism however, both gives a focus to the public's anxiety and acts as a cover for an evolving soft fascism from these other directions.

Sennett also sees a major contributor to this diffuse anxiety as the changing status of the middle class. As people’s economic well-being is increasingly jeopardized by various factors outside their control (e.g. hard work, loyalty, values, or hard earned skills become
increasingly irrelevant), they try to find something on which to assign “blame” which in turn breeds anxieties that become a fear of something or some other who may in fact be a placebo.

The class map is shrinking the number of people who matter, who are included. The new class map breeds fear, and the counter to fear is to assert that the old values matter. By shifting the centre of gravity, you assert your own value when confronted with conditions you can do nothing about. (para. 18)

Sennett’s analysis might be said to summarize a decades long transition in American politics and economics as these were influenced by technological advances.

Seven years earlier, Stone (1995) painted a different kind of picture of the transition from an industrial to a technological society.

Suffused with that electronic glow, her face almost seems to be taking on an illumination of its own. She seems to evince a generous permeability, an electronic porosity that is pathognomonic of the close of the mechanical age...and as I glance up at the image I can see the machine doing it too, as they both hover on the brink of collapsing into each other...here at the close of the mechanical age, where neurology and electronics, musculature and hydraulics, biology and technology, all hover on the edge of a stunning and irrecuperable mutual annihilation. (p. 166)

In Stone’s (1995) vision, annihilation and transcendence seem to merge and contrary to conventional depictions, the computer is rendered in the feminine. It is hard to decide whether what is happening is a threat or a wondrous future, but there is no missing that something momentous is happening. The passage is Stone’s description of her two-year old daughter sitting at a computer and she explains what the image means to her as follows:

For me she represents not only her own future but our future. Hers, mine, and yours. The importance of this habit of mine for our purposes lies in the simple aphorism that software produces subjects. When we engage with symbolic structures of sufficient complexity, to a certain extent we synchronize our own internal symbology with those structures. In this we are carrying out our own
programs as social beings....interactive entertainment software, the Internet, cyberspace, and virtual reality, are not a question of market share or even of content. In a fundamental McLuhanesque sense these things are parts of ourselves...it’s hard to see what they do, because what they do is structure seeing. They act on the systems—social, cultural, neurological—by which we make meaning. Their implicit messages change us. (1995, p. 167)

Earlier in the book, Stone (1995) describes some of the early history of computer game development and its early sexism and fascination with violence. She notes the progression from small groups of boys making games for themselves to a culture of a slightly larger group of boys making games for not only themselves, but for “millions of other boys” and sees a culture rather devoid of ethics (p. 163). Stone escalates the problem from one of merely boys’ computer games to what she calls the “ludic dimension of human-computer interaction” (p. 163). Concerned that these games are quite limited in their ability to stretch “players’ imaginations and skills beyond the ability to hit targets and dodge obstacles, she asks:

How is it that the very young, the very talented, don’t perceive the incredible power for change that has fallen to them by default—and the hideous consequences of failing to grasp that weapon when it’s offered? (p. 164)

Stone captures three momentous relationships or situations. One is a prophetic merger of the human with its technological creations, as her daughter metaphorically melds with the computer. A second is that we humans have both the opportunity and responsibility to think about what kinds of human-computer interactions we want to create and support. A third is the multiplicity of options and the vast scale of the ethical, human, and technological consequences tied to how we proceed as the industrial age gives way to the digital.
Capturing an entirely different kind of anxiety is Gates’ written testimony to the U.S. House of Representatives (Gates, William H.) to mark the occasion of the 50th anniversary of the House’s Committee on Science and Technology.

Today I am here to highlight the gathering threat to U.S. preeminence in science and technology innovation, and to propose a four-part plan that I believe will help us maintain our position as the world’s innovation leader.

During the last 50 years, the world has witnessed truly revolutionary advances in science and technology. We as a nation can take pride in knowing that American scientists, researchers, and entrepreneurs have been at the forefront of many of these advances. Our unmatched ability to turn new ideas in science and technology into thriving businesses has been the engine of growth and job creation that has made our economy among the most dynamic and competitive in the world. (para. 2-3)

Gates’ anxieties emphasize a different angle where the fear is a loss of American stature as the premier technoscience innovator. One anxiety is a concern over an unprepared and insufficient STEM workforce in the U.S.; second is an anxiety over the prediction that the U.S. will lose its dominance in technoscience because of this workforce inadequacy; and third is a perceived insufficient level of federal support for basic scientific research.

I believe this country stands at a crossroads. For decades, innovation has been the engine of prosperity in this country. Now, economic progress depends more than ever on innovation. And the potential for technology innovation to improve lives has never been greater. If we do not implement policies like those I have outlined today, the center of progress will shift to other nations that are more committed to the pursuit of technical excellence. If we make the right choices, the United States can remain the global innovation leader that it is today.

These four policy prescriptions – strengthening educational opportunities, revamping immigration rules for highly skilled workers, increasing federal funding for basic scientific research, and providing incentives for private-sector R&D – should in my view be top priorities as Congress and the Administration consider how to maintain the nation’s leadership in science, technology, and innovation. (Conclusion)
Although the Bill and Melinda Gates Foundation is committed to the improvement of lives across the globe, Gates’ congressional testimony reflects a different tenor of concern than does Stone’s. However, concerns over flawed or limited techno-literacies and vision drive both of their arguments.

The anxieties are not whether we are in the midst of a paradigm shift, but rather, much of the anxiety is due to the fact that there are so many competing interests, expectations, and visions of what this transition entails and what waits at the other end. The questions are not merely pedagogical nor are they questions of what new technologies will capture our attentions and pocketbooks. The crux of the anxieties stem from the ways in which the technological era signals the likelihood of significant socio-political economic realignments as well as fundamental shifts to who we are and how we are in the world.

Beck’s reflexive modernization (1994) suggests that while there may be much to be optimistic about in the transition to a post-industrial form of modernity, this transition is not without, at a minimum, significant readjustments to a large number of social, economic, and political structures and relationships. For many, realizations that both the risks of the transition and the spoils are not equitably distributed weigh heavily.

Situated in this complex and often incommensurable stew of anxieties is the g/t story, problem, and relationship. In this stew, sometimes women and technology are brought together to help women better participate in the economic and political spoils of high technology culture; sometimes women are needed as workers to support an economic-political-technological shift that they may not in fact reap many benefits from; and
sometimes the meta g/t story has women situated at the center of these far reaching yet largely diffuse anxieties as a kind of mediating force of technological progress itself.

**Gendered Play, Passions & Values to Mediate Techno-Anxieties**

**Tools, toys, and passions.** In *The War of Desire and Technology* (1995), Stone draws on the anthropological work of Barbara Joans to describe a hierarchical and conceptual divide between two cultures of technological development. Joans had classified cyberspace workers into two groups—an instrumental culture and a visionary, play culture, calling the latter “Creative Outlaw Visionaries” and the first, “Law and Order Practitioners” (p. 14). The distinguishing characteristic is that “one group has the visions; the other group knows how to build stuff and get it sold. One group fools around with technology and designs fantastic stuff; the other group gets things done and keeps the wheels turning” (p. 14).

According to Stone, Joans saw these cultures operating oblivious to each other and Stone elaborated on this point, arguing that the utilitarian culture reflects an older paradigm of computers as tools and the visionary culture, a new play ethic that mirrors, on the one hand, a new paradigm for corporate agendas and on the other, a highly situated and elite culture. Stone's depiction of this elite culture helped her unpack a new idea about presence to understand networking in the age of the virtual. I use her (and Joans’s) work for a different purpose, to think about how girls and women’s desires, play, or passions are used
to articulate or guard a set of values-ethics and to intervene in a number of anxieties that manifest in the human-technology intersection as it plays out in school, work, and play. 103

Specifically, within the g/t story are numerous accounts suggesting that girls and women self-attribute their preferred—and morally superior—connection to the computer as one that is tool-oriented, utilitarian, and socially directed. Known as the “tool-toy” divide, the distinction is thought to be quite significant, to the extent that there is now an increased focus in computer science education in accommodating girls’ desires that social and utilitarian aspects of computing receive more attention early in the curriculum (AAUW, 2000; Margolis & Fisher, 2002). I do not mean to suggest that rethinking computer science education is not needed; my interest here is to investigate some notions about women, creativity and passions, and utility that seemingly precede these efforts. One way these play out is in a conflation of creativity-passion, play, and computer games—a kind of triad that in turn is used to frame a relationship where highly playful and passion-driven computer engagements by boys are described in opposition to girls and women’s social and humanitarian values or ethical core.

For example, the g/t story identifies early passions for computing as a defining characteristic of boys, and through this, either derides or exalts boys’ obsession for computing. This is in part possible because girls are depicted as lacking this level of passionate engagement with computers. In addition, there is a belief that play and gaming

103 I use values-ethics here for two reasons. One, both words deserve in depth development to unpack their meaning and intellectual or practical meanings. Second, I do not have time or space to do this, and so take this short cut, which in turn reflects the limited explication either term receives in the texts I cite, or across the g/t story.
are likely to be mitigating factors for future and ongoing success in computing across
groups and individuals. An individual or group’s disinterest in computer games or
passionate hacking is measured in terms of degrees of passion or as a marker of gendered
interests. In this way of thinking, other kinds of interests or passions become invisible or
are eliminated as relevant factors; for example, examinations of preferences for visual,
textual, or musically focused technological tinkering rather than more standardized game
playing are quite rare.

In *Unlocking the Clubhouse* (2002), Margolis and Fisher make a point of highlighting
boys early and sizzling passion for computing to contrast this with girls more tempered
explorations. Early in the book they state:

Most of the men describe an early, sizzling attraction to the computer. It is as if they
fell in love at first sight....The computer became his ultimate plaything....I just
played with the computer, and that was like my big toy, and that’s pretty much how
everything happened. (p. 16-17)

The language used to describe girls’ activities is quite different: “Many girls are also
interested in games but not generally with the same focus” (p. 40). A bit further on
Margolis and Fisher add:

Girls want to make things...are interested in games with engaging characters,
opportunities for communication and collaboration, a rich narrative, and roles
involving positive social action. (p. 45)

The idea promoted is that girls engage with technology because of its social potential.
However, suggesting that there are some core contradictions in the meta story, *TechSavvy*
commissioners argue, when talking about teachers, something quite different, that women
find little social value in computing:

K-12 public education is one of the more prominent “pink collar” occupations,
employing three women to each man. Realistically, the question of teacher
education becomes an issue that must be highly sensitive to issues of gender. But research on educational technology has too often treated teachers as an undifferentiated population. Teachers’ concerns about technology use echo women’s greater skepticism about technology’s ability to solve complex social problems. (p. 13-14)

In the Carnegie Mellon study (Margolis & Fisher, 2002), the driving gender narrative is that girls are drawn to computing for how it might help society and say they are driven by the opportunity to connect computing with social agendas. However, when the AAUW (2000) describes teachers, they are characterized has having little belief that technology has much social value in terms of solving the kinds of problems we can surmise drive the women at Carnegie Mellon. I have no specific answer to this riddle. The discrepancy might reflect a digital divide between experts and users rather than women’s innate understanding of computing. However, it is important to note that gender specific characterizations are often slippery in the story.

