Identity Fragmentation in Post-Secondary Computing Education

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Abstract

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Impending climate crises, profound wealth inequality and unprecedented vulnerability to global catastrophe at the hands of technology make working towards justice a necessity, and a desperate one at that. However, engaging in work towards justice requires deconstructing the dominant narratives and norms that restrict what actions are permissible and what futures are possible. While prior work has challenged dominant societal narratives within computing contexts (e.g. anti-blackness, ableism, sexism, and cis/het-normativity), dominant narratives specific to computing often remain implicit and unaddressed. Theoretically, even if dominant societal narratives are critiqued, students' agency may still be bound up in these dominant disciplinary narratives, preventing critical engagements from occurring.

My work has two objectives: surfacing dominant disciplinary narratives so that they may be critiqued and challenging student-held dominant narratives through pedagogical interventions. In this thesis, I describe work that surfaces dominant disciplinary narratives around students' careers and neurotypes, as well as two interventions: a narrative-based intervention within post-secondary computing contexts, and a co-constructed seminar centering dominant disciplinary narratives within students' disciplinary space. I make three contributions: 1) I explicate normative career practice and the conditions that make career norms self-reinforcing, 2) I describe neurotypic legitimacy in computing spaces and how these expectations contradict neuronormative expectations in society broadly, and 3) I reconceptualize identity work and identity fragmentation in computing, and offer conditions to resolve

this fragmentation.

My dissertation demonstrates the following thesis: Individuals who experience dissonance between computing culture and their identity frequently fragment their disciplinary identity from their positional identity. While this can occur when computing contexts reify societal marginalization, it can also occur through discipline-specific cultural norms that both mirror and contradict societal legitimization. This fragmentation can be resolved independently, but reconciliation can be accelerated and scaffolded through safe and vulnerable spaces that welcome individuals' positional identity. Furthermore, when these communities develop around mutual fragmentation, they can be become intersectional coalitions that encourage students towards activism.

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DEDICATION

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Chapter 1
INTRODUCTION

Human beings are fundamentally storytellers, from collective histories built out of storytelling traditions (Corntassel et al., 2009) to dinner-time rituals of asking "how was your day?" (McLean and Syed, 2019). These stories, or narratives, are contextual, subjective, and flexible (Hammack, 2008; Sarbin, 1986) and shape how we see our experiences within a broad reality, what futures we see as possible, and what capacity we have to create those futures. Taken together, these stories form one's *narrative identity*: a temporal, sequential, and selective retelling of how one came to know one's present self (Singer, 2004; McLean and Syed, 2019).

Narratives are not limited to one's own experience, they can also exist as explicit cultural stories and implicit social frameworks that guide behavior. Building on an extensive body of work in developmental psychology, recent work has sought to surface *master narratives*: shared stories that describe what it means to be a "good" member of society (McLean and Syed, 2015). Master narratives implicitly push identity construction towards dominant norms — unproblematic for those with identities that fit, incongruous for those that do not. Critically, master narratives inherently limit agency by foreclosing on potential life choices, emphasizing individual decisions independent of societal structures, and limiting the breadth of voices that can be heard, even among those who fit (McLean and Syed, 2015). Master narratives are not limited to psychology, work within education and critical race theory detail *dominant narratives* that seek to silence marginalized individuals and uphold systems of structural oppression (Solórzano and Yosso, 2002; Miller et al., 2020).

While dominant narratives[1] are not universally accepted, the lack of cognizance around

[1]I embrace the duplicity of language, but opt for language from fields more adjacent to my own. For

them frequently leads to their perpetuation (McLean and Syed, 2015). For instance, narratives affecting life course and socialization are often generational (McLean et al., 2019; Bourdieu, 1977) and unquestioned dominant narratives tend to become embedded within the fabric of social spaces, calcifying into structures (Nash, 1990; Bourdieu, 2000; Freire et al., 2018). Those who surface and dispute dominant narratives, especially narratives intertwined with structural oppression are often delegitimized and penalized (Bumpus, 2020; Erete et al., 2021a), as challenges to dominant narratives are also challenges to systems of structural power.

However, individuals are not beholden to a lifetime of narrative replication: both one's internal landscape and one's replication of dominant narratives are subject to change. At a personal level, much of social work and developmental psychology emphasizes how one's narratives can change over time (McLean et al., 2019; McLean and Syed, 2015; Rogers et al., 2015; Rogers, 1957). As past experiences and future possibilities are viewed through alternative perspectives, one can begin to re-story histories that may be in conflict, developing one's agency to affect change (Holland, 1998). At a collective level, prior work describes *alternative narratives* (McLean and Syed, 2015) and *counternarratives* (Miller et al., 2020), stories that run counter to established dominant narratives. Counternarratives have been utilized for several decades in social work (Cooper, 1994; Rogers et al., 2015; Rogers, 1957), activism (Fish and Counts, 2020; Ryoo et al., 2020), and education (Miller et al., 2020; Kirdani-Ryan and Ko, 2022; Everson, 2022; Ryoo et al., 2021b), to "name one's own reality" (Ladson-Billings, 1995) and surface the malleability of collective stories (Solórzano and Yosso, 2002). As both collective and personal narratives change, identity can change as well, leading to new stories, new selves, and new understandings of reality.

While prior narrative work primarily engages with narratives on a societal and structural level, collective narratives can also exist within the scope of a discipline. This dissertation is beholden to a School of Computer Science; work within computing has focused on the

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those curious or concerned, terminology from psychology draws from Audre Lorde (Lorde, 2018).

mechanisms by which broader societal narratives take residence within a discipline. Seminal work has surfaced that students frequently bring stereotyped expectations and narratives about computing (Kahle and Schmidt, 2004; Clarke and Teague, 1996) that are frequently reinforced by their communities (Margolis and Fisher, 2002; Margolis, 2008), and rarely corrected by CS curricula (Vesisenaho et al., 2009). Furthermore, computing spaces frequently manifest collective narratives of racism (Benjamin, 2019; Eubanks, 2017; Rankin et al., 2021; Erete et al., 2021a; Margolis, 2008), sexism (Margolis and Fisher, 2002), ableism (Spiel et al., 2020b; Ymous et al., 2020), as well as the intersections between these (Ross et al., 2020; Rankin et al., 2021; Brown et al., 2017), into systemic and epistemic violence within the discipline.

However, while prior work has attended to how collective societal narratives manifest within a discipline, little work engages dominant narratives specific to a discipline. Both are necessary, and the two are frequently intertwined, but dominant disciplinary narratives might create forms of constraint unique to the disciplinary scope. For instance, work has examined the process of "becoming an engineer" (Stevens et al., 2008) and found that as students move through engineering programs they become disengaged with issues of public welfare (Cech, 2014; Cui, 2020), and are encouraged to pursue jobs centering prestige over impact (Chapter 3). It is possible for students to examine these dominant disciplinary narratives, but as prior work emphasizes that these dominant narratives are transmitted as part of students educational experience (Binder et al., 2016; Stevens et al., 2008; Cech, 2014), it is far more likely that newcomers will learn to replicate dominant narratives as a component of their professional practice (perhaps by spreading disinformation (Salam, 2021), incentivizing addiction in teens and children (Journal, 2021), and aggressive automation (Eubanks, 2017), among others (Cadwalladr and Graham-Harrison, 2018; Kaori Gurley, 2020; Wakabayashi et al., 2018; Sainato, 2020b)). Moreover, the invisibility of dominant narratives and a default impetus for their enforcement (McLean and Syed, 2015; Olson, 1995; Bourdieu, 1977) means that dominant narratives are typically replicated without ever becoming explicit — space for questioning is likely to only occur outside a discipline.

To bring about a just world, "we don't need allies, we need everybody" (Benjamin, 2022). While challenging dominant societal narratives allows learners the possibility to engage with justice, their agency may still be bound up within dominant disciplinary narratives, restricting critical engagements from actually occurring. Pedagogical conditions can encourage the rapid adoption of dominant disciplinary narratives (Binder et al., 2016), restricting agency (McLean and Syed, 2015), but addressing dominant disciplinary narratives could have a dual-affect of clarifying and breaking these agentic restrictions offering the potential for learners to authentically engage with justice.

1.1 Dissertation Outline

My goal is to engage postsecondary computing students in justice work, and I present two approaches within this dissertation: surfacing dominant disciplinary narratives, and constructing pedagogical experiences to challenge them.

In Chapter 2, I describe my epistemology through critical interpretivist and critical pedagogy, and review prior work. Utilizing and situating within theories of social learning to surface dominant narratives, I present my framing of identity work, then apply that framing to ethics education and justice-centered computing approaches in computing education

In Chapter 3, I present a qualitative study investigating dominant disciplinary narratives around computing careers in postsecondary education, departmental mechanisms for their reinforcement, and students' experience of these narratives. This work surfaced that students within the context I studied were taught to prioritize work at highly selective prestigious firms, which was reinforced through organizational recruiting footholds, assumptions within careers advising, and curricular objectives. For students, those whose career aspirations were aligned with these norms opted for prestigious work to alleviate future uncertainty and because they perceived prestige as a prerequisite for more fulfilling work. Those who were unaligned experienced crises, only articulating alternative aspirations through considerable work.

In Chapter 4, I present a qualitative study investigating what expressions of neurodi-

vergence are legitimized in computing spaces and how members of these spaces relate their own experiences to legitimized expressions. Through this study, I found that computing spaces legitimized a particular and narrow pocket of non-normative neurodivergence, that individuals outside this pocket masked their expressions to fit these expectations, and that those within this pocket found refuge against broader societal delegitimization.

In Chapter 5, I present a case study integrating pedagogical approaches for identity work into existing computing curricula. I position this as an ethics embedding that centered structural critiques of the computing discipline through counternarratives (Miller et al., 2020), and offer findings around assessing critical understandings, an analysis of student responses to these assessments, and instructor reflections on the intervention.

In Chapter 6, I present a direct investigation of identity work in computing that explored the conditions that foster identity work, connections between computing's dominant narratives and students' personal narratives, and changes that manifested through engaging with identity work. I situated this work within a novel seminar in postsecondary computing and found that individuals who fail to fit dominant narratives in computing fragment their identity to fit within disciplinary norms. Safe, trusting, and vulnerable disciplinary spaces that centered shared fragmentation over students' positionality fostered reconciliation, and though this was often a painful and emotional process, those that engage with it were able to surface additional disciplinary norms and consider activism in their disciplinary space.

Finally, in Chapter 7, I reinterpret the findings of this dissertation within a broader context and contextualize these findings within the broader landscape of computing education. I review the limitations of this dissertation, offer opportunities for future work, and conclude by positioning this work within my vision for a loving and just world.

1.2 Thesis Statement

This thesis demonstrates the following thesis statement:

> Individuals who experience dissonance between computing culture and their iden-

tity frequently fragment their disciplinary identity from their positional identity. While this can occur when computing contexts reify societal marginalization, it can also occur through discipline-specific cultural norms that both mirror and contradict societal legitimization. This fragmentation can be resolved independently, but reconciliation can be accelerated and scaffolded through safe and vulnerable communities that welcome individuals' positional identity. Furthermore, when these communities develop around mutual fragmentation, they can be become intersectional coalitions that encourage students towards activism.

1.3 Contributions

Within this thesis, I make three contributions. First, I explicate normative career practice within a postsecondary computing institution, and demonstrate both self-reinforcing nature of this norm and how this norm causes harm to students. Second, I detail expectations for neurotypic legitimacy in computing, and given that legitimacy contradicts neuronormative expectations within society broadly, demonstrate that legitimacy within computing uniquely refuges some while marginalizing others. Finally, I reconceptualize critical computing efforts as identity work, and contribute a framing of identity fragmentation within computing spaces, conditions that foster resolving this fragmentation, and the effect that this resolution has on students.

1.4 Positionality

As I embarked on this body of work, I held a set of identities that both affected my ability to pursue this work and the standpoint from which I engaged with it. I began identifying as a queer man, and in the plural, flexible, ever-changing nature of identity, came to hold myself as non-binary, autistic and transgender throughout this work. Throughout, I held many privileges: I am white, young, able-bodied, well-credentialed and English-speaking, raised in upper middle-class suburbs within the Northeastern United States, and global north, who always had access to education, healthcare, and financial stability, but nevertheless, I moved

towards a more marginalized positionality as I engaged in this work.

After pivoting from computer architecture to computing education, I sought to pursue work that was both deeply personal and had a potential for societal ramifications. I came to this work for passionate reasons (Williams and Boyd, 2019), with the goal of remedying the harms I experienced within computing culture that led me to pursue personal and professional identities incongruent with my sense of self. In one sense, this was an attempt translate my experiences "tending my own garden", such that the fruits from my own restorative practice could aid others, and throughout, I utilized qualitative methods and interpretivist epistemologies to curiously approach the nuances of others' experiences, while holding my own with skepticism. Nevertheless, as I acknowledge, neither my perspective, nor the experiences that I relay are objective measures; I present the truth of experience that may otherwise go unknown.

My experience of harm within computing, however, by no means encompasses the harms experienced at the hands of computing culture. The fact that racism, sexism, ableism, and transphobia were absent from my initial experiences of computing begets the privileges of the positions that I have held, and continue to hold in my scholarly engagements. While the harms from my own experience pale against those for whom computing is a saturated site of violence (Rankin et al., 2021), I have held, and continue to hold, that the harms caused by computing culture are indiscriminate and seldom few, even those with privilege, persist without experiencing any of them. The affect differs, but we share the same poison — I present the work of this dissertation with the hope that through coalition, we can begin to heal. One day, may we only know how to be free.

Chapter 2

BACKGROUND

In this chapter, I present the epistemological stance that I bring to this work, review relevant theoretical background, and situated this theory within prior work. I center this review in two spaces: 1) how to make the assumptions that underpin dominant narratives visible and 2) how understandings of dominant narratives can be utilized to prevent their reproduction. As the first is sociological, I primarily draw from theories of social learning for guidance[1], noting contributions of other fields with touchstones to narratives when appropriate. As the second question is pedagogical, I contrast two approaches in computing education that aim to address dominant narratives: Ethics Education and Justice-Centered Computing.

2.1 On language: Norms, Narratives, and Identity

First, on language, I use "norms" and "narratives" somewhat interchangeably throughout this document. Defined formally, I describe *narratives* as contextual, subjective, and flexible stories of past, present, and future that individuals use to shape their experience within a broad reality, what futures we see as possible, and what capacity we have to create those futures and *norms* as the assumptions that constraint both the content of narratives and the ways that narratives are told. However, these quickly reify each other: norms inform narrative structure and content, which, when told, concretizes normative beliefs, which further informs narratives, and so on. Furthermore, norms, when made explicit, can typically be structured as a narrative — norms around life course, for instance, can be structured as

[1]Dominant narratives have touchstones to a variety of fields: sociology, education, developmental psychology, social work, and others; I opt for social learning out of familiarity.

a narrative sequence of events (Halberstam, 2005). The two intertwine methodologically as well; within this body of work, I use synthesis and analysis of participant narratives to surface cultural norms. As the practical and pedagogical aims of this thesis benefit little from linguistic hair-splitting, and both are utilized within the theoretical background I describe, I opt to relax the distinction between them in favor of maintaining an emphasis on how they might be utilized.

Additionally, I note that identity, agency, and voice are *hefty* words within anthropological, sociological, and educational academic traditions. In this work, I utilize theoretical perspectives to guide action, noting that, relatively speaking, my theoretical engagement is shallow with respect to those within these disciplines. This work is interventionist, and this construction risks appropriating specific theoretical constructs into unsound framings for the sake of putting constructs to practice, now. As above, in service of action, I prioritize how identity, agency, and voice conceptually impact instructional design, over the particularities of this framing of literature.

2.2 Epistemology: Interpretivism and Critical Pedagogy

Interpretive approaches aim to intertwine knowledge with the cultural production of actors and institutions that create it (Orlikowski and Baroudi, 1991). However, while interpretive approaches distance themselves from the strict empiricism required by positivism, they do not necessary contextualize interpretations within societal normativity. Thus, *critical interpretivism* holds that 1) interpretations are grounded and constructed in a situated context, 2) these interpretations are used to challenge normative assumptions within that situated context, and 3) while interpretations are local, they exist within broader structures of privilege, power, and oppression (Doolin and McLeod, 2005). Proponents of critical interpretivism emphasize the need for criticality and reflexivity to be integrated into researchers' construction of knowledge, alongside political and historical contexts (Doolin and McLeod, 2005).

Critical interpretivism lends itself well to contextualized sociological work, and is well suited to the situated interrogations of normativity that I describe here, though, as with

sociological traditions broadly, is not a fundamentally interventionist tradition. While production of knowledge within education is frequently theoretical, the field grounds in action: when one comes to teach, one does need to do *something*. Therefore, I supplement critical interpretivism with critical pedagogy, which aims to engage individuals in *"our collective vocation to become more fully human"* (Freire et al., 2018), or, more directly, to *"liberate humans from the circumstances that enslave them"* (Rasmussen, 2003). Both critical interpretivism and critical pedagogy frequently utilize qualitative methods, with the latter employing participatory methodologies and action research, through which the oppressed can become the source of their own emancipation (Freire et al., 2018).

Within this dissertation, I ground within critical interpretivist epistemologies when they are of use, namely, in surfacing aspects of normativity within computing contexts, and extend these with critical pedagogies to engage learners in normative deconstruction. My work is motivated through critical pedagogy — I have sought to produce knowledge in service of collective liberation. While those with access to postsecondary computing sharply differ from how critical pedagogy has traditionally defined "the oppressed" (Freire et al., 2018) these approaches are needed everywhere, and my background offers me a disciplinarily legitimized access to computing. Additionally, I hold, as have others (Benjamin, 2022), that just as computing has reified and magnified societal oppression, it could also be used to spread liberatory practices. To this end, I prioritize the voices and experiences of those marginalized within computing contexts, center qualitative methodologies, and utilize these through design-based experiments, with an eye towards translating these experiments to pedagogical contexts beyond my own.

2.3 Utilizing Social Learning to Surface Dominant Narratives

Theories of social learning explore the learning that occurs as a component of group membership, largely drawing from Bandura's Social Cognitive Theory (Bandura, 1986). Some variation exists depending on whether the group in question is a community (Wenger, 2008) or society broadly (Bourdieu, 1977), but generally, learning occurs within spaces of social-

cultural relations, or *fields*, in which members seek financial resources, beneficial relationships, and other forms of capital (Bourdieu, 1986). To navigate these fields, members bring a set of past experiences and embodied cultural forms[2], cemented from a lifetime of memberships and learned negotiations (Bourdieu, 1977). One's history of cultural and community experience informs one's actions, but this is mediated by one's sense for "how to play the game": one's sense for what actions are permissible and will establish or maintain one's capital. This sense of "how to play the game" not only includes the rules within a field that dictate acceptable competition but also what forms of capital a field considers legitimate (Bourdieu, 1977).

While not strictly implicit, one's awareness of "how to play the game" is a typically outside of what can be discussed, questioned, and debated; what "goes without saying because it comes without saying" (p167) (Bourdieu, 1977). Thus, members frequently act without cognizance that a set of rules exist, without the language to describe such impositions, and treating legitimized forms of capital as established canon. Furthermore, rules of the game, or norms of practice, tend to favor those whose past experiences match the expectations imposed by a field, and those whose behavior signals established capital. For instance, prior work notes how educational settings tend to favor certain ways of speaking that demonstrate established capital (e.g. "you're so articulate" (Khan, 2020)) and police those that do not (e.g. African-American Vernacular English). Those who act within norms of practice often impose supremacies; tacitly imposing rules that define what is "acceptable": legitimizing those with histories around similar norms, and delegitimizing those with alternate histories.

Theories of social learning strongly align with narrative perspectives; both norms of practice and dominant narratives dictate what thoughts and actions are possible, what identities are permissible, and what futures are plausible (McLean and Syed, 2015; Olson, 1995; Bruner, 2009). Indeed, Olson writes that "one of the most pervasive ways in which we create and recreate experience is through the stories we live and tell", offering special distinction for *sa-*

[2] *Habitus*, in Bourdieu's work.

cred stories that are "known so well that they do not need to be told" (Olson, 1995), aligning with Bourdieu's description of field norms (Bourdieu, 1977). What is taught implicitly, yet remains outside the realm of what can be questioned is almost certain to be reproduced — the invisibility of the quiet rhythms of the world leads to their reproduction.

Typically, sociological work is concerned with societal fields from which there is no clear exit (e.g. mass media (Bourdieu, 2010), and education (Bourdieu, 1998b; Bourdieu and Passeron, 1990)) and the impositions from norms of practice within them (e.g. anti-blackness, classism, ableism, cis/het-normativity). While examinations within larger fields allow for dominant societal narratives to surface, my scope is localized to a disciplinary field, which requires attending to nuances in participation. Within localized fields, learning occurs through participation in peripheral practices that are viewed as legitimate by established members (Lave, 1991; Wenger, 1998; Ison, 2010b)[3]. As newcomers come to identify with a field and are recognized as legitimate by those within a field[4], they become accountable to dominant field narratives that dictate what the field deems legitimate (Ison, 2010b).

Individuals do not exist solely within a single field, rather one exists at a nexus of multi-membership between various fields (Bourdieu, 1998a; Wenger, 2008). As the norms, narratives, and legitimized forms of capital are often not wholly aligned between fields, existing at this intersection is frequently unharmonious, especially when the forces of various fields come into conflict (Ison, 2010b). If possible, one may maintain peripheral participation within several fields to avoid compromising one's sense of self, especially if one looks to keep one's sense of self coherent (Handley et al., 2006). However, when peripheral participation is not an option (e.g. within society broadly), those bound within a multitude of constraints are often required to improvise (Stevens et al., 2008), orchestrating one's positions and histories to exist in situations "replete with contradictions" (Holland, 1998). For instance, Holland et al. offer a vignette in which a Nepalese woman of caste considered "untouchable" is caught between competing constraints of a command to come to the second-floor balcony and a

[3]Legitimate Peripheral Participation, within Lave and Wenger's work

[4]*dyadic identification*, if you're feeling fancy

societal mandate against entering kitchens (typically on the first floor) and opts to scale the outside of the house to attend to both (Holland, 1998).

I utilize theories of social learning alongside narratives to illustrate both how dominant cultural forms become so pervasive and how those dominant forms can be surfaced and brought into spaces of critique. While social learning and narrative approaches vary in their descriptions of identity, both emphasize how identification creates accountability to norms of practice and the possibility for change by surfacing assumptions underpinning the legitimacy of the game. Within social learning, assumptions can be surfaced by surfacing stories from those who maintain peripheral participation, conflicting senses of self or de-identify with a field, examining points of improvisation, or by questioning existing beliefs in the legitimacy of a field or its' rules. Among these, however, prior work emphasizes that those whose position requires adherence to conflicting accountabilities tend to be especially aware of dominant narratives (Aarseth et al., 2016; Bourdieu, 2000).

When dominant narratives become visible, the conventions of the social world can lose their tacit nature, constituting a crisis [5]. Crises do not guarantee that the constrains of the social world disappear; they can be resolved by improvising (as discussed) or by fracturing one's identity between the fields in conflict (Handley et al., 2006). Alternately, one can avoid examining the agentic constraints of dominant narratives (McLean and Syed, 2015) through *cover stories*, eschewing one's identity to fit within dominant narratives, which frequently lead to feelings of inauthenticity and alienation (Olson, 1995).

Breaking from dominant narratives, however, requires critical discourse (Bourdieu, 1977). From theories of social learning, critical discourse demarcates between rules of a field and opinion, thereby bringing tacit norms into a space where they can be consciously critiqued (Bourdieu, 1977). Though questioning dominant narratives is insufficient to address the structural power that cements dominant narratives (McLean and Syed, 2015; Miller et al., 2020), questioning offers the ability to re-story the past (Olson, 1995; Van der Kolk, 2015) and

[5]Bourdieu's terminology (Bourdieu, 1977)

imagine new futures (Miller et al., 2020). Furthermore, if learning is "becoming a certain kind of person" (Ison, 2010b) and the stories that describe one's identity constitute components of identity (McLean and Syed, 2019), then creating alternative personal narratives is akin to changing one's identity, becoming a different person.

2.4 Framing Identity Work: Definitions

Throughout the remainder of this thesis, I define identity through narrative and sociological perspectives: *identity* is the set of stories we use to describe ourselves, coupled with the memberships and degrees of participation that we hold within various fields; contextual, plural, and ever-shifting. In this thesis, I am primarily concerned with changes to identity through *identity work*. From social learning, engaging in *identity work* begins with a deconstruction of dominant narratives (perhaps by demarcating between tacit social norms and opinion), producing a capacity to move where one was once constrained (Holland, 1998). I defined this capacity as *agency*, "the realized capacity of people to act upon their world and not only to know about or give personal or intersubjective significance to it...the power of people to act purposively and reflectively" (Inden, 2000; Holland, 1998). While agency gives the capacity to act upon the world, utilizing that capacity is a realization of *voice*: a projection of self-knowledge and expertise into a realized form, and with it, a new identity. From theories of social learning, identity work is the process of attending to existing *identity*, deconstructing dominant narratives to bolster *agency*, and then enacting that agency through an expression of *voice*.

2.5 Prior Approaches in Computing Education

Theories of social learning outline what conditions can give rise to crises, what constitutes identity work, and what agency and voice might develop from identity work. However, given that sociology is generally not interventionist, there is relatively little practical advice

within that scholarship tradition [6]. To better understand the pedagogical implications of an interventionist space, I focus on two settings: Justice-Centered Computing in K-12 contexts and Ethics Education in postsecondary contexts. As the former is primarily situated with marginalized students and the latter is primarily situated within the class-reproduction scheme of postsecondary (Carnevale and Strohl, 2013; Davis and Binder, 2019), different pedagogical techniques and assumptions are employed to address dominant narratives. I begin with Justice-Centered Computing, as these approaches are frequently more aligned with narrative perspectives.

2.5.1 Justice-Centered Computing

Justice-centered computing approaches look to examine social implications of computing (Vakil, 2018; Ryoo et al., 2021a,b), acknowledge social-political contexts in which computing teaching and learning occurs (Ryoo et al., 2021a; Leonard and Sentance, 2021), and develop the agency of learners (Ryoo et al., 2021a, 2020; Vakil and McKinney de Royston, 2022) to empower and inspire activism (Morales-Chicas et al., 2019; Scott et al., 2015; Miller et al., 2020; Ryoo et al., 2021b; Vakil, 2018)[7]. As prior work in justice-centered computing primarily engages with minoritized learners, a key tenant is to disrupt narratives that gatekeep marginalized learners from accessing computer science, and center the use of computing technologies to bring about social, economic, and racial justice (Ryoo et al., 2021a). These efforts look to explicitly counter the exclusionary and elitist nature of dominant computing culture by creating space for newcomers to develop a "rightful presence" within computing classrooms (Calabrese Barton and Tan, 2020b), rather simply be included. Beyond the computing learning context, Justice-Centered Computing looks to build newcomers' awareness of com-

[6]For instance, Bourdieu is notably vague on the specifics of critical discourse, practical advice on how to conduct it, or what actions can result from a crisis.

[7]Many approaches exist: culturally relevant (Leonard and Sentance, 2021) and responsive computing (Scott et al., 2015; Leonard and Sentance, 2021) and youth as philosophers of technology (Vakil and McKinney de Royston, 2022). I use "justice-centered" to broadly describe approaches that have a goal of student-led activism.

peting social norms so that they can be disrupted (Freire et al., 2018)[8], connecting broader systemic marginalization from computing technologies (Benjamin, 2019; Noble, 2018) to the expertise and agency of learners in imagining and constructing alternatives (Miller et al., 2020; Ryoo et al., 2020, 2022).

As making dominant narratives visible to learners is a primary objective of justice-centered computing, many relevant pedagogical contributions exist within this body of work. Alongside acquisition of course material, Justice-Centered Computing emphasizes making pedagogical space for students' existing identities outside of computing while developing students' disciplinary identities within computing (Scott et al., 2015; Leonard and Sentance, 2021; Vakil, 2018). With respect to *identity*, prior work allows students to personalize their course material to their interests (Lin, 2022; Kirdani-Ryan and Ko, 2022; Morales-Chicas et al., 2019; Ryoo, 2019) or to social issues that affect their lived experience (Morales-Chicas et al., 2019; Ryoo, 2019; Ryoo et al., 2020; Vakil, 2020) and by making connections between course material and everyday life (Ryoo, 2019; Vakil and McKinney de Royston, 2022). Within Justice-Centered Computing, students engage dominant narratives when friction arises between their existing identities and dominant narratives around computing; for instance, racial or gendered stereotypes of who performs computing (Ashcraft et al., 2017), or the lucrative and unfulfilling career prospects offered by computing (Vakil, 2018, 2020). As deconstructing dominant narratives is often uncomfortable (Ashcraft et al., 2017), prior work highlights trusting relationships as a necessary prerequisite for students to feel safe exploring discomfort (Vakil and McKinney de Royston, 2022; Everson, 2022; Kirdani-Ryan and Ko, 2022; Ashcraft et al., 2017; Ryoo, 2019). To build learner *agency*, prior work stresses the importance of devaluing hierarchies of knowledge in favor of earnestly recognizing and validating the authority of student perspectives and expertise (Ryoo et al., 2021a; Freire et al., 2018; Ryoo, 2019; Vakil and McKinney de Royston, 2022; Ryoo et al., 2021b), perhaps by co-constructing curricula and learning environments to better fit students (Everson,

[8]Critical Consciousness in Freire's work

2022). And, to make space for student *voice*, learners typically concretize their understanding of technical and disciplinary understandings of computing into an artifact: video games, applications, and web-based artifacts, among others (Vakil, 2018, 2020; Ryoo et al., 2022).

Though the principals of justice-centered computing extend well beyond the K-12 contexts that they were developed in (Lin, 2022), I note that learners in justice-centered contexts likely have already engaged in some identity work through deviation from dominant structural narratives. For instance, prior work tends to illustrate *identity work* through vignettes describing learners who came to reject deficit narratives that constrain who is interested in computing and who can access computing classroom environments on the basis of race, gender, or class (Scott et al., 2015; Ashcraft et al., 2017; Vakil, 2020). While the vignettes offered in prior work are not all-encompassing, in my readings, they tend to highlight learners who self-describe existing deviations from dominant narratives. For instance, when describing students using computing for activism, Ryoo et al. exemplify Alvaro, who identified as a Queer POC, used he/they pronouns, and described activism as one of their greatest passions, expressing pride in creating a gender-neutral restroom at his school (Ryoo et al., 2020). Later work by Ryoo et al. stories around Camila, who was "unafraid of how others might judge her particular interests as 'geeky"' and "proudly embraced her identity as an artist" (Ryoo et al., 2021b). Other work exists as well, describing students' challenging their instructor's language around racial identity (Ashcraft et al., 2017), critiquing structural policies at their institution (Vakil, 2020), or with deep desires to engage in sociopolitical issues (Vakil and McKinney de Royston, 2022).

Given that Justice-Centered Computing, as a primary goal, seeks to engage, empower, and uplift students who would otherwise be excluded from computing spaces, students' prior experience with identity work is perhaps unsurprising. Indeed, prior work has found that that identity development and narrative deviation are related (McLean et al., 2019) and that those who describe deviation from dominant narratives are most likely to occupy structurally marginalized positions (McLean et al., 2017). This experience does not come by privilege, but by necessity: for instance, prior work describes efforts among Black Americans

to prepare children for structural racism in order to minimize both systemic and bodily harm (McLean and Syed, 2015; Anderson et al., 2022; Benjamin, 2022). Identity work is a requirement; a lack of identity work would mean internalizing narratives that devalue one's own bodily existence[9]. Perhaps, then, a component of the justice-centered computing's success in narrative deconstruction may be students' prior experience before they arrive in the classroom, which would mean that little is known about how to engage students for whom identity work is a less familiar concept.

2.5.2 Ethics Education

Ethics Education has sought to make the systemic harm brought by technological systems visible, with the hope that computing students consider the ethical implications of their work as a component of their engineering practice (Fiesler et al., 2020; Hoffmann and Cross, 2021b). To this end, prior work has tended towards integrating ethics education into students' existing coursework rather than provide separate instruction (Cech, 2014; Fiesler et al., 2021; Hoffmann and Cross, 2021b; Vakil and Ayers, 2019), with established integrations into a variety of computing courses (Kirdani-Ryan and Ko, 2022; Peck, 2019; Reich et al., 2020; Saltz et al., 2019b; Skirpan et al., 2018b; Oleson et al., 2018; Jia et al., 2021; Bates et al., 2020b). As of this writing, Justice-Centered Computing and Ethics Education differ in their pedagogical context: Justice-Centered Computing has sought to engage learners with friction between their existing identities and potential disciplinary identities (Scott et al., 2015; Leonard and Sentance, 2021), while Ethics Education has primarily engaged learners who have already developed disciplinary identities. While both seek to critique technology's role in amplifying systems of oppression, Justice-Centered Computing focuses on encouraging and uplifting those who directly experience systemic harm towards dismantling those systems, whereas Ethics Education typically situates among learners who may not be personally affected by

[9]While my own privilege generally allows assumptions around my bodily safety, in my experience, the identity work to deviate from dominant narratives along axes of marginalization has been a requirement to exist wholeheartedly in spaces where I would be otherwise dismissed

what they choose to build.

Pedagogically, recent literature reviews have found that the overarching goal of most Ethics Education interventions was to recognize ethical dilemmas in existing technologies[10], especially regarding laws governing the use of technical systems (Fiesler et al., 2020; Hoffmann and Cross, 2021b). To this end, some courses have emphasized philosophical reasoning about ethics (Grosz et al., 2019), while others have utilized techniques from design, encouraging students to utilize divergent stakeholder perspectives when reasoning through ethically nebulous situations (Shapiro et al., 2021). Though Ethics Education challenges dominant narratives that emphasize the technical decisions of technologists over the social context in which these decisions are made (Vakil, 2018), implementations of Ethics Education tend to focus on the decisions of single actors, independent of the systemic factors that affect those decisions (Hoffmann and Cross, 2021b; Vakil, 2018; Vakil and Higgs, 2019; Ko et al., 2020). However, more recent work has critiqued the systemic authority of technologists and interrogated systems of power and oppression that technologists exist within, challenging dominant narratives of individualism (Kirdani-Ryan and Ko, 2022; Lin, 2022; Williams et al., 2022).

Between Justice-Centered Computing and Ethics Education, I highlight a difference in students' experience and capacity for engaging in identity work. As discussed in Section 2.5.1, students within Justice-Centered Computing likely come with some prior experience in identity work, either by necessity or by previous approaches to activism. In contrast, given the pedagogical context, students within Ethics Education may have little experience with identity work, especially with respect to their discipline. Prior work has found that students' social conscientiousness declines over their engineering program (Lucena, 2013; Cech, 2014; Malazita and Resetar, 2019), as they learn to prioritize prestigious work and defer impact (Binder et al., 2016); students may even view Ethics Education and identity work with skepticism. Part of this is foundational: the motivation for Ethics Education is that students will, regardless for their propensity for engaging in identity work or their

[10]Fiesler et al. draw parallels to the practice of "issue-spotting" in legal education.

prior experience with identity work, be exposed to sociotechnical topics (Saltz et al., 2019b). However, the efficacy of these approaches remains untested (Hoffmann and Cross, 2021b) and it is unclear if embedding interventions throughout a student's educational experience would sufficiently counter disciplinary norms and narratives. Williams et al., for instance, found that even students with strong foundations in social justice continued to blame human factors over systemic factors for the harm enacted by technological systems (Williams et al., 2022).

Beyond students' experiences and capacity for identity work, Justice-Centered Computing and Ethics Education also differ their engagement with student identity, agency, and voice. With regard to identity, even if students are enthusiastic about engaging with ethics and the critiques presented are relevant from a disciplinary perspective, alignment with learners' personal narratives or identity is typically coincidental. With regard to agency, development of ethics education generally exists within the cultural hegemony of postsecondary education where the expertise of instructors is prioritized over students (Ryoo et al., 2021a; Vakil and McKinney de Royston, 2022). And, unlike Justice-Centered Computing, attending to student voice is not a stated goal of Ethics Education, so while students may learn to deconstruct dominant narratives, little instruction is given in how to enact their knowledge into practice.

To illustrate with an example, present work in Ethics Education has sought to build repositories of ethics "modules" to embed within computing courses (Grosz et al., 2019; Morrison and Craig, 2022). These modules are generally developed by instructors, education researchers, or others endowed with institutional capital, and the choice of which modules to utilize in a given course remains with the instructor, giving little opportunity for expression of student agency or alignment with student identity. Some ethics education approaches encourage students to build critiques into solutions, to "build good technologies" (Fiesler et al., 2020) in contrast with the abject villainy of current systems, but generally student voice is legitimized insofar as that voice is utilized within expected contexts. While Justice-Centered Computing instructors who, for instance, examine racial marginalizations within computing might expect student interruptions around disparities between who is present,

and who, stereotypically, should be (Ashcraft et al., 2017), similar interruptions in Ethics Education are relatively rare (Kirdani-Ryan and Ko, 2022).

As discussed, identity, agency and voice are central within Justice-Centered Computing contexts that seek for students to become agents of technosocial change (Ashcraft et al., 2017), and the lack of Ethics Education's attention to these specifically, and identity work broadly, might lead to a lack of longitudinal change. A lack of attention to student *identity* might mean that critiques of existing technologies, even if situated systemically, might not transfer to dominant narratives held by students. A lack of attention to student *agency* might prevent students from nurturing the legitimacy of their own expertise and experience, leading to a lack of substantial self-concept. And, a lack of attention to student *voice* might preclude students from developing their interventional expertise, potentially hamstringing future interventions. Ethics education is *work*, but without attention to identity, agency, and voice, Ethics Education is unlikely to be the *identity work* required to, as lovingly put by Ruha Benjamin, "grow the fuck up" (Benjamin, 2022).

Given existing gaps within Ethics Education, Lin argues for enacting Justice-Centered Computing within postsecondary education (Lin, 2022). However, while justice-centered approaches are well suited for students with expertise in identity work, what about everyone else? For those without substantive experience engaging in identity work, Justice-Centered Computing's call to dismantle existing oppressive regimes might be beyond their capacities. While attending to the student identity, agency, and voice is necessary to create pedagogical situations where identity work can occur, the implementations may look vastly different for students who have already come to identify with dominant disciplinary narratives. In contrast to prior justice-centered contexts, students' dominant narratives within postsecondary education may be more situated in their disciplinary identity (for instance, the corporate incentives that their computing work is situated within (Vakil, 2018)), than students' broader identities.

Chapter 3

"TAUGHT TO BE AUTOMATA": EXAMINING THE DEPARTMENTAL ROLE IN SHAPING INITIAL CAREER CHOICES OF COMPUTING STUDENTS

In this Chapter, I describe an investigation of discipline-specific cultural norms surrounding career choice in postsecondary computing education. This, as with all the scholarship I describe within this thesis, was personal — my journey through computing taught a narrow definition of career success that led me to pursue work at large, prestigious, multinational corporations; I wondered what of my experience was shared. And largely, it was; though the context was different than my undergraduate, I found that students learned to prioritize career prestige in their initial career decisions, and that their department enforced that narrow form of legitimacy.

With regards to my thesis statement, I note that this work surfaced student experiences of resolving and failing to resolve their relationship to discipline-specific cultural norms. Prestige-centric norms largely mirror norms within society broadly, but students within this context that signaled distance from societal expectations still struggled to find recourse from norms within their disciplinary space and found their own motivations for work separate from their career trajectories (Section 3.4.4). Finally those that experienced resolution typically had that resolution scaffolded by a mentor external to their department, though the degree of mentor involvement varied between students.

3.1 Introduction

For many post-secondary computing students, one's graduation is closely tied with a series of significant career choices. These choices might determine where a new graduate lives,

potentially severing them from their community. They determine the kind of learning a new graduate does, whether learning to be productive in an organization (Begel and Simon, 2008b), or learning to be productive on a team (Begel and Simon, 2008a). Perhaps more importantly, one's choice of job shapes what problems a graduate chooses to invest in, whether for-profit consumer products, enterprise solutions for businesses, or not-for-profits and government organizations with pro-social motives. While a student's choice of first job after graduation is likely not their last, their initial choice can also shape their future earnings and opportunities (Brunner and Kuhn, 2014).

Frequently, this transition from formal education to professional work happens in community. Faculty might advise students on computing careers, career and academic advisors might support students with mock interviews and résumé reviews, and students might attend job fairs and practice coding puzzles with peers. Beyond academic spaces, students might look to family and friends for expectations and guidance.

This transition, and the choices that shape it, are complex, sociocultural decisions. For example, graduates' self-efficacy about their skills and career choices is strongly related to their level of confidence in their choices (Alexander et al., 2011; Choi et al., 2012). The choices available to graduates are strongly determined by their life circumstances, such as income, race/ethnicity, and their social network (Diemer and Blustein, 2006). Educators, peers, and family all influence student interest in STEM majors and careers, which in turn affects STEM self-efficacy and career outcomes (Nugent et al., 2015). Career choices are also influenced by students' values (Trapnell and Paulhus, 2012). Race and ethnicity are also related to career aspirations, but only in that different racial groups face different opportunities and barriers (Fouad and Byars-Winston, 2005).

These factors are broadly explained by existing theory on career choices. *Social Cognitive Career Theory (SCCT)* (Lent et al., 1994) presents a model for these factors, including self-efficacy in career skills, outcome expectations, goals, social supports and social barriers. The theory posits a complex interplay; for example, structural barriers might influence self-efficacy and outcome expectations, which might reshape interests and goals. Prior work

within computing education, for instance, shows that social supports are particularly important for students' decision to study computing (Alshahrani et al., 2018a).

Prior work on students' career choices is consistent with SCCT, and emphasizes that perceptions of computing majors are entangled with perceptions of computing careers. For example, parents occupations and attitudes, early computer experiences, social expectations and encouragement, role models, and self-efficacy all influence both major and career choice (Ahuja et al., 2006), and there is clear evidence that structural barriers, stereotype threats, and environmental cues can shape the influence of these factors (Fincher and Robins, 2019). Prior work has found that students who value the social impact of their career have a lower sense of belonging in some Computer Science (CS) departments (Lewis et al., 2019); similar work has shown that such communal goals are more common amongst students with marginalized identities (i.e. students who identify as cis-gender women, ethnic and racial minorities, first-generation, queer, transgender, non-binary, and gender non-conforming) (Lewis et al., 2019; Tellhed et al., 2018; Diekman et al., 2017; Allen et al., 2015). The communities that students come from to study computing can also enforce cultural stigma to learning CS and pursuing CS careers, shaping their willingness to learn (DiSalvo et al., 2013). Students may also bring stereotyped perceptions about CS careers (Kahle and Schmidt, 2004; Clarke and Teague, 1996), which are often reinforced by their community (Margolis and Fisher, 2002; Margolis, 2008) and rarely corrected by CS curricula (Vesisenaho et al., 2009), but nevertheless can strongly shape students' choices of what to learn.

While prior work in computing has examined students' career choices through SCCT's factors, framings that center social learning have received less attention. Theories of social learning examine what norms of behavior exist within social groups, and how those norms affect group members. Within a sociological framing, one's career decision is affected by one's sense of belonging and self-efficacy, but these factors are a byproduct of both implicit norms within social groups that govern behavior, and one's habituation to norms experienced throughout one's lifetime (Bourdieu, 1977). From this perspective, norms shape language, action, and career choice, and typically create spaces of competition that push individuals to

make choices along defined norms, often without knowledge that any norms exist. Specific to career choice, prior work has adopted *Field Theory* to demonstrate how prestigious universities are organized and structured to push students towards prestigious work (Binder et al., 2016; Daoust, 2020; Bourdieu, 1998b), leading to students at prestigious universities to opt for careers with prestige more often than students at less-prestigious universities (Davis and Binder, 2019).

Prior sociological work has examined computing career choice within a factor lens, and careers broadly, but examinations of computing career choice are unexplored. Theories of social learning argue that one's learning is inextricably tied with one's participation within a social group, and that this participation shapes what future choices are possible (Bourdieu, 1977, 1998b). For post-secondary computing students, learning is inextricably tied with participation within the department, and the departmental norms of career practice would shape students' choices of future enterprise. From prior work examining institutional effects on student career trajectories (Binder et al., 2016), it is likely that CS departments favor careers that fit the implicit departmental norms, perhaps rejecting or delegitimizing those that do no. This follows conjectures from Kallia and Cutts, who also note a literature gap around the affect of CS organization, structure, and norms on participation (Kallia and Cutts, 2021). As one's future career prospects are one of the primary motivators to study computer science (Carter, 2006), the affect of departmental norms on student career choice could illuminate larger affects on participation.

Thus, in this investigation, I look to surface the norms of career practice within computing, as well as the interactions between these norms and the numerous social and rational factors described in prior work. As examinations of computing career choice are largely unexplored, I sought to deeply understand a single CS department within higher education[1], leaving multi-institution work for future studies that would hopefully benefit from the richer insights of our deeper case study. Given that our university houses a CS department that

[1]For this work, I use "department" to refer to departments, schools, colleges, and other academic units.

centers theory of computation and software development and whose graduates tend to pursue engineering positions, I centered my inquiry around this program out of convenience, familiarity, and access. I adopted a sociological perspective, treating this department as a *field*: a structured social space that ascribes norms of career practice, norms that subsequently shape students' career choice by virtue of their participation. Within this case, I ask the following research questions:

- What norms of career practice exist within this Computer Science department?
- How are these norms reinforced by members of the department?
- How are these norms experienced by students?

By examining this department through Bourdieu's *Field Theory*, I surface CS career norms and the affect of those norms on student experiences. This chapter contributes one of the first investigations into CS career choices as intertwined with the norms of a CS department. Throughout, I report in detail on the perspectives of students, advisors, graduates, and program leaders on careers. I begin by discussing our theoretical framing and method in more detail, then present the results of our case study, and end with a discussion of the implications of this work, reframing prior work surrounding CS participation and offering avenues for future work[2].

3.2 Theoretical Background

To investigate the norms of career practice within a CS department, I primarily ground within theories of social learning, but utilize perspectives from Social Cognitive Career Theory and prior work in career norms outside of computing to shape my analysis.

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[2]Following convention of a single-author thesis, I use singular pronouns throughout this chapter, but I note that this work was a collaboration between myself, Amy J. Ko, and Emilia A. Borisova, and was published in Taylor & Francis Computer Science Education, Volume 34, Issue 1, in 2023 (Kirdani-Ryan et al., 2023). Amy acted as an qualitative "second" and assisted with framing and reviewing the work; Emilia assisted with preliminary analysis and transcription cleaning.

3.2.1 Social Cognitive Career Theory

The most modern attempt to explain career choices is Lent's and Brown's *Social Cognitive Career Theory* (SCCT) (Lent et al., 1994; Lent and Brown, 2019). Building on Bandura's Social Cognitive Theory, SCCT attempts to surface a unifying theory to describe career interest development, career choice, and persistence and performance in career aspirations (Lent et al., 1994). SCCT derives several predictive models based on individual self-efficacy and outcome expectations (social cognitive mechanisms (Bandura, 1986) relevant for careers), as well as social supports and barriers (contextual factors) (Lent and Brown, 2019). Prior work has demonstrated adequate fit of SCCT's performance model among computing students (Lent et al., 2008) and has utilized SCCT as a grounding theory for examining students' choice to study CS (Alshahrani et al., 2018a) and students' career development among marginalized students in STEM (Garriott et al., 2017; Turner et al., 2019). In contrast with prior work utilizing SCCT to analyze barriers to participation in specific career enterprises, this chapter instead chooses to focus on the established norms of a CS department. While a theoretical grounding centering SCCT might surface students' experiences of norms as social supports (when norms fit one's experience) or social barriers (when fulfillment of enforced norms felt inaccessible), I would need more explanatory power to specifically describe the norms themselves, due to the tendency for norms to be implicit and unstated. Thus, this chapter primarily utilizes theories of social learning to describe institutional norms, but I note SCCT's career-centricity, the affect of social barriers and supports on one's agency and capacity to act within various career domains, and the large body of existing literature that centers factors described within SCCT.

3.2.2 Social Learning

Theories of social learning examine learning that occurs as a component of group membership, largely drawing from Bandura's Social Cognitive Theory (Bandura, 1986). However, in addition to describing how skills and practices are learned without formal instruction, social

learning theories can be used to describe implicit learning. Of particular relevance to this work is how social groups maintain norms of practice, how those norms are enforced and reproduced, and how newcomers and established group members respond to existing norms.

I detail theories of social learning in chapter 2, and, as *Field Theory* is well-utilized within prior work that examines social learning of students within elite career contexts (Binder et al., 2016; Daoust, 2020), and the university career context has been explicitly addressed by Bourdieu (Bourdieu, 1998b), I ground this chapter within *Field Theory*. In surfacing norms of career practice within a CS department, I view a CS department as a *field* that legitimizes certain forms of career *capital*. As students seek these forms of *capital*, a set of career norms are formed within the *field* (RQ1). This process of seeking capital can be treated as competitive game, one with a set of enforcement mechanisms to ensure that competition remains acceptable (RQ2). However, no *field* is wholly encompassing; individuals (especially students) bring their intersection of membership between various *field* to bear upon their career practice. This multi-membership, along with students' existing *habitus*, might be consistent with practice within the departmental *field*, but also might bring expectations of behavior that conflict with notions of legitimized *capital* and contradict norms within the department (RQ3).

Prior work has emphasized that as students bring their existing *habitus* to computing practice and computing culture, many experience dissonance when computing *capital* conflicts with their *habitus*. Stereotypes that paint computing careers as individualistic, isolated, and with low-social impact (Alshahrani et al., 2018a) likely dissuades students whose *habitus* lacks *field* alignment from studying computing (Kallia and Cutts, 2021), while students that persist will likely feel a lack of belonging (Lewis et al., 2019). Additionally, some prior work finds that the computing profession is largely perceived as interesting, competitive, and prestigious (Papastergiou, 2008). Broadly, those whose *habitus* aligns with notions of *capital* within computing likely feel an identity alignment, a sense of belonging, and are more likely to persist within the *field*. However, a gap in literature exists with regard to the specific organization and structure of CS *fields* with respect to the forms of *capital* legitimized within

the *field* (Kallia and Cutts, 2021).

3.2.3 Career Funneling

Prior work has also examined students' learning of institutional career norms. In 2013, Cech detailed a "culture of disengagement" within engineering education through three pillars: (1) the belief that engineering work should be disconnected from social and political spheres that might bias engineering practice, (2) the ideological dualism separating technical and social work, devaluing the latter, and (3) an ideological endorsement of meritocratic beliefs, emphasizing the fairness within existing systems of social advancement (Lucena, 2013). In 2014, Cech extended this line of inquiry with evidence, finding that engineering students' interest in the interplay between public welfare and their engineering work declined over the course of their undergraduate program and did not rebound upon leaving college (Cech, 2014). Drawing from Bourdieu, students' sense of *capital* legitimized within an engineering program directly affected their own beliefs, persisting within students' *habitus*.

Prior work has also utilized field theory to examine learning of institutional career norms. Looking specifically at highly selective, elite universities, Binder et al. (Binder et al., 2016) found that many students arrived on campus experiencing uncertainty around their career prospects, but quickly learned to distinguish between elite work within elite employment sectors and ordinary jobs through *Career Funneling* where elite institutions acted as pipelines to elite jobs. More recently, Davis and Binder examines the multi-layered career advantages conferred by elite institutions, finding that students at elite private institutions enter more prestigious firms within elite industries than their public university counterparts (Davis and Binder, 2019).

Within an individual employment sector, Daoust examined Canadian undergraduates' experience of the recruitment process in accounting where students learned to measure jobs at a set of prestigious "Big Four" companies against all others (Daoust, 2020). Daoust, also utilizing *Field Theory*, found that accounting students belief in the legitimacy of the recruitment game was constructed around three mechanisms of securing capital (1) the long-

term career opportunities offered by firms, (2) the social recognition conferred by peers upon landing a Big Four position, and (3) and the appeal of a "fun" and "exciting" career. Students beliefs in the recruitment game were maintained unless students experienced some split, for instance a rejection from elite accounting firms. These "points of disjuncture" allowed the possibility for students to distance themselves from the recruitment "game", allowing space for reflection and new, more independent understandings.

3.3 Method

As students' *habitus* was likely formed well before they arrived to the department, and my goal was to surface the career norms of the department, I primarily employed the notions of *capital* within the departmental *field* and career norms that curtail deviations or devaluings of legitimized *capital* within the department. To this end, I sought to surface experiences of career norms from individuals with varying amounts of *capital*, thus I interviewed four populations: students, graduates, advice givers and program leaders. Prior work has primarily focused on students (Daoust, 2020), and recent graduates (Binder et al., 2016); I also sought to assess how members with greater *capital* within a CS department experienced, identified with, and replicated forms of career *capital*. With the goal of surfacing counter-narratives Solórzano and Yosso (2002) from the perspective of students, I chose students (11 total) as my primary population[3] I recruited students through email lists, word of mouth, and posts to student groups. Students were not compensated, so I phrased my recruiting statement around my perception of student interests, emphasizing this work's goal to create "organizational, structural change" to incentivize participation. I recruited recent graduates (graduated within 5 years) in the same way as students (3 total). For participants with greater *capital*, I recruited faculty and staff that students looked to for career advice (referred to as advice-givers, 3 total, recruited via snowball), and senior-faculty program leaders (1, recruited directly). While the number of participants with greater *capital* is small relative

[3]I obtained approval from my university's Institutional Review Board before beginning this work.

to the number of students, I note that prior work examining post-secondary career socialization exclusively interviews students and recent graduates (Binder et al., 2016; Daoust, 2020). Additionally, I intended to situate my departmental framing around the students interviewed, and that I interviewed a significant proportion of the relatively few department members who have notable *capital* with regard to student careers. In total, we interviewed 18 participants and obtained 14 hours of interview data.

After all interviews were complete, a demographics survey was sent to populations recruited at-large (graduates and students). Out of 14 at-large participants, 13 completed this survey; among those, 3 identified as women, 10 as men, and respondents were between 20 and 25 years old. In terms of ethnicity, 6 identified as White, 3 as Asian or Asian American, and 2 as both White and Asian. Two participants opted to self-describe their ethnicity; one identified as North African, another identified as "Teochew and Hakka from Vietnam — two Chinese ethnic minorities that have diaspora populations in Vietnam".

With regard to positionality, the analysis team consisted of two members: the author of this thesis (a graduate students in the CS department studied at the time of this work) and the program director of a computing-related undergraduate program at the same institution, but in a different department. These positions within the institution gave context, perspective, and access, while also requiring examinations along *reflexivity*, the careful, self-aware analysis of the dynamics between researchers and those being studied (Finlay and Gough, 2008). Prior work emphasizes the importance of engaging in reflexivity, but little agreement on how best to approach reflexivity (Call-Cummings and Ross, 2019); the analysis team's approach involved recurring reflections around the claims in the results, our relationship to those claims relative to our positions, and a reconsideration of claims when the team's positionality had warped our interpretations. This approach does not aim for objectivity, but rather a transparent account of subjectivity amenable to future interrogation in scholarly discourse.

With the intent of following a semi-structured, fluid, conversational, and flexible interview protocol (Aydarova, 2019), I crafted a open-interview protocol around three themes: (1)

how the participant understood the process of finding a job after graduation, (2) what was required of them and how they struggled in fulfilling those requirements, both explicit and implicit, and (3) their reflections and feelings on the entire process. Additionally, students were asked to reflect on their choice to major in CS to build rapport and frame career decisions in the context of the department, and graduates were asked to contrast their recollections of their initial job search with their current career perceptions. For advice-givers and program chairs, I centered their interactions in students' career processes, and how they viewed their role in serving students.