The point that is largely glossed over in the meta story is that Margolis and Fisher’s research participants were, by-and-large, an elite class of women academically and professionally well-positioned to enter the kind of creative, visionary computing culture that Joans identified (Stone, 1995). In the g/t story, it is this visionary passion that never really meets up with characterizations of girls and women, who tend to be described in ways more like the following:

Women commonly saw technological instruments as people connectors, communication, and collaboration devices. Their technological fantasies were often embedded in human relationships and they served to integrate their public and private lives. (Honey, et al., 1991, sec. 2, para. 2)

Highlighting this contrast, Honey et al. portray a male computer scientist’s fantasy as follows: “A direct brain-to-machine link. Plug it into the socket in the back of your head
and you can begin communications with it” (para. 5). Picking up the thread of the earlier TechSavvy quote, the AAUW continues its focus on how teachers might develop a greater sense of the social value of computing:

Teachers’ concerns about technology...also echo women’s lack of interest in understanding technology “for itself.”...these perspectives ‘can be seen as a healthy counterbalance to a more masculine technophilia’ in K-12 education....research suggests that what teachers need is sustained and ongoing education about how to integrate technology with curricular materials and information about how to make technology part of a humanistic classroom culture. (p. 14)

Blurry across the meta g/t story is the interconnection between play, passion, teaching, gender, and a values orientation to computing. On the one hand, the story portrays competing narratives about how women view computers in terms of social value. Moreover, there seems to be a discursive move that wants to position teachers to support this values orientation. On the other hand, there is some indication that passion and gender are never in the same picture. Sometimes this lack of passion seems to be ontological in girls, as in the AAUW (2000) report and in other studies, gendered ‘passion’ might be construed as socially constructed (e.g. Castell & Bryson, 1998). My argument is that girls and women’s passion or values-ethics are strategically used depending on the context or scale of anxiety under discussion.

On the FACES list serve, the following narrative was posted on November 16, 2007, with sentiments meant to contest mainstream positionings of women and technology:

In the spirit of sharing cyberfeminisms I want to post that just this week I’ve been sticking all my videos up on YouTube, including 'lovehotel' from 2000 which uses the text, voice and gorgeous visage of Francesca Da Rimini. You can almost read all the text !! via the serious compression. It includes the line "cyberfeminists, data deviants and pathogenic vectors" which may or may not include you. Francesca, like
her 3 other VNS Matrix collaborators, was kind of 'living online' for a lot of the nineties and lovehotel charts the period of writings from 1994 to 1997.\textsuperscript{104} (2007; cited with permission)

This is merely a taste of the cyberfeminist discourse, but it suggests a level of engagement—passion—that is missing from the mainstream story. In the dominant meta g/t story, women and gender tend to mediate a host of anxieties society carries about the human-technology intersection and resist an overly passionate engagement with computing that seemingly provokes some of these anxieties. In portrayals of disparate levels of engagement with the computer, the discursive demarcation is largely one of a significant gender difference regarding passions and the erotic as these play out in too close, or not close enough, associations with the computer. Too close and not close enough suggest oppositional anxieties about a deep human-technology connection as these oppositions play out in the spaces of gender difference.

**Disciplining passion to preserve society.** One production of the g/t story has been a governing of girls and women’s desires as these meet the computer. In the g/t story, girls are said to naturally hold the computer at bay (for example, Turkle’s “Computational reticence” (1988)), but there is evidence to suggest that sometimes this distancing is a result of which stories are allowed into the mainstream story. Castell and Bryson (1998) argued along these lines, that desire itself was a construct used by both the marketplace and conventional schooling to construct girls to fit into the “unwritten law of Gender” (p. 251). They posit, rather forcefully, that

\textsuperscript{104} It was shot in New York (with Francesca), and Japan in 1998. Find it at http://www.youtube.com/user/machinehunger
Girls’ desires have far less to do with what girls want than with what kind of girl adults, whether in education or in the marketplace, want to produce. Reenacting the ancient Greek myth, they eagerly create and then consume their own children as commodities, hungrily introjecting adult fears and desires onto their children, in the name of satisfying the children’s own wants and fantasies. (p. 251)

The Stone quote I cited earlier (p. 271) portrays a girl in what appears to be a rather extreme, intimate unification with the computer. More commonly, in the meta g/t story, women and desire are on opposite sides. Stone (1995) however locates desire differently, where desire itself is not in opposition with social values.

I see...identities engaged in a wonderful and awesome struggle, straining to make meaning and to make sense out of the very idea of culture as they know it, swimming for their lives in the powerful currents of high technology, power structures, and market forces beyond their imagination. In this struggle I find certain older structures stubbornly trying to reassert themselves in a techno-social milieu that to them seems to have gone berserk. These are the structures of individual caring, love, and perhaps most poignant, of desire. (p. 36)

Taking a different path, Haraway (1991b) also wants to integrate a kind of passion and desire with responsibility and social values and she does this through the cyborg, itself a merger of machine and organism, in part gendered, and in part neutralized. The machine, and playful engagement with it, facilitates a future dissolution of gender and the limitations it has wrought:

The cyborg is our ontology; it gives us our politics...a condensed image of both imagination and material reality...the relation between organism and machine has been a border war. The stakes...have been the territories of production, reproduction, and imagination. This chapter is an argument for pleasure in the confusion of boundaries and for responsibility in their construction...an effort to contribute to socialist-feminist culture and theory...and in the utopian tradition of imagining a world without gender. (p. 150)

Characterizations of women’s relationship to things technological are evidence of a discursive disciplining of girls and women in the mainstream g/t story. In this disciplining,
there is also resistance, but this too, shifts. The question is what is being resisted or disciplined.

The mainstream g/t story carefully separates boys and men’s techno-passions from girls and women’s social-ethical interests. It is not just the different foci or drives associated with genders that should be noted but also, the differing tenor of the engagements. Boys and men have desires and passions whereas girls and women have interests.

These girls’ descriptions of what boys are doing with technology are missing some very important elements. There is strong value in boys’ activities that girls are quick to denigrate. For example, there is intellectual importance to getting to understand computers from the “inside out” and developing skills and an intuitive feel for programming. There is intellectual value in tinkering with technology. And there is no question that there is defensiveness in the way girls denigrate these activities. But it is also clear that getting girls involved with computing will require overcoming resistance based on their negative feelings about getting involved with the machine “for itself.” This resistance also stems from girls’ view that a machine-centered, technical worldview is what the computer culture is all about. Girls reject a computer culture that they see as primarily focused on playing with machines. (AAUW, 2000, pp. 9-10)

In their analysis, the AAUW commissioners find something desirable in boys’ passions for computing but they re-envision the quality of the engagement for women. Here, passions become intellectual and social values.

The idea that women’s passions should be monitored, for the protection of society, is not new. Lacqueur (2003) identified the new nineteenth century habit of women’s passions for reading novels alone as something of enormous concern in Victorian society.

Reading in private...especially by women, was thought to inflame desire, encourage both prurient and romantic curiosity, and permit the reader to withdraw from society into a rich and seductive world in which self-absorption had no consequences or benefits other than individual pleasure. (Maines, 2004, p. 479)
Women’s solitary reading had to be monitored because society could not afford to have women secede from its cultural norms by reading novels, which, Lacqueur argued, Victorians feared would lead to women’s withdrawal from heterosexual sex; the concern was that they might find greater satisfaction in reading. This would lead to “withdrawal from the material and economic world” and “the social fabric would collapse as formerly productive individuals vanished into private worlds of the imagination” (p. 479).

Connecting Victorian era concerns over solitary reading of novels—that society’s new cultural form—and our contemporary concerns over video games and the Internet, Lacqueur (2003) argues that both reflect a fear that social norms were and are under siege. In the nineteenth century, women reading alone were perceived to be not simply reading; instead, this act signified a threat woven of desire, the imagination, and solitary sexual pursuits that, as women took them up, signified the immanent demise of society.

A monitoring of risk, passions, and play pepper the meta g/t story, often centered around computer gaming. Jenkins, in his essay “‘Complete Freedom of Movement’: Video Games as Gendered Play Spaces” (1998), develops a thesis of gendered play spaces by first examining nineteenth century gendered play cultures in relation to contemporary video games. In the former, boys’ freedoms to explore the outdoors allowed them “recognition from their peers for their daring...stunts” (p. 271). Similarly, he argues, today’s video games provide boys a culture where they are encouraged to “gradually develop their mastery over the entire digital terrain...by passing goal posts or finding warp zones” (p. 271). Jenkins draws a number of parallels between boys’ Victorian era and modern video game play (e.g. mastery, social hierarchies, violence and aggression, “scatological humor”, and role playing
and bonding) activities that mirror the adult, business, and fraternal world (p. 273). In contrast, he sees girl-oriented games as transposing “traditional feminine play cultures into the digital realm” (p. 276). Jenkins’ suggests that contemporary girls’ express desires for different kinds of video games than do boys; these spaces are characterized as spaces for “solitude and introspection...spaces...full of life...less to master nature than to understand how we might live in harmony with it” (p. 282). Evoking a different sensuality to women’s games—as a contrast to the high risk and violent experience of boy’s games—he states: “Unlike twitch-and-shoot boys’ games, ‘Secret Paths’ [his girl game example] encourages us to stroke and caress the screen with our cursor” (p. 282-283).

Our attitudes towards women and girls’ sexuality may have evolved from the strictures of the nineteenth century, at least as Jenkins portrays them, but women and girls retain their role as signifiers of values in danger of being lost; separated m-f passions is one way this is managed. In his exposition of the gendered nature of video game play, Jenkins illustrates that while 19th century girl play promoted domesticity, in contemporary game culture it appears that the feminine role has expanded outward, situated to protect our relationship to nature as well as a broad range of social values.

A methodological question is how women and gender become positioned to manage our socio-techno anxieties, but the more significant question is why. Lacqueur’s Victorian analysis of 19th century solitary fiction reading suggests it not improbable to link fears over society’s future to emergent new forms of activities that challenge conventional social norms around passion and desire and the transformations they might provoke. Our anxieties thus may be said to reflect a number of tensions over concerns about the
continuity of sociality and traditions, the rising need for a productive (and cooperative) workforce, and anxieties provoked by the computer with its potential to reshape not only social-economic relations, but also, the core of what we have thought, to date, makes us uniquely human subjects, in terms of our thinking and the objects of our passions.

Gender, passions, and desire are used to respond to or mediate these anxieties.

**Passions, play, values, & social class.** In focusing on gender, the ways in which socio-economic class plays a role is often glossed over (while I do not exclude race as another significant site of analysis, I am not clear how it fits in this specific analysis).

Throughout the g/t story are examples of micro-stories that describe girls and women’s socially driven or innate technological reticence that portray women as not particularly passionate about computing. The narrative created blurs several strands of thought, as if they are talking about the same things. First is the concern that with so few women in computing, society loses too many ethically concerned, potential workers. This notion of workers, however, is more multifaceted than its use in the story explicitly recognizes. Sometimes, these workers are in the elite domains of computing (e.g. the women studying at Carnegie Mellon, on paths to the creative center of technology design); in other stories, “workforce” is used more specifically to infer lower level technology workers. These workers tend to be trained in particular skills but their jobs are more mundane and regimented than those in the elite, creative class, as Jones or Stone (1995) suggest. The connection between technology, opportunity, and play is more socio-politically nuanced than is represented in the g/t story. Thus, a play ethic and culture
Is only possible for workers of a certain type and at a certain job level...it is only possible to the communities who are perhaps best described as hackers—mostly young...mostly educated...mostly white...and mostly male. (Stone, p. 15).

Stone’s analysis is useful for the way she explicitly acknowledges the elite position that precedes the possibility of inclusion in—or relevance of—play culture and its associated passions. This problem of elites and workers is not new. While new technologies tend to create opportunities and creative challenges for some, they also become a means for deskilling or disempowering others into drones. In the g/t story, there has been a tendency to overlook the complex interplay between class status and the possibility of integrating play and “work” in real terms. This is far too complicated to pursue here, except to note that a playful and passionate connection to computers is so often offered as an explanation in micro g/t stories. Certain kinds of play—as Jenkins alludes—are taken to reflect gendered dispositions or expectations as well as beliefs about what kinds of technologies and technological experiences men and women might deliver, if they become designers. The opposition presented is of women’s versus hackers’ values.

Stone (1995) suggests an alternative perspective, by offering a description of hackers’ play and culture in highly social terms:

In particular, because they [hackers] are thoroughly accustomed to engaging in nontrivial social interactions through the use of their computers—social interactions in which they change and are changed, in which commitments are made, kept, and broken, in which they may engage in intellectual discussions, arguments, and even sex—they view computers not only as tools but also arenas for social experience. (p. 15)

The hackers in Stone’s world are tinkering with the human-machine relationship, not to displace or ignore the social, but instead, to enhance this aspect of their lives. Stone sees identities in flux, negotiated in relation to technological experiences,
The critters we ourselves are in process of becoming, here at the close of the mechanical age...identities engaged in a wonderful and awesome struggle...swimming for their lives in the powerful currents of high technology, power structures, and market forces beyond their imagination. (p. 36)

In an era of radical, technological change, Stone locates evidence that even those at the vortex of this change hold on to “structures of individual caring, love, and perhaps most poignant, of desire” (p. 36).

The problem for future thinking about g/t seems to me to be how to connect a number of heretofore disconnected or conflicting threads, experiences, insights, and analytic positions. Stone was interested in how we hold on to human social values and practices as we transition from the mechanical to the digital era. I have tried to highlight how Stone, Castell and Bryson, and Haraway, each in their way, subvert or contradict dominant conceptions of the g/t story that depend on a separation of women, men, passions, and technology.

Conclusion

The mainstream g/t story must be seen as a response to a number of anxieties provoked by new realities and challenges that the shift to the digital era foreshadows. Just as g/t research has not given sufficient space to the social-political-historical background, neither has it acknowledged advances in theory that bring helpful and important ideas to the table for thinking about the complex issues at stake. Kurzweil, in The Age of Spiritual Machines (1999), predicted that although the problems that humans have tried to solve over the centuries have remained fundamentally similar over the centuries, this will not be true in the 21st century:
Before the next century is over, human beings will no longer be the most intelligent or capable type of entity on the planet...The truth of that last statement depends on how we define human. And here we see one profound difference between these two centuries: The primary political and philosophical issue of the next century will be the definition of who we are. (p. 2)

If we are on the road to becoming other than we have been, or at least, in need of a new understanding of who we are and can be in the digital era, is it not also likely that we could use a new way of approaching the problem of gender and technology? The next chapter considers some possibilities.
De-Essentializing the G/T Story

The standing meta g/t story describes a relationship framed around ten concerns or ideas. To recapitulate, these are as follows. First, the story black-boxes long-standing binary oppositions of nature-culture; m-f; body-mind; human-non-human (e.g. animals or technologies); and subject-object; and because of this, there seems to be no reason to think or perceive in any other way—the story remains within a closed, recursive system of thinking. Second, theorizing as well as analytic and representational strategies remain grounded in reductivist thinking and subject-object relations derived almost exclusively from the psychological, behavioral, or cognitive sciences that share an ethical ideal with cultural-liberal feminism. This is a totalizing approach that supports either the liberal or neoliberal subject that provides no resources for thinking beyond limited and limiting conceptions of human-centered social-political relations so that they could become more responsive to the social-political-intellectual re-adjustments characterizing post-industrial society. Third, standing notions of disinterest or passionate engagement within the g/t story (e.g. discussed as concerns over masculine, elite, or adolescent irresponsible play) are constrained within these same essentializing oppositions. Fourth, technology is singularly conceptualized as tools or tool culture and this constrains thinking more expansively about technology in the bigger picture (e.g. in the learning sciences, the computer is, ideally, a transparent tool or environment to support learning). Fifth, there is a notable absence of
contemporary feminist thought in this “feminist” intentioned story. Sixth, the story remains bound to representationalist, reductivist, constructivist, and determinist epistemologies and practices that have given us valuable information, yet contemporary conditions and relationships require new perceptual lenses and positions. Seventh, a black-boxed mixing up of ideals of equity and a neoliberal politics and economics better serves the market than it does individuals, and serves capitalist interests more than democratic ends. Eighth, the g/t relationship is articulated through a liberal humanist concept of women’s ethic of care, morality, or values and yet these ideas remain under-defined and under-conceptualized. Ninth, the story remains bound to a liberal humanist tradition that is now thought, by a large number of thinkers, to be insufficient for understanding the complex problems we face as a society. Tenth and last, the role of education in this intersectional stew could be more powerfully explicated.

Taken in its entirety, the g/t story articulates a political intent to transform or intervene in an oppressive and circumscribing masculinized computing culture. However, this story, and the relationship it tries to describe and remake, is about much more than this. The problem is that we cannot see this ‘more’ unless we access resources that are currently outside the conceptual reach of the story, e.g. posthumanism, feminist technoscience, and new materialist ideas. These new resources reflect a contemporary postindustrial struggle over how to articulate a new ethics-aesthetics-politics and to create both the space and means for a radical shift in how we think and relate. This new ethic and ways of thinking are fundamentally in tension with a number of traditions and beliefs that dominate approaches to thinking about STEM education and educational research.
and policy. In this new thinking, ontology supersedes epistemology and connectedness becomes more significant and useful than reduction and essentialization (e.g. Barad, 2007; Colebrook, 2009; Haraway, 1997). In this new model, research, methodology, and theory building are recognized to be not merely outcomes of correct executions of scientific principles, but also, and more importantly, exercises in responsibility and relationships of being as well as knowing. Dynamism becomes the ontological and conceptual paradigm most relevant for thinking through the problems and interconnected relationships of this new era (Braidotti, 2002, 2006; Colebrook, 2009).

These new resources of posthumanism, feminist technoscience, and new materialism suggest a new way of thinking that is concerned not only for human futures, but also, for the rest of the world, where nature and culture are conceived as interconnected and co-evolving. This new thinking is also intersectional, non-dichotomizing, and non-essentializing. For example, in this new paradigm, nature and culture, ontology and epistemology, being and knowing, and so on are no longer viewed as oppositional conditions or positions. This chapter explains these ideas and resources, describes the opportunities that this new thinking opens up, and explores a shift to a posthumanist ethic through the lens of the g/t relationship and story. Finally, the chapter articulates the significance of this conceptual and ethical shift for educational research and STEM pedagogy in ways that extend beyond and challenge current STEM initiatives and pedagogical emphases.
Getting Over the Liberal-Humanist Ethic-of-Care

Pervasive across the meta g/t story is the notion that bringing more women into technology fields will fundamentally change technology, inferring an “easy” solution to a pervasive discontent with many of the effects of technological progress. As g/t micro-stories unfold and collide, women and gender are used to mediate a broad set of ill-defined complex technology associated anxieties that in turn are manifestations of a number of problematic, black-boxed conceptualizations and beliefs.

Re-imagining the g/t story is an opportunity to consider more closely what is at stake when it is suggested that bringing more women into computing will change computing, its culture, or the kinds of technologies developed. In these narratives, much is attributed to women’s ethic-of-care, yet this ethic itself has been well-criticized within feminism. Thus, an important question to consider is what is at stake in articulating the g/t relationship as this kind of ethical, transformative agent. This ethic-of-care is inseparable from liberal-cultural feminism but both have met substantial criticisms by major feminist and feminist technoscience scholars.

The idea that women will dramatically alter or transform the field of computing largely builds from liberal feminism’s conception of a gendered ethic-of-care that has been articulated through the work of Gilligan (1982, 1993) and Noddings (1984, 2003), among others. In the g/t story, this ethic, in part, is positioned to soften the blow of technological progress and the instrumentalization of technology by neutralizing the “technology for technology’s sake” play ethic of boys and men. As I argued in chapter seven, the technology of gender both constructs and relies upon a gendered object functioning as a kind of
apparatus to both serve and mediate technological progress. One significant problem is that this gendered liberal-humanist ethic of care is unreflexively used and under theorized. Another is that it understands the gendered subject or object (and its “ungendered” opposite) as improbably static as well as too facilely locatable or fixable. New theories coming out of neurobiology (Damasio, 1994, 2005), posthumanist and new materialist scholarship (e.g. Braidotti, 2006; Colebrook, 2009; Hayles, 1999), and feminist technoscience studies (e.g. Barad, 2007; Haraway, 1991b, 2003) bring new ideas for rethinking the core questions, theories, and methodologies that have grounded the g/t story. The liberal ethic-of-care, specifically, is found to be wanting. In essence, my argument is that the meta g/t story to date has been quite constrained but it can be opened up with some radical conceptual intervention and by moving away from the constraints wrought by Gilligan’s ethic-of-care.

Shifting Paradigms: From Humanism to the Posthuman

The g/t story has largely been taken to be a descriptive story with two key intentions: (a) constructing explanations and causes of the gender gap in computing and (b) transforming women, computing cultures, and computing education. While the first goal has been more successfully realized, the second has not—largely because its underlying premises are insufficient to the task.

In essence, the g/t story has been largely ineffectual in its aims as a transformative or interventionist narrative because it remains wedded to ways of thinking no longer sufficient for understanding the increasingly complex intersections between humans and
non-humans (e.g. Haraway, 2003; Latour, 2005) and nature and culture (Barad, 2007; Grosz, 2005; Wilson, 1998). Posthumanist, new materialist, and feminist technoscience scholarship has much to offer in re-imagining the significance and subsequent study of the g/t relationship, particularly as it continues to play out in the ways STEM education and research are themselves conceived.105

Ways of thinking that have served modern science’s quest to control nature are dependent on a separation of humans and human culture from nature. Located within the domain of nature have been emotions, affect, and intuition. This suggests how women, too, have been largely situated within nature rather than culture. In this way of thinking, culture has been understood to move forward exclusively through the intentions of man and reason. Thus, a central organizing feature of modern thinking has been that the rational mind functions independently of its body. I will not delve into these complex ideas here, as my intention is merely to highlight the dominance of this modernist, Enlightenment notion of thinking as the conceptual framework behind the g/t story. This framework, in its transparency and dominance, severely limits the possibility of thinking in terms of connections and non-essentialisms. In essence, we have become so comfortable in a way of thinking (much of this comfort achieved through schooling) that it requires significant, reflexive effort to begin to articulate and think through a different kind of thinking.

105 I am not specifically addressing race, class, or other categorizations because (a) I do not have space and (b) I am not convinced that the additive treatment called for in mainstream g/t research is sufficient. That is, race, class, ethnicity, disability, and so on—in relation to technology—might benefit from substantively different analyses. For example, Alcoff makes a compelling case that race and class do not constitute a similar metaphysics as does sex.
For example, the old thinking depends on dichotomous conceptions of men versus women in essentializing a techno-patriarchy that a liberal feminist ethic is intent on disrupting. Similarly, social constructivist arguments depend on a form of essentializing and dichotomous thinking that becomes determinist and fixed even as it wants to describe dynamic social interactions. Re-imagining, in the ways that I use it, refers to a process of drawing on new concepts that may help us get more comfortable with thinking that is less dichotomous, reductivist, essentializing, determinist, or static.

My argument has been, in part, that limited conceptual frameworks constrain the g/t story. Following Braidotti, a responsibly evolving feminist imaginary requires countering old ways of thinking not because they were wholly wrong, but because they are no longer sufficient to the problems we face or thinking about the ways in which nature and culture themselves are evolving (Alaimo & Hekman, 2008; Barad, 2007; Colebrook, 2009). Before discussing in more depth these new ways of thinking, it is important to understand what is meant by posthumanism and new materialism, the arguments being made by feminist technoscience scholars, and why these are so significant.

To What Do Posthumanism, New Materialism, & Feminist Technoscience Refer?

Posthumanism, new materialism, and feminist technoscience draw on a set of shared ideas about ontology, ethics, agency, and connection. Thus, each notion or field is difficult to define independent of the others. Posthumanism might be described as a shift away from thinking about humans as singular and dominant agents with the resources to control nature and drive culture. Instead, there is a growing recognition of and respect for
a multiplicity of agents, which might be organic or inorganic, human or non-human, 
natural or cultural and who each contribute to an evolving nature-culture in some way. 
This intersectional and interspecies perspective necessitates a new ethical orientation to the 
world, in part, because humans are no longer viably the dominant agent at the helm. 

New materialists argue that the material world carries implications central to ethics 
and politics. They emphasize a shift from “ethical principles to ethical practices” and from 
rules to “embodied, situated actions” (Alaimo & Hekman, 2008, p. 7). New materialist 
thinking reflects a dissatisfaction with thinking about nature, culture, or the body as 
products wholly of discourse or as independently functioning entities. It also emphasizes a 
shift from discourses about the body to thinking about “the body itself as an active, 
sometimes recalcitrant, force” and how attending to material realities informs the 
construction and progression of discourses (p. 4). It is a turn away from the dominance of 
discourse and the motivation is a new ethics concerned with being, ontology, and 
experience. Together, posthumanism and new materialisms dismantle the grounds for 
thinking in terms of masculine hegemony. 