After transcribing interview data, the analysis team's process followed the spirit of Hammer and Berland's perspectives on qualitative data analysis, who encourage those in the social sciences to distinguish between qualitative coding done to test claims, requiring inter-rater reliability, and qualitative coding done to generate claims for future investigation (Hammer and Berland, 2014). The team's goal was to generate claims. Analysis began by analyzing the transcripts for career norms and how they were enforced and experienced by participants. I first corrected interview transcripts, and anonymized statements that discussed specific members of the department, which also provided an opportunity to read each transcript, then performed an additional reading where I pulled out statements that described participants' career choices, or the career choices of others within the department, as well as statements that described the overall department in terms of perceptions, norms, and practices. These statements were then thematically analyzed through an inductive coding by thesis author, who presented the results of this coding to the other researcher. The other researcher offered reflections, insights, and raised reflexivity concerns when the results felt too removed from the data, after which I revised codes and claims accordingly. The analysis that I present resulted from several iterations of revising codes, recoding data, and forming new analyses from the recoded data. The final themes represent a grounded consensus interpretation between members of the analysis team.

3.4 Results

3.4.1 The Norms of Career Practice

Throughout this work, I identify participants by a letter and number – the letter refers to the type of participant (S for students, G for graduates, A for advice-givers, and L for program leaders), the number distinguishes between participants of the same type. Researcher interjections within quotations are enclosed with square brackets.

First, I situate this case within prior work. Prior work utilizing Field Theory to describe undergraduate career practice studied students within highly selective institutions with established paths towards increasing one's *capital*: elite institutions. The work I draw on here found that students within elite institutions learned to opt for highly selective firms, viewing those firms as garnering the greatest career *capital* and admiration; prestigious, by another word (Binder et al., 2016; Daoust, 2020).

Unlike institutions under study in prior work (Daoust, 2020; Binder et al., 2016), this was a public university. However, the CS department within which I situated has a highly selective and competitive admissions process, analogous to those at elite institutions. I began many interviews with students and graduates by asking why participants chose to major in CS as a way to build rapport, and in their justification, several emphasized the stress of the department's admissions process. To compare, I asked a graduate if departmental admission was more stressful than finding a job, they replied:

> *Oh, 100 percent…you can always look for a job later, what happens if you don't get in? (G1)*

At the time of this work, the department's admissions requirements emphasized introductory CS course grades, leading these courses to become sites of competition, one marker for an elite institution. From one student:

> *It's very, very competitive, you know. And so, like, tests are super high stress and, like, you feel like you're never, like… Any of the work you do is never going to be enough.*

(G3)

Choosing to participate in the department's competitive admissions process also came with a broader reputation on campus, described by one student as:

> *Like cut-throat and like, 'cause it's very competitive to transfer into the major here. Um... I think a lot of external people (would be) like oh I get it you're a CS major. Like, oh you're a sellout you're just gonna like do that to make a lot of money. (S3)*

Many students, however, were less concerned what values might be signaled by pursuing work in CS and more concerned with gaining entrance to the highly competitive space:

> *Yeah, and uh, yeah it was just a my first couple years of college were incredibly stressful. Um, just feeling really like a ton of pressure to perform at a very high level constantly…ultimately for me…I [stammers] …if it wasn't for me being a teaching assistant, and probably be being a veteran. I don't think I'd be here. (S7)*

With this institution competitiveness, the only form of career capital that I found to be legitimized was jobs at highly selective, prestigious firms. Notions of prestigious work incidentally included highly selective graduate programs, but prestigious industry jobs were the primary norm of career practice. This replicates prior work (Daoust, 2020; Binder et al., 2016): elite institutional *fields* legitimize roles at highly selective, prestigious firms and students learn to value and prioritize these legitimized roles.

The department's career counselor was the most frequent source of career advice for participants; they noted students' familiarity with departmental career norms and how that reflected in their advising:

> *When you look at the articles that are written about this program, so many of them focus on the jobs and high paying salaries that our kids are getting. This department is marketed as a program that will enable you to go for those high paying software jobs. The comp expectations are between 150 - 200k total comp per year. So many of the students are aware of this coming in and the majority of the students I talk to are going for the same thing. As a career counselor, it's convenient that so many of my students*

are trying to solve the same problem. (A3)

Prestigious employers, matching those studied by Binder et al. (Binder et al., 2016), have highly competitive recruiting processes, with salaries among the highest offered to new college graduates. Within this case, I found specific companies were prioritized over others; again the career counselor:

I think for most students, they're like, 'I wanna go to, like, one of the big companies', so that's why they're like: Facebook, Microsoft, Google, Amazon (A3)

These companies formed a colloquialism, the "Big Four" within this case, referring to the four largest department recruiters.

A simple definition of normative career practice might examine jobs frequently selected by recent graduates, and, indeed, out of 470 students that responded to the department's 2019 graduation survey (when this work was performed), 312 planned to be employed (66.4%) and of those 312, 152 planned to be employed by Big Four companies (48.7%) [4]. Granted, Big Four employment was not exclusive; survey results show a long tail of other employers (over 80), but no company outside of the Big Four hired more than 8 graduates.

However, I emphasized student career preferences in the analysis, following prior work (Binder et al., 2016), and found that students who internalized systems of career prestige came to delineate between forms of future work, based on the work's affinity to prestige. In this case, I found that among many students this belief was absolute, outside the realm of opinion, and forming an "arbitrary distinction" (Bourdieu, 1977) between firms. In this work, one student described occupational preferences through a tier list.

I guess the top bar would be like…Amazon, the big tech companies that pretty much everyone knows. (Then) a respectable start up, right? That's like growing explosively…Um, and then below that I think it kind of breaks down into more like, industry specific things, right? (S10)

Interpreting "the big tech companies that pretty much everyone knows" as Big Four com-

[4]Unfortunately, existing data only asks about student plans, rather than where students actually end up

panies, in this list, Big Four companies received the most legitimacy within departmental norms. I asked where their perceptions of this tier list came from:

> *Things like what people say in, um, Blind…CS Career Reddit* [5] *…Um, (A3), the career seminar…Um, and then friends and coworkers at the various places that I worked at. I would say (the rankings have) been pretty consistent. (S10)*

The consistency of rankings from sources outside the departmental *field* aligns with Bourdieu's Theory: a *field* is not isolated, rather it exists within larger *fields* and often aligns with established routes to capital within these larger *fields*. From this student's experience, departmentally legitimized career *capital* was consistent within and beyond the departmental *field*. Other participants were less explicit about tier lists, but I consistently found Big Four companies prioritized or named as normative career practice. S4, for instance, saw Big Four companies as a departmental norm, and felt insecure measuring up to others pursuing careers in line with that norm:

> *When I started kinda looking for jobs I- I just had like no interest in applying for like, Microsoft or Google or anything…I can't really explain why. Uh, maybe it was just 'cause like I felt like, uh, just because like everyone applies there, you know? Just, yeah, feeling like I just couldn't really stand out, uh, that much from like anyone kinda here. (S4)*

For prior work (Binder et al., 2016), and Bourdieu's theory broadly, one's success is inextricably tied up with how *field* members perceive routes towards *capital*, and success and *capital* are frequently equated. Some students' beliefs in career *capital* were outside the realm of questioning, however, others were able to surface their perception of departmentally legitimized *capital*. S2, a CS junior, offered:

> *If you get into the Big Four, you've made it? You know, I think it's a form of getting validation for me…I think that a lot of people say 'they specifically have the resources available for me to do this project'…But maybe like, subconsciously, everyone (thinks)*

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[5] `https://www.reddit.com/r/cscareerquestions/`

> *'I must be a successful person. Um and if I (get a Big Four job), that's like the next step in being successful person. So that's what I must aim for'. I think that's maybe under a lot of people's heads. Um just cause that's definitely under mine. (S2)*

3.4.2 Enforcing and Reinforcing

Given the situated nature of this work, I chose to specifically examine the modes of reproduction. Within a *field*, Bourdieu emphasizes that notions of *capital* are not given, rather members enforce their own adherence to norms and the adherence of others (Bourdieu, 1977). This enforcement is especially powerful when performed by those with capital (*dominators*, in Bourdieu's language), but can also be performed and enacted by those without (*dominated*, in Bourdieu's language) (Bourdieu, 1977).

Given a norm of career practice that led students to prioritize prestige broadly, and Big Four companies specifically, I found three mechanisms by which *field* members reinforced and strengthened student adherence to that norm. First, organizations with established capital were given space to create recruiting footholds within the department. Second, departmental career advising assumed alignment between students' *habitus* and departmentally legitimized career *capital* leaving little space for students to explore alternative modes of career success. And third, courses and curricular objectives emphasized preparation for careers in line with departmental career norms, at a pace that left students little space to consider much else. I discuss each in turn, and note that not every participant could name career norms — in this section I primarily draw from those who could.

Using established capital to gain capital

Bourdieu emphasizes reproduction of existing social hierarchies as members with capital utilize their power and position to obtain more capital. Within the department, I found that organizations with established capital utilized their position to gain more capital, in the form of student job applications, employment positions, and renown within the CS department. Organizations, especially larger, established entities like the Big Four, used their existing

capital to recruit more effectively than smaller companies, recognized by a senior-faculty program leader when describing student career decisions:

> *I'm so proud of our students, they do so well, but I think a lot of times they follow their friends from the year before and they stay within the guard rails and they do what they've seen, seen to be the normal…a lot of them prefer the larger companies, some of it is risk aversion. Some of it is the (larger) companies can just beat the mid-sized companies and the start ups because they're using their resources effectively to win at recruiting…And a lot of this is inertia…go where your friends go. And recruiters go where they've recruited great employees in the past. So it's just literally straight up inertia. (L1)*

In their simplest forms, established pipelines (or, funnels, from prior work (Binder et al., 2016)) between university and industry lead students to prefer organizations emphasized within those pipelines. To restate in Bourdieusian terms, notions of *capital* within a *field* are self-reinforcing and self-replicating as members choose actions legitimized as ways to gain and maintain capital.

Beyond pipelines between organizations and academia, several participants noted career norm signaling from explicit markers in their academic space. Specifically, one CS building prominently featured names of organizations that supported the construction of the building, primarily Big Four companies and others with established *capital* with which to finance support. An advice-giver described the results of a student survey on this naming;

> *The students were like, 'It feels like (the CS department) is only pushing us to work at these big companies,' right? Because they're named. And that is a true perception. And we were like, we didn't think about that, but also, building is expensive. Like someone's got to pay for it. (A2)*

A student also emphasized that company names on rooms and buildings in which courses were held gave a clear signal of legitimacy:

> *It really normalizes going into big tech just after undergrad. Which I think implicitly*

> *normalizes not going down other paths, and not asking questions of these big tech companies. I mean, this is what makes (the CS department) money, right? (S1)*

Here, the "inertia" between firms and the CS department affected student career outcomes, but also students' academic space whereby only companies with sufficient *capital* could be named within this space.

Advising assumes aspirational alignment

From my interviews, I found several routes for students to receive career advice: the department's career counselor, the department's career seminar, advice from advice-givers beyond the career counselor, and a variety of routes outside the departmental *field* (e.g. friends, family, and faculty outside the department). As this chapter's focus is the departmental *field*, I examined the advice that students received within it. I found that advice from within the *field* tended to assume alignment between students' *habitus* (in the form of career aspirations) and departmentally legitimized career *capital*; that students would follow career norms, and that little space needed to be left for students to examine and assess their career aspirations.

This work was performed as part of a larger project that examined career norms across two departments, and within that larger sample I found two types of career-advising: mechanics-based advising and situated advising. Mechanics-based advising looks to teach the mechanics of job seeking to prepare students for applying to a variety of jobs — this might include résumé reviews and mock interview sessions. In contrast, situated advising work with students to assess their values, motivations, and various competing factors that leads them to choose certain jobs over others. The two are not strictly distinct, a single advising session might begin with situated advising to assess student motivations to better inform feedback for a résumé review; modern career counseling recommends approaches that incorporate both (Busacca and Rehfuss, 2016). However, without situated advising to understand student motivations for their work, I found that exclusively mechanics-based advising within a *field*

tended to assume normative alignment, as no space is made to understand student's personal disposition.

Within CS, I found that advice-givers tended towards mechanics-exclusive advising, and situated advising was seen as unnecessary or beyond students' capabilities. I center the department's dedicated career counselor in this work as they were the most frequently cited source of career advice for students, and because their position explicitly centered advising, whereas advising was a more ancillary job component for other advice-givers. They offered their perspective:

> *Do (students) understand, what motivates them? Like, and how do they bring that into (their) job? Like, even if a student thinks that they know what they want, I'm always like, 'You just have to go and get more information, because there's nothing here in school that can teach you'…I think it's, like, literally they don't have the apparatus to even think about, like, how you should even think about that, you know? It's like that Maslow's pyramid thing, right? Like, our kids just don't exist in that, that upper triangle. (A3)*

They also taught the department's career seminar, another source of career advice, and noted that the advising was primarily mechanics-based as well, prioritizing preparing students for technical interviews. Occasionally, students experiencing dissonance between departmental career norms and their own *habitus* would come for advice, but this was rare:

> *It's maybe once a month that I have a kid in my office being like, "I actually don't want to be a software engineer, and I don't know what to do now." But, for the most part, most kids do want to pursue software engineering and that makes my job as a career counselor easier because I have a lot of experience helping students pursue that. (A3)*

I found that adherence to departmental career norms was largely left unquestioned and that situated advising was only available if students specifically asked for it. Situated advising could constitute critical discourse, space to critique departmental career norms, but the career counselor was unconvinced that this type of advising would be helpful for most students:

> *We can talk about job content, but also, at the end of the day, and this is probably just me being really jaded, like, it's all the same shit. Corporate America is all the same shit…like, you are building things to make the company money…Most kids are gonna just go to make money somewhere, and that's totally fine. You know? (A3)*

Beyond the department's career counselor, I asked other advice-givers if they would help students examine their own career motivations, and give space for students to deconstruct departmental career norms. One offered:

> *I think it's important (to make) sure that they're thinking about things, like I don't really just want all of the students to go be cogs at Google and Facebook. Not saying that you can't work at Google and Facebook. Um, but if the only thing you care about is money... Not that you shouldn't care about money. Um, but like, if, you aren't thinking about impact on people, that's not great. Like, would you be happy there? That's something maybe they don't think about. Would you be doing something that you think is making the world a better place? Not saying that you have to be a, like a poor person that's only doing charity work your whole life. (A2)*

I offered a hypothetical space through which this advice-giver navigated with tentative statements and conversational hedging, which signals that this space may have been unfamiliar — they were unsure of exactly what they felt comfortable expressing to students and where an intervention felt possible. While uncertainty to intervene against established norms is understandable, this investigation did not find any official context within which students could examine departmental career norms and career beliefs. Primarily, I found that departmental career advice was focused on preparing students to succeed in applying to prestigious organizations that fulfilled the departmental norm.

Courses and curricula optimized for prestigious jobs

Academic courses are the primary mode of interaction between students and departments, and, while CS courses were not explicitly focused on career funneling, departmental career

norms found hold in students' coursework. First, as students came to prefer firms aligned with departmental norms, course material came to reflect the narrow reality of student career experiences. One advice-giver that previously taught data structures worked to meet student motivations:

> *You want to motivate your work. And the majority of your students are going to go work at internships at big companies. And so you make your example kind of about these. (A2)*

They also recommended the department's teaching assistant program to students looking for ways to prepare for technical interviews, framing one's decision to teach within departmental career norms.

Beyond a specific course, several participants noted that the pace and rigor of coursework left little room for career reflection. A program graduate emphasized how course content, independent of motivation, could lead students towards big tech companies:

> *Preparing graduates does not mean allowing them to think in a reflective manner about, software about…staples in (CS). It means they need to learn how to do Paxos so that they can understand a distributed system…so that they can go work at whatever it is (G2)*

From their perspective, course curricula optimized for preparing students to gain career *capital*, as legitimized by the department, at the expense of other forms of career preparation.

For others, the intensity of coursework meant that finding a job became another task on an already long list. From a student:

> *This quarter was just really like, really hectic especially for the first half. I just wanted to get…the job kinda thing…out of the way, right? Like, I was like, 'I just need to get that figured out and then I can like, relax and just focus on school or whatever.' (S4)*

Another graduate (G1) was looking for work "anywhere where the name doesn't make you shudder", and beyond that, felt that the job search was another chore to complete:

> *To be able to get (the job search) done as soon as possible was just great. Looking at it*

in the simplest terms um…like a chore, you know. I need to clean my bathroom, like I can put it off or I can just get it over with. (G1)

While the intensity of students' coursework left little space for much else, career reflection was largely absent from CS curricula. A program graduate, in addition to noting the "ridiculous" amount of work, observed that career reflection (and metacognition broadly) was entirely absent:

I mean everyone knows that none of (students' experiences), uh, (laughs) are related to metacognition. (laughing) You don't find that in getting all your tests to pass, You don't find it in, you know, the grades that you need to get in to be in the major (G2)

They explicitly named departmental career norms and existing modes of replication in my interview, and identified career beliefs among other students that seemed wholly unquestioned:

So, why is it that I didn't feel I was valued, by that kind of cohort? Because I think that they, unfortunately, have been taught to be automata. And, (laughs) that's like, that's so sad. (G2)

I asked a senior-faculty program leader if there was curricular space for career reflection, they also felt that curricular demands might interfere:

Um. We're trying to do more of that.…I could point to bullets on slides or discussions in classes, but if you asked the students they'd probably say no and therefore they're probably right. (laughs) I'll think we're trying. And I think it is there. But it'd be easy to blow by when you're trying to understand Djekstra's shortest path algorithm. (L1)

3.4.3 Students' Experiences: Aspirational Affinity

At the time of their interview, most students had aligned their career aspirations with departmental career norms, prioritizing prestige. Not all students chose Big Four opportunities, many chose work that was less prestigious, but still fulfilled existing norms, following the "rules of the game" within the departmental *field*. The analysis team categorized the ma-

jority of students and graduates (7 students, 1 graduate) that I interviewed as aligning with these norms, opting for software engineering work that centered prestige without experiencing crises (in contrast with those I discuss later in Section 3.4.4). Among the participants that I interviewed, this was a narrow majority, but I believe that most students within the department would fit this category, as the recruitment messaging in this work likely attracted students feeling some degree of emotional conflict or crisis.

Alleviating Uncertainty

Among the students that opted for prestigious work, few justified their choices by emphasizing prestige. Following prior work (Binder et al., 2016), several students chose prestigious majors and employment as a way to alleviate uncertainty around one's future career interests. As rationale, Daoust notes the effectiveness of prestigious organizations in convincing students that working elsewhere entails risks (Daoust, 2020).

I found this to hold for student career prospects, but also for their choice of major. For one, their choice to pursue a prestigious CS major allowed security around career interests that could change over time. They described their decision to pursue CS over other degree options:

> *It's hard to get into CS but it's easy to leave. So, I thought, 'I'll go for the most competitive thing that I'm…interested in.' And then hope that I can leave it. So I guess to me it was less like, 'Oh I have to make a decision now.' It was more like here's time to play the system. (S9)*

For this student, the competitiveness of the department, intertwined with notions of an elite institution, drew them to pursue CS:

> *I think we would all love to say that's not part of it. But I think that it was, you know, the competitiveness is a draw because it allows me to hedge my bets. You think, 'Yeah, there's a reason it's competitive. Like, this must be something good.' (S9)*

Prior work notes competitiveness as a potential draw of elite institutions (Binder et al.,

2016), here opting for a competitive major allowed for "hedging", a sense of security against the uncertainty of changing career aspirations.

This student's beliefs were not unquestioned, they understood their choice to pursue prestige as a conscious choice. However, prestige was not the stated object — for them and many others, prestige was a means to some other end. This student mentioned a desire to teach, but predicted that it would be more likely for them to end up at a Big Four company than a not-for-profit, as the Big Four company would allow them to explore many potential interests. Another student voiced the same rationale, hedging future interest development:

> *Um, it was kinda split between big companies where I knew they would have like all sorts of roles that I could like find something that I would be super interested in…I was like finding big companies, like Amazon or Google…I know they have these opportunities um, so that is where I'm currently planning on going. (S8)*

Others emphasized a desire for resources and support to grow, which, from their perspective, was most available at prestigious companies. One student specifically named the Big Four earlier in their interview:

> *Um, I think right now, what I'm considering is sort of, um I wanted to work for like a bigger corporation on my first new grad because I feel like they have the resources to train you and to grow you. Right now, I don't think that I'm actually going to be able to have too much impact on any product. Because you know, that these things are designed so then you're sort of a small cog. (S2)*

Deferring Impact

Binder et al. (Binder et al., 2016) note that when asked about career trajectories within the 5-10 year time frame, many students centered impact, opting for careers in healthcare, research, or entrepreneurship, career aspirations that students felt were contingent on a prestigious first job. While some students in case emphasized goals other than prestige in their career search, most that expressed desires for impact-oriented careers opted to defer

those desires in favor of prestige for their first job. S9, who framed their choice to major in CS as a "hedge" against future interest development, described their career choice in a similar way:

> *Yeah, so when I see my career through that five year lens of you know, big company and then uh lecturing or smaller company that does something that's education based. But I guess I just think of that because um, I realize that I'm hedging my bets in some ways by going to a large company with the assumption that it may uncover a new interest for me. (S9)*

S8 also mentioned strong interests in education and they were considering graduate work, but chose an internship at Amazon over work with greater personal alignment:

> *Um, it was a few things. I definitely like feel emotional conflict about working for Amazon…but like on the other hand, it's a very good offer and like money is a thing that I need to live. So in that respect, I'm just like this is the best offer that I've gotten. [good offer?] Oh, just in terms of salary, relocation, benefit's, stuff like that. (S8)*

Prior work found that students' insecurities, born from stringent comparison to other elite students led them to opt for high-status careers (finance, consulting, tech) over low-status careers (teaching, social work) (Binder et al., 2016). In this case, I found that students' insecurities limited the scope of job options that felt accessible. Some saw prestige as a temporary necessity to gain industry experience; S2 felt that they weren't established enough to find work beyond "a small cog" (see Section 3.4.3), likewise, S5 felt they needed to break into the industry first:

> *Well, my current plan is to try to get hired at a big- bigger company or maybe just to break into the industry, get some experience. Uh, not necessarily stay there, because like, well, I have an idealistic hope to help the world more than harm it. And so, you know, working at, like, Amazon and just having... Like, getting money and, I don't know, donating some of it wouldn't necessarily be the best use of... That's how I feel about it. [Which bigger companies?] Not Amazon. So, like, being at Microsoft would*

be a great resume thing. (S5)

Another felt that work-value alignment was unreasonable:

I guess like when…I like…realized like it was probably like unreasonable for me to go to grad school and…to like get a job where I felt like the mission aligned with my value right away it's like that's the next thing…[why?] Um, maybe I didn't have the skill sets to get the jobs at those companies, I don't know (S3)

For others, centering prestige was an inevitable result of a competitive recruitment process. S7 wanted to "help solve the problems of the world", offering the climate crisis as an example, but felt like they would probably end up "somewhere like (Amazon Web Services)", somewhere that centered prestige over social impact. I asked why this felt inevitable, they replied that the number of "really cool jobs" that centered social impact felt limited when compared with the number of jobs centering prestige:

I guess the way that I see it is, there's only a limited number of really cool jobs out there. And those are the ones that everybody wants. So they're the most highly competitive, especially at the, especially at the entry level…there's a lot of like, amazing, amazing undergraduate students that are coming out here. And so, uh you know, not necessarily comparing myself to them, but also at the same time kind of comparing myself to them, right? It's when when an employer is looking for who they're going to hire they're going to hire the most qualified candidate, right? (S7)

While impact-oriented jobs did not fit notions of career *capital* legitimized by the department, the competitiveness of the departmental *field* nevertheless precluded this student from pursuing more impactful work.

3.4.4 Students' Experiences: Crises

The majority of students and graduates within CS described career aspirations aligned with forms of career *capital* legitimized by the department, prioritizing prestigious work without crisis or dissonance. However, Bourdieu notes that those without positions of *field* power (i.e.

students in the department) have a special interest in deconstructing existing notions of *capital* (Bourdieu, 1977). This deconstruction requires work (as described in 2.3), but departing from established norms may enable students to chose roles that offer greater fulfillment, at a time when students are just beginning to establish their career aspirations (Binder et al., 2016).

Within the CS department, many students and graduates described some degree of dissonance or emotional conflict, but few (2 graduates and 4 students) articulated that conflict into a crisis during our interview. Among the students experiencing crises, the analysis team found that: (1) crises predominately originated from a conflict between participants *habits* and the limited forms of career *capital* legitimized by the department, (2) the critical discourse necessary to question one's belief in departmental career norms only occurred outside the department, and (3) engaging with work that conflicted with departmental career norms required substantial effort from participants. Rather than present data around these themes, I opt to share stories along the trajectory from crisis to critical discourse and resolution, emphasizing the barriers that participants' experienced.

Selling Out and Inadequacy

I begin with one student whose crisis, at the time of our interview, came from conflicts between perceptions of the department and the career choices available to them. Early in our interview, S3 noted that the reputation of CS majors on campus was "cut-throat", and that being a CS major meant they were a "sellout", creating a dichotomy between other students who could connect their values with their work and CS students who prioritized career prestige (i.e. Big Four jobs) and financial gain. As application season came around, they felt it was unreasonable to find work where the mission aligned with their values, and, as such, they were unsure why they wanted a job in the first place. They had signed an offer at the time of their interview, and reflected:

I definitely feel like a sellout. I'm not even like working for a big company or anything

> *but I still just feel that way…my work won't be helping (to create equality in the world) at all. (S3)*

While students taught within a prestige-centering *field* are certainly not required to adhere to departmental norms, S3 perceived few legitimate alternatives to enacting that stereotype.

During our interview, the reality of their career prospects left them unfulfilled and scrambling. They asked themselves:

> *Like why do I want a job? Maybe I should've thought about a lot more before I even started searching for a job. [Do you want a job?] Well, I mean, I don't know. That's like something that I still don't know. Like I don't know that it's gonna be the most fulfilling thing. Not that that was like the main purpose, but like, you know. (S3)*

I asked why they felt that fulfillment was important to them, they replied "I don't know". In our interview, they mentioned that their role as a teaching assistant felt fulfilling, they felt that other avenues towards fulfillment existed, but they weren't sure what those avenues were.

Throughout this work, many students expressed feelings of insecurity and inadequacy, I pressed gently for explanations, and their responses indicated that pressing further could shift the interview tenor into an interrogation, potentially harming students. For one, however, I felt that I had established enough rapport to more concretely question existing norms and imagine alternatives without causing harm. Our conversation with S10 was similar to others in Section 3.4.3; they felt they needed to develop their skills before they could pursue more impactful work, and that prestigious companies would be the best place engage in that learning. Given this perception, they deferred career wants of "helping other people" in favor of positions more situated around professional development:

> *Um, I feel right now I definitely am in the "learning what it's like to be a software engineer". Um, so that would probably lead me away from risky companies. I want somewhere that's a little bit more stable and has the resources, um, to support software engineers, for the short-term…I feel like right now, given my limited experience, I*

> *would only feel comfortable sticking with what I know, which I know can't solve a lot of problems. And I feel like I want to gain more experience…before I'm ready to tackle like bigger, bigger problems that have the impact that I want. (S10)*

Similar to others in Section 3.4.3, S10 emphasized stability, deferring work that was in-line with their values and centered social impact for work legitimized by departmental norms.

Compared with S3, S10 felt little crisis around their work, but I wondered what could result from critical discourse within our interview. As S10 was one of my later interviews, I asked for specificity around insecurities, asking what needed to change before they were able to have the impact that they wanted, what would be different after 5 years at a prestigious company that would allow them to pursue impact.

> *Right. And I kind of, now that got me thinking too, is like I did- I had a smaller scale project (during my internship) that I actually did design, create and implement. I guess I do have experience kind of on a smaller scale of that. And now it's like, 'Well okay, I've done that on a small scale, what's stopping me from doing that on a bigger scale?' And I guess there is no answer, like there is no- yeah, I could do it on a larger scale, I do have that experience. Yeah there's nothing. (S10)*

Finally, I asked them to define where their notions of inadequacy came from, they responded: "Myself. That's uh…That's the problem." For S10, enacting a critical dialogue and scaffolding self-examination allowed for a recognition and some resolution of the inadequacy that I heard from many students.