Feminist technoscience draws from posthumanism and new materialisms to think 
about technology more expansively, in a way that ontologically connects “the human, 
nonhuman, technological, and natural as agents that jointly construct the parameters of 
our common world” (Alaimo & Hekman, 2008, p. 5). It is also concerned with the 
implications of this ontology and interaction for women (broadly construed).  

106 I highlight several women scholars, but some significant others who also work in this 
landscape of technoscience theory are Bruno Latour and Andrew Pickering
What becomes evident in feminist technoscience scholarship is the value of embodied-situated, intersectional, diffractive, or transdisciplinary methodologies in effecting a change in our ethical relationship to technology, nature, and culture. These conceptual and methodological strategies refer to a way of thinking about problems and questions as having multiple, intersecting nodes of influence and interests, none really separable from the other. Rather than reifying oppositions and essentialisms, they suggest a critical engagement with “mattering” (Barad, 2007). Thinking in this way, the significance of science, politics, knowledge, bodies, philosophy, the arts, and education (to name some) is not their singular or self-sufficient bodies of knowledge, but their intersection as a multiplicity of lenses for thinking about the relationship between nature and culture. This quest is a search for a dynamic, responsive, complex, and interspecies sensitive ethic of care (Barad, 2007; Haraway, 2003). To focus on one location—e.g. women or technology, nature or culture, art or science—is to leave out what in reality cannot be reduced or left out.

Much of my thesis has emphasized the limitations of the g/t story due to the way it has been conceptualized through psychology, behaviorism, and cognitive science. While I believe the criticisms to be fair, this is not to wholly dismiss any of these out of hand. The problem is the way in which these conceptualizing tools are used to construct a totalizing story that enframes women, men, nature, technology, culture, and education. For g/t research to be substantively transformative, it must rethink the kinds of questions asked as well expand the base of theory and concepts that foreground research questions and agendas.
Posthumanism, new materialism, and feminist technoscience appear to be unfamiliar terrain for g/t researchers or policy makers within education, who tend to be more versed in psychology, evaluation, or the learning sciences. Moreover, these ideas remain controversial within feminism and other research discourses. Nonetheless, the ideas are compelling for the reasons I outlined in earlier paragraphs and might be viewed as responses to a growing dissatisfaction with essentializing, cultural, discursive, or postmodern or relativist explanations of socio-political-technological relationships or subjectivities (Alaimo & Hekman, 2008; Barad, 2007; Grosz, 2005; Haraway, 1997).

Both posthumanist and new materialist scholars attack two long-standing oppositions: epistemology versus ontology and language versus reality. Posthumanism and new materiality aim to move beyond the limitations of dichotomous thinking that drive both modernist and postmodern epistemologies (Alaimo & Hekman, 2008; Barad, 2007; Colebrook, 2009; Connolly, 2002; Grosz, 2005; Haraway, 1997). These ideas suggest a better approach to theorizing, conceived as a dynamic enterprise that permits “a deconstruction of the material/discursive dichotomy that retains both elements without privileging either...to more productively account for the agency, semiotic force, and dynamics of bodies and natures” (Alaimo & Hekman, 2008, p. 6). Realigning how we think about the intersections and co-existence of humans and non-humans along with nature and culture is not merely an abstract theoretical exercise—it is an ethico-political shift that brings together, as fundamentally inseparable, a number of longstanding oppositional constructions: materiality and language; human and non-human agencies; epistemology and ontology; mind and body; and the natural (human) and technological.
The posthumanist turn is also an ethical and political shift away from liberal humanism. For example, Colebrook suggests “a feminist politics that ‘frees matter from the human through the human’” (cited in Alaimo & Hekman, 2008, p. 11). Hayles (1999) characterizes the posthuman as follows: “There are no essential differences or absolute demarcations between bodily existence and computer simulation, cybernetic mechanism and biological organism, robot teleology and human goals” (p. 3). Posthumanism is a critique of sorts, of the liberal humanist subject, thought to be endowed with free will and at the center of the world, yet in service to the market. The humanist subject is no longer a viable conception theoretically, in actuality, or ethically, which Hayles explains as follows:

If ‘human essence is freedom from the wills of others,’ the posthuman is ‘post’ not because it is necessarily unfree but because there is no a priori way to identify a self-will that can be clearly distinguished from an other-will....the construction of the posthuman does not require the subject to be a literal cyborg. Whether or not interventions have been made on the body, new models of subjectivity emerging from such fields as cognitive science and artificial life imply that even a biologically unaltered *Homo sapiens* counts as posthuman. The defining characteristics involve the construction of subjectivity, not the presence of nonbiological components. (p. 4)

Hayles’ project in *How We Became Posthuman* (1999) is to retheorize the interplay of embodiment, materiality, subjectivity, and information, to contest, as she puts it, the “materiality/information separation” that has been presumed across the cybernetic movement (p. 12). Posthumanist and new materialist feminisms emphasize a turn to “theorizing”—rather than “proving theory”—to better construe an ethical realignment of subjects and objects, theorizing and ethics, and materiality and language. The intent is a return to thinking about reality and being without the empiricism of modernist, human-centered epistemologies. As Barad (2007) puts it, the aim is to make room for matter to
matter. Moreover, these intersecting relationships are dynamic and thus, another ideal is a return to uncertainty and ambiguity as an ethical stance. Relational unfolding, rather than singular accomplishment or final explanations takes center stage.

Feminist new materialist and posthumanist thinking is itself highly multi-faceted but overall, it reflects a deep ethical concern for how we think about the intersection of nature (the body, the material world, the environment and animals), culture (language, mind, cultural artifacts, and technology), and technoscience (tools, non-humans, knowledge, or methodology). These are complex ideas to navigate or connect, which is why an intersectional and diffractive methodological lens becomes useful and necessary.

**Articulating a New Intersectional Ethics**

The gender gap addressed in the meta g/t story is not a falsehood, but it has been miscalculated. First, it is not sufficiently or appropriately “objective” as an explanatory narrative and the story itself has become a limitation for both women and society. Second, rather than a representation of disparate abilities, interests, or access, the gender gap and g/t story are products of how we construe women and what society wants or needs from women, as much as for women. It is also a narrative that reflects a conflicted and insufficiently articulated understanding of both the intersections of technology, progress, and education and the dynamic relationship between science and politics and nature and culture. The g/t story tries to mediate our human condition and ethical position in this technological era, but relies on an insufficient arsenal of conceptual tools.
Re-imagining the story and g/t relationship presents an intellectual and ethical challenge and significant conceptual framings are needed to open up how we think about the intersection of gender, technology, education, and society. At stake is an opportunity for examining and integrating new yet potentially controversial ways of thinking that put the focus back on ontology and foreground the increasing interdependence and complexity of nature with culture and mind with body. In this understanding, scientific knowledge, if it is to be objective, must be grounded in contexts of knowing and being; it cannot be disengaged from the embodied knower. Although STEM literacy, equity issues, worker productivity, more human-centered technologies, or sustaining America’s global competitiveness have been the overarching concerns of U.S. g/t research and policy, what is ultimately at stake, as Heidegger suggested, is the future of an interconnected nature and culture and how we think about our human role in shaping this future. This suggests that what we need is not merely technocratic, skills driven STEM education, but a more philosophically attuned set of pedagogies and policies. These should be at least as concerned with building critical and reflexive “ethical” dispositions for thinking forward as they are with building technological literacies, as these have been commonly understood. By commonly understood techno-literacies I mean views that have narrowly defined and focused technical competencies as well as those that push literacy a bit farther to
encompass the socio-cultural contexts and influences on learning (e.g. Gee, 2003; Lankshear, 1999). In all of these however, individual competencies as users, teachers, or consumers of technologies have been central.

That is, STEM education, while preparing students to become literate in the techniques and knowledges of STEM fields could attend equally to developing the kinds of highly nuanced techno-ethical dispositions that our contemporary situation demands. The challenge is how to integrate posthumanist and new materialist ethics as a core aspect of STEM learning, thus bringing ontological and philosophical thinking together with the techno-scientific.

One of the driving concerns in these new ways of thinking is how to think outside dominant and long-standing oppositional framings that, for example, have separated humans from the rest of nature or technology, tried to articulate gender as a social construction independent of biology, or argued for the independence of scientific knowledge from the producer of that knowledge. Haraway (1991a, 1997), Barad (2007), Braidotti (2002, 2006), Colebrook (2009), Grosz (2005), Hayles (1999), Alaimo & Heckman (2008), and Wilson (1998) each suggest a complex intersectionality wherein technology and humans, along with nature and culture, have evolved to be so intertwined that we need to be thinking in posthumanist terms. Posthumanist, new materialist, and feminist technoscience thinking open new opportunities for both g/t research and for

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107 Other scholars address some of these concerns, many of whom I have highlighted in earlier chapters. Here I largely focus on this group because of the ways in which they bring together ideas about women, technology, society, and ethics in a search for alternatives to dominant binaries and the assumptions that they have fostered.
thinking about STEM education as a disposition rather than merely a skill set. The next sections explicate five shifts in thinking that move towards this new intersectional techno-ethical literacy: non-dichotomizing, non-essentializing, non-determinist, intersectional, and dynamic-nomadic.

**Five Shifts in Thinking**

1. **Non-dichotomizing thinking** (reconnecting mind-body and nature-culture). A significant limitation of the g/t story is the way it depends on fixed ideas about gender as an identifying marker sufficiently stable so as to be locatable and easily available for re-engineering to meet societal needs. One reason that gender is such a key signifier is that it facilitates a way of talking about a number of dichotomous relationships, e.g. m-f, nature-culture, and technoscience-values. Braidotti’s (2006) reading of Haraway explains this as an ideology dependent on an epistemology tied to normal science’s reliance on oppositions of nature-culture and subject-object, which depend on conceptualizations built around “patriarchal, Oedipal familial narratives” (p. 5).\(^{108}\) Within this epistemology, even a socially constructed notion of gender or the g/t relationship has great difficulty escaping dichotomizing (and determining) oppositional constructions. “Opposition” is the conceptual framework of the g/t story, which can be seen clearly as a lineage that traces through Chodorow’s *The Reproduction of Mothering*, Turkle’s *The Second Self*, to Margolis and

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\(^{108}\) This idea refers to the ways in which liberal feminism draws on a Freudian psychology framework that delineates boys and girls at an early age through their differing relationships to the symbolic mother or father.
Fisher’s *Unlocking the Clubhouse*. The following illustrates Margolis and Fisher’s attachment to that lineage:

Turkle (1984) describes the constraints of computer games as ‘those imposed by rule systems, not physical realities or moral considerations.’...She finds a compelling explanation in the writings of...Chodorow...[who] explores how boys' gender identity development is linked to their awareness, at around four or five years old, that they are different from the mother...They must separate and become autonomous from their mother...girls experience no need for separation, and girls' and women’s style of relationship is therefore based on intimacy and closeness. (2002, p. 42)

From this conceptual position, the g/t story largely plays out as a problem of minds and culture. Psychological, behavioral, and cognitive theories frame the oppositions as innate to the object (e.g. male or female aptitudes or interests) but these differences are conceived around matters of mind where biological m-f sex differences are of nature, and thus, not deemed relevant. Discursive perspectives suggest that gendered behaviors and beliefs are products of culture. Nature, understood as something apart from culture, has been relegated to the margins as the problem that constructivist practices shape and reshape (Braidotti, 2006; Haraway, 1997).

In the view of new materialist and feminist technoscience scholars, the nature-culture and m-f binaries must be rethought in order to reflect interconnections rather than oppositions. Following this challenge, g/t researchers might productively consider the significance of this turn to ontology, materiality, change, and embodiment. To do this will require expanding both the conceptual lenses in use and the notion of theorizing itself. In essence, within g/t research and policy-making, materiality and the body, which are central in engaging with the world, seem to have gone missing due to methodological and dichotomizing concepts and practices that have privileged lenses of the psychological,
cognitive, and behavioral sciences. Arguably, this is in part an outcome of the strong methodological dependence on the methods of disengaged, unbiased normal science that in turn are the basis of believing that the g/t story is a broadly encompassing and explanatory portrayal of women, gender, and technology, where researchers can draw on the past to predict the future. The meta story has something in common with earlier feminist critiques of science (e.g. those of Fox-Keller or Harding), that “have argued that ‘culture’ is more important than ‘nature’” (Valentine, 2008, p. 356). Feminist technoscience scholars argue however, “in fact, it is the other way around” (p. 356), but not in an oppositional way.

2. De-essentializing concepts. Feminist scholars have long grappled with the question of sex versus gender from a number of perspectives and disciplines. Alcoff (2006) states “the philosophical core of the debate over essentialism was a debate over the metaphysics of gender” (p. 153). Her argument is that in making essentialism the focus, both cultural feminists—in insisting on differences—and poststructuralists—in taking a wholly anti-essentialist position, are both headed in an unproductive direction. Neither sufficiently attends to historical, contextual, or embodied realities of being female—in essence, they all ignore the metaphysical dimension of being and of sex. Alcoff suggests that even poststructuralist feminist positions still rely on a nature-culture binary and thus fall into the trap of reifying the very position that they criticize—that Enlightenment reason can prevail over nature. The problem is falling into the conceptual trap of thinking that nature can be transcended and mastered (e.g. that bodies do not matter, for example, as technologies increasingly intervene in bodily functions). She suggests an alternative, where
“our cultural practices and productions occur within a material world, which would eschew both a neat nature/culture divide and the commitment to transcend and master nature” (p. 161).

Also challenging modernist conceptions that dismiss biological essentialism, Wilson draws on Damasio’s (1994, 2005) work in neurobiology and an historically neglected neural network model of computing and human intelligence. In *Neural Geographies* (1998), she counters both feminist anti-biology stances and the dominance of models of mind and AI fostered by cybernetics (e.g. Minsky’s symbolic processing model of computing). Additionally, she suggests that feminism’s insistence that women not be defined by the biological has severely limited the usefulness of feminist psychological theory. Similarly, in her estimation, Minsky and Papert’s success in suppressing the neural network and parallel distributed processing models of computing derailed the possibilities of these connectionist models for developing better models of cognition.

Wilson’s (1998) concern is that cultural feminism has been too successful in rendering the body abiological as an object shaped and understood exclusively by culture, psychology, and experience (1998, p. 15). New work in neurobiology and neurocognition opens ways for biology to become more useful to the feminist project and to social transformation. In arguing for a new significance to ontology, Wilson suggests a reconnection of critique and science that will be better positioned to overcome or unravel a history of “debts and disavowal” that have kept these domains separate and consequently have supported the contemporary neoliberal project. In her estimation, feminist thinking must reorder its focus—through ontology—to be more critically cognizant of how bodies
operate as a filtering mechanism and where feminist psychology, in its theoretical
distancing from biology or ontology, has unproductively aligned itself with empiricism and
liberal humanism. The reconnection of nature and culture is a return to ontology
grounded in ideas that cross philosophy and science. Moreover, within this intersectional
thinking is the basis for deconstructing the essentialisms derived from dichotomizing
epistemologies.

3. Non pre-determined thinking (rethinking objectivity & causality). Ever more
precisely articulated methods and unbiased scientific objectivity are increasingly argued to
be the needed corrections to improve educational g/t research (e.g. National Research
Council, 2002). However, the notion of objectivity in play in these arguments has been
increasingly recognized as not viable (nor particularly objective) by major feminist and STS
scholars. Specifically, feminist technoscience regards mainstream science’s dogma of
objectivity as an apparatus of patriarchal science and a practice that ultimately produces a
flawed and limited objectivity and ethic. Haraway (1991a, 1997) deconstructed the
epistemology behind an all-knowing view-from-nowhere, which has been key in this critical
correction. New thinking is that knowledge and objectivity require contextual and
embodied engagement without which both the quality of this objectivity and its ethical
basis must be questioned.

In pursuit of a similar correction, Grosz’s Time Travels: Feminism, Nature, Power
(2005) puts temporality at the center of a new ethics. She resuscitates Darwin’s theory of
evolution for feminism. She posits a way of thinking about the interconnected, temporal
unfolding of nature and culture as central to any objective or ethical rendering of either.
Moreover, she provides a way around concerns about the efficacy of prediction based on historically bound causal relations by thinking in terms of becoming to make it possible to responsibly respond to the increasing interdependence of nature and culture, humans and non-humans, and science and politics. Rather than oppositions, she suggests a way of thinking in terms of continuity:

These ‘others,’ these inhuman, subhuman, and extrahuman forces—forces that structure culture, the law, representations, and all the other products of the human—need to be understood in terms of a continuity with rather than in opposition to the human. (p. 4-5)

At the center of this shift is a reappreciation of ontology as “the center of knowledges and social practices” (p. 5). Ontology, previously thought to refer to “static, fixed...universal principles or ideals, indifferent to history, particularity, or change,” is reconceived to refer to a material world that is always in becoming through the ongoing interplay of “history, biology, culture, sexuality”; ontology is “what is fundamentally at stake in such struggles” (p. 5).

Grosz (2005) states that her essays are “experiments in practical philosophy, philosophy harnessed to explore various social, cultural, and epistemological practices...from the point of view of their dynamic direction forward” (p. 1). Her thought experiments in Darwinian theory offer several opportunities to g/t researchers and policy-makers in education. First, she articulates a way of thinking about differences that both matter and evolve in relationship, over time. This is something other than the quest to identify differences that continue a line of oppositional hierarchy building that can only be predictive as long as the objects so differentiated remain as they were, indefinitely and predictably. In Grosz’s view, feminist theory must recognize its own limits as an explanatory
force and be willing to transform as circumstances, subjects, and objects change. The same might be said for g/t research, which seems bent on strengthening its ties to a dated feminism and to a modernist epistemology that runs counter to the underlying ethical narrative of g/t research.

Grosz (1995) specifically argues that Darwin’s theory “provides a striking response to various theories of oppression” (p. 28). Life proceeds as an interplay of “struggle and development” that forecasts “a more ‘postmodern’ concept of emergence” rather than the model of oppression relied on in liberalism (p. 29). Similarly, the dominant g/t story, in the ways it supports market-driven agendas, reveals how political agendas tend to be hidden behind a wall of modern science’s ideologies and epistemologies. Ultimately, the value of Grosz’s work for thinking about g/t lies in the way she articulates an ethics of theorizing. She finds in Darwinian evolution much to think about in terms of bringing to the foreground the value of ontology, rethinking the nature-culture opposition, and examining power as an outcome of both top down and bottom up relations. Her idea that feminist theory must evolve in relation to shifting realities seems to me to be an argument for a new approach to theorizing. This is an ethic of thinking relationally where theory itself must be responsive and emergent. This ethic is sensitive to temporality and differences that are both ontological yet intertwined and always dynamic. This theorizing builds from a practice of ambiguity and it rejects pre-determined thinking.

Driven by similar concerns, Dewey suggested a flaw within an epistemologically construed “dogma of the superior reality of ‘causes’” (Hickman & Alexander, 1998, p. 136). He argued that the central “fallacy converts consequences of interaction of events
into causes of the occurrence of these consequences...‘Matter,’ or the physical, is a
class of events when they occur at a certain level of interaction” (p. 139). These efforts
at articulating nature-culture and the interactive nature of events endeavor to
accommodate dynamism as more significant than is a focus on cause-effect relationships.
The thinking is that dynamism better conceptualizes relationships that are inherently
always in flux and in relationship.

These ideas seems useful for thinking about the g/t relationship, which to date has
largely been conceptualized through an ethic of care articulated through Gilligan (and
Freudian psychology) that in turn relies on liberal humanist values that place human
culture at the center of the world. Liberal feminism’s ethic of care aims to give women an
equal status to men in this human centered conception where human culture is a triumph
over nature. New materialist inspired feminist technoscience argues a different kind of
ethic where nature and culture and the human and non-human are intimately
interdependent. As Barad (2007) suggests, reconnecting nature and culture necessitates
rethinking our conception of causality. I do not have a definitive answer here, but rather,
propose that a productive next question would involve connecting posthumanist, new
materialist, and feminist technoscience and examining what such a connection offers for
thinking about g/t and STEM pedagogy and research. How might these ideas help in
thinking about not only STEM curricula and individual student and teacher literacies, but
also make central the ethical dimensions where technology, humans, and education
increasingly intersect?
4. Intersectional thinking. The emerging ethic of care also rethinks assumptions about the Cartesian split between mind and body, reason and affect. One example of this thinking is Connolly’s *Neuropolitics* (2002) wherein he builds on Damasio’s work to argue a political perspective that ontologically recognizes a body-brain and affective-reasoning network that is central in thinking about culture wholly interconnected with nature. Nature, in Connolly’s view, can no longer be viewed as separate from culture. Also useful in making this shift is James’s (1997) work that suggests that modern science has misconstrued Descartes such that our twentieth century mind-body dualism is our own construal. Her argument is that in the 17th century the passions were more integral than we have presumed and that revisiting this period will help us in better understanding the role of the passions and recognizing the centrality of the body and emotions where previously the mind was thought to rule.

Intersectionality and diffraction are a means of bridging these polarizing oppositions in search of better conceptions and ways of knowing. As an example of what is at stake, James’s (1997) work on the passions aims to bridge the gulf between psychology and philosophy and argues that grasping the significance of the passions in the seventeenth century brings the body and its affective states back to philosophy, healing the modern intellectual rift between mind and body.

More specifically, for the purposes of thinking about g/t, passion is another concept overused and underdefined in g/t research. It is used to explain gendered engagements with computers through oppositions of utilitarian versus playful dispositions to the computer as either tools (girls and women) or toys (boys and men). Grounding these
oppositions are the psychological constructs enabled by the modern insistence on
separating mind and body, reason and affect, enabled by reductivist epistemologies. The
g/t story has used passion to explain both an instrumental orientation to technology and to
posit women’s ethic of care not blinded by this passionate connection to the computer.
The g/t story is often framed around ideas about passion and reason but neither have been
particularly well explicated. James (1997) offers an analytic that suggests these are
connected in ways not evident in the g/t story. As she states:

The seventeenth century continues to be portrayed as the dawn of modernity, the
cradle of a culture in which man becomes set over against nature and nature takes
on a purely instrumental significance, and in which a range of emotional responses
to the natural world give way to dispassionate calculations of utility. (p. 17)

What she argues is that emotions (the passions) are contained through a cultural impetus
for utilitarian arrangements. I see here a potentially useful thread of inquiry that would
support the development of more sophisticated conceptions regarding how the passions,
instrumentality, and suppositions about m-f natures are utilized in thinking about the g/t
relationship or STEM education.

I highlight this because the mind-body separation, in many ways, forms the
conceptual basis of the g/t story. Mind is reason, logic, and abstract thinking and is most
often associated to the masculine; its oppositions—passion, intuition, and concreteness—are
given over to the body and women. This binary is quite strong yet its application within the
g/t story is conceptually thin and because of this, a concept of passion too easily “travels” as
an attribute given to men or women, depending on the hypothesis being promoted. For
example, throughout the story, men’s connection to the computer is described as
passionate, and yet women are articulated as the more emotional and engaged gender. The
conceptual gap is in explicating the connections (or lack thereof) between mind-body and passion-emotion (or affect).\textsuperscript{109} James (1997) troubles the assumed veracity of this binary in two ways that are particularly relevant to thinking about gender and technology. First, she argues that feminism has too easily criticized Cartesian-inspired philosophy as a patriarchal structure that “served to attach women more firmly to the physical world, and a comparable split between reason and passion condemned them to the realm of affect” (p. 18). In her estimation, this assumption has become a limitation for feminism, arguing that long-held beliefs about Cartesian philosophy are ripe for reexamination. At stake is an opportunity to realign the mind and body relationship to better serve feminism and to support an ethical realignment by bringing together philosophy and psychology where the emotions become more central to philosophy. To be gained is a better understanding of “moral motivation and growth, the springs of action (rational and otherwise), and the nature of reasoning” (p. 22).