While I scaffolded critical discourse for S10, a graduate, G3, leveraged the crisis of an academic failure to engaged in critical discourse on their own.

> *Me as, like, a person, I'm very introspective…This, like, one experience…I did horrible in this class, like, so bad. And, like, I-I just sat there, you was, like, okay, so, like, who do I want to be? Like, what kind of life do I want to live, versus, you know, like, versus what my parents want me to do, you know? (G3)*

For G3, the work of demarcating between legitimized forms of *capital*, both within the depart-

mental *field* and outside, allowed for broader reconsiderations of their work. I note, however, that for both S10 and G3, critical discourse occurred independent of the department; in my interview with S10 and independently for G3.

Considerable Work for Resolution

While most participants had yet to articulate a crisis or engage in critical discourse, two students described prior crises, mechanisms of critical discourse, and future plans to engage with work conflicting with department career norms. One, S1, experienced a crisis after being accepted into the department, when a department faculty member published an article critical of efforts to broaden participation in CS:

> *I read the article and he was just talking about why women don't code, and I was like, I'm not surprised, based on my experience in his class. But wow he really published this. I remember just questioning, like, 'Wow, is this, like, really what I want to go into?' But, I was, like, intent on pursuing EdTech. So, I went, whatever, that's really frustrating. (S1)*

This article surfaced dissonance between their values and legitimized forms of career *capital* within the department. They attended the department's New Major Orientation, but a lack of any discussion of the article alongside existing diversity efforts within the department led them to distrust department career advisors (A3 and others). Fortunately, they found mentorship from a professor outside the department, and engaged in critical discourse:

> *He would just, like, ask me questions and I would start bawling. (laughs) Especially during that first quarter in CS. That just, I feel like... Everything that I'm doing is at odds with who I am and what I value. (S1)*

This mentorship, and the critical discourse scaffolded within, allowed them to engage in work outside the department's career norms, but not without consequence:

> *And, (through my own research) I found out about like, this movement towards tech with social impact. I know that I can explore (EdTech and social impact) in, like, these*

different ways. Um. But I had to do it in such, like, a tiring way…I, like, was fortunate enough to be able to (go to Impact Labs in NYC). But, I had to go cross country to learn about these interests that I have. (S1)

S1 engaged in critical discourse outside the department to demarcate between the impositions of legitimized career *capital* and their own *habitus*, finding work outside existing career norms. However, it is critical to note the work and persistence required, both to separate from departmental career norms while maintaining major status, and to pursue more personally aligned work, rather than accepting existing norms.

For the participants that described a crises, spaces for critical discourse were critical to their ability to question established norms. However, the analysis team only found these spaces outside the department. I established this space for S10, S1 found space in another department, G3 established space independently and another student, S11, found space to question within industry. Like S1, S11 felt a mismatch between their sense of themself and their departmental experience that manifested into a crisis:

I was in CS, and all the CS courses were all technical, and everyone around me was trying to get a software engineering internship. So I was like, 'This is the path forward.' And I like coding. It's not like I don't like it. But then doing it for 40 hours a week, it's just like, is this the right track moving forward? (S11)

Without space within the department to engage in critical discourse and surface alternatives, they followed established routes of career practice and accepted a Big Four internship. However, they found mentorship within this position:

So I was at Microsoft, and (a project manager) told me, 'Here's what you should build.' And I was like, 'Why don't I get to decide that?' Like 'because that's my job'. And I think we had a conversation from there. (S11)

This conversation spurred an interest in product management; well-established within prestigious organizations, but outside of departmental norms that centered software engineering. After redirecting their career trajectory, they felt concerned about their ability to secure

positions within product management, so they looked to better understand the landscape:

> *Yep, so I was like, 'Okay, let me go ahead and do, um, you know, customer interviews. Go talk to PMs in industry' And eventually um, I …networked with around 10-15 PMs. Um, I just want and had coffees with them. So for one whole quarter every week probably get two- two coffees with someone and just talk with them about product …[So you- you did a user study?] Basically, yeah. (S11)*

S11 followed a similar trajectory to S1: conflicts between established departmental norms led to a crisis that was unresolved until they found a context for critical discourse. This discourse, over time, led to a change in their career direction. However, discourse alone was insufficient to change career direction; a considerable amount of work and persistence was required to secure work outside departmental career norms. siderable amount of work and persistence was required to secure work outside departmental career norms.

3.5 Discussion

My findings hold consistent with Bourdieu's theory, and provide nuance into the landscape of CS students' career experiences. Participants described a highly selective and competitive CS department, similar to "elite" institutions described in prior work. Through investigating my research questions, I found that the primary career norm within this CS department was to choose highly selective, prestigious firms, which led students to primarily pursue work at the "Big Four": Microsoft, Facebook, Amazon, and Google (RQ1). Unquestioned norms have a tendency to become self-reinforcing; within this case I found three mechanisms of reinforcement (RQ2). First organizations with established capital utilized that capital to create recruiting footholds within the department to "win at recruiting". Second, departmental career advising assumed alignment between students' *habitus* and departmentally legitimized career *capital*, leaving little space for students to explore alternative modes of career success. And third, courses and curricular objectives emphasized preparation for departmental career norms at a pace that left students little space to consider alternatives.

For those with capital within a field (i.e. students), Bourdieu argues that a crisis is necessary to adopt a reflexive stance with which to examine established norms, along with a critical discourse to demarcate between norms and opinion (Bourdieu, 1977). For students whose career aspirations were aligned with departmentally legitimized career *capital*, crises were largely absent: students chose prestige to alleviate uncertainty around changing future interests, for the perceived potential for growth that prestigious firms offered, and because work with greater personal alignment felt inaccessible without gaining *capital* from prestigious work first (RQ3). Those that experienced crises were able articulate career goals independent of departmental norms, but only if they engaged in critical discourse and found space for the considerable work required to resolve a crisis (RQ3). I found no official space for critical discourse within this CS department; the combination of norms and reinforcement left many students to endorse prestigious work, despite more pro-social career aspirations.

These results also expand interpretations of prior equity and inclusion efforts in computing education. This body of work has focused on students' choice to study computing and their persistence within computing majors to surface causes of underrepresentation across gender and race (Margolis and Fisher, 2002; Teague, 2002; Margolis, 2008), but the focus has been primarily on entry, rather than exit. The prestige-centric career norm that I surfaced in this work aligns with agentic goal orientations (those that emphasize performance or achievement), leaving little space for communal goal orientations (those that emphasize collaboration and helping others) (Diekman et al., 2010). Prior work has explored links between goal orientations and career choice; Lewis et al. (Lewis et al., 2019) found that cisgender women and racially minoritized students in computing tended to have higher communal goal orientations, and Wang et al. (Wang et al., 2015) found that students seeking social-impact oriented careers were less likely to study CS. Meanwhile Ross et al. (Ross et al., 2020) found that women introduced to CS in school were less likely to chose CS careers, suggesting that outreach methods that utilize exposure may not be effective in engaging participants with computing. Given these results, it seems broadening participation within CS would be unsuccessful without addressing legitimized career norms, following conjectures from Kallia

and Cutts (Kallia and Cutts, 2021).

This work was an exploration of normativity within CS careers; many avenues of future research exist. As this work only looked at learners within CS, it suffers a survivorship bias, ignoring those whose conflict exceeded their capacity to manage it. As prior work has looked at students' decision to not pursue CS (Margolis, 2008), future work could uplift narratives from those that opted against CS due to a lack of fit, or a lack of belonging. Additionally, this work examined a single elite department; future work could examine career norms in other computing spaces, especially ones without this department's highly competitive backdrop. However, as norms within elite institutions are supported by prior work (Binder et al., 2016; Daoust, 2020), future work also could look to intervene, aiming to improve belonging for students experiencing dissonance and improving cognizance for others. Those with dissonance are likely to be the best guides through existing norms and while some work has examined tensions among students considering CS (Vakil, 2020), future work could expand these efforts into domains of computing practice (industry professionals and faculty, as two potential options).

Given the career norm and mechanisms of reinforcement surfaced in this work, and that these likely hinder inclusion efforts, some clear steps exist for CS departments. As students will likely come to computing spaces with an existing *habitus*, and a corresponding set of assumptions, departments and educators should create space for students to question and interrogate their own assumptions. Freirian problem-posing (Freire et al., 2018), person-centered therapy (Rogers et al., 2015), counter-stories (Solórzano and Yosso, 2002) and counternarratives (Miller et al., 2020; Kirdani-Ryan and Ko, 2022) all offer mechanisms for surfacing assumptions of learners and presenting one's *habitus* as an object of critique. For those with power within CS, broadening the legitimized forms of career *capital*, or, better yet, enacting a career support practice that "takes nothing for granted" (Nash, 1990) in line with Freirian (Freire et al., 2018) and Bourdieusian pedagogies (Nash, 1990) could have a dual effect of allowing individuals and groups (Wang et al., 2015) to find holistic belonging within CS, rather than be seen as "sellouts". A practice of empathetic "not knowing" would

aim to assume as little as possible and encourage questioning; this practice of surfacing underlying career assumptions and re-authoring career narratives is well-supported (Busacca and Rehfuss, 2016). However, this space for questioning must be made explicit as many students may be either unaware of existing assumptions or negotiating "situations replete with contradictions" (Holland, 1998) resulting from other mechanisms of marginalization (Rankin et al., 2021; Erete et al., 2021a).

Finally, these findings raise a critical question: who do we want our students to become? Some have described computing as a "discipline in service of society, its people, and their needs" (Committee et al., 2016; Fincher and Robins, 2019), and broadly, theories of social learning describe how participation within a *field* is a process of identification, a process of "becoming a certain person" (Ison, 2010a). Who do our students become, by virtue of their participation in CS? These findings, substantiated by prior work, argue that students replicated the prestige-centricity of their institutions, and while this benefits established organizations, it limits students' capacity for self-expression within their careers. I hope that, somewhere over their lifetime, students take space to deconstruct their own *habitus*, but I am uncertain where this would occur. Universities are likely one of the most intellectually diverse spaces that students encounter throughout their lives, and, in this case, departmental career norms limited the diversity that students could express, and the diversity that they could experience in career aspirations of others. What would happen if we taught students to form their own career response, rather than to replicate the career response that was assumed of them? Furthermore, I wonder how the diversity of careers, and expectations of careers in computing change if computing education researchers and practitioners made space for students to consider themselves in their careers, rather than pursue prestige at the behest of their institutions.

Chapter 4

NEURODIVERGENT LEGITIMACY IN COMPUTING SPACES

In Chapter 3, I described prestige-centric career norms that both inhibited students' agentic expression and also resonated with my own experience. After completing this work, I could restory some aspects of my time in computing — I pursued prestige at the behest of my institution, found the fanciest job that I could, was thoroughly unfulfilled by the experience, and eventually transitioned towards work that offered more fulfillment. However, even while reflecting on this disconnect, I recognized that so much of me still with within computing, and through the work within this chapter, I began to explore why I still found resonance within computing culture.

At the time that I began this work, I was coming to terms with my own neurodivergence, and, in my view, found that many of the parts of myself that I named as neurodivergent resonated in computing despite lacking affinity in nearly every previous context of my life. Thus, in this chapter, I explored manifestation of neurodivergence in computing, aiming to assess whether the cultural fit that I experienced was due to legitimization of my own neurodivergent traits. Largely, I found alignment; computing spaces refuged aspects of my identity that typically caused friction, but I also found that this legitimacy was narrow, and was typically utilized to police neurotypic expressions that failed to fit. With regards to my thesis statement, this chapter offered context for the fragmentation that I describe in Chapter 6, and primarily clarified that dominant disciplinary norms can contradict societal legitimization, as well as mirror it (as described in Chapter 3).

4.1 Introduction

For computing to be a discipline in service of humanity, all individuals must be able to feel that the discipline is a space for them. To this end, it is critical that newcomers to computing[1] (and individuals within computing) feel that they belong (Walton and Cohen, 2007), that the spaces are personally relevant (Madkins et al., 2019), and that their presence within these spaces is not incidental or temporary, but rather situated within their existing personhood (Calabrese Barton and Tan, 2020a). In one sense, this work involves reauthoring and reconstituting existing computing spaces; in another sense, this work requires supplanting dominant narratives that shape newcomers' affinity to computing (Miller et al., 2020; Ko et al., 2020). To make space for all computing learners to feel that their whole identity is legitimate in computing, without compromise (a rightful presence) (Calabrese Barton and Tan, 2020a), prior work extensively notes the role of stereotypes and perceptions in newcomers' decisions to pursue study in computer science (Master et al., 2021; Cheryan et al., 2015a, 2013).

However, while prior work has given direct attention to gender (Margolis and Fisher, 2002; Wendy Dubow et al., 2020; Menier et al., 2021), race (Erete et al., 2021b; Margolis, 2008), and the intersections between these (Ross et al., 2020; Erete et al., 2021a), prior work has only indirectly attended to neurodivergence within computing spaces (Spiel et al., 2019) and intersections between neurodivergence and other axes of oppression (Brown et al., 2017). Similar to narratives that deconstruct how race and gender shape power relations and marginalized individuals (hooks, 2015; Butler, 2006; Donna J Haraway, 1985), neurodiversity paradigms (Walker, 2021) look to deconstruct the mechanisms that privilege certain ways of thinking and being (*neurotypes*[2] in this work) (Broderick and Ne'eman, 2008; Leadbitter

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[1] I use "computing" as a shorthand for the socio-cultural spaces in which computing is performed.

[2] Prior work primarily uses "neurotypes" to linguistically differentiate between autistic and non-autistic individuals, I use the term to distinguish between neurodivergent identities more generally (i.e. extending to other pathologized and non-pathologized cognitive differences). One's neurotype is not a static construct, nor is the neurotype expression perceived by others.

et al., 2021; Legault et al., 2021; Singer, 2017). Primarily, neurodiversity narratives have built from autism advocacy (Dyck and Russell, 2020), but recent scholarship (Gillespie-Lynch et al., 2020; Spiel et al., 2022) and advocacy (Kras, 2010) look to broaden to other aspects of neurodivergence, and beyond neurodivergence as an identity solely held by white, upper-class boys.

While neurodiversity narratives on a societal scope are explicit about which neurotypes are privileged over others (Leadbitter et al., 2021; Hull et al., 2017; Legault et al., 2021; Norbury and Sparks, 2013; Silberman, 2016), narratives surrounding neurotypes in computing are often implicit. Historically, dominant narratives (Miller et al., 2020) purported that one's programming ability was innate, rather than a learned skill (Ensmenger, 2010), and potential programmers were diagnostically identified by their interest in problem-solving activities and their disinterest in people (Perry and Cann'On, 1967). More recent discourses have emphasized the so-called "geek gene" (Ahadi and Lister, 2013), that those who succeed in computing have a "different internal wiring than most in the population" (Guzdial, 2014). While evidence for a "geek gene" has been shown primarily to be instructor bias (Patitsas et al., 2016) and no test has successfully measured programming aptitude (Robins, 2010), the core of this belief seems to point at an inherent cognitive difference in computer scientists relative to the general population. This belief is waning, but prior work has found that computing is stereotypically perceived as a socially isolated practice, performed by White and Asian men who are obsessed with computers and lack interpersonal skills (Cheryan et al., 2013, 2015a; Margolis and Fisher, 2002; Campbell-Kelly et al., 2014). However, to my knowledge, no prior work has examined neurotype legitimacy: how these stereotypes, beliefs, and narratives privilege certain neurotypes and reward specific expressions of these neurotypes.

Therefore, defining neurotype expressions as the ways in which one's neurotype is presented[3], I ask the following research questions:

- What neurotype expressions are legitimized in computing spaces?

[3]I point to discourses between gender identity and gender expression as an analogue.

- How do members of computing spaces relate their own experiences to these legitimized neurotype expressions?

Given the lack of prior work examining the legitimacy of neurotype expressions in computing, I chose to center my investigation on legitimacy across neurotypes. I incidentally attend to intersections between neurodivergence, race, and gender, but leave specific intersectional examinations as a focus for future work[4].

4.2 Prior Work

As any landscape of oppression contains both those that are dominant and those that are dominated (Bourdieu, 1977; Freire et al., 2018; Costanza-Chock, 2020a), the history of neurodivergence constitutes a fraught and complex space. The primary goal in this work is not to give a history of the ways that scholars and the academy have treated, and continue to treat, neurodivergent individuals as less than human: those resources already exist (e.g. (Silberman, 2016; Price, 2022; Williams, 2019; Spiel et al., 2022)). Rather, my goal is to utilize prior work for methodological guidance, and to avoid well-worn paths of subjugation and manipulation.

4.2.1 Neurodiversity

Historically, work investigating interactions between neurodivergent people and society falls under disability studies. Similar to work within feminist studies that examines experiences of those marginalized due to their gender, or work within critical race theory that examines experiences of those marginalized due to their race, disability studies examines the experiences of those marginalized due to their ability. Critiquing "medical" models of disability that center an individual's physical condition, prior work articulates a "social" model that presents societal and structural factors as more central to the marginalization experienced by

[4]As with Chapter 3, I use singular pronouns throughout this chapter, and note that this work was co-authored with Amy J. Ko, and is currently in-review.

disabled people than one's embodied status (Oliver, 1990, 1996). For instance, while medical models of disability frequently center biological and physical differences (*impairments*, when viewed negatively), social models typically focus on the forms of systemic oppression that manifest against those who are seen as impaired, and the ways that individuals are *dis-abled* through marginalization. Approaches primarily utilizing medical models are often individualistic and focus on "fixing" an impairment: for instance, by providing screen readers that enable computer use for those with impaired vision, or by developing cochlear implants for those with impaired hearing (Mankoff et al., 2010b). In contrast, approaches primarily utilizing social models (Oliver, 1990, 1996) focus on fixing systems, not people by, for instance, pushing for legislation that requires that public spaces be made accessible. Social models of disability and subsequent postmodern/justice-centric models emphasize power imbalances between those with disabilities and those without, and seek to center the self-determination and agency of disabled people in deciding which courses of action are best suited to them.

Conceptually, neurodiversity movements (Walker, 2021) build upon disability studies to question whether cognitive disability results from innate qualities of an individual, or from the structural harm experienced by moving through spaces designed for dominant neurotypes (Singer, 2017; Leadbitter et al., 2021). In addition to movements for autism advocacy, neurodiversity paradigms build from critiques of neurological normativity (Stephens and Cryle, 2017; Sinclair, 1993) which frame psychiatric pathology as a mechanism for policing deviations from neuronormative expectations (Foucault, 1988). Neurodiversity movements question deficit-centric pathological framings (e.g. the DSM-5 (American Psychiatric Association, 2013)) through a central premise: that variation in neurological function is a natural component of human variation. Critiquing existing neurological medical models that utilize deficit-framings to pathologize variation, many proponents of neurodiversity paradigms do not view neurodivergence as an impairment. Rather, utilizing social models of disability, some argue that neurological variation is only a disability within a society that does not make space for those that fail to adhere to established norms. Many neurodivergent individuals[5]

[5]While prior work emphasizes person-first language, some neurodivergent people reject it, arguing that

do not view these norms as fact, but rather as a socio-political standard that creates power imbalances across neurotypes, imbalances that neurodiversity movements seek to equalize (Gillespie-Lynch et al., 2020).

Because existing neurotypes have primarily been defined through the medical model, the language used to define neurotypes tends to position difference as deficit. For instance, autism is officially defined as a "triad of impairments": deficits in social-emotional reciprocity, communication, and developing/maintaining/understanding relationships (American Psychiatric Association, 2013). Much of prior autism theory has been dominated by "Theory of Mind" discourses: that autistic people lack a mechanism for modeling others as distinct from themselves, leading to a total lack of empathy and understanding (Dinishak, 2016). Interventions centering the medical model often view these deficits as a disorder that requires a medical cure (Kras, 2010), but many neurodiversity advocates note that these "deficits" largely result from a mismatch between modes of communication and expression. Critiquing deficit-centric diagnoses, recent work notes that rapport between matched neurotypes (i.e. two autistic people or two non-autistic people) is rated significantly higher by participants and observers (Crompton et al., 2020a), and indicating that listening with verbal responses seems less important in interactions between autistic people (Rifai et al., 2022). Recent work also challenges "Theory of Mind" discourses, noting that prior work correlating empathy deficits and autism was largely based on cognitive tests that lack ecological validity, and that more ecologically valid measures have shown no empathy differences between autistic students and their non-autistic peers (Chapple et al., 2022). Current theory posits the "double-empathy" problem: the notion that individuals with different neurotypes (autistic and non-autistic) will mutually struggle to understand each other (Crompton et al., 2021), over prevailing associations between autism and communication deficits.

For all the epistemological issues with present diagnoses, a diagnosis is often still necessary to obtain institutional support, and receiving a diagnosis is an imperfect and fraught

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they should not be required to remind people of their humanness (Botha et al., 2022; Kenny et al., 2016; Bottema-Beutel et al., 2021)

process. Autism diagnoses, in part, depend on behavioral deficits in social communication and interaction (American Psychiatric Association, 2013), and whether one fulfills this criterion is a largely arbitrary (Dyck and Russell, 2020) and cultural decision (Norbury and Sparks, 2013), based on behavioral inventories that may trigger a patient or clinicians' own stereotypes of autism (Dyck and Russell, 2020; Seers and Hogg, 2021) rather than an individual's experiences (Williams, 1996). As neurodivergence stereotypes tend to favor those with otherwise dominant identities, namely, wealthy white boys, (Botha et al., 2022; Keyes, 2020; Hull et al., 2017; Sami Timimi et al., 2019; Brown et al., 2017), those that fail to fit these stereotypes are far less likely to receive a diagnosis (McCrossin, 2022; Hull et al., 2017; Maenner et al., 2020) or to have their experiences seen as legitimate (Seers and Hogg, 2021). Further work has examined diagnostic measurements themselves and found them deeply pathological, commercialized, and "infected with Western colonial arrogance" (Sami Timimi et al., 2019; Meadows, 2021a). Moreover, symptomatic overlap between Autism (American Psychiatric Association, 2013), Borderline Personality Disorder (Iversen and Kildahl, 2022), Post-Traumatic Stress Symptoms (Stavropoulos et al., 2018; Rumball et al., 2021; Rumball, 2019; Folger and Phelps, 2018), abuse and neglect (Child Welfare Information Gateway, 2019), and ADHD (Gargaro et al., 2011; Meadows, 2021b) create additional confounds that are left to the disposition of the diagnostic purveyor.

As existing diagnostic measures are framed in deficit (American Psychiatric Association, 2013), and stereotypes of neurodivergence are largely negative (Hull et al., 2017; Wood and Freeth, 2016; Seers and Hogg, 2021), many neurodivergent individuals are concerned with the stigmatization associated with their diagnosis or their behaviors. One's neurotype is often an invisible identity (Corker and French, 1999), thus those with non-normative neurotypes frequently engage in *masking* and *camouflaging*, consciously and unconsciously concealing neurodivergent presentations in order to avoid the stigma inherent in visibility (Bernardin et al., 2021; Miller et al., 2021; Hull et al., 2017). Those who are neurodivergent are often placed in a double-bind (Yuksel et al., 2014): either mask and experience the turmoil of a fractured self (Cassidy et al., 2020; Botha et al., 2022), or present fully and experience the

stigmatization that results from deviation (Botha et al., 2022; Clouder et al., 2020). Over time, masking can result in a loss of self-concept and identity (Hull et al., 2017) and masking has been shown to predict lifetime suicidality (Cassidy et al., 2020), leading to 72% of autistic adults having contemplated suicide at some point (Hedley and Uljarević, 2018) with the rates of suicide attempts among autistic adults triple those within the general population (Kõlves et al., 2021; Miller et al., 2021). As of this writing, masking tends to be more pervasive in individuals socialized as women (McCrossin, 2022), as well as individuals marginalized due to their race (Price, 2022; Brown et al., 2017). Generally though, difficulties in obtaining a diagnosis, the problematic nature of neurodivergent diagnoses, the stigmas associated with neurodivergence, negative stereotypes of neurodivergent people, and the propensity for individuals to mask neurodivergent behavior (both consciously and unconsciously) lead prior work to suggest suspected rates of neurodivergence much higher than those reported by official diagnoses (McCrossin, 2022; Price, 2022; Brown et al., 2017).

4.2.2 Neurodivergence within computing

Within technical computing scholarship, prior work attending to neurotypes has primarily utilized the "corrective" lens of medical models (Spiel et al., 2019), frequently seeking to shape behavior towards neuronormative expressions (Williams and Gilbert, 2020; Spiel et al., 2022), subordinating the needs of neurodivergent individuals in favor of the needs of caregivers, families, therapist, and teachers (Williams, 2021, 2019), and discrediting and delegitimzing neurodivergent scholars (Ymous et al., 2020) Regarding social spaces of learning, prior work has found that computing is stereotypically perceived as a socially isolated practice performed by White and Asian men who are obsessed with computers and lack interpersonal skills (Cheryan et al., 2013, 2015a; Margolis and Fisher, 2002; Campbell-Kelly et al., 2014), which match the gendered, racial, and behavioral stereotypes of autistic people (Wood and Freeth, 2016; Botha et al., 2022). Journalistic narratives connecting autism and computing are widely prevalent (Silberman, 2016; Coupland, 1995; Jack, 2014), and scholarly work has found that young adults diagnosed with autism are more likely to major in STEM generally

and computing specifically (Wei et al., 2013). Prior work has also found that a majority of autistic youth were reported to spend most of their time alone with screen-based media (Mazurek et al., 2012), aligning with prevailing perceptions of computing (Cheryan et al., 2013). Though scholarly work tends to a) utilize diagnostic measures without problematizing them (e.g. (Grant and Kara, 2021; Clouder et al., 2020)), b) sample from those who have already obtained a diagnosis without problematizing the means by which one obtains a diagnosis (e.g. (Holmes and Annabi, 2020)), c) utilize the medical model's "helping" model towards neurodivergent individuals (e.g. (Moster et al., 2022)), or d) stereotypically compare autistic individuals to computers (Picard, 2000), one can surmise some degree of alignment between the expectations imposed within computing spaces and "normative" autistic traits, as framed through diagnostic measures.

Given this, it is possible that individuals who fit societal assumptions and expectations of neuronormativity mask their neurotype expression to fit within computing spaces. Prior work has theorized about what would constitute a developmental or neurological disorder if, for instance, all 20 million autistic people were in one space (Broderick and Ne'eman, 2008). Even without monolithic framings of autism, we might hypothesize about separate spaces collectively constructed by primarily neurodivergent individuals, away from neuronormative expectations (Ensmenger, 2015). However, as those that seek to leave conventional society can carry the imprint and policing of normative expectations into their separate space (Odell, 2019), we might expect norms of neurotypic policing to continue into this separate space, even among those who are openly autistic (Brown et al., 2017). As those primarily permitted to claim both neurodivergent and computing identities are wealthy white boys, it is likely that this policing would uniquely burden those marginalized due to their race, gender, or class. Aside from those that leave computing due to lack of alignment with stereotypes, prior work has yet to wrestle with how discrepancies between one's neurotype, the neurodivergent expressions of others in computing, and the neurotypes and neurotype expressions legitimized in computing affect participation and belonging. Similar to the experiences of autistic individuals in neuronormative spaces, we might expect neuronormative or non-

autistic neurodivergent individuals to struggle to find fit in computing, to camouflage traits that fail to fit expectations, and perhaps find themselves in the same "double-bind" between sharing their identity and masking that is common among neurodivergent individuals.

4.3 Method

The astute reader is likely experiencing a pressing ennui; neurodiversity research is an inherently fraught subject that requires both care and humility. Broadly, it is critical that any research examining oppression and marginalization partners with (and, ideally, is lead by) those whose lived experience is situated within that oppression, and that no work is done about communities experiencing marginalization without members of those communities (Charlton, 1998; Barnes and Shakespeare, 1999; Shakespeare, 2013; Williams and Gilbert, 2019; Spiel et al., 2020a). To clarify: the dissertation author is autistic, the qualitative "second" of the analysis team is a committed ally. We begin with our positionality with respect to this work.