5. Dynamism & a political nomadic knowing. Feminist technoscience scholars are revisiting Darwin’s theory of evolution as a theory of dynamism and intersectionality most useful in helping to articulate the ontological questions and relationships thought to be at stake. Building from Darwin, Grosz (2005) suggests that nature and culture are inseparable and that both evolve, as must feminism, technology, or politics, through “continuous revision and revitalization” (2005, p. 28). As she thinks about Darwinian evolution and

\textsuperscript{109} Also quite relevant to this discussion, although I do not have space to go down this path, is the recent scholarship on affect theory, e.g. Massumi, B. (2002). The autonomy of affect Parables for the virtual: Movement, affect, sensation. Durham, NC: Duke University Press; and Connolly, W. E. (2002). Neuropolitics: Thinking, culture, speed. Minneapolis and London: University of Minnesota Press.
articulates its usefulness for feminism and for “explain[ing]...languages, technology and cultural practices” (p. 26), it is an “ingenious temporal machine for the production of the new” (p. 25). Gross’s insight that time itself is not a unity but contains the past (as virtual memory), the real (present), and an unknowable future seems to me to be a significant opportunity for thinking about the intersection of g/t research and STEM pedagogy as serving ethical commitments of significance to both culture and nature, humans and non-humans. The thread of g/t research and policy that suggests women’s ethic of care will change technology seems to be struggling for an appropriate conceptual language. At the least, there is evidence of a growing discontent with the status quo of current g/t research.

Colebrook argues (2009) that our contemporary, humanist “ethic of care” just repeats a long-standing human cultural dominance and patriarchy. Her concern is the environment in particular, but this same ethic of care pervades the g/t story. Drawing on a post Damasio conception of life, conceived around notions of dynamism, creativity, and “life always in meaning,” she suggests that man is no longer best conceived as a calculating animal but as a dynamic organism of nature as much as of culture. The logic of humanism and anthropomorphism is, in Colebrook’s (2009) estimation, ultimately fatal. The self-preservation motivations of humanism are ultimately a path to eventual self-extinction because they are so exclusively focused on human survival. (This idea resonates with Heidegger’s explication of our modern relation to technology as an imperative to control nature.) Colebrook, building on Braidotti’s seminal work, makes a case for a nomadic posthumanism-feminism better situated to allow thinking in terms of interconnections that fracture the comfort zone of human centered, knowable boundaries. She posits a new
notion of vitalism able to extend beyond the centrality of Western man, of oppositions of male-female, and of the human-non-human. Moreover, she suggests that as high philosophy increasingly turns to cognitive science, referring to Heidegger becomes a necessary, even oppositional, practice. On the one hand, biology becomes increasingly significant, but the nature and significance of biological difference itself is being reconceived.

Concurring with Colebrook, Braidotti suggests that new materialist feminism shifts the location of otherness from axes of difference and from the limitations of m-f oppositions.\textsuperscript{110} In a posthumanist conception, liberal sex and gender oppositions are no longer useful. Instead, the focus shifts to acknowledging transversal connections between multiple kinds of subjects and subjectivities. This is the terrain broached by Barad’s (2007) agential realism as she too, offers an argument against the limitations of a liberal humanist conception of agency. For Barad, agency is not something one has or can deny, but instead manifests as a relational ontology where interactions are never determining, but instead, outcomes of entangled doing and affecting. At stake, in her estimation, is how to rethink an ethic of causality to better accommodate the interactive nature of actions, community, relationships, and disparate actors. She wants a re-envisioning of causality and temporality, where time is not universally given but resynchronized through various practices: the future is not what will unfold and there is no inherent determinism between past, present, and future. There can be no undoing of the past but instead, productive reconfigurations that

\textsuperscript{110} Braidotti’s response is to Colebrook’s keynote address at the 7th European Feminist Research Conference: Gendered Cultures at the Crossroads of Imagination, Knowledge and Politics, (2009), Utrecht.
bring to the foreground the centrality of an ethics that is about mattering and that responds to the other in a responsible way. Barad’s voice contributes to feminist interventions that are interweaving ethics-scholarship-science; hers is an ethical-ontological-realist holism that carves a path around dualisms and the limitations of critique, as it has heretofore been practiced.  

New Thinking for a New Techno-Ethics in STEM Education

If humanism, representationalism, scientism, binarism, and constructivism are the limiting ideologies to be transcended, what does this mean for education’s g/t story, pedagogies, research, and policy-making? To consider some possibilities, I return to Haraway. Braidotti (2006) develops Haraway’s thesis that situated knowing facilitates a greater objectivity than does normal science. In contrast to Enlightenment epistemologies of disembodiment, post-humanism describes an embodied, engaged, and situated stance in knowledge building and being-in-the-world—fully interconnected across nature and culture. The shift is from reductions to thinking in terms of process, time, contexts, and connections. Braidotti explains this as follows:

Philosophical post-humanism does not...result in anti-foundationalism. It rather stresses the need for process ontology. Thinking is a nomadic activity, which takes place in the transitions between potentially contradictory positions. It is not topologically bound, especially in the age of the global economy and telematic networks, but this does not make it ungrounded, like a view from nowhere. To be in process or transition does not place the thinking subject outside history or time: postmodernity as a specific moment of our historicity is a major location that needs to be accounted for. A location is an embedded and embodied memory: it is a set

111 This references Barad’s teleconferenced interview format keynote at the 7th European Feminist Research Conference.
of counter memories, which are activated by the resisting thinker against the grain of the dominant representations of subjectivity. A location is a materialist temporal and spatial site of co-production of the subject, and thus anything but an instance of relativism. The politics of location, or situated knowledges, rests on process ontology to posit the primacy of relations over substances. (2006, pp. 4-5)

At the center of new materialist and posthumanist feminism is a renewed valuation of ontology that resituates the body, nature, perception, knowledge-science, and dynamism as essential conditions and ways of knowing or affecting the world.

European g/t scholarship appears more advanced in this area than it is in the US. For example, Corneliusen’s thought experiment asked “what...can [we] learn from focusing on change, and exploring what seems to be a gap between the theoretical and empirical level of gender research” (abstract). Her move to highlight change reflects a major shift from what has been promoted in the two broad-based reviews of the g/t literature I examine in this dissertation (Cohoon & Aspray, 2006a; Singh, et al., 2007) or in the NSFs funding agendas, all heavily concerned, ultimately, with a search for explanations of relationships that emphasize a causal interplay dependent on the old ways of thinking through reductions and oppositions.

Thinking about the world in ontological and non-dichotomous, non-essentializing, and non-determinist terms also requires a new conception of causal relations that might better be framed as an intersectional ethics conceived of intentions, thinking, and consequences. My remaining questions consider the significance of shifting the ethical
locus from one that is primarily human centered to one that benefits a multi-actored world and how this might help g/t researchers and STEM educators.\footnote{112}{Also pertinent is Bruno Latour’s actor-network theory, which I have not elaborated on, but which also has much to offer for future thinking.}

**Significance of This Thesis for Education**

In order to better address the challenges of a postmodern and posthumanist era and the ethico-political-conceptual concerns and dilemmas that drive g/t and STEM research agendas, g/t and STEM research and education need to be reconceived. If, as I have argued, the meta g/t story is an expression of our attempts to mediate a set of socio-techno anxieties bound to a liberal humanism that itself is wanting, how might feminist technoscience, new materialisms, or posthumanist intersectionality and related methodologies better engage or develop this new ethic of connectivity and dynamism? What does posthumanist, new materialist feminist technoscience have to do with education?

**What’s at Stake in Re-imagining Through a Posthumanist Lens?**

The problems that the g/t story tries to mediate are something greater than girls and women’s underrepresentation in computing or an overly masculinized computer culture. Hence, there is ultimately, or alternatively, something more at stake in articulating the g/t relationship as an ethical mediation trying to intervene in a pervasive dissatisfaction with the instrumental turn of society or a no longer sufficient liberal humanism. What is at stake is a an opportunity for g/t researchers, policy makers, as well as feminist
technoscience, new materialist, and posthumanist scholars to think across fields and practices to engage in conversations bent on articulating a set of dispositions relevant and necessary to a posthumanist understanding and ethics of technoscience and techno-ethical literacy. In this intersectional thinking, STEM education, and technology orientations more broadly, will engage more with feminist technoscience studies. Similarly, technoscience scholars would become more engaged with the issues, policies, and pedagogies relevant to K-16 education.

Posthumanist, new materialist, and feminist technoscience studies articulate a practical philosophy of technology that is of great significance for how we think about STEM education and offer some key opportunities for rethinking some core beliefs and pedagogies. In this new model, the point of STEM education becomes not merely about fostering traditional STEM competencies (e.g. calculating, programming, the scientific method, or the acquisition of scientific knowledge), it becomes more fundamentally about preparing critically reflexive learners able to think in ethical—rather than merely technocratic—terms.

To date, STEM education and research has over-emphasized skills. In the US this has meant a proliferation of programs designed to (a) get more students interested in STEM fields, (b) to push the teaching of STEM competencies to the foreground of educational policy agendas, and (c) build an evaluation and assessment culture that measures the success of the first two programs. The ways in which this is thought about are somewhat varied, ranging from using computer games to make learning and schooling
more fun or emphasizing the practical applications of technology to better appeal to students’ social-utility concerns or interests.

The significant question that is not sufficiently addressed in current STEM policies and pedagogies is how to better engage and prepare students and citizens for the challenges of a “posthumanist” future. Moreover, feminist, posthumanist, and new materialist scholars do not, by and large, concern themselves with K-16 pedagogies or policies. However, the feminist stake in technology is also a broader social stake that should include education as the site wherein crucial dispositions are shaped and fed. The significant question is how, specifically, technology, education, and feminism might better intersect as we evolve into the 21st century?

In order for these intersections to happen, some key ideas, assumptions, and orientations need to be opened up. Specifically in need of reconceptualization or repositioning are the following: (a) conceptions of “the subject” and subjectivities; (b) objectivity; and (c) the networked interconnections between multiple kinds and locations of actors and relationships conceived as other than oppositional (e.g. humans and technology, mind and body, male and female). Also, (d) how to better transcend the learned impetus towards oppositions, negativity, or being consumed (instrumentalized) as the other (Braidotti, 2006, p. 15); and (e) how to locate technology research and education within an ethic of care that serves the interests of both nature and culture. Addressing these will necessitate a reconsideration of the connections between tradition (which some frame as nostalgia or a continuation of old hegemonies), progress, and disciplines.
There is moreover, an ethics at the center of the mainstream story’s relegating much of this “humanizing” element to the feminine dimension. One concern has focused on the way in which a utilitarian ethic supposedly separates women from creative engagement with technology. Can women be part of a technological story that imagines new futures and potentialities rather than simply as signifiers or keepers of values that a male culture of technology is thought to trample? These are significant problems that in numerous ways, the g/t story attempts to navigate. However, it has been unable to consider these ideas in more than a superficial fashion. In the meta g/t story, women, technology, and theory have been reduced and ossified and continue to serve a modernist, liberal humanism that itself is insufficient in the face of rapid technological, cultural, and natural change.

Addressing these significant challenges requires that education (in its pedagogies, research, and policy-making) address the underlying concerns and incommensurabilities in the g/t story because these are not so evident as dominant research questions and funding agendas have led us to believe. To date, the drive in g/t research has been producing a better descriptive and authoritative theory of g/t that might ultimately both explain and rework the gender gap in computing. The argument has been that more scientific and objective methods are the means to a better theory. My thesis has argued in part a flawed notion of objectivity built around methods, but more significantly, a limited and limiting notion of theorizing.

Although theory and theorizing are a significant concern and thus, opportunity, this problem extends to the ways in which research questions are conceived and,
subsequently, pursued. This thesis argues that some of the core questions of g/t research and policy need to be rethought. Current problem or question formulations have limited the transformative potential of g/t research and run the danger of being either disingenuous about the effect of bringing more women into technology or conversely, of underestimating the potential impact. The significant work to be done is a clearer sorting of problems, concerns, and what is at stake. For example, the tendency has been to blur concerns about re-engineering women’s interests to address market needs, promoting democratic aims of social transformation, and articulating an ethic of care that will mediate technological progress. We need to better articulate how and why values-ethics are “assigned” and mediated in and through subjects and objects and what this means for STEM education and g/t research and policy.