Dissertation Author. I am white, and I have always had access to education; when I entered computing spaces, the stereotypes and perceptions of computing fit well enough that I had the privilege of ignoring them. I wasn't obsessed with computers, but I found joy in Vim, an unfathomably intricate tool with no other purpose than to edit text and thousands of options to be tuned to the user's preference. I have access to oral speech, but struggled to speak often enough that my parents doubted that I would be able to maintain any sort of conversation. - [ ] Fix neurotype interview table, wider first column I have rarely had more than a few friends, but I found deep affinity and community in computing, more so than nearly any space I've existed within. I am about as privileged as an autistic person can be, but I've learned to avoid explicitly describing myself that way, lest what I say be discredited (Ymous et al., 2020). Hans Asperger wrote that "Once one has learnt to pay attention to the characteristic manifestations of autism, one realizes that they are not at all rare." [6]. I

[6]We are aware of Asperger's Nazi affiliation, we follow Silberman's view (Silberman, 2016) that critiquing the complex and twisted morality of individuals within "The Grey Zone" (Levi and Rosenthal, 2017) is,

embarked on this project from a passionate curiosity (Williams and Boyd, 2019), seeking to witness others' experiences in one of the few places that I have called home. Recognizing that my history might lead me to project narratives onto others' experiences, I sought to temper my bias with others' perspectives, both in design and analysis. My experiences, both of privilege and oppression, are certainly not shared with all neurodivergent individuals, but through this work, I hold the care I necessarily developed from surviving in a world that did not allow me to exist, as I am.

Qualitative "Second". My experiences in computing have been highly differentiated. Playing with code alone in my youth, I found its embrace of logic a bit silly and foreign, but saw its utility, and found joy in using this utility to make things that would bring others joy, particularly close friends and family. In this personal setting, computing was a form of play, art, and making, just as were the other media important in my life, including pencil illustrations, music, sound, and animation. When I entered a post-secondary CS space, I expected to find others like me, but was surprised to find that very few were like me. Whereas I often saw computing as a means to an end, I perceived that many saw it as an end in itself. I was not sure if that was a difference in values, personalities, or minds. In parallel, I did weekly respite care with families with autistic children throughout college, and I saw many parallels between how the youth I cared for communicated and saw the world and how my peers in CS did. But I did not see those in myself, which often made me feel othered in CS. I came to this project from a stance of allyship, curiosity, and advocacy.

My research questions centered perceptions of neurodivergence, though, I required a mechanism for surfacing those perceptions. Although one mechanism would be to utilize existing diagnostic measures (American Psychiatric Association, 2013; Baron-Cohen et al., 2001), given the problematic nature of these pathological framings (see Section 4.2.1), I felt that exclusively utilizing existing measures would likely perpetuate medical models of

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at best, a murky and nebulous task.

neurodivergence. Thus, given a lack of suitable instruments or frameworks for facilitating conversations about neurodiversity, I sought to create a method for surfacing perceptions primarily informed by critical neurodivergence studies (Jack, 2014; Price, 2022; Keyes, 2020) and narratives from neurodivergent-identifying people[7], using existing diagnostic measures (American Psychiatric Association, 2013) as a supplement.

From my analysis of existing literature and narratives, I construed neurodivergence as a series of axes. For instance, diagnostic criteria for both autism and ADHD delineate differences in attention, so I constructed an axis with one end tending towards hyper-focus (i.e. struggling to switch away from a single task) and hypo-focus (i.e. struggling to maintain focus on a single task), though in my view and from my experience, individuals are rarely defined by a single point along such an axis. Similarly, some ADHD narratives describe nourishment from messy, highly-stimulating spaces, which directly opposed narratives from autistic people who sought contextual organization to reduce extraneous stimulation. I crafted a broad set of these axis, then excluded several based on their lack of relevance to computing specifically (e.g. seasonal affect), their overlap with other axes (e.g. tendency to systematize), and axes that are no longer accurate with respect to prior work (e.g. communication deficits among autistic individuals), leaving the axes in Table 4.1. Prior literature and narratives also noted the deep joy and satisfaction experienced by neurodivergent people around topics of interest (Jordan and Caldwell-Harris, 2012; Grove et al., 2018; American Psychiatric Association, 2013) (*interests*, discussed with P15, P22, P23, P27, P28, P33, P40, P48, P99), but as existing narratives did not describe a suitable converse to this, I opted to ask participants how they related to topics of interest, rather than represent with an axis.

I do not claim that this construal of neurodivergence is an instrument, framework, or theory, rather I sought to create a reflective mechanism that was accessible to both neurodivergent-identifying participants with deep expertise and non-neurodivergent participants lacking expertise. As with design probes (Mattelmäki et al., 2006) or cultural probes

[7]Drawn from several neurodivergent forums and subreddits: /r/autismtranslated, /r/autism, /r/autismmemes, /r/adhd, /r/adhdmemes, /r/neurodiversity, WrongPlanet.net and others.

(Gaver et al., 1999), my intent was to frame a potentially inaccessible conversation and catalyze insight that would otherwise be unavailable. From this work, my experiences supports that limited use. However, as this framing had the potential to prime participants towards specific insights, I sought to only utilize the axes when necessary by 1) providing clarifications only when specifically requested, 2) avoiding the axes altogether when participants had sufficient expertise around neurodivergence (2 participants), 3) modifying the axes when a participant felt that another construct better suited their experience (1 participant), and 4) omitting participants' axes drawings from analysis altogether.

Axis	**Hypo-Extreme**	**Hyper-Extreme**	**Used With**
Attention	Easy to switch tasks, struggling to maintain focus on a single task (American Psychiatric Association, 2013); *"Multi-Task yay!"*	Easy to maintain focus on a single task, hard to deviate focus from that task to, e.g. attend to basic needs (hyperfocus) (Hume, 2008; Gargaro et al., 2011; Price, 2022; Meadows, 2021a; Buckle et al., 2021); *"Single-Task Yay!"*	P5, P6, P22, P28, P33, P36, P48, P54

Organization	Preferring disorganization, organized spaces feel overly sterile and impersonal (some explanation from (Price, 2022)); *"Organization Boo!"*	Preferring organization, order, and cleanliness, disorganized spaces feel messy and overwhelming (Samson et al., 2012; Price, 2022) (related to "visual clutter" in (Price, 2022)), also tied to executive function (Meadows, 2021a; Brown, 2013); *"Organization Yay!"*	P5, P6, P12, P23, P73
Details & Systems	Easy & exciting to think about minutia & intricate details, thinking "big picture" is overwhelming or uninteresting (bottom-up processing, see (Takarae and Sweeney, 2017; Price, 2022); *"Details Yay!"*	Easy & exciting to think about how structures fit together, approaching details is challenging or boring (American Psychiatric Association, 2013); *"Systems Yay!"*	P15, P47, P67
Routines	Routines are nourishing and necessary; novelty, spontaneity, and breaking routines might be especially uncomfortable ("normative" autism (American Psychiatric Association, 2013)); *"Same Thing Yay!"*	Novelty and spontaneity are nourishing and necessary, struggles to maintaining routines; *"Novelty Yay!"*	P22, P33, P48

Speech	Rarely speaking, preferring other modalities of communication, echolalia (American Psychiatric Association, 2013) (see etymology of autism); *"Speaking Boo!"*	Interrupting others, voicing answers before a question is completed, lecturing is easy, turn-taking is challenging (see infodumping) (American Psychiatric Association, 2013; Price, 2022; Jordan and Caldwell-Harris, 2012); *"Speaking Yay!"*	P40, P99	P47,
Feelings	Feeling differently, emotional response to event comes much later, sometimes not having the "right" emotional response in some setting, perceived as lacking empathy (American Psychiatric Association, 2013; Atypical Autism Traits; DeThorne, 2020; Poquérusse et al., 2018); *"Feelings?"*	Struggling to not pick up on others feelings, struggling to not internalize the emotional perturbations of others (DeThorne, 2020; Price, 2022); *"Feelings!"*	P27, P73	P72,
Sensory	Stim-seeking: frequent fidgeting, easy to filter out sensory input, enjoying cacophonies of sounds and being surrounded by sensory input (Lane et al., 2014, 2011; Price, 2022); *"Filtering Yay"*	Stim-sensitive: filtering out sensory input is challenging, loud noises/harsh lighting might cause distress, deep comfort from some sensations (Hazen et al., 2014; Ghanizadeh, 2011); *"Sensory Yay!"*	P28, P72	P67,

Table 4.1: Axes of neurodivergence, designed as a reflective tool. Labels used with participants are in italics. We cite sources used for grounding and inspiration.

After developing these axes, I utilized them in pilots, quickly realizing that (1) each participant only had expertise in a subset of the axes, (2) this expertise was generally based around personal experience, and (3) considerable rapport and a grounding in a specific computing space were necessary for many participants to give substantive answers around the axes. Thus, as I needed to both develop rapport and situated within participant's neurodivergent expertise, I opted for a semi-structured interviews, crafting a protocol to serve these objectives. Interviews began with a discussion of a participant's history of participation in computing, their perception of those spaces, and their affinity with others in computing (or lack thereof). Typically, participants mentioned a few of these axes during this discussion, if they did not, I emphasized that this work was examining neurodiversity and asked for reflections around that. After spending about half the interview discussing neurodivergence and computing broadly, I worked with participants to create an artifact for each axis mentioned.

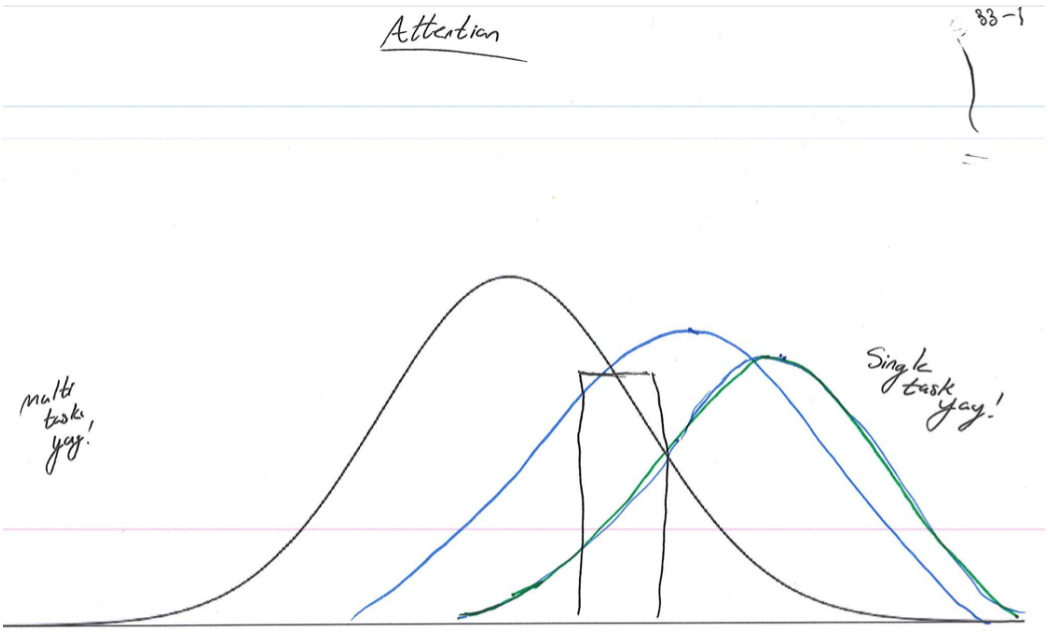
Each axis was presented as a bell-curve[8]. For each, I labeled the extremes in-situ, opting for playful euphemisms (e.g. "single-task yay") over pathologizing terminology (e.g. "hyper-focus"), as stigmatization and oppression seemed to increase towards an extreme. I then asked participants to label themselves, their perception of the distribution of others in computing, and their perception of those legitimized within computing (i.e. those who not only survived, but thrived within computing). Participants could label with a single point, several points, a range, or a distribution; I emphasized that one's neurotype is shaped through prior behavioral reinforcement (Kupferstein, 2018), one's trauma history (Van der Kolk, 2015; Stavropoulos et al., 2018; Rumball et al., 2021), and self-regulatory strategies

[8]Bell curves were a familiar representation for participants, and prior work notes the distribution of autistic traits as as bell-curve (Posserud et al., 2006), though when introducing any axis I noted that the specific distribution was unknown.

Table 4.2: Interview Protocol

Consent	*You have consent and agency in this space, and that's a continual process, you can leave at any time, you don't have to be nice about it. I'd also like this to be enjoyable, if you're bored, uninterested, or don't feel like you're getting anything out of this, that's really helpful to hear.*
Data Usage	*No one will know who you are but me, analysis will be shared with the research team, and we may quote you in a future publication.*
Definitions	*This work is examining neurodivergence: all brains are gorgeous, but they're not all treated that way, and we don't have great conceptions of how they're different. We're situating into computing spaces; spaces where computing is the primary practice — typical spaces like computer science degree programs and industry jobs, but also coding bootcamps, after-school classes, any space where folks are primarily practicing computing.*
Intro	*Can you tell me a bit about yourself? Can you tell me about the computing spaces that you've been in? What were other folks in those space like? Were there ways you were expected to be in that space?*
Optional	*In the survey we sent out, you said you (identified as neurodivergent), can you tell me more about that?*
Axis	*We don't know much about how brains are different, and it's a bit reductionist, but let's say that folks are distributed on a bell curve. Most folks would be in the center because that's how bell curves work, but also, society tends to smush folks towards what's considered normal.*
Example	*Some folks are really, really good at focusing on one task, and really struggle to switch away from that task, let's call them "single-task yay". Conversly, some folks are really, really good at switching between tasks, but really struggle to maintain focus on a single task. That doesn't mean that they don't get anything done, it might just mean that they're rotating between several tasks throughout the day instead of exclusively focusing on one. And, most folks aren't just one point on this, we can regulate ourselves, we might feel differently day to day, and all is affected by how we were socialized, trauma experiences, and frequently changes over time. Does that make sense?*
Placing Self	*I'm curious where you are on this. It can be a single point, a series of points, a range, a distribution curve, really whatever fits you best.*
Follow-up	*I'm seeing that you're somewhere between…, am I understanding you?*
Perception	*I'm not looking for objective truth, just how you see the spaces that you're in. I'm wondering if you draw how you see other folks in computing spaces are along this? (then, follow-up to check understanding)*
Legitimacy	*So, there's how everyone here, and then there's the folks that not only survive but thrive, folks that have never had to question whether or not they fit in computing spaces. Where would you place them on this? (follow-up to check understanding)*
Comparison	*Ask how difference (if any) between self-perception and perception of others feels, and how the difference between self-perception and perception of legitimacy feels.*

Figure 4.1: An attention axis from an interview. I began with a blank bell curve, and noted that individual neurodivergence varied around attention and that the distribution likely modeled a bell-curve. I then labeled the extremes ("single-task yay" and "multi-task yay"), with the explanations in Table 4.1. I asked participants to label themselves first (a black rectangle somewhat towards "single-task yay"), then how they perceived others in computing spaces (a blue curve centered further towards "single-task yay" than the bell curve), and how they perceived those legitimized within computing spaces (a green bell curve, even further towards "single-task yay"). Afterwards, I asked participants how the contrast between themselves and others felt.



(Kupferstein, 2018), and that neurotypes tend to change over time (Pender et al., 2020). I encouraged participants to push back if either the axis or the extremes failed to match their own conceptions, and I adjusted to accommodate requests however I could. As the construal of neurodivergence I developed was intended only as a conversational tool, I focused on the congruence or contrast that participants experienced between their neurotype and their perception of others' neurotype expressions in computing spaces over participants' specific placement.

I designed interviews to be multi-modal: participants less inclined or able to participate in a synchronous interview could participate through an email exchange, though no participants selected this option. To avoid participant discomfort, I openly identified as neurodivergent broadly within this recruiting survey, but only disclosed the label "autistic" if participants asked or disclosed their own neurodivergence. This selective disclosure of an invisible identity (Corker and French, 1999) was my attempt to balance the benefits to participants with neurodivergent identities (Pellicano et al., 2021) against the threat of delegitimization upon disclosure.

Typically, work investigating power relationships would seek to surface perspectives of those marginalized within the relationship, as perspectives of those dominant within the relationship are likely pervasive. However, though stereotypes and journalistic accounts of dominant neurotypes in computing point towards legitimization of "normative" autistic traits, the lack of prior scholarship requires a degree of skepticism towards these narratives. I sought both neurodivergent-identifying and non-neurodivergent-identifying members of computing as participants, beyond that, I recruited students, industry professionals, and faculty. As diagnoses are an inherently problematic criterion for selection, I opted to let participants self-identify as neurodivergent in my recruiting survey. I excluded participants who had been members of a computing space for less than a year, otherwise, I sought to gather a diverse range of perspectives across the strata above. I sought IRB approval before contacting any participants, and this work was given an exemption[9], though I treated participant disclosures

[9]That is, still governed under my university's human subjects research policies, but viewed as low-risk

as non-sensitive health information regardless.

I focused recruiting within two spaces: the computer science department at my institution and industry positions within the region surrounding my institution. I recruited through posts to Slack channels, email lists, and social media, recruiting both neurodivergent and non-neurodivergent participants from each of the three population strata. My recruitment survey asked about participants' neurodivergence status, and unfortunately, there was a stark lack of interest from non-neurodivergent industry participants. However, given the lack of neurotypic expertise in the non-neurodivergent public, I felt that I had sufficient coverage from the existing participant set. To include more participants and to protect anonymity, I relaxed the institution-specific criterion for faculty and students (some students and faculty had recently left this institution), but I did not send out recruiting calls beyond my institution.

From these recruitment efforts, 38 individuals completed the screening survey. I reached out to every eligible participant to sign up for an interview slot, 21 individuals chose to participate. I report demographics in the aggregate to protect participants from identification. In terms of gender, 9 participants identified as men, 8 as women, 2 as non-binary, and two participants identified as either "agender woman" or "woman-ish". I did not ask for participants' sexuality or transgender status, though 2 participants self-identified as transgender, 5 as queer, and two as questioning during interviews. In terms of ethnicity, 7 identified as Asian, Asian American, Taiwanese-American, or Vietnamese, 6 identified as White/Caucasian/Northern European, 4 as Jewish, 1 as Filipino, 2 as Indian or South Asian, 1 as "Middle Eastern with light sprinkles of Malaysian and other heritages", and 1 as Persian. To ensure that both non-neurodivergent and neurodivergent participants were included, the screening survey asked participants' neurodivergence status: 6 participants had obtained ADHD diagnoses or identified as ADHD, 2 suspected they might have ADHD or were questioning, 3 obtained autism diagnoses or identified as autistic, 2 suspected they might have

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to participants.

autism or might be autistic, 1 noted that "Slow Cognitive Tempo" fit, and 1 identified as having OCD. Interviews were intended to last an hour; in practice, interviews were between 23 and 84 minutes, with an average of 53 minutes, and 18.5 hours of data were collected in total.

While my institution is generally tolerant, disclosing invisible identities is inherently risky, especially identities that overlap with health records. To protect participant identities and neurodivergent statuses, I exclusively ran interviews, cleaned transcripts, and analyzed the entire dataset. I began the analysis by correcting automated transcripts and removing participant identifiers, performed concurrently with interviews. I noted emergent themes between participants while conducting interviews, and after the interviews were completed, they read each transcript to refamiliarize themselves with the data and create a set of initial codes. Coding followed thematic analysis techniques (Braun and Clarke, 2012) while stratifying across the axes discussed, though, as some participants were comfortable articulating their experience without scaffolds, not every interview utilized the axes, and some axes were utilized more than others. The data were first inductively coded for participants' identification within an axis, perceptions of neurotype expression prevalence and legitimacy, and participants' relationship between identification and their perception of computing, emphasizing semantic meaning over interpretation. Then, the data were deductively coded for themes aligned with prior literature (e.g. masking, belonging, stereotypes, labels of self-description, etc.) and inductively coded for emergent themes, merging, modifying, and removing codes to surface themes. I emphasize that my goal was to generate claims for future research rather than verify the objectivity of these claims, the latter would require multiple coders and inter-rater reliability (Hammer and Berland, 2014)).

Methodologically, this maximized coherence between data collection and analysis, in line with recent work (Botha et al., 2022), but risked a greater potential for bias in these results. To mitigate this bias, I provided the other analysis team member with a majority of the transcripts (16 out of 21, 76%)[10] after these themes were developed to perform a

[10]Some participants did not respond to an ask for this specific consent, some had existing relationships

critical read. The other analysis team member read this subset, noting themes within each theoretical frame developed by the dissertation author. They then looked for context and contrast between what the dissertation author reported and their own notes. As participants' axes drawings were not treated as data, the analysis team did not have access to these, but the interview context was sufficiently clear from the transcript. While the second member of the analysis team read the dissertation author's interpretations before accessing participant transcripts, which may have influenced their view of the data, she approached analysis with an explicit goal of disproving claims made by the dissertation author. Both then met to discuss contrasts and resolve disputes between interpretations; disputes were strictly based around context that could be added for clarity, or contrasting participant voices that weren't present. No interpretations were fundamentally challenged, but several points of nuance were added to offer greater context and participant voice, and the final themes represent a grounded consensus between both authors. I also member-checked both the final themes and quotations with participants; all that responded and had capacity to review the results (9 out of 21) validated the themes and a few (2) provided missing context and corrections so that the results better fit their experience.

4.4 Results

Given well-established stereotypes surrounding neurotype expressions in computing (Section 4.2.2) and that readers' stereotypes were likely triggered by the title of this work, readers with prevailing biases might be drawn to view those legitimized in computing, or the traits that those individuals exhibit, as "autistic". However, rather than utilize problematic diagnostic lenses of interpretation that give little space to attend to experiential nuance and remain ripe for misinterpretation, I set aside diagnostic language in favor of more fluid granularities. With that, this work contributes three findings: 1) *Legitimacy*: that computing spaces legitimize a particular and narrow pocket of neurodivergence, that lies outside of neu-

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with the analysis team and feared deanonymization, even with a redacted transcript.

ronormative expectations, 2) *Masking*: that those outside this pocket, neuronormative and neurodivergent, masked their neurotype expressions to fit expectations within computing, and 3) *Refuge*: for those legitimized, computing spaces were spaces of refuge against broader societal delegitimization. I frame these findings first through a subset of the axes that I utilized, and subsequently through participants' broader experience, referring to participants by their chosen numerical identifier (e.g. P-18), and by utilizing participants' own language for neurodivergence when possible, centering agency around diagnoses (i.e. "obtained a diagnosis" rather than "diagnosed as"). Again, I do not consider the axes to be a validated framework, I present through them as a way of giving voice to cross-sections of experience, understanding that these sections both overlap and do not constitute a whole. Notably, neurodivergent-identifying or otherwise, many participants noted that it was easier to notice aspects of neurodivergence in others that they viewed as a deficit for themselves.

4.4.1 Interests

One aspect of neurodiversity addressed by conventional diagnostics (American Psychiatric Association, 2013), emergent literature (Price, 2022), and personal narratives from neurodivergent people are *special interests*: topics of deep passion and nourishment. Special interests are traditionally associated with autism (American Psychiatric Association, 2013), but this criterion has been problematized (Price, 2022) to where special interests should be considered a aspect of neurodivergence more broadly. As individuals within computing are stereotypically perceived to be singularly obsessed with computers (Cheryan et al., 2013, 2015a; Margolis and Fisher, 2002; Campbell-Kelly et al., 2014), a lens of neurodivergent special interests was warranted.

Legitimacy

Throughout our interviews, participants largely agreed that computing legitimized individuals who held computing as a special interest and measured their own interest in computing

against the standard of special interests. Computing interests were expected to be exclusive; every participant that noted personal interests outside of computing felt that those interests couldn't be brought into computing. P-15, a student who did not disclose any neurodivergence, identified that this stereotype forced them to change how they presented themselves:

> *It feels like it's there, like, a stereotype that you have to fit into to be part of the space. And so, when I'm outside, like, I have a lot of different interests. Like, I play the piano, and I like watching different kinds of shows…like, I don't do like programming or anything for fun. That's like a strict, like, work/school kind of thing. So when I'm in the computing space, I feel like I have to display myself as being interested in computing and like, yeah, like it kind of goes back to like, proving that I'm belonging kind of thing. Um, and so it feels like- like some sort of like context switch that when I'm in a computing space, I feel the need to act more interested towards computing in a way or act more, like, computing focused? Even when it's, like, a social scenario versus a actual, like, computing typical kinda situation. (P-15)*

After hearing this, I shared a description of masking and asked if that fit their experience, to which they responded:

> *Exactly, it feels like you have to…perform to make people recognize or accept you. (P-15)*

Another student who had obtained an ADHD diagnosis identified several existing special interests in their life. However, they felt imposter syndrome in computing, unsure if they actually liked computer science (CS) because their interest in computing wasn't a special interest for them:

> *Particularly in music theory things…I can just, like, sit there and go on for hours about that. But I can't do that with CS. It's like, I can't- like, I feel like I can't go*

> *on about CS but maybe it's like, only specific to- like, when I'm around other CS people. But may- I have noticed that if people don't know things about CS, I can do it. And I- it might just be that like, like a subconscious thing of other people know more than me, so I don't want it- I don't want to go on about it. (P-28)*

Masking

While P-28 felt that their interest in CS was insufficient, others masked legitimized interests in computing. Two faculty members, P-99 and P-67, noted that aspects of their interests fit within computing, but were concerned about the harm that might come from reflecting those stereotypes, opting to hide that aspect of themselves. One mentioned an interest in video games:

> *But I rarely try to bring that up in computing because of the stereotypes that we think about with, like, all CS people are gamers. As a teacher, I don't want to reflect that stereotype. So that's- sometimes I have to hide that, because I think that's actually better overall (P-99)*

Indeed, most participants who discussed interests felt that special interests were canon, noting how conversations seemed to always turn towards some computing career topic (P-12), that course staff sharing non-CS interests broke expectations (P-33), and that non-computing interests were legitimized based on their proximity to "traditional" computing, (e.g. favoring Rubik's cubes over artistic shading (P-22)). Participants felt that interest masking was prevalent: one faculty felt that most students' interest in computing was derived from the field's career prospects, rather than an intrinsic interest in computing:

> *I feel like a lot of students don't have a genuine interest in being here…I can't remember the last time I've had a conversation with a student about an interesting idea or that we're talking about something in class…It's all "I lost this point. Can you tell me why I lost this point?" and all of this, just, meaningless stuff. (P-99)*

Furthermore, some participants connected industry expectations to have computing side projects to special interests; P-99 noted that students' engagement in side projects was often performative:

> *They don't actually care about the calculator they wrote in Haskell. They wrote it, because they thought it made the resume look better. (P-99)*

One student who suspected they were autistic noted that while they didn't find themselves masking socially in computing, they felt they had to mask non-normative career pursuits (P-11), and an industry participant corroborated the need for side projects to get a job, reinforcing the legitimization of a deep interest in computing:

> *Like, it's not uncommon to go into interviews and [be asked] 'Oh, well tell us about some of your side projects.' Well, I don't have any side projects, because this isn't my hobby. And that's seen as like a negative. And so there's like, a lack of separation there that happens. That yeah…my job isn't everything to me. (P-27)*

These experiences were primarily within computer science, participants also noted that non-CS computing spaces required less masking due to the diversity of career goals present (P-12, P-22).

Refuge

The majority of participants felt a lack of fit computing's legitimization of special interests, but a few shared experiences of refuge. Many narratives around special interests emphasize the need to tone down, or otherwise mask one's interests, lest they be perceived as weird or annoying (Price, 2022). However, within computing, these interests were uniquely encouraged. P-48, who identified as autistic, shared a contrast between computing and societal spaces:

> *So in most cases I am myself in a computing space. Sometimes you need to tone it down for other people. Like they don't care what a binary tree is…But I found that the reason [computing] is a shelter is I am able to finish my sentence. And I don't get the air in the room from the other person that thinks I am from another planet. (P-48)*

Others recalled so much initial excitement around computing that they were reading textbooks for fun, despite hating reading (P-47), or that they still, after decades in the field, found themselves "*laying on a beach on a so-called vacation with a textbook for fun*" (P-23).

4.4.2 Attention

Individuals within computing are largely stereotyped as preferring solitary spaces free of distraction, coding for hours at a time, skipping meals and forgetting to sleep, all of which aligns with narratives around "hyper-focus". Hyper-focus is diagnostically associated with both ADHD and autism, and associated with "task inertia" or "activation energy": starting a task can be challenging, but once "the ball gets rolling", individuals struggle to stop until a task is complete (Price, 2022).

Legitimacy

Participants generally agreed that computing legitimized neurotype expressions prone to hyper-focus, succinctly put as "*Coders are some hyper fixating pieces of shit*" by an industry participant who obtained an ADHD diagnosis (P-6). Furthermore, hyper-focus was purported as a necessity, from an industry participant who identified as neurodivergent:

> *What's important to an enterprise is, is this work. Because if you can think really clearly about a problem, you can completely alter, the chance of success and the ability to navigate risk of an enterprise. There's no amount of people you can throw at a problem and no amount of process that you can create that's*

> *a substitute for a person, or a small group of people, working really deeply on a-on a problem. And this is the this is what justifies the big bucks. (P-36)*

Many participants resonated with descriptions of hyper-focus, identifying with our description upon hearing it. Hyper-focus was rarely viewed negatively; participants described hyper-focus as "*like inhabiting a cozy room…but it's entirely abstract*" (P-36) and others sought to make their work space cozier and more amenable to hyper-focus (P-84), though one student who identified as autistic noted that "*above a certain point, you get into trouble*" (P-48). Similarly, a student who identified as ADHD felt that they could multi-task on many things, but they needed singular-focus for coding (P-28). Participants' experience of hyper-focus was closely tied to topics of interest, especially special interests. One student who suspected that they had ADHD identified as someone who, with enough topic-interest or deadline pressure would "*be absorbed in a single task*" and would "*skip meals and not shower and be a hermit*" (P-33). I described hyper-focus as *"single-task yay"*, they offered:

> *I think the expectation, and the sort of, like, the cultural expectation, which is interacting with my perception, is that if you are in CS, you pretty much have no life, and you just sit at a desk all day long and go with the "single-task yay" idea. On a more practical, realistic level. I think CS students multitask a lot. But I think they prefer to single task, they prefer to just get lost in that one program they've been debugging for three days. (P-33)*

Masking

Broadly, hyper-focus was described as inherent to problem solving within computing, and participants who found hyper-focus less accessible critiqued the ableist expectations and requirements to exist in computing. An industry participant recalled their undergraduate exam experiences that required code-tracing through a recursive function:

> *For some people, like, they can really bang it out and focus on it. Some people, like, they're not bad, it just might take them longer. And so one of the things*

> *that came up at some point, which is like, are we really, like, doing a disservice to some people by kind of demanding that they do this in a really short period of time, when it's just like, not…when it's attentively very challenging, especially during an exam? And that for me a little bit reinforces the like, people being more [towards hyper-focus]. I guess, I would imagine people who are more [towards hyper-focus] having an easier experience on a question like that. (P-22)*

Expectations of hyper-focus extended outside of introductory assessment: one faculty member who identified as "*definitely ADHD*" easily hyper-focused on tasks of interests (coding for 14 hours straight during the week before our interview), but struggled to maintain focus on "boring" tasks (e.g. reading papers, or attending meetings). Alongside hyper-focus, maintaining focus on "boring tasks" was required to persist in computing. They recounted their experiences in faculty meetings describing graduate exams requirements:

> *So, by the time, you know, you've passed [the doctoral qualifying exam], you should be able to, you know, sit through a talk at a major conference and understand everything. And I heard a similar- similar quote about papers. And I'm like, you know, what if you get distracted, and go off and do something else for a few days, and then you don't remember what happened on page six, because like…you can always pull up the page six and look at it. And it's like it, it just never entered their mind that that people work so differently from them. But I think it's obvious to me because I come in from the other side of things. (P-5)*

For them, persisting in computing required both hyper-focus and an ability to "focus on boring things", and that both were so deeply legitimized that, at every stage of the process to becoming faculty, those who couldn't fit computing's expectations for attention were filtered out.

> *In college, I think there were enough people who were different, and then even through grad school, but like grad school and the pandemic, like several of my*

> *ADHD friends dropped out, a lot of them weren't diagnosed yet. They got diagnosed after they dropped out, or they got, you know, fired by their advisors or whatever. I think what bothers me, I think a lot of people, with the way my brain works, are attracted to research and can be really good researchers. And so you end up with over representation at the beginning, followed by dropping off, dropping off, dropping off until it's like, I would guess underrepresented by this point if you're at the, like, especially at the faculty level, and that- that really bothers me. Because it's just- it's just so unnecessary. (P-5)*

Refuge

However, similar to special interests, computing's legitimization of hyper-focus offered unique affordances unavailable within society broadly. For one industry participant who identified as autistic, computing's legitimization of hyper-focus was historic:

> *I think computing comes from a very, like, interesting background, and that for a long time, like it was a space for folks with like a hyper focus, to be able to, like flourish in that when it didn't flourish in like social situations, or, you know, in other areas of their life. And like, we continue to reward that. (P-27)*

Another industry participant who obtained an ADHD diagnosis remarked that individuals legitimized in computing were particularly susceptible to "nerd sniping" (Munroe, 2007), but that this wasn't inherently bad:

> *I think back to some like stereotypes about people who it's just like, they seem very apt to get on one topic, and then spend a long time going after that topic. And like, like, I feel like that's in part like a stereotype in computing that's bad, but also like a legitimate experience for people who are like, neurodivergent in the space. (P-22)*

4.4.3 Organization

I am unaware of prior scholarship that surfaces stereotypes around organization, though requiring organization to reduce stimulation and aid executive function is established within neurodivergent narratives (Price, 2022), and some ADHD-identifying individuals attribute organizational struggles to their neurodivergence.

Legitimacy

One participant noted that computing people "*like efficiency and organization…more than the average bear*" (P-6), but most participants that discussed organization noted that computing work inherently required organization and that disorganized thought was delegitimized. One faculty member noted that "*we're literally taught to organize code and think hierarchically about the world*" (P-23), and recalled prior experiences hating tasks that required high organization (e.g. mathematical proofs), but eventually conformed to organizational expectations:

> *[laughs] you need to conform to work with other people. And you cannot contribute to a code base, if you're not willing to write organized code. And if you refuse to fit in, to a system that other people have agreed to work in, that's not going to go very well. And I imagine yeah…it'd be impossible to continue, I think, if you refuse to accept that structure… You can change the structure, but you need to conform at some point. (P-23)*

Another faculty member also viewed organization as inherent to computing's culture of abstraction:

> *All the reading I've been doing with, like, cultures and infrastructures of abstraction, you're talking about this idea encoded in the field is like, we have to organize things in order to build bigger things. (P-73)*

Masking

Given organizational expectations within computing, participants who identified towards "organization boo" struggled within computing. One industry participant who obtained a childhood ADHD diagnosis, felt that organization was required to persist and, not having that, they survived because of their work ethic (P-54), additionally, a student felt that they needed to mask their organizational struggles:

> *I think like, I definitely struggle on my day to day job as a researcher as a result of some of my, like, ADHD symptoms. And so I've had previous experiences where I had research mentors be like, "Oh, you need to go faster". Like, I don't know how to tell him like, Yo, like, I just really cannot…it feels like moving a mountain. And I think there is this, like, lack of openness or, like, knowing what I can say to people makes it really hard for me to be, like, so the reason why I'm not performing up to my own standard, to your standards, because like, honestly, I just really struggle with like executive function sometimes. (P-47)*

Similar to Attention, participants also noted that while computing norms skew towards organization, too much organization might not be valued (P-23) and might interfere with industry priorities to ship software (P-6), though one student who identified as "organization yay" felt that one's level of organization didn't matter in computing (P-12).

Refuge

While I did not find that computing spaces uniquely offered refuge to organizational neurotype expressions, one participant felt that their degree of organization was very validated (P-73) and another noted how their affinity for hyper-focus compensated for their organizational struggles:

> *So I've creating my own set of tools for a very long time. So it's like, oh, I need to be organized, Well, that's not a fucking thing for me, right? I didn't even*

graduate high school. I haven't been to college a day in my life. And I worked at COMPANY for 20 years. Why? Well, it's probably because of my work ethic. It's it's a double edged sword, but it's a superpower. Like, I remember clearly people at work were like, oh, we can't figure it out, well, let's just look at it tomorrow. And I'm like, no, no. I'll just stare at it for four- three or four days…like, if I'm interested in something, I see that as a differentiator, because I can stay focused, you know, like, I don't need sleep, like meals just fall by the wayside. (P-54)

4.4.4 Beyond the Axes

I originally crafted axes of neurodivergence as a tool to catalyze a richer conversation with participants with less expertise, but many participants had enough expertise that the axes were unnecessary, and it was sufficient to talk broadly around computing and neurodivergence. I discuss their perspectives below.

Computing as a Refuge

For many neurodivergent participants, computing spaces offered shelter from societal delegitimization of their neurodivergence. One faculty member who obtained an ADHD diagnosis described their experience working at a big tech company:

I think a lot of the culture is designed around neurodiversity honestly like, the free food. That's just like, you don't even have to think about it, you just go and show up and get some food and then go back. All the meetings are like 30 minutes by default…and like the communication style that they default to is like, kind of like all tiptoeing around rejection sensitivities[11] *[laughs] Yeah, I think it looks to me like a bunch of like neurodivergent people just designed this maybe without knowing what they were doing [laughs] Which is kind of maybe refreshing. (P-5)*

[11]Rejection Sensitivity Dysphoria (RSD) is characterized by severe emotional pain following a rejection or failure and estimated to affect 99% of adults and adolescents with ADHD, (Bedrossian, 2021)

Several participants also described the flexibility offered in computing as friendly to neurodivergence; one industry participant (P-27), for instance, described their "*uneven attention*" (some days with "*zero productivity*" and some days "*productive on a tear*") within the flexibility that computing offered:

> *I mean, I've talked about leaving computing, but in some ways, I'm like, this feels like the only thing that I could do because it's so flexible …[on] a day where like, the news sucks or something and I'm like, I don't want to do stuff today, like, you know, in any other job really, you can't really say that. So [computing's] so competitive and I'm not competitive, but at the same time, it's like, could I do anything else with the way that my, like, attention span works? (P-27)*

Two autistic-identifying participants, though, were particularly grateful for the existence of computing. After their family lost everything financially, one student became the breadwinner, making websites for small businesses to sustain themselves as an immigrant and eventually a refugee (P-48). They often struggled relating to family members and other individuals broadly, but found precious connections in computing:

> *This- this is a safe space…I'm getting emotional as I'm talking. It's not just that it's a place for like, we have shiny computers and we do crazy things. It's- it's a lot of people who have, I guess, this yearning for absolutes, but at the same time, they can talk at a specific frequency and, you know, let others communicate (P-48)*

Another described childhood experiences waiting for computer time at the public library to work on their websites (P-84). Computing gave a unique space for them to exist and thrive, even with otherwise marginalized identities:

> *I have only the best feelings about computing. This despite all of the kind of, you know, being an immigrant or being like a girl or whatever, like it wasn't*

> *necessarily easy, but like, I have always felt understood and loved and like- like I could contribute and, like, connect meaningfully with people around things. And it was like always, like, a space of curiosity and, like, immense power. Like, it was like literally, the limiting factor is what I can imagine. (P-84)*

Intersectional Inclusion

While I would typically be wary of giving an entire section to a single participant, both P-84's experiences (coding from a young age) and identity (trans, non-binary, autistic) gave them a unique perspective on the field that, to our knowledge, has yet to be surfaced. For them, computing was an artistic practice that accommodated their autistic identity, and they viewed the prototypical coding "basement" as an autistic refuge where they could explore while having their needs respected.

> *As a creative endeavor, [computing] is autistic in a way that other creative endeavors aren't…I go to creative coding [spaces], I'm like, Y'all are great. I love you. I love this for you. But I need to not be here. Because all y'all are resonating on a different wavelength. And, like, this is actually not for me, and like, I understand that you feel gate-kept from my basement, and I'm very sorry for that. But I feel gate-kept from here. But I'm not going to tell you about that. Right? (P-84)*

Their established position within computing gave them many opportunities for mentorship, often encouraging other femme-identifying individuals to remain in computing careers, even if they felt that coding might not be the best fit. Throughout our interview, they recounted several points in their careers where men in positions of power told them "you are not a coder" and were adamantly against replicating that harm in their mentoring relationships, but, if asked for advice, they would occasionally recommend that individuals avoid coding specifically, but explore computing generally:

> *I have a sense within five minutes of talking to somebody. And so far, it has not been wrong, even though I feel like I have taken it in grace, which is you are not a coder. And the thing is, I know how it feels to hear that. I will not ever say that. But the thing is, it's true.…They just don't seem robust to a certain kind of frustration. This was the autistic thing, like, I can't put the idea down, right? Like, it's a whole discipline to learn how to put an idea down. (P-84)*

P-84 originally came to computing identifying as a woman, and involved themselves in a variety of STEM outreach activities for women throughout their career. While our interview focused on their neurodivergence, their gender identity was inseparable from their autistic identity, and so I made space for that discussion as well:

> *For me being a "woman in STEM" is not really about internal experience of gender; it's an appointed positions. When someone, often a man who holds a position of power and is trying to be nice, comes up to you at a networking event and says, "so, how does it feel to be the only girl/woman in the room/workshop/etc?", then you are a "woman in STEM." It's often a well-intentioned thing, and that makes it worse, because then you feel the need to play along like it is well-intentioned, so you can maintain the relationship, and keep this ally an ally. The playing-along is particularly difficult for neurodivergent people, extending beyond micro-aggression into a persistent energy sink. (P-84)*

Given this intersectional interplay, and their prior involvement in outreach efforts, they were critical of efforts to expand CS inclusion:

> *A lot of women go into computing, because there is an effort to include more women in STEM. But that results in a lot of people really holding on by their teeth to these roles that are A) frustrating because the work is intrinsically frustrating. But B) frustrating because when many organizations fear feminine competence and competent femininity, and fail to take feminine voices seriously. And if a*

person can't even find solace in the work it is very stressful. For me, watching people dissolve in that stress is horrible…In retrospect, I worry that a lot of outreach, which I did in undergrad and grad was deeply counterproductive, because it would get people who actually are not happy with the work. We did get also a lot of autistic students who wouldn't have been diagnosed with anything because there's a big problem generally in recognizing autism in people assigned female at birth. So there's a lot of good that came from it as well, but it's not good when it makes some people hang on to careers that don't work for them, when they stay in them to prove that they can, even though the work itself brings them no joy. (P-84)

4.5 Discussion

I contribute three findings: 1) *Legitimacy*: that computing spaces legitimize a particular and narrow pocket of neurodivergence, that lies outside of neuronormative expectations, 2) *Masking*: that those outside this pocket, neuronormative and neurodivergent, masked their neurotype expressions to fit expectations within computing, and 3) *Refuge*: for those legitimized, computing spaces were spaces of refuge against broader societal delegitimization. Across the axes presented in this work, computing spaces legitimized hyper-focus, special interests, and high organization, gate-keeping participants who failed to meet these neurodivergent expectations, and forcing both neuronormative and neurodivergent participants to mask their neurotype expressions to fit in. I note some alignment between legitimized neurotype expressions and computing stereotypes [12], however, much nuance exists: computing is not the only space that legitimizes and rewards neurodivergent expressions (neurodivergent expressions are rewarded everywhere from sales to artistry (Price, 2022)) and stereotypic alignment is not a requirement for entry into a space. Nevertheless, our results demonstrate some cohesion between neurotype expressions within computing (as perceived and

[12]Though, I would argue that "lacking interpersonal skills" is more likely the result of a mismatch between neurotypes or communication preferences (Crompton et al., 2021)

experienced by our participants) and diagnostic profiles of "normative" autism (a socially constructed and arbitrary standard that few autistic people meet completely and many non-autistic people meet partially (Maenner et al., 2020)).

I also found that, despite participating in egregious hegemonic oppression and repression, those legitimized within computing may have aspects of identity that are marginalized outside of computing. I see a possible parallel to first-wave feminist movements that advocated for justice for those marginalized along some aspects of identity (namely, cis-gender and gender-conforming women), but not others marginalized due to their race, class, sexuality, or ability. In doing so, these movements became spaces of both justice and violence, where justice was only accessible to the those least marginalized. Within computing, I found that some neurodivergent expressions were legitimized and found unique refuge from societal expectations, but this legitimization was narrow, minoritizing those who expressed neurodivergence outside this legitimization. This need not be inherent — computing culture should certainly change — but efforts to change computing culture may encounter fears that one's only shelter is being eroded. While other neurodivergent-dominant spaces surely exist, for many of us, computing is the only space, or perhaps the first space where we did not need to bend our backs to be understood.

This work also raises implications for inclusion efforts within computing. For decades, stereotypes of what it means to be a computer scientist (often with a neurotypic implication) have been demonstrated to discourage minoritized individuals from participation (Cheryan et al., 2013; Margolis and Fisher, 2002). These stereotypes are not canon, but for some they might signal a rare safe space for self-expression. What might inclusion efforts look like that also seek to maintain this kernel of safety? Efforts that, for instance, solely look to dismantle and rebuild might break the aspects of computing that create refuge for individuals that need it (e.g. "the basement" for P-84), and efforts lacking a neurotypic lens might eliminate neurodivergent safety in favor of inclusion, only to produce computer scientists that "can't even find solace in the work".

I emphasize, however, that this work is exploratory, and while I encourage reflection

on existing priorities and identities, more scholarship is desperately needed. Returning to the epistemological quagmire that surrounds any work centering neurodivergence (Section 4.2.1), we have little language that concretely describes how individual neurotypes differ from each other. As of this writing, existing scholarly language is largely pathological, though undergoing a steady deconstruction through the work of neurodivergent scholars and allies. The language that I utilized in this work (Table 4.1) is surely imperfect and was not intended to be an objective, replicable instrument, but achieved our goals of surfacing specific neurotypic perceptions and being accessible to both neurodivergent-identifying participants with deep expertise and non-neurodivergent participants lacking expertise. Furthermore, as I had no interests in enforcing any pathology, I emphasized individuals' identification and perceptions of others in this work and construed a fuzzy conception of computing culture from there.

However, notions of culture in this work, were inextricable from broader U.S. cultural contexts that tend to pathologize neurodivergence. This work also did not directly address the intersections of marginalization experiences by racialized neurodivergent people; more work that uplifts these experiences, especially in computing, is deeply needed. Concretely though, many participants noted the ableist nature of timed assessments, programming interviews, and other educational structures that delegitimized aspects of their neurodivergence. I do not think any more scholarship is required to prove their pain.

Future work need not be without guide; I surfaced several insights from this scholarship. While this lens required emotional availability on the part of the researcher to navigate insecurity, shame, and trauma, I found rich data from this lens of investigation, especially when examining aspects of neurodivergence for which participants had expertise. Furthermore, given the neurodivergent expectations that I surfaced through this work, I would implore those within computing to examine and deconstruct both how aspects of their neurodivergence have fit hegemonic structures, conferring systemic power, and also how those expectations may have led their delegitimized expressions to be masked. The lack of intersection between neurotypic expectations of computing spaces and those within society broadly,

leaves no one exempt from this work. Within computing spaces or society broadly, all are needed to bring about a just world (Benjamin, 2022).

More work is needed to unravel computing and societal neurotypic expectations, but I would advise that future scholars proceed with immense caution. As with other disability and inclusion work, much neurodivergence scholarship has chosen to ignore the voices of those that the work purports to help. Prior work that addresses neurodiversity has no shortage of violence; I note that at the time of this writing electric shocks are still considered a medically necessary treatment for autism (JUDGE ROTENBERG EDUCATIONAL CENTER, INC. v. UNITED STATES FOOD AND DRUG ADMINISTRATION), and Applied Behavioral Analysis (ABA) is both well-utilized as a treatment for autism and covered by insurance, despite causing PTSD in about half the individuals that the technique purports to treat (Kupferstein, 2018). The fact that our work lay outside the precipitous realm of treatment made it no less problematic: this required an inordinate amount of care. One participant, for instance, disclosed their neurodivergence as part of an interview, and said that I was the first person to know, outside of their spouse, and others shared experiences of violence and shame within and outside of computing spaces. I am here for passionate reasons (Williams and Boyd, 2019): I would strongly recommend that those who chose to engage in this work incorporate crip (Williams et al., 2021) and neuroqueer (Rauchberg, 2022) perspectives that center neurodivergent individuals, or consider alternative paths of scholarship.

Our hope is that computing becomes a space for all learners to grow both as technologists and as individuals. There is much dismantling to do, surely, but I wonder what can be kept of the basement, the lab, and all the other undoubtedly problematic spaces that some of us still call home.

Chapter 5

THE HOUSE OF COMPUTING: INTEGRATING COUNTERNARRATIVES INTO COMPUTER SYSTEMS EDUCATION

In chapter 3 and 4, I described qualitative work to surface dominant disciplinary norms within computing, and through my engagements in that work, I both recognized the necessity of work that clarifies normativity, and the lack of amenability towards action through that work alone. This chapter, as well as chapter 6, describe interventions, as I sought to translate my own restorying into a collective engagement.

In this work, I describe an ethics education case study, in which I built upon existing approaches to embed sociotechnical content into traditionally technical courses. Rather than attempt to better the decisions of individual technologists, I utilized counternarratives (Miller et al., 2020) to create a more structurally focused embedding. Given that computer systems are an explicit requirement of many computing degrees (Accreditation Board for Engineering and Technology Inc., 2016), a lack of prior integrations, and my experience both with counternarratives and computer systems, integrating counternarratives into computer systems offered a foothold to address multiple shortcomings of prior work. I position this chapter as an attempt to integrate pedagogical approaches for identity work within existing curricula — I attempted to address existing pitfalls of ethics education by attending to students' identity, agency, and voice within the integration, but note that these modifications were more superficial than the work I describe in Chapter 6. With regards to my thesis statement, I note that this work, while novel within computing education and countering established pedagogical norms within computing, did not approach students through a lens of identity fragmentation. Thus the offering of this intervention was primarily restorying

students' view of computing technology and computing culture, and did little to attend to their personal relationship with computing, their presentation of their identity in computing, and their ability to approach cultural change and action.

5.1 Introduction

Social upheaval through widespread disinformation (Center for Combating Digital Hate, 2021), aggressive automation (Eubanks, 2017), and algorithmic oppression (Benjamin, 2019) have led to an increasing focus on the ethical considerations made by technologists. Computing accreditation requirements mandate that graduates of computing programs have an understanding of legal and ethical principles (Accreditation Board for Engineering and Technology Inc., 2016), but recent actions taken by computing professionals and technology companies (Cadwalladr and Graham-Harrison, 2018; Kaori Gurley, 2020; Wakabayashi et al., 2018; Sainato, 2020a) demonstrate that fulfilling these requirements is insufficient to change the ethical practice of these actors. Critiques of technologists specifically, and the field of computing broadly (Vardi, 2018), advocate for more comprehensive integration of ethics into computing curricula, whereby students would learn to consider the ethical implications of their work as a component of their engineering, programming, and design practice (Costanza-Chock, 2020b; Ko et al., 2020).

While critiques and accreditation standards give little guidance for educators, prior work offers two primary approaches for addressing students' ethics education. One approach creates ethics-exclusive courses: spaces for students' socio-technical learning separate from their technical learning, most commonly covering law, privacy, European philosophy, and inequality (Fiesler et al., 2020). These courses offer opportunities for in-depth and comprehensive approaches to ethics education and avoid conundrums where ethics inclusions are contingent on "if time allows" (Garrett et al., 2020). Prior work, however, argues that standalone courses allow students to view their ethical considerations as separate from their engineering work, rather than as an integrated component of their practice (Hoffmann and Cross, 2021b; Fiesler et al., 2021; Vakil, 2018; Cech, 2014). As an alternative, a second approach embeds

students' ethics education into existing technical coursework. This approach spans several decades of scholarship (Hoffmann and Cross, 2021b; Moore et al., 2006), and its popularity has increased recently, with embeddings within artificial intelligence (Garrett et al., 2020), data science (Bates et al., 2020a), machine learning (Saltz et al., 2019a), human-computer interaction (Skirpan et al., 2018a), and introductory programming courses (Fiesler et al., 2021; Peck, 2019), among others. While both approaches have their benefits, we center ethics embeddings in this chapter because they require less administrative intervention and offer the opportunity to critique computing in context.

Within courses that embed ethics, instructors have taken several approaches: adding short ethics modules taught by subject matter experts (Grosz et al., 2019), inviting guest speakers to present ethics content alongside technical content (Skirpan et al., 2018a), and modifying assignments to focus on ethical considerations, especially with reflections (Saltz et al., 2019a; Fiesler et al., 2021). Existing integrations provide valuable space for students to consider their roles and decisions as individuals, but, as Vakil notes (Vakil, 2018), instructors also need to make space for students to adopt a critical focus on the structures and systems that they exist within. Approaches without a structural focus also risk centering dominant narratives that utilize individualism as a tool to silence, supplant, and distort the narratives of marginalized groups and individuals (Solórzano and Yosso, 2002).

As a vehicle for structurally focused embeddings, counternarratives look to give epistemological weight and theoretical grounding to narratives that run counter to existing dominant narratives (Solórzano and Yosso, 2002). As an example, one might consider the argument advocating for ethics integrations into computing curricula as a counternarrative, one that runs counter to dominant narratives that frame computing as objective, apolitical, and unbiased, with little need for ethics education (Martin, 1997). Pedagogically, counternarratives have been used in K–12 and teacher education contexts to surface the structural nature of individual problems, examine underlying motivations and factors that have lead to these problems, and support students in social interventions to address problems structurally (Miller et al., 2020).

Prior ethics embeddings have aligned with counternarrative pedagogies; any embedding that seeks to center ethics implicitly employs counternarrative methods, countering dominant CS narratives that frame ethics as "off-topic". However, while students that learn counternarratives implicitly may be well positioned to change their own behavior or incorporate ethics into their decision making, they might be unprepared to name or advocate against dominant narratives within computing. One's ethical decision-making does not exist in a vacuum, rather it tends to be situated in a broader context of one's work, one's positionality, and one's relationship with structures of power and oppression. Following counternarrative scholarship (Miller et al., 2020), this work looks not only to educate students in naming dominant narratives, but also to resist and advocate against them, thus an explicit approach is necessary.

Given this explicit approach, many existing ethics embeddings could be modified to center counternarratives. For instance, embeddings in artificial intelligence (AI) could draw from counternarratives that highlight the racist behavior of so-called "race-neutral" technologies (Benjamin, 2019). Embeddings in Human-Computer Interaction (HCI) might draw from counternarratives detailing manipulative interaction design (Zuboff, 2019), disability studies (Mankoff et al., 2010a; Spiel et al., 2020b), or diverse genders in research (Keyes et al., 2021). However, while prior work has established a growing list of potential embeddings, courses that center computer systems remain notably absent.

Unlike AI and HCI, computer systems are an explicit requirement of many computing degrees (Accreditation Board for Engineering and Technology Inc., 2016). Additionally, an introductory course in computer systems that focuses on interactions between architectural systems design and software abstraction might be the lowest level of the computational stack around which students develop proficiency. Given the importance of computer systems in CS degree programs, the lack of ethics embeddings within computer systems, and the first author's prior experience researching computer systems and counternarratives, I felt that explicitly centering counternarratives into a required, introductory systems course could create a foothold for multiple avenues of future work.

In this chapter, I sought to take an explicit approach towards integrating counternarratives into an introductory computer systems course. I describe my process for framing and presenting counternarratives, establish a counternarrative assessment, and report student and instructor reflections on the course integration [1].

5.2 Course Design

I embedded ethics into an introduction to low-level software (computer systems) course that emphasizes the architectural interface between hardware and software, available for students to take after their introductory programming sequence, and completed at a variety of different points along students' degree timelines.

The course takes "a programmer's perspective" (Bryant and O'Hallaron, 2016), though, unlike the Carnegie Mellon course that ours is based on (Bryant and O'Hallaron, 2001; Railing and Bryant, 2018), this course is intended to be students' first exposure to the C programming language. As C's many historic quirks tend to lead to an unsafe and challenging programming experience for newcomers (Arnold, 2010), this course aims to place a minimal programming burden upon students by modifying labs from *Computer Systems: A Programmer's Perspective* (Bryant and O'Hallaron, 2016) to make them more accessible to students without a strong C background. Lectures in summer course offerings have an additional 10 minutes, which, along with a slight increase to the pace of lecture and the removal of a few specialized but inessential topics, left enough time to accommodate counternarratives.

5.2.1 Counternarratives in Systems Education

This integration of counternarratives involved three changes: (1) an overarching course metaphor, the *House of Computing*, (2) relevant socio-technical content and counternarratives presented alongside technical material in most lectures, and (3) assessments of coun-

[1] As with previous chapter, I use singular pronouns within this chapter, but note that this work was a collaboration between myself and Amy J. Ko, and was published at SIGCSE in 2022 (Kirdani-Ryan and Ko, 2022).

ternarrative understanding, *floorplans*. I discuss each below.

The House of Computing

Effective pedagogical use of counternarratives requires establishing links between individual problems in society and their structural manifestations. Often, the connection between individuals and their surrounding structures needs to be made explicitly visible; dominant narratives tend to conceal the existence of structures, especially those that seek to oppress, under the guise of objectivity (Miller et al., 2020). For instance, dominant narratives surrounding work and poverty in the United States tend to emphasize self-reliance and personal responsibility, with little space given to the myriad of structural factors (e.g., 50 years of wage stagnation) that affect one's reliance on social services.

I expected some students to come to this course with an understanding of broad structural oppression, perhaps along axes of gender, race, and class, but I anticipated that most would lack an understanding of structural oppression within computing, as prior courses primarily taught dominant, technical narratives. Dominant computing culture emphasizes values inherited from industrial society such as efficiency, automation, and individualism over alternative priorities such as inclusion and justice, and is frequently presented without question within computing education. In addition to students lacking exposure to counternarratives, I was concerned that students who had completed much of their coursework might have already internalized these dominant narratives, leaving little space for any discussion of counternarratives. Thus, I looked to both motivate the inclusion of counternarratives as well as establish individual-structural connections.

Countering narratives that frame computing as objective, apolitical, unbiased and valueless, I utilized the *House of Computing (HoC)* to frame computing as a structural object warranting critique. The course's syllabus began with a metaphor:

> *Let's imagine that computing is a house, maybe one that your parents lived in, maybe one that your grandparents lived in as well. This house was built quite*

> *a long time ago, somewhere in the 1940s, and has been lived in by many, many people since. There's a foundation that's been built a few times, there's many, many floors, there's lots of furniture and decoration, some that's stayed around since the house was built.*

The *HoC* represents the discipline of computing, a structural edifice built slowly over time through the labor of individuals and groups. I emphasized that the *HoC*, like many other older houses, has a variety of structural features that were created by people who, at the time, thought that their addition would be an improvement. Today, some features have aged beautifully, some were trendy and fell out of style, some have become dingy, and others are unequivocally unsafe, especially for those with greater accessibility needs.

Each floor within the *HoC* builds on the foundation of the floors below it, much like how abstractions within computing machines build on each other. I divided this course into three units — Data Representation, Programs, and Scale & Coherence — and treated each as a floor within the house. Within this metaphor, many floors exist beyond the ones explored in this course: lower floors might house spaces for computer architecture, digital logic, and transistor design, while higher floors might house more familiar high-level languages like Java or Python. By framing course material as explicitly structural and learning as an exploratory process through this structure, I hoped to frame this course as an opportunity to question structural assumptions and pose problems, rather than implicitly accept the validity of existing structures.

In addition to establishing connections between individual and structural problems, pedagogical approaches that incorporate counternarratives should emphasize the malleability of structures (Miller et al., 2020). The *HoC* has features that need fixing or remodeling, but structural repair requires more finesse than simple demolition. I argued that, for students seeking to remodel, it's critically important to understand the existing structure and motivations for creating features that might now be considered obsolete. Without understanding the existing structure from a socio-technical perspective, remodeling projects might uninten-

tionally destroy load-bearing walls and cause widespread collapse. For students that don't intend to remodel, I emphasized that the *HoC* remains inaccessible from many decades-old design choices, and that we should strive for a *HoC* that all students could access and feel a sense of belonging.

Socio-Technical Content

Prior work recognizes that students are shaped by their perception of professional practice (Stevens et al., 2008; Fiesler et al., 2021), so I sought to give counternarratives sufficient weight, relative to existing technical content, by integrating them into as many lectures as possible. Aiming for counternarratives with a connection to existing technical content, I examined established course topics through the *HoC* metaphor, drawing upon my existing knowledge of counternarratives within computing, and researching additional content as needed. Rather than describe this inclusion to students as counternarratives, I framed additions as socio-technical content that linked technical structures and social underpinnings.

Course Topic	**Bridge Concept**	**Counternarratives**
Accessing Memory	Course Foundations	The first programmers & computers as people, and the racist, sexist motivations for automating devalued labor (Margolis and Fisher, 2002; Benjamin, 2019)
Introduction to the C language, Pointer arithmetic	History of C	C as rugged, minimalistic & individualistic, mirroring the spirit of the frontier from 1970s (space) and 1870s (manifest destiny)
Signed & Unsigned integers	Historic Tabulation	Babbage's analytical engine automating away jobs, inspired by Gaspard De Prony and Adam Smith

Bitwise & Boolean Operators	The influence of Navya Logic on George Boole (Boole, 1909)	The duality of computing's intellectual insulation, both as isolating and as a refuge, especially with autistic people (Ko, 2021)
Floating Point	Shame from comparing floats for equality	The exclusionary role of knowledge policing, community legitimacy, and shame within CS, comparing "man cards" and "CS cards"
x86 Programming I	Contrasting CISC and RISC ISAs	Arguments have ideologically underpinnings, with a focus on 1980s CPU advertisements and motivations for RISC ISAs (Patterson and Ditzel, 1980)
x86 Programming II	Processor Market Domination	The growth of monopolies, within, and beyond computing, is a result of neoliberalistic anti-trust policies (Doctorow, 2020)
x86 Procedures	—	Textbooks and course goals have ideological underpinnings and design goals that can be examined through critical reading
Arrays in C	Lack of array bounds-checking	C's inaccessibility when viewed from a structural lens of access and ability, rather than an individual one (Oliver, 1990)
Buffer Overflows	Lack of array bounds-checking	Technology, specifically programming languages, can be inaccessible, expanding to race and technology and racist technologies (Benjamin, 2019)

Direct Mapped Caches	Performance motivations for caches	Metrics, especially efficiency, are an ideological choice that defines success and shapes structures as a result
Associative Caches and Locality	Assuming code with "Good Locality"	Optimizing for the average case can be problematic by erasing diversity, drawing from critiques of machine learning (Ko, 2021)
Optimizing Code for Caches	Objectivity in CS	Positivist epistemologies and objectivity claims can cause harm when computing and science interact with human diversity
System Control Flow & Processes	Historic Operating Systems	The first operating systems as people, whose jobs were automated
Virtual Memory	Computing at a Global Scale	"Utopian" societal visions, especially from tech leaders, emphasize an all-encompassing scale and a technocratic, oppressive society (Zuboff, 2019)
Memory Bugs	Debugging challenges	Debugging is often disembodied and intellectualized, are there alternatives?
Java and C	—	Students' career practice within elite institutions centers prestige (Binder et al., 2016)
Course Wrap-Up	Finality	How can we act to achieve alternative futures? (Freire et al., 2018; Miller et al., 2020)

Table 5.1: Connections between course topics and counternarratives, ordered by their appearance in our course.

Table 5.1 details the counternarratives that I chose alongside corresponding technical

topics. For each course topic, I include the link between topic and counternarrative that I established when constructing this course. For instance, arrays in C famously lack bounds-checking, and dominant narratives tend to put the onus on the individual to remember to use library functions that dictate strict bounds checking. This individualistic framing matches dominant narratives surrounding accessibility and one's ability to use technology without causing harm, thus I drew from established work in disability studies that posed accessibility issues as structural problems rather than individual failings (Oliver, 1990).

This course met for lecture three times per week for 8 weeks, with the last 15 minutes of nearly every lecture devoted to socio-technical content and counternarratives, with three slots devoted to in-class critique on students' floorplans. Counternarratives were presented as lecture, supplemented with small group discussions and pre-lecture readings when appropriate. I chose to place counternarratives last in lecture so that I could present dominant narratives for contrast before delving into socio-technical topics, though I often referred to socio-technical content throughout. This approach allowed us to establish technical legitimacy among more technically-minded students, ensured that technical material for the course was adequately covered, and assured students that this course offering would be as technically focused as prior offerings. I considered counternarrative-exclusive lectures, but I was concerned that technically-minded students might skip, whereas this structure might force some degree of engagement.

Floor-plans

Prior offerings of this course during the COVID-19 pandemic had opted to replace exams with Unit Summaries, in part due to the infeasibility of administering exams remotely. The intent of Unit Summaries was to give space for students to create a personal artifact while engaging in the reviewing and summarizing that would typically occur with exam review. For this offering, I looked to assess students' understanding of counternarratives and opted to remain within the *HoC* metaphor by assigning *floorplans* in lieu of Unit Summaries or exams.

For each unit, or "floor" within the *HoC*, I asked students to create a representation of the spaces that the course visited throughout the unit. The definition of a floorplan was intentionally vague: students could submit schematics, sketches, narratives, or other formats that felt accessible and expressive to them. Floorplans needed to include representations of socio-technical content; I argued that those with career success within the *HoC* (for instance, programming language designers) often have deep understandings of both social concerns and technical concerns. I also emphasized that established scientists and engineers go beyond descriptions of "what is" by supplementing with context when appropriate. Likewise, floorplans should include descriptions of why features were included within the *HoC* ("what was"), as well as what students would change about this space ("what could be").

As prior work emphasizes the importance of creative expression as necessary for feeling that life is worth living (Winnicott and Rodman, 2010) and resisting and acting against oppression (Holland, 1998; Freire et al., 2018), I wanted to make sure that floorplans offered space for students' creativity. Thus, no examples of existing floorplans were provided to students; I felt that examples might short-circuit students' creative process. Students also submitted reflections on learning the unit's content. I evaluated students along four axes: (1) how completely the floorplan represented the unit's content, though students could justify omissions, (2) the cohesiveness of the floorplan representation relative to the unit's content, emphasizing the importance of prototyping and iteration when designing a floorplan, (3) the clarity of the floorplan and the metaphors that a student chose, and (4) the degree that students were creative, incorporating their own experiences and creating a piece that was unique and personal to them. For each, I evaluated using a 3 point standards-based grading scale (Marzano, 2010), averaging and rounding up to produce a grade.

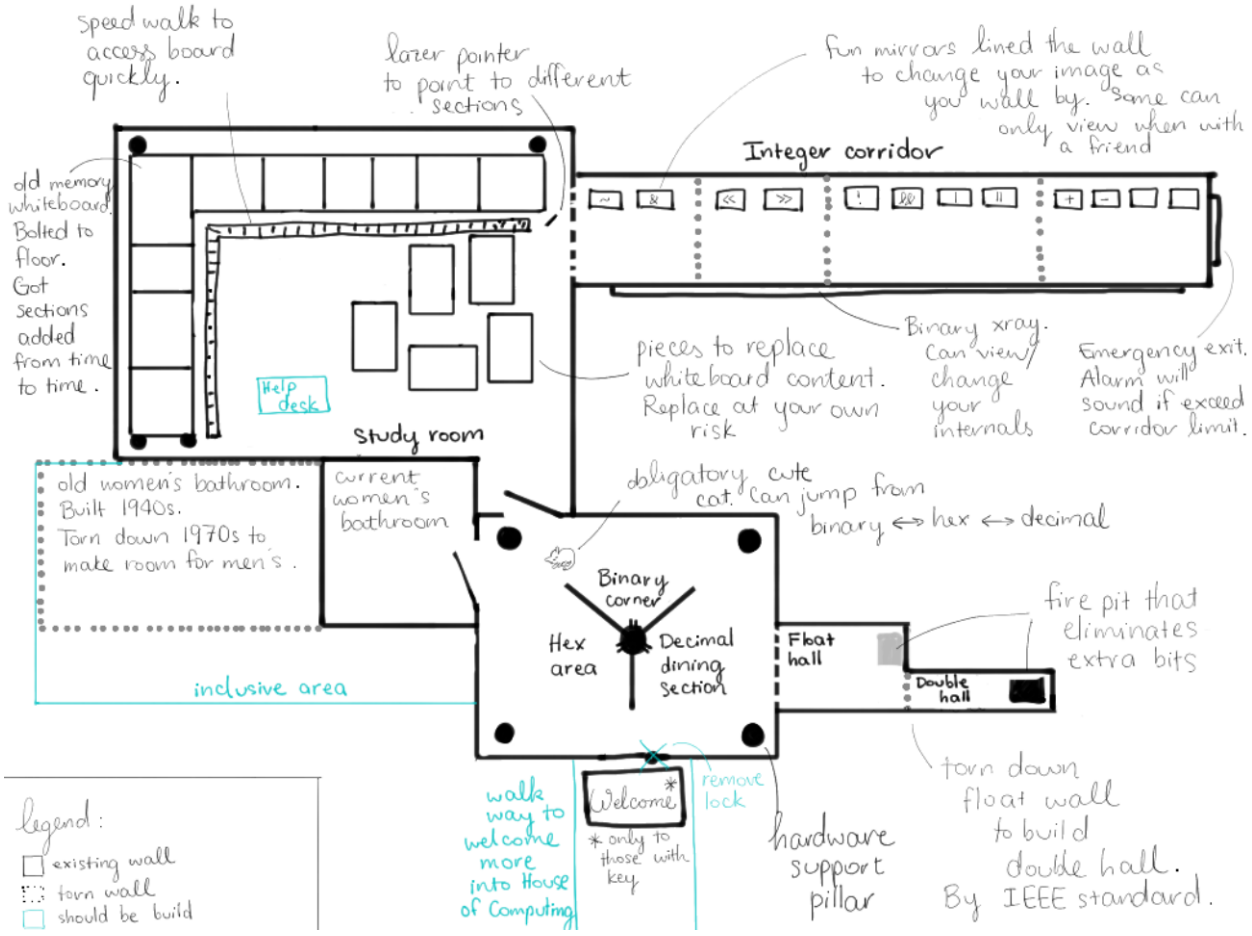

Figure 5.1: One student's floorplan for Unit 1

5.3 Experiences and Reflections

5.3.1 Student Experiences

Most interesting to us was students' metacognitive awareness towards structural problems (Miller et al., 2020), especially among students that had not previously connected CS to widespread structural inequity or were unaware of structural inequity at all. In analyzing students' floorplan reflections and mid-quarter surveys, I found that nearly every student expressed either some existing metacognitive awareness situated within CS, or some newfound awareness that resulted from this intervention. One in particular realized that:

> *A computer scientist is not always an objective individual working with universal principals, which one might gather from the word 'scientist'. Rather, computer scientists must be mindful of their role in historical systems [...] and view their work through an informed lens.*

Several students expressed a change in how they viewed themselves and CS. One said that as a *"CS-minded person who believes efficiency more than anything, this unit alters my mind"*, the awareness of *"cultural values which implicitly affect how creators make certain choices"* was *"priceless; it changes my perspective on viewing many things"*. Another found:

> *'Priorities are baked in'. Even as a self-proclaimed skeptic, I have seen this ring true.*

Some students were less enthusiastic, but noted some degree of change:

> *I don't think the socio-technical content has really changed my life in big ways just yet, but I find myself thinking about what I've learned throughout the day.*

However, a few students didn't display this awareness. One reflection viewed historic counternarratives and present-day computing as separate:

> *I've gained a better understanding of what computer science used to be, compared to how it is now.*

Another ignored socio-technical content when responding to a scaffolding prompt that asked if their idea of what it means to be a computer scientist had changed:

> *Disagree, I don't think we've learned much about computing yet, but this unit did get me curious about how computers work at the fundamental level.*

In their mid-quarter feedback, a few students wanted to keep socio-technical content, but worried about their ability to keep up with course technical content:

> *The socio-technical content is really interesting but it does kind of take time away from what a really difficult set of technical content. I'd keep it, but it also means making sure the technical content isn't rushed.*

Students offered several options: one wanted socio-technical content to be an optional recording alongside lecture, another suggested devoting one lecture per week to socio-technical content:

> *I find the constant flipping between the two rather jarring during lectures sometimes as it might often detract from the new content that I am trying to digest or follow the thoughts forming in my head.*

Other students advocated eliminating socio-technical content:

> *Everything I'm learning in this course is excellent, but the socio-technical content is boring [and] unnecessary.*

While floorplans are by no means a perfect assessment of students' socio-technical understanding, they acted as an artifact representing students' relationships with course material. Looking to assess students' experience with the course redesign and focusing on students'

first floorplan, the first author graded floorplans along the rubric presented in Section 5.2.1, then performed a second round of analysis, grouping for themes independent of the rubric. Two students submitted floorplans following requirements from a prior course offering, so I omitted them from analysis.

At a high level, student floorplans either utilized metaphors to connect socio-technical and technical material, or they avoided using metaphors. For students that utilized metaphors (25 of 32 students), their floorplans varied around how well-suited their representations matched the course material (cohesion) and the uniqueness of their expressions (creativity). Students with strong cohesive and creative representations (12 total) chose a variety of forms: narratives that described walking through a house, pamphlets for gentlemen's clubs, pop-up rooms, and a variety of visual forms. Most chose to stay within a conventional "floor", connecting, for instance, operators that transformed binary representations to kitchen knives that "transformed" ingredients into different forms, and the English-centric ASCII encoding to multiple residents that struggled to communicate across different bit representations. Students that met expectations for creativity and cohesion (5 total) surfaced metaphors that mostly fit, but likely would've benefited from iteration and feedback, for instance, a multi-course meal where utensils were pointers. Other students (8 total) had metaphors that seemed somewhat haphazard, with strained connections to course material or other metaphors, for instance, conflating variable assignment to bringing in new items from outside and uniquely naming them.

Students that chose to not utilize metaphors (7 total) created floorplans analogous to a typical unit summary. Of these students, 3 created mind maps and 4 summarized the material linearly, with one student submitting a linear summary alongside personal reflections from posing socio-technical material as critical questions. I find it worth noting that the only students that didn't demonstrate awareness of structural problems were those that summarized the unit material linearly, without personal reflections (3).

Several students preferred floorplans to traditional exams:

> *Brainstorming and designing the project was extremely refreshing as opposed to the traditional review for exam.*

However, several students struggled with the unfamiliar format of an open-ended, creative assignment. In their mid-quarter feedback, one student offered:

> *The floor-plan part of the first unit summary was my biggest nightmare come to life. I still enjoyed it, don't get me wrong, but it was a lot tougher to focus on.*

Others were concerned about the correctness of their solution:

> *It took me quite a long time as I was stuck for a while trying to figure out what to do for the project.*

Some students procrastinated, due to the unfamiliar format:

> *I was extremely intimidated at the vague instructions for the floorplan and ended up putting it off.*

For some students, the vagueness proved beneficial:

> *I realized that innovation means working with little to no instruction and relying on knowledge and creativity to create a final product.*

While for others, it was a waste:

> *I wasn't sure what to do, and I spent a lot of time doing a thing that did not help me learn.*

5.3.2 Instructor Reflections

When designing this integration, my goal was a somewhat extreme embedding, integrating counternarratives within every lecture, with some spanning several lectures. I might have taken a more restrained approach by incorporating curricular perspectives and integrating

counternarratives that fit best within this course, leaving the rest for future courses (though I argue that some especially crucial counternarratives should span multiple courses). While my approach was ambitious and should provide scaffolding for future instructors, student concerns about lecture pacing indicate that more cuts to course content were needed. As suggested, an approach that devoted one lecture per week to counternarratives might offer more reasonable pacing, but I worry that students may devalue or skip socio-technical lectures. I note that this was my first time instructing a course, and more experienced instructors might find a better balance.

Throughout the course, I stressed that I was willing to meet with students who questioned the validity of presented counternarratives or the legitimacy of their adoption, but no students chose to engage in this capacity. I suspect that the enthusiasm for counternarratives that students with prior experience brought to the classroom bolstered the material's legitimacy and led students critical of my approach to perceive themselves as a minority. Lecture attendance dropped throughout the term; I wonder if students critical of counternarratives elected to not attend. For those that chose to attend, I noted that students seemed more comfortable with counternarratives, and themes surrounding dominant computing culture became more familiar. Some counternarrative content was more polished than others; for less-polished material students seemed less engaged but never combative.

Regarding floorplans, I recognized that an unfamiliar assignment format and open-ended rubric requirements might unsettle students. My goal was an assignment that felt challenging, but accessible and supported. While I didn't provide example floorplans, several students found in-class critique to be especially valuable, both as an incentive to start their floorplan and an opportunity to integrate direction from others. However, some students still rushed to piece together their floorplan, and perhaps attaching a superficial grade to students' check-in would have aided motivation.

Students varied widely in their comfort with creative expression, and there were many additional opportunities to add scaffolding for students with less prior experience. In general, I graded floorplans leniently in an attempt to alleviate students' concerns around grades given

an unfamiliar assignment and a unique socio-technical context, but these concerns persisted for several students. I could have offered a framework for approaching creative work, as well as more explicit instruction in iterative design. I also could have further emphasized that non-visual formats, especially narratives, were welcome representations for floorplans, as several students expressed concern around the additional cognitive load of learning a new expressive medium on top of an already challenging assignment. More iteration is needed to balance assessment feedback with student anxieties around a new assignment.

5.4 Discussion

For instructors looking to embed counternarratives within CS classrooms, I offer a few parting words of advice. First, I found that some of the most expressive and powerful counternarratives were personal. Every instructor, even those with primarily dominant identities, experiences oppression at the hands of dominant narratives and structures. In this case, body scanners within airport security assume binary, cisgendered bodies and algorithmically optimize for efficiency based on that assumption, at the expense of non-normative bodies being labeled as anomalous. The dissertation author, who identifies as transgender, incorporated their airport experience into a counternarrative around common case optimizations within CS. Many complex experiences exist, but for us, a close connection to one's history and one's experience was a compelling guide towards constructing counternarratives.

Second, the task of choosing counternarratives to incorporate is a creative and challenging one, requiring mental and emotional space, and ideally would be completed before the course began. At the onset of this course, some counternarratives felt familiar, so constructing a framing for students was relatively simple. Others felt less so, and constructing a framing required several hours of research. For instructors looking to avoid overburdening themselves, choosing several counternarratives and noting the accessibility of each before the course began would be a splendid start. This would also allow cuts to existing technical material to be more conscious than ours, hopefully allowing for a more coherent course plan.

Finally, I feel that many spaces within CS would benefit from an embedded counternarra-

tives approach. Much of computer systems and CS broadly involves teaching about concrete, human-made, historic structures alongside their modern-day counterparts. Few would argue the infallibility of these structures, and so a holistic approach could frame those structures as present but not permanent. Teaching these structures could be a praxis between constructing and critiquing these structures, perhaps utilizing the metaphoric framing of the *House of Computing*. This framing could make space for students to not only be critical of technical structures, but also socio-technical structures and oppressive structures, especially when instructors are willing to co-create that context with students.

Chapter 6

DECONSTRUCTING & CHALLENGING CULTURAL NORMS IN COMPUTING

As with Chapter 5, this chapter utilized understandings of normativity within computing to inform pedagogical interventions with a goal of cultural change. Chapter 5 offered an approach within existing curricula, in this chapter, I sought to explore what might be accomplished with a dedicated intervention. To this end, I advocated for, designed, and facilitated a course for 22 students in deconstructing cultural norms, offered over 10 weeks in Spring 2023. With regards to my thesis statement, this chapter clarified the bulk of my claims: this work surfaced that students' experience identity fragmentation due to computing culture, that resolving fragmentation can be scaffolded, and students had a more amenable view of political action and activism after resolving fragmentation.

6.1 Introduction

As demonstrated by the previous chapters in this thesis, computing culture must change. The computing community has reckoned with the ways that computing magnifies societal oppression for over a decade (Vakil, 2014), and prior work has illustrated how technologic innovations, from camera film to artificial intelligence, have reified dominant norms of racism, sexism, ableism, and transphobia (Spiel et al., 2022; Noble, 2018; Costanza-Chock, 2020a; Benjamin, 2019). Prior work has emphasized that reforms be necessarily structural (e.g. (Buolamwini and Gebru, 2018)), and has also clarified a need to focus on pedagogical contexts in computing (Ko et al., 2020; Vakil and Higgs, 2019; Margolis, 2008). As described in Chapter 2, cultural transmission is typically intertwined with any learning endeavor and while computing education is but one apparatus of normativity, pedagogical reform has the

potential to spread reform with virality (Benjamin, 2022) beyond a single institution.

With a goal of pedagogical reform, prior work has taken several approaches. Some approaches focus on teacher education, Ko et al., for instance, created a pre-service pathway for CS educators that emphasized connections between computing, equity and justice (Ko et al., 2023). Some focus on professional development: Washington, for instance, created a scale for measuring cultural competence in computing (Washington, 2020; Washington et al., 2023) and a cohort-based approach to educating computing faculty (Cultural Competence in Computing , 3C). In addition to these, prior work has also examined institutional reform through broadening participation, mentorship, and outreach (Margolis and Fisher, 2002; Margolis, 2008; Fisk et al., 2024).

Within the scope of this thesis, I focus on pedagogical approaches to cultural change that students' learning, and while others exist, I focus on ethics embeddings in post-secondary education and culturally-responsive and justice-centered approaches in K-12. In the former, prior work has sought for computing students to consider the ethical implications of their work as a component of their engineering practice (Fiesler et al., 2020; Hoffmann and Cross, 2021b). Typically ethics education works to integrate ethics education into students' existing coursework (rather than create dedicated courses) (Cech, 2014; Fiesler et al., 2021; Hoffmann and Cross, 2021b; Vakil and Ayers, 2019), and prior work has established integrations into a variety of technical courses (Kirdani-Ryan and Ko, 2022; Peck, 2019; Reich et al., 2020; Saltz et al., 2019b; Skirpan et al., 2018b; Oleson et al., 2018; Jia et al., 2021; Bates et al., 2020b). Alternately, justice-centered approaches look to examine social implications of computing (Vakil, 2018; Ryoo et al., 2021a,b), acknowledge social-political contexts in which computing teaching and learning occurs (Ryoo et al., 2021a; Leonard and Sentance, 2021), and develop the agency of learners (Ryoo et al., 2021a, 2020; Vakil and McKinney de Royston, 2022) to empower and inspire activism (Morales-Chicas et al., 2019; Scott et al., 2015; Miller et al., 2020; Ryoo et al., 2021b; Vakil, 2018)[1]. Contextually, these approaches have utilized

[1]Many approaches exist: culturally relevant (Leonard and Sentance, 2021) and responsive computing (Scott et al., 2015; Leonard and Sentance, 2021) and youth as philosophers of technology (Vakil and

research-practitioner partnerships within computing classes (Vakil, 2020; Ryoo et al., 2020, 2021b), after-school programs, or dedicated learning spaces (Ashcraft et al., 2017; Vakil and McKinney de Royston, 2022; Everson, 2022; Madkins et al., 2019; Shaw et al., 2023).