Another contribution of this thesis is methodological. Representational and reductivist epistemologies present a significant obstacle in moving towards a new ethic of dynamic relationality. This thesis illustrates how an intersectional methodology makes it possible begin to unravel difficult or black-boxed problems. It suggests the value in (a) rethinking ideas about causality, dynamism, and ontology—even as these are not normally part of STEM conversations and research; (b) expanding how subjectivity and objectivity are thought about and in turn, suggesting reasons to extend borders of knowledge, knowing, knowers in search of an “ethic of care” that itself is intersectional; (c) insisting on greater sensitivity when promoting programs bent on generalizability and scalability that at the same time must accommodate local needs and interests and (d) expanding how theory,
objectivity, and causality are not only conceived and pursued, but why they are deemed so valuable.

**Ongoing Challenges**

Despite potential opportunities, substantial challenges remain and are made more visible as posthumanist, feminist technoscience perspectives problematize a number of longstanding and comfortable beliefs and practices. Some of these are a persistent scientism-empiricism and the ways democratic or ecological concerns transparently overlap with neoliberal politics and economics. For example, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* (National Research Council, 2007) is an example of how science dominates the conversation. In addition, I suggest we might be more concerned about the conservative nature of national research funding agendas, where funding largely goes to safe bets likely to produce results, rather than to risky yet potentially more transformative projects.

Educational research is usually faulted for a perceived lack of rigor or ‘quality,’ which is something different than I mean here (see *Scientific Research in Education* (National Research Council, 2002)) for this type of discussion). In educational research, these methodological and epistemological concerns have taken precedence over vision and risk-taking. As an example of the problem I am trying to articulate, the June 27, 2009 issue of the *NY Times* (Kolata) featured the article “Grant System Leads Cancer Researchers to Play It Safe.” The author argues that cancer research is not providing any significant leaps
forward towards cures or prevention because national research funding agencies have been taking it too safe by funding projects that are generating results of little consequence because they were viewed as more certain to produce findings of something even if of little consequence. Risk avoidance has thus steered funding away from higher risk projects that, if successful, could be more transformational.

Another way vision gets constrained is by closing the gates to other kinds of theories and conceptions. For example, in physics, Amy Bug (2003) notes the resistance within physics to consider influences from feminist theory on physics (that is, for anything other than considering alternative pedagogical strategies to accommodate “others” - those not white and male). The significant challenge is how to bridge the gap between educational research centered around psychology, technology and cognitive science to also include studies of technology from the perspectives of feminist, cultural, sociological, political, and philosophical thought. While methodological rigor is not to be dismissed, it must not be pursued without due consideration of the values and goals framing research agendas or without deeper reflections on what objective rigor entails. Educational research without vision or a politics-ethics seems to portray research as a view from nowhere, which to paraphrase Haraway, is not really possible.

The last challenge that I want to briefly mention is that of moving from an educational culture-politics built around instrumentality and assessment to one more open to imagination. That is to suggest that the overarching federal emphasis on standards and testing is a large barrier to overcome.
Conclusion

The overlooked question of prime significance is why we care so much about women’s representation in computing. A similar drive for research or programs addressing women’s underrepresentation is not considered nearly as pressing in a multitude of other professions where women have actively been clamoring for greater opportunities.\textsuperscript{113} My thesis argues that the focus on equity, representation, or economics masks the ways in which the g/t story represents a struggle for a new ethics. This new ethics itself is intersectional in the ways it recognizes a broader conception of agents and subjects as co-participants in shaping the world. Two significant themes emerge as potentially significant for STEM education. One is the re-emergence of ontology that suggests, for example, that how we conceptualize human and non-human agents should carry at least as much weight as the epistemologies relied on to study them. The insufficiency of dichotomous and essentializing conceptions is the other significant theme, and one not readily addressable if epistemologies themselves are not revisited. That is, the new ethic understands nature and culture as two parts of a whole yet the language of STEM education is currently not equipped to think in this way.

Generally, STEM education pedagogies and policies depend on a way of thinking that served a modernist epistemology and ethic when humanity was viewed at the center of the world, ready and able to dominate nature. This ethic, in many ways, has not served humans or the world particularly well. The significant opportunity and challenge is finding

\textsuperscript{113} One need only look to women’s representation numbers in the US Senate, the Supreme Court, with the rank of full professor in higher education, or in the arts, across a wide spectrum of occupations.
a way to connect this posthumanist ethic, with its regard for ontology and connection, with pedagogical strategies that have tended to focus on instrumental competencies, individual achievement, and assessments. Exactly how to do this is beyond the reach of this dissertation, but beginning to think, research, and assess through alternative epistemologies will help in moving away from the problems of the standard reductivist and recursive epistemology. This suggests that a new ethic requires a greater cross-disciplinarity in both research and pedagogy. Similarly, given the increasing perception that education is the necessary prerequisite for both an economically and socially productive life, education (e.g. colleges of education and national policy regarding STEM pedagogy) needs to think about technology more expansively than merely how or what people can learn through technology tools and environments.

I have tried to show that in many significant ways, gender and women are at the center of technology, rather than at the margins, as is most often portrayed in the g/t story. Dominant concepts and techniques used to characterize and separate women and technology have become tools for managing a number of competing anxieties and desires regarding technology in all its multi-faceted aspects. This thesis serves as an argument to begin to conceive of the g/t story and relationship as not so much as something to “fix” by dwelling on inequities and power struggles, but rather, as story that reflects or expands through the social imagination and in how we construe the intersection between science-philosophy and nature-culture.

My intention has also been to highlight a core dilemma, wherein the process and the mindset necessary to explicate, appreciate, and teach or research from within our
background social imaginaries or enframings requires, on the one hand, critically examining transparent practices and ideologies while also living and thinking within these same paradigms. This is the problem of enframing. Transparent ideologies are only a barrier to the extent that we reject intersectional thinking, complexity, and ambiguity to instead settle for what we already know and expect. In many ways, the social imaginary and our enframings present a similar challenge to the one Heidegger unfolded in “The Question Concerning Technology” (1977): How open are we to becoming a society that embraces reflexivity, ambiguity, and diffractive thinking? Are we open to seeing the value, and perhaps inevitability, of ambiguities and multiplicities inherent in understanding the complex interactions that infuse social life and its study, particularly as these intersect in educational research?

Education and educational research and policy need not so much a better, generalizable and replicable theory of gender and technology, but an expanded way of thinking in intersectional ways. This new thinking would draw from social, philosophical, and scientific theories, recognizing that these evolve in response to the dynamic interplay of nature-culture, science-politics, mind-body, as these intersect with education and our drive for progress—whether focused on democratic ideals of equity through learning, improving the quality of human life, or respecting and supporting our environment. Significantly, this suggests an opportunity for education to become more central rather than reactive in this techno-social and nature-culture dynamism.

STEM education is about building a range of competencies that are both instrumental (skills or knowledge focused) and ethical. The g/t story seemingly locates the
latter within women, based on some old ideas. Moreover, a tendency to think in oppositions mirrors an epistemology that is insufficient for thinking about the shifting natures of women, men, technologies, politics, culture, nature, and education. My argument has been for more ambiguity, intersectionality, and complexity in search of greater objectivity and a stronger and more relevant ethics that serves a dynamic nature-culture relationship and that does not deny the deep intersections across humans, technology, and non-humans. This brings me back to Calvino’s Marco Polo (1972, 1974), to suggest that dominant, reductivist lenses of the g/t story describe and explain girls, women, and men in ways “too probable to be real.”

“I have also thought of a model city from which I deduce all the others,” Marco answered. “It is a city made only of exceptions, exclusions, incongruities, contradictions. If such a city is the most improbable, by reducing the number of abnormal elements, we increase the probability that the city really exists. So I have only to subtract exceptions from my model, and in whatever direction I proceed, I will arrive at one of the cities which, always as an exception, exist. But I cannot force my operation beyond a certain limit: I would achieve cities too probable to be real.” (p. 69; italics in original)

While there is reason to be optimistic about the future of g/t, there remains the problem of a particularly far-reaching techno-rationality that infuses so much of contemporary life, especially as economic and the political agendas persist in efforts to produce workers to sustain states rather than benefiting citizens and their environments or neighbors. This disposition also infuses much of education and policy agendas. The significant obstacle of g/t story making is a tendency to want clearly defined variables, explanations, and outcomes of research studies (producing widely generalizable theory), even as we accept a fuzzy delineation of the core concepts and problems. The intersections between women, men, expertise, society, nature, and so on are quite complex. In essence,
the reasons why we care about women’s intersections with technology are not merely more ambiguous than it has seemed, but the reasons and the questions that have been put forth largely divert our attention from the real issues at stake. Posthumanist, new materialist, and feminist technoscience argue for a new kind of thinking as a new ethical disposition to the world. A willingness to re-imagine some of the longstanding beliefs and epistemologies that have driven g/t research and STEM thinking is a first step in moving towards this new ethic. The questions driving this new ethic are existential, and far less so, epistemological.
Facet 11

What Ought To Be Done?

The temptation is to expect (or demand) a concrete solution to the g/t problem—e.g., to define just what the NSF should do or how it should change. My first inclination was to comply, and I started to flesh out that premise. Upon further reflection however, I do not believe this is the essence of the “problem” or where my thesis leads. Yes, the NSF might think more expansively about gender, technology, and how to teach and promote STEM, but given the mission of the NSF, they are probably relatively on track.\textsuperscript{114} It would be so much easier to say that if the NSF did x, y, and z things would turn around. This is what the dominant g/t story has already argued, in essence, yet women’s under-representation continues and political concerns escalate.

Thinking about the gender-technology relationship in terms of ethics necessitates a different approach than does framing the problem in political or scientific terms. Thinking politically foregrounds concerns over a hegemonic computing culture, oppressive or gendered pedagogies, (in)equity, and so on. The quest for scientific answers to these political or educational problems put the hope in “better research methods” that would better locate appropriate educational or political interventions. These are not

\textsuperscript{114} This NSF mission is “to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense...” and “NSF's goals–discovery, learning, research infrastructure and stewardship–provide an integrated strategy to advance the frontiers of knowledge, cultivate a world-class, broadly inclusive science and engineering workforce and expand the scientific literacy of all citizens, build the nation's research capability through investments in advanced instrumentation and facilities, and support excellence in science and engineering research and education through a capable and responsive organization. We like to say that NSF is 'where discoveries begin.'” (http://nsf.gov/about/glance.jsp; para. 1 & 3)
inconsequential tasks. However, they have diverted attention from ethical concerns that are no less significant. These necessitate that we think differently about the significance we attach to the g/t relationship. Thinking in ethical terms, it becomes clearer that what we desire is a better set of ideas for thinking about how we are in the world—especially in our relationship with technoscience—that goes beyond an equal representation of genders in computing. It elevates existential thinking that is values driven and brings these values into the circle of STEM practices and pedagogies.

Questions of “what’s to be done” to fix underrepresentation have, to date, focused on better taught and more equitably distributed STEM skills and opportunities and a more welcoming computing or STEM culture. Re-defining the problem of gender representation as a quest for a new ethical relationship to STEM fields is an opportunity to critically expand how we think about technology, STEM pedagogy, and the STEM and research imaginaries that have served and produced our modern epistemologies and techno-rational thinking. These imaginaries and our techno-rational enframing have made the desired new ethic elusive and enormously difficult to conceptualize or access. Without dismissing problems of STEM competency, what we ought to do is expand the notion of what constitutes competency and value. That is, if the new desired ethic decenters the human, thinks in terms of dynamism and ambiguity, and does not conceive of workers, researchers, nature, technology, or knowledge merely as political-economic tools but rather, as nodes in a complex system of mattering, what does this mean for STEM pedagogy and policy or for women and technology? What kinds of cultural “noise” distracts us from this essential question?
It is hard to miss the cacophony of voices concerned with the small number of women in computing. For example, I have followed the ACM TechNews listserve for many months and my informal observation is that, at a minimum, every couple of weeks there is a link to a new article or research finding focused on the lack of women in computing.\textsuperscript{115} In a November 2008 New York Times article (Stross), Justine Cassell cautioned against viewing women’s growing representation in applied computing fields (e.g. web design or computer animation) as progress of any real significance. She dismisses this reality when she states, “it’s not much of a victory, however. The pay is considerably less than in software engineering and the work has less influence on how computers are used.” Looking at her research profile on her Northwestern website it is clear that she is an exemplar of how social values can be integrated with a technical research agenda.\textsuperscript{116} Nonetheless, for her, technoscience seems to be the center, which suggests why she considers more applied fields as too far outside this center and lesser in the hierarchy of significance. Cassell’s thinking reflects how the g/t problem continues to be argued in political and scientific terms even when ethical concerns or social values are the motivations for pursuing technoscience.