Ethics education and justice-centered computing differ pedagogical content and outcomes, but also in the ways that they approach identity work. As discussed in Chapter 2, I define identity work as narrative deconstruction that creates agency; agency which individuals act upon to project their self-knowledge into a realized form. Ethics education aims to give learners the background to engage with the ethical and societal implications of their work, but ethics education rarely considers learners' identity beyond their disciplinary work or considers approaches to building learners' agency (Vakil, 2018). This might mean that learners come away with robust sociotechnical understandings of technology, but lack the skills to advocate for cultural or technologic change within their professional work. In contrast, justice-centered computing often centers the development of learners' agency (Ryoo et al., 2020; Ashcraft et al., 2017), but learners within justice-centered contexts often come to computing with prior experience deconstructing cultural norms, and self-describe existing deviations from normative expectations (Ryoo et al., 2021b, 2020; Ashcraft et al., 2017). Justice-Centered approaches have been effective for the students that they aim to serve, but it remains unclear if these approaches will translate for students without that prior experience, and furthermore, who have already developed disciplinary identities within the cultural hegemony of computing education.

Ethics education and justice-centered computing approaches are not mutually exclusive, Lin, for instance, has argued for postsecondary approaches to be more justice-centered (Lin, 2022). Nevertheless, a gap remains: those without substantive experience engaging in identity work may find calls to dismantle oppressive regimes to be beyond their capacities, and simply embedding critical content (Chapter 5) is unlikely to aid in expanding students' agency. This is necessary work: without it, students might have the intellectual capacity

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McKinney de Royston, 2022). I use "justice-centered" to broadly describe approaches that have a goal of student-led activism.

to critique dominant approaches to technologic construction, but lack the wherewithal to supplant those critiques with action. Given that prior approaches in ethics education generally do not engage students in identity work, and that prior approaches in justice-centered computing seem most effective with students who have already engaged in strong degrees of identity work, I sought interventionist work to engage identity work directly. To that end, I explored the following research questions:

- How can identity work be fostered in post-secondary computing education?
- What connections exist between computing students' personal narratives and computing's dominant disciplinary narratives?
- What changes in student identity and perceptions of students' disciplinary space manifest when dominant disciplinary narratives are addressed through identity work?

To answer these research questions, I investigated these questions within a postsecondary computing seminar that I developed and taught, entitled *Deconstructing Cultural Norms within Computer Science*. This was an optional course, primarily aimed at juniors and seniors in computer science, where course material was co-constructed. Beyond the theoretical perspectives in Chapter 2, I offer additional theoretical framings that proved more analogous to this work, describe students' development throughout the course, and conclude with implications that identity-work approaches have for critical computing[2].

6.2 Background

As discussed in Chapter 2, this thesis was grounded in theories of social learning and identity work. For the former, I utilized theories of social learning to describe how 1) individuals come to replicate normativity, 2) aspects of normativity can be unique to a disciplinary field, 3)

[2]I use singular pronouns in this Chapter, and note that this work was a collaboration between myself and Amy J. Ko, and will be submitted for publication when I have the emotional and temporal capacity to wholeheartedly attend to it.

individuals navigate different definitions of normativity between various fields, 4) that these frequently conflict, especially for individuals that experience systemic marginalization, and 5) individuals can learn to break normative expectations through critical discourse. For the latter, I defined identity work as a deconstruction of dominant narratives that produces a newfound capacity for expression which individuals utilize to project their self-knowledge into a realized form. This has reasonable alignment with framings of *praxis* from critical pedagogy (Freire et al., 2018), but as I embarked upon the work in this chapter, it quickly became clear that this theoretical frame was an inadequate lens through which to view the experiences of students. Thus, I pivoted the theoretical grounding to *Parts Work*, described below, but first describe existing conceptions of identity work in teacher education. I note, though, that this section strays from both computing and education in favor of the explanatory power offered by framings from other disciplines: I invite the reader to prioritize their own learning over forming connections between divergent disciplinary approaches to scholarship.

6.2.1 Identity Work in Teacher Education

Teacher identity work takes the form of activism, personal development, and professional learning as teachers reflect and iterate on their knowledge of themselves, their teaching practice, and the disciplinary and political spheres that they find themselves within (Mockler, 2011; Clarke, 2009). Prior work has utilized conceptions of identity work to describe how teachers might develop and utilize their agency amidst the power relations of their profession (Clarke, 2009), and focuses on how teachers enact their conceptions of pedagogical best practices, purpose for teaching, and self-practices within their professional contexts (Robertson and Yazan, 2022; Yazan and Lindahl, 2020; Neumayer-Depiper, 2013). These conceptions of identity work contribute an emphasis on the interplay between students' identity and disciplinary normativity that details legitimate professional practice (Mockler, 2011), especially in neoliberal standards-based teaching contexts (Reeves, 2018; Buchanan, 2015; Mockler, 2022). While, broadly, this work calls for more integrative approaches to teacher education that incorporate reflective practices (Clarke, 2009; Reeves, 2018) and build teachers'

capacity for managing emotional labor (Acton and Glasgow, 2015), these primarily situate in educators' desire to improve their teaching. Within this context, computing learners conceptions of disciplinary authority are intertwined with normative expectations for their professional practice (Chapters 2, 3, and Chapter 4), and these, as with teacher education, are continuous and iterative approaches. However, as students' participation in professional practice is mediated through the authority of their institution (Wenger, 1998; Stevens et al., 2008), their expressions of agency are largely limited by their pedagogical context, rather than the broader systems of power and politics that teachers exist within. Thus, I maintain an approach to identity work based around learners' relationship with dominant disciplinary narratives, and utilize my own theoretical framings and parts work throughout this work.

6.2.2 Parts Work

The notion that each individual contains a multiplicity of voices, personalities, archetypes, or parts is well-worn within psychological literature (Schwartz and Sweezy, 2019; Jung, 1968; Rowan, 1990; Stone and Stone, 1993; Watkins and Watkins, 1997)[3] despite several centuries of pathologizing cognitive difference (Foucault, 1988) that continues to the time of this writing (JUDGE ROTENBERG EDUCATIONAL CENTER, INC. v. UNITED STATES FOOD AND DRUG ADMINISTRATION). For instance, individuals often intuitively describe their inner state as a variety of parts, e.g. part of me wants to keep engaging in research, part of me is curious about teaching. The notion of multiplicity is particularly old, especially when accounting for indigenous (McVicker, 2017) and spiritual (Allione, 2008) forms of knowledge outside Western colonialist epistemologies, and there is a general consensus that individuals function best when the relationship between various internal parts is harmonious and balanced. Harmony and balance are often not a default state (Jung, 2014; Schwartz, 2021), rather, attaining harmony and balance requires leadership through one's Core Self [4].

[3]Real talk: a bunch of these feel super dated, and very 90s pop-psych, but one doesn't need to look terribly hard to see a link between inner critic/inner child work and parts work/internal family systems.

[4]At the time of this writing, Internal Family Systems (IFS) is the most well-worn framing of parts work (Schwartz and Sweezy, 2019), and typically treats the core self as singular, which fails to capture the

This is *parts work*: developing and utilizing leadership in the Self to attend to the beliefs, wants, and needs of a multitude of parts, mediate conflicts between them, and ensure that all voices are valued and understood (Schwartz and Sweezy, 2019)

Whereas theories of social learning effectively describe the mechanisms by which individuals fracture their identity between conflicting spheres of normativity, they often lack explicit guidance on how to approach the act reconstitution [5] However, *parts work*, directly offers guidance for working within fragmented identities. First, *parts work* distinguishes between parts that are fragmented, parts that maintain that fragmentation, and the Self that mediates communication between them[6]. Typically, fragmentation occurs as individuals attempt to align non-normative aspects of self with normative expectations, though attempts to integrate traumatic experiences can also result in fragmentation (Schwartz and Sweezy, 2019). As a example, many autistic and neurodivergent individuals are discouraged from pursuing *special interests*, as openly pursuing non-normative interests often has negative ramifications for one's social standing (Price, 2022). Many autistic individuals develop a sense of shame around their *special interests* (Price, 2022); within a parts work framing, individuals would have fragmented the part of themselves that derives deep nourishment from engaging in a special interest, while another part replicated societal shame internally to maintaining that fragmentation.

Second, successful integration requires that individuals 1) identify what parts work to maintain fragmentation, 2) understand fears of integration, offering reassurance, and 3) witness the experiences (and frequently pain) of fragmented parts (Schwartz and Sweezy, 2019). As with any therapeutic endeavor, this process strongly benefits from a positive therapeutic relationship (Rogers, 1957), and therapists utilizing parts work often facilitate a client's development of the Self's role in mediating between separate parts (Schwartz and Sweezy,

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experiences of plural systems (Christensen, 2022)

[5]This largely makes sense; I do not view sociology as a particularly interventionist tradition, especially when compared with education.

[6]Prior scholarship refers to these as *exiles* and *managers*; parts work originates with clients who had experienced environments of abuse, neglect, and assault.

2019). Fragmentation often exists to mitigate the stigma of an authentic presentation, and clients' internal landscape often includes parts who's resistance to reconstitution has been the correct response to perceived threats. In the previous example, one approach might be to work towards understanding fears of the parts that manifest shame, such that those parts might step aside and allow a burgeoning relationship with fragmented parts. Through this, an individual might be able to experience both 1) the joy they felt engaging with special interests as a child, 2) desires to continue that engagement, as well as 3) the painful experiences (bullying, for instance) that led fragmentation to be the correct response. Trust and sensitivity are required throughout the process, and no part can be forced to change without consent, but through parts work, individuals can reintegrate fragmented parts, reassure parts maintaining that fragmentation, and present more authentically (Price, 2022; Schwartz and Sweezy, 2019).

While theories of social learning and my previous framing of identity work (Chapter 2) was sufficient to frame prior work in ethics education and justice-centered computing, parts work offers alternative explanations. Justice-centered computing contexts often exist as a first computing experience for systemically marginalized youth, and work to build a cultural base within computing to avoid the fragmentation that might occur in more homogeneous contexts. Computing education has frequently been an endeavor that fails to acknowledge learner identity (Scott et al., 2015); culturally-responsive or culturally-sustaining approaches have sought to prevent individuals from fragmenting their cultural identity from their computing context, by actively integrating students' cultural context into computing. Utilizing parts work, one might view justice-centered computing as a context in which students build trust in their Core Self, such that their sense of self might persist in computing. Alternately, ethics education attempts to broaden notions of legitimacy to include socio-technical content and ethical considerations, and may resonate more with marginalized students (as many embeddings attend to issues of inequality and justice (Fiesler et al., 2020)). However, as connections between learners' identity and curricular context has largely been circumstantial, it is unlikely that learners will engage in identity work. With parts work in particular, to my

knowledge, ethics education does little to build trust in the Self and the self-leadership that might be necessary to utilize the knowledge from ethics embeddings towards professional advocacy. Furthermore, barring a complete curricular integration, it is likely that students with marginalized identities may still see the core of their experience as separate from their intellectual endeavors.

With this chapter's work, my critique stands: prior literature in justice-centered computing centers learners with established trust in their Core Self (and with some degree of experience with identity work), and prior work within ethics education does little to build trust in one's Core Self. Parts work seeks to build this trust, but the process by which individuals engage in parts work is rarely harmonious. Prior work in psychology has examined why individuals engage in therapeutic work (Galster, 2017; Gourash, 1978; Cusack et al., 2004; Gulliver et al., 2010), but as this chapter focuses on educational contexts, I opt for theories of interest development.

6.2.3 Interest Development

Building from existing models of individual (intrinsically triggered and sustained) and situational interests (environmentally triggered, variable persistence), Hidi & Renniger offer a four-phase model that describes how individuals come to develop interests (Hidi and Renninger, 2006). Initially, individuals experience a *triggered situational interest*: a psychological state that is sparked by one's environment, typically externally supported, and may encourage re-engagement over time. If this psychological state persists, individuals may continue to a *maintained situational interest*, whereby one's interest is maintained through tasks and/or personal involvement, but still typically externally supported. At some point, if an individual continues to engage in an interests, they may build stored knowledge, value, and positive feelings associated with the interest, and may opt to reengage with their *emerging individual interest*, though still may require some external support, especially when faced with difficulty. Finally, if one continues to build their stored knowledge and stored value, they may develop a *well-developed individual interest*, still benefiting from external support,

but capable of persevering through difficulties independently.

Within the context of this work, that is, an optional seminar in postsecondary computing education, interest development offers an explanation students' engagement. In this case, course titles and descriptions might trigger a situational interest for several students, perhaps students that had experienced interest in sociotechnical topics or ethics education within their degree. Upon entering the course environment, some might opt to maintain their interest and continue their participation. I utilized Parts Work to describe the interplay that individuals may experience when reconciling their relationship to normative structures, and interest development to describe one's inclination to form any degree of engagement in that process.

However, while interest development describes how individuals develop intrinsic motivations for learning, it only incidentally attends to the social dynamics of learning. As discussed in Chapter 2, learning is intertwined with normative expectations that dictate requirements for legitimacy, membership, and participation. The practice of deconstructing cultural norms is decidedly outside computing's milieu; thus some students, especially those marginalized within computing culture, may be more likely to experience a triggered situational interest from this study's context. Furthermore, as individuals often experience more visibility into cultural norms that they fail to fit, students drawn to deconstructing norms (and identity work broadly) may be seeking a space to reconcile their own experiences with others.

6.3 Methodology

Given that prior approaches in ethics education generally do not engage students in identity work, and that prior approaches in justice-centered computing seem most effective with students who have already engaged in strong degrees of identity work, I sought to engage identity work directly. Furthermore, as justice-centered computing efforts have typically situated in K-12 education (Lin, 2022), I situated this work in postsecondary computing, advocating, developing, and teaching a seminar in deconstructing dominant disciplinary narratives. I offered this at my own institution, chosen due to the established relationships that allowed exploration into more experimental pedagogical contexts.

To familiarize the reader, the Paul G. Allen School of Computer Science & Engineering (referred to as the Allen School) is a public R1 institution in Seattle, Washington, typically ranked among the top 5 computer science programs in the U.S. (Best Computer Science Schools). The institution's prestige (see Chapter 3), relatively affordable tuition for in-state residents, and proximity to elite technology firms within the Puget Sound region has created a fervent demand among students who come from 1) exceedingly well-resourced suburban schools, frequently with parent technologists, 2) relatively low-resource rural schools in Eastern Washington, and 3) relatively low-resource urban schools in South Seattle, among others. This diversity among students' economic backgrounds (which also affects students' position within postsecondary education, many students also transfer from 2-year colleges (Kwik et al., 2018)) creates a wide breath of prior experience in computing students' familiarity with navigating prestige broadly and computing culture specifically. Students position a CS degree as everything from a way to gain familial approval (Covarrubias and Fryberg, 2015), a mechanism for students and families to jump class strata (Covarrubias et al., 2019), and a route to near-guaranteed employment upon graduation. Demand for CS consistently exceeds the Allen School's capacity, thus leadership have sought to aggressively scale the program in the name of serving students, with multiple 350-student sections of intro programming offered per quarter [7].

As the norms of both an institution and a discipline are transmitted as part of students' educational experience, and membership within a discipline is required to experience the imposition of dominant disciplinary narratives, I positioned my seminar as an optional 400-level elective, offered to junior and senior students. The course, entitled *Deconstructing Cultural Norms within Computer Science* was offered in Spring 2024[8] with a maximum enrollment of

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[7]Computing education has used CS1 colloquially, at the time of this writing, the Allen School offers a three-course introductory sequence that covers the basics of procedural programming, the usage, design and implementation of data structures, and object-oriented programming

[8]With regard to post-lockdown culture, courses at UW were primarily synchronous at the time of this offering, though I note that many students had experienced a majority of their postsecondary education either remotely or with required masking.

25 students, and met for two contact hours per week in a seminar room within the CS building. Students were not recruited explicitly, but I advertised the course via announcements to students in 300 and 400 level courses, as well as posts to the undergraduate student board. The course was described as follows, advertising blurbs and longer descriptions are available in appendices B.1 and B.2, respectively.

> *Seminar on career and cultural norms within computer science learning spaces, exploring how these norms are reinforced and replicated, and the systemic ramifications of those norms. This course looks to help students explore their identity, how it relates to the field's cultural norms, and how to respond in ways that may counter prevailing norms and narratives. Students will be lovingly asked to reflect on their position within computer science learning spaces and society broadly in order to find practices that sustain positive cultural change.*

At the end of the course, 22 students were enrolled, 17 of whom filled out the initial demographic survey[9]. Of these 17, 6 identified their gender as male, men, or he/him, 10 identified their gender as female or woman, and 1 offered "good question :/" in response to the prompt. In terms of ethnicity, 3 identified as Chinese or East Asian, 2 as South Asian or Indian, 2 as Asian, 7 as White or Caucasian, 2 as Hispanic, Latina, Peruvian, or Latino, 1 as Ethiopian, and 1 as half Russian[10]. Students also disclosed other identities in this initial survey and throughout the course: 3 identified as autistic, ADHD, or neurodivergent, 4 identified as lesbian or queer, 1 identified as trans, and one offered that they were "from a pretty small town and that…affected my perspectives and who I am as a person". Students were primarily Computer Science majors, though a few were pursuing Computer Engineering or the Allen School's Data Science option, and students had been taking courses at UW for two to four years. Broadly, group was diverse across racial identity, gender identity, socio-economic background, cis/transgender status, sexuality, and ability but relatively

[9]For any course, enrollments fluctuate throughout a quarter; end-of-quarter statistics offer a more holistic account of retention

[10]Several students disclosed multiple or mixed ethnicities

homogeneous across age, primary language, and regional context, and (obviously) access to postsecondary education.

With regards to the course organization: Olson (Olson, 1995), Freire (Freire et al., 2018) and others (Everson, 2022; Ryoo et al., 2021a) emphasize student-centered instructional designs, and given the sensitivity surrounding dominant narratives (Ashcraft et al., 2017), I opted to co-construct the course with students. Co-construction draws from culturally responsive pedagogies (Gay, 2018), and offers pedagogical space for students to center their existing and developing identities in deciding the direction of course material with a goal of developing students' personal and professional expertise. This largely counters existing pedagogies within the Allen School, so, anticipating that students would view the agency afforded by co-construction with suspicion (Everson, 2022), I spent the first several classes offering foundational work in cultural norms, and building trust with students so that students felt comfortable sharing what felt "normative" to them within their pedagogical space. As discussed in Section 6.2.3 and given the course description, students demonstrated an interest in normativity by registering for this course, most had previously experienced a lack of belonging in computing. From this list, we decided on course direction: typically near the end of a session, I would summarize the group's discussion and offer a few potential directions that students chose from. I would then select relevant readings or generate reflection questions for students to prepare for the next session. When students did not voice opinions (for instance, when many students were experiencing significant demands from other coursework), I would reluctantly decide the course direction. In my view, the course addressed nearly every potential topic — notably, I considered a space to directly discuss racialization in computing, but felt that approaching activism would be more fruitful.

Course Topic	**Prep**	**Description**
Introductions	None	Course Overview
Normativity	Initial Survey	Normativity in Computing, Course Direction

CS Curricula	Curricula Reflection	Experiences with CS Curricula
Anti-Political	(Malazita and Resetar, 2019) and (Ko et al., 2020)	Societal Norms around Adulthood (Halberstam, 2005), and my experiences.
How We've Had to Be	None	Experiences of Conforming to Computing
Escapism	(Odell, 2019)	Escaping with/from Computing
Time	(Wajcman, 2019)	Time Conceptions & Expectations
Careers	(Kirdani-Ryan et al., 2023)	Career Expectations, within CS
Nothing	None	Exploring Offerings from Space
Warmth	Reflect on Self-Criticism	Critique, Support, Parts Work
Masculinity	(Ensmenger, 2015)	Computing's Masculine Stereotypes and Legitimacy.
Masking	(Price, 2022), (Meadows, 2021b)	Covering, Code-Switching, Conforming, Masking
Vulnerability	Reflection	Relationships with Vulnerability in Computing
Neurodivergence	Chapter 4	Neurotypic Identity, Neurotypic Expectations
Rest	None	Practicing Self-Nourishment
What's Next	Brief Reflection	Future Course Direction

Action	(Ko, 2022) and (Activist Handbook)	Considering Approaching Action
Brainstorming Action	Nothing	Ideating Change, Independent of Feasibility
Vision	Read (Vakil, 2018)	

Table 6.1: Class Topics, Preparation, and Discussion

In addition to co-constructing direction, I also strived to make the course opt-in: everything was optional, and students could leave a class session at any time without penalty. As given in Table 6.1, many discussions required content warnings and potential sensitives for students: my objective was, drawing from literature within social work (Rogers et al., 2015; Schwartz and Sweezy, 2019), for students to approach the work of deconstruction with enthusiastic consent so that both 1) discussions stayed within students' boundaries and emotional capacities, and that 2) students *stretched* their boundaries and capacities from their own intent, rather than my imposition. Additionally, I spent a portion of the first class clarifying terminology around consent, boundaries and capacity, set discussion norms that allowed for an explicit opt-out, and offered my office if students needed a quiet place to recover during or after class.

I implemented co-constructed and consent-based course to facilitate student agency, but I also brought my own identity and preferences to the pedagogical space. With regards to my identity, I am a white, non-binary, autistic, transgender and queer; in this space, my neurodivergence leaves me with a predisposition to build warm and personal relationships that center the emotional dispositions of all involved. I sought to create the forms of relationships that nourished me, and, as with my other endeavors, likely brought an eager vulnerability to students. This was also my second teaching experience as instructor-of-record, my position as a graduate student also may have offered a lower power differential than conferred by

typical postsecondary faculty-student relationships.

To maintain a record of course experiences, I collected four forms of data: 1) instructor reflections 2) in-course notes, collected whenever it was accessible for me to gather them, 3) student reflections, in the form of initial, mid-quarter, and end-of-quarter surveys, as well as reflections tailored to relevant topics, and 4) student interviews. Instructor reflected were collected while planning and after each class and broadly guided by the questions: *How were dominant narratives challenged*, *How did student identity manifest in class space*, and *What narratives were voice, both within and outside of computing.* Student reflections emphasized how students saw themselves broadly, how they perceived the computing spaces that they're in, and how they found themselves existing within computing spaces. As students were thoroughly inundated with other commitments and course-work, I was unable to collect interviews from a focus group of students (as prior work has done (Ashcraft et al., 2017; Ryoo et al., 2020)), and instead interviewed students when available, typically immediately after class, and focusing on students who signaled emotional resonance with the topic at hand (e.g. students who started crying during class, students who asked for space to chat afterwards, and students who made particularly vulnerable disclosures, either in-class or as part of a reflection).

After collecting these data, I began a thematic analysis (Braun and Clarke, 2012), utilizing inductive coding and following the spirit of Hammer and Berland (Hammer and Berland, 2014) who argue that those who perform qualitative work should treat the results of coding processes to generate claims as a catalog of claims about the data, rather than a measure of the reproducibility or objectivity within the coding process. As institutionally required for the course's existence, Amy J. Ko (my PhD advisor) served as a faculty member responsible for course content, execution, and mentorship; throughout the course, we discussed how to maintain responsiveness to shifting student demands, as well as preliminary reflections on the data. As part of the analysis process, after generating themes from the data, I presented these themes to Amy, who voiced reflections, disagreements, alternatives, and reflexivity concerns. Largely, this discussion surfaced alternative theoretical lenses with which to view

the data, thematically, the results matched her own experience situating with students over 15 years.

After solidifying themes between myself and Amy, I contacted students to member-check themes. I made this request to a subset of students: those who were reasonably engaged with course material (i.e. were present for most classes) and who I felt could comfortably process relationships between the course, the Allen School, the computing discipline, and their own identity while hearing emergent themes. The sensitivity of themes made the latter point necessary; it would neither be epistemologically fruitful, nor pedagogically responsible for member checking to create deep emotional distress for students. I considered 13 students, contacted nine (Appendix B.3), and seven consented to a discussion; these seven represented a demographically diverse cohort. Our meetings were approximately 30 minutes — after reiterating that my goal was to surface any nuance related to themes, especially disagreements, I asked how each theme compared with the students' pedagogical experience and offered space for additions. Largely, students validated the themes that I presented; I addend student affirmations, qualifiers, disagreements to my results where appropriate.

6.4 Results

As discussed in Section 6.2.2, *Parts Work* emerged during analysis as a theoretical frame within which to view the data and develop claims. Concretely, I construe participant identity through two parts: their *disciplinary identity* and their *positional identity*. Prior work has extensively detailed the ways in which individuals construct both a computing identity (Lunn et al., 2022; James DiSalvo et al., 2011; Clarke et al., 2023; Kapoor and Gardner-Mccune, 2022) and an engineering identity (Stevens et al., 2008); I use *disciplinary identity* to describe the aspects of identity that participants present within their disciplinary space, and associated with the work of their discipline. In contrast, I use *positional identity* to encompassing the aspects of self associated with participants' positionality: their ethnic and gender identities, sexuality, cultural background, aspects of disability or neurodivergence, and socioeconomic background.

Given this, I found that 1) despite desiring a more unified self, participants who didn't fit normative expectations in computing fragmented their positional identity and their disciplinary identity because they received signals that maintaining a fragmented identity was in their best interest, 2) participants' fragmentation could be reconciled by creating safe, trusting, and vulnerable disciplinary spaces that welcomed participants' positional identity, and 3) those who reconciled their positional and disciplinary identities were able to surface additional disciplinary norms and consider activism in their disciplinary space. Generally, this follows theoretical groundings within parts work, albeit with a few caveats that I surface throughout these results, and I close with reflections on facilitating this pedagogical context and the emotional work required. I refer to participants by a numeric identifier, and note that while these results are representative of the data I gathered, those data favor the voices of students who were more engaged in course reflections, as well as those that I interviewed.

6.4.1 Maintaining a Fragmented Identity

Parts Work describes how individuals fragment their identity when circumstances demand that aspects of their self be kept separate. Since Western conceptions of parts work are housed within social work (Schwartz and Sweezy, 2019), classic framings developed around clients who had experienced some traumatic event[11], and lacked conscious awareness of fragmentation. Broadly, though, prior work connects experiences of marginalization and fragmentation: work within critical race theory (Du Bois, 1999), second wave feminism (Friedan, 1963), disability studies (Corker and French, 1999; Oliver, 1990; Bernardin et al., 2021; Miller et al., 2021; Hull et al., 2017), queer studies (Halberstam, 2005; Stone, 2013), and intersectional work broadly (Volk, 2017; Ginsberg and Pease, 1997; Samuels, 2003) describe code switching, passing, or masking as conscious and necessary acts, whereby one splits or selectively presents their identity to persist through societal normativity and marginalization.

[11]Notably, conceptions of trauma have expanded broadly since Schwartz's initial writings; Schwartz utilized Internal Family Systems Therapy with individuals who had experienced physical or sexual trauma, or adverse household circumstances within their childhood (Felitti et al., 1998).

Prior literature has contextualized these within computing (Cheryan et al., 2013, 2015b; Erete et al., 2021a), and were demonstrated within my analysis: participants described performing geniality to balance potential racialization and judgement (P8), having their access to computing attributed to their gender or racial identity (P4, P7, P8), and that it took extra effort to fit in (P7). One participant, for instance, experienced stereotype threat with respect to their gender expression:

> *Being (perceived as) a woman in computing has meant this constant pressure to be exceptional. I've felt like I need to do effortlessly well in classes, figure out how to function without adequate accommodations and just do more and be more interested in computing than others. (P10)*

However, rather than cite experiences of systemic marginalization in computing when asked about their motivations for joining this course, participants primarily centered culture. Participants shared that they wanted a space to talk about how computing didn't share their values, and, as the course primarily served juniors and seniors, they were concerned with what this meant for their work: what it meant to enter professional spaces that were in conflict with their values, feeling unsure how to navigate a job search where they didn't see their values reflected in academic and industry opportunities, and to learn more about how to exist in compromise. This was the majority: others wanted to understand the lasting impacts of their work and their direction; though, one mentioned that they simply needed a credit and that the course seemed interesting.

Positional Identity Absent from Coursework

For students, coursework was the most prominent interaction with departmental culture, and courses typically sidelined students' positional identity in favor of career-centric topics. One, for instance, shared in a reflection that they "*don't feel immersed in computing, like my social life is outside of computing. (