The case could be made that concerns about women’s underrepresentation in computing are often disingenuous or convenient distractions. A recent issue of the New York Times (Dargis, 2009) carried an article discussing the fact that although women fill

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\textsuperscript{116} “to develop technologies that evoke from humans the most human and humane of our capabilities, and to study their effects on our evolving world” http://www.soc.northwestern.edu/justine/
movie seats and portray many of the characters that captivate audiences, women are rarely
directors of these films. This gender gap in Hollywood film directors was evident as far
back as the 1920s and persists relatively unabated. The disparity I want to highlight is that
there is no national policy agenda or funding agency charged with rectifying this
underrepresentation of women film directors. I am not going to dwell here on the multiple
fields that now count a higher percentage of women in graduate programs (all fields except
for engineering, the physical sciences, and business (Bell, 2009)) that have not translated to
higher representations of women in these professions, at least in the highest levels. These
kinds of comparisons raise numerous questions and challenges but the one I want to
highlight, specifically, is that there is both a quantitative and qualitative difference in the
meaning and significance attributed to the gender gap in computing than there is to
gender disparities in these other fields.

The hidden problem is a misconstrued and overly simplified theory of gender,
technology, and “ethics” that presumes that equity and representation are the core issues.
The dominant theory of gender and technology has two main suppositions: the equity
problem is central and can be remedied with proper interventions and doing so will, in
turn, fix computing and its culture. Given the degree of institutional complacency
regarding the ongoing underrepresentation of women in other professions, what would
fixing the gender problem in computing actually fix? That is, the gender gap in computing
seems to be more troubling than other gender gaps (e.g. in the number of women judges,
senators, or film directors) and this suggests that the operational theory of gender and
technology represents a strategy of following a path of “least” resistance but high visibility.
Focusing on gender underrepresentation in computing is a way of not dealing with the problems that arise from competing fears and fascinations over the changes computing brings and the responsibilities that we ought to bear, as a society, in either serving or impeding technological progress.

The NSF’s role is to promote science and other STEM fields and to see that research and education are duly supported. It also carries the responsibility to evolve an ethic of science and technology that serves both technoscience and society’s needs. While the success of each might be disputed, the primary emphasis is on the first, and fewer resources are devoted to ethical questions. This does not necessarily place the (full) burden on techno-science or the NSF. The primary ethical burden is on society and the programs and policies we choose to support. (I am not going to get into the difficulty of rational debate in the current political climate except to recognize the enormous challenge.)

Women and gender have transparently become both the site and means of finding and fixing the ethical dimension of technology, yet the assumptions supporting this are both poorly defined and broadly assumed. The ethical gap is not merely a product of women’s underrepresentation in computing and a problem of gendered STEM pedagogy, although education could be the best way to begin to change things. In current policy and thinking, the g/t story mirrors a contemporary social imaginary that is increasingly STEM-centric. Thus, a new ethical relationship to technology is fundamentally connected to how we think about STEM pedagogy more broadly.

The evidence is everywhere. For example, and to be brief, one could look to funding amounts awarded to the NSF and two other agencies, the National Endowment
for the Humanities and the National Endowment for the Arts. Even the two words—foundation and endowment—suggest differences in stature. Foundation refers to a tenet or grounding principle and to a permanently funded organization, where funds are provided for future as well as present needs. An endowment, while still prestigious and funded, infers more that monies are given as a kind of dowry, which does not carry the weight of longevity; it is more of a gift than a grounding principle. A recent essay in Time Magazine (Brinkley, 2009) portrayed the current fascination with STEM—increasingly positioned as the only solution to the country’s flaccid performance in innovation—as akin to thinking with half a mind. Moreover, this partial mind sees a very rose-colored picture of STEM as the solution to a multitude of contemporary woes, from education to maintaining the country’s global domination in innovation. This in turn mirrors an increasingly technocratic social-political ethic, in turn sustaining an imaginary where the humanities, arts, social sciences, and education increasingly must be filtered through this STEM imaginary for their justification.

These arguments are not particularly new. My contribution is in extending them to how we think about a theory of gender and technology, through two convergent ideas. First, our concerns about women’s underrepresentation in technology have become less about equity and more about a desire for women to save us from a dominant technoscience (and to make it seem that as a society we actually care about gender, racial, or class equity). We want to think the problems we have with technology can be attributed

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to a culture of boys devoted to technology who pursue technological innovation just because it is fun and challenging, akin to climbing Mount Everest. This belief becomes a convenient way of sidestepping the roles we share in promoting a social imaginary that overly privileges technoscience and where the dominant ethic is not so much masculine hegemony, but technocratic, as Heidegger (1977) and Gadamer (1977) argued years ago.

Is the Problem the Question?

National priorities, evident in NSF funding agendas, presume a primary question: “Why are girls and women (or other groups) underrepresented in computing and what factors will allow us to change these numbers?” This research question, in turn, has depended on inappropriate and narrowly conceived concepts of gender, women, technology, and research, to name the most salient and recurrent. Similarly, educational researchers rely heavily on a highly problematic liberal feminist “ethic of care” that has shaped the tenor of the gender and technology question. If researchers, policy makers, educators, and women were to become more critical and reflexive about how girls and women (along with race and class, etc) are conceptualized or used, the primary research questions would shift. Moreover, if women were more assertive in pushing not only for “equity” but also for the right to a place as creative and visionary beings in our increasingly technological world, the arguments and stakes might also change. That is, the question or problem of gender and technology, as it is has been framed, is a mirror to the stakes we attach to the problem. If the problem is however, not so much equity but a desire for a new ethics, should the research questions also change? Moreover, is it not reasonable to argue
that a theory of gender and technology ought to be sufficiently dynamic to reflect the changing nature of technology, women’s roles, globalizing relationships, and our growing ethical awareness of the ramifications of these relationships?

Thinking for Change

Agendas and thinking in national STEM policy. If we are serious about change, organizations and agencies that play a role in setting policy in the STEM fields, such as the NSF, could lead the way by supporting research aimed at identifying new or alternative foundational research questions. Specifically, funding policy might shift to become more open to research questions that examine existing assumptions made about the nature and significance of the gender gap and to critical lenses that provide additional ways of thinking about constructs and problems associated with gender or STEM. Current funding policies tend to pre-define primary research questions without also creating space for examining underlying beliefs that make it seem that the primary research questions are what we need to know. For example, if there were more institutional support for alternative lenses on foundational ideas—e.g. in what ways is it useful to intersect technology, gender, innovation, and ethics—the theories grounding gender-technology research could also develop in more responsive ways. Instead, there tends to be a theoretical complacency in STEM research that functions, in practice, as a kind of theoretical illiteracy. This is one area where cross-disciplinarity has much to contribute towards the conceptualization of concepts. Specifically, critical conversations between intellectual cultures—STEM and philosophy, political theory, feminist, or cultural studies, for example—offer a way of
building a more comprehensive and sustainable techno-cultural literacies and theories, where theory is something to think with rather than a tool for prediction, and literacy includes becoming conversant with these ideas.

**Do we know what we want from education?** We have become so steeped in an instrumental way of being that we now assume STEM curricula should normally and always be about tool literacies, access, and careers and that STEM success is the means for curing a host of ills. Ideas advocating a more critical or reflexive STEM curricula are not themselves all that new, but they seem to have been cast aside in recent years, following the humanities into the pile of disregarded pursuits. Thus, a re-invigoration and updating of STS and philosophical or critical perspectives, as an integral element of STEM education and research or policymaking, could foster a more civic, ethical, and reflexive technological literacy.\(^{118}\) However, this too is not a new idea, but it butts up against another contemporary imaginary and rose-colored optimism wherein computers and ICTs will fundamentally change education.\(^{119}\) A less instrumental STEM curriculum, focused not merely on tool literacies and technical careers, but one that recognizes in a fundamental way, technology as our way of being in and relating to the world and to each other has some merit. If this case has already been made—and it has, by many—why is change so

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\(^{118}\) I merely introduce this idea here; it will be expanded in a separate article by tracing the shifts in STEM thinking within the NSF.

difficult? It has become too easy to want to insert women into STEM instead of balancing the scales of technoscience and the humanities.

Since objectivity has been promoted as the prescription for a better theory of gender and technology, objectivity itself is opened to question. It might be helpful to start to think about objectivity as not merely the means to a true representation of reality. Instead, how we think about objectivity reflects an ethical stance towards the world and towards knowing this world in its diverse and complex relations. The notion of objectivity driving the mainstream theory of gender and technology is tied to a belief in a quantitative or procedural notion of equity. It pursues a flawed idea that either technology or gender can be pinned down. Objectivity itself is not to be dismissed. However, women and society could benefit from a more expansive, dynamic, and reflexive ethical concept and language in search of a more dynamic and responsible objectivity.

This new ethical discourse might make it possible to address the ways in which an overly instrumental view of women and technology functions as a conceptual limitation to transformation and the project of developing a literate, capable, or creative citizenry or workforce. On a policy level, this suggests that greater openness to fundamental ambiguities could better meet an ever-shifting ground. Thus, a respect for uncertainty and for the dynamic quality of social life is essential to the quest for explanatory theory. Among other things, the new ethic is about a respect for intersections among concepts, subjects, objects, and contexts that cannot depend on a fixed or exclusionary objectivity or problem.

**Do we know what we want from women?** I argued in chapter 9 that both gender and women are used to a culture of anxiety to suggest that this use of women becomes a
way of keeping women outside the center of technology. Expanding the conceptual lens through which we theorize both technology and gender is a way of showing this division to be rather disingenuous. However, and this is the essence of the problem, just as we both fear and desire technological progress, we also both fear and desire a greater participation of women in computing; how this plays out is dependent on who’s asking or doing, and in what context.

It has not escaped my notice that my own “relationship” to technology shifted in unforeseen ways when I moved from the arts to education for my doctoral studies. I experienced firsthand education’s instrumental orientation to technology, in particular, computing. On the one hand, this instrumentality is visibly tied to the increasing technocratization of society and to the learning science’s embrace of the computer as a tool that facilitates learning. I suspect that this instrumentality also has something to do with the fact that education is overrepresented by women, and so the circle goes around.

However, there are two quite different effects. On the one hand, these computing tools do offer valuable new opportunities for facilitating learning. On the other hand, an over instrumentalization often extracts the life out of these same technologies. That is, in writing my way through the mainstream gender-technology story, I came dangerously close to writing myself out of technology. I could become the gendered outsider to technology, if only I better fit the profile of gender as it is used in the gender-technology story. I do not, which I bring up to remind us that the dominant theory of gender and technology is flawed because of an insufficient objectivity tied to a desire for a widely conceived generalizability and scalability. These desires serve an overreaching idea about objectivity
that in reality cannot be separated, even in science, from an ethics of knowing and being.

The resultant knowledge (or theory) derived from this objectivity is not so much a representation of reality, but a mirror to how we understand that reality to function.

Any useful theory of gender and technology must address such existential questions to encompass concerns over the intersection of education, ethics, technoscience, and research or policy. Any “solution” lies in our ongoing, individual, or societal pursuits of questions about the role of technoscience and women in society in both political and ethical dimensions. These are foundational questions, yet the circumstances or answers will likely always be in flux.
References


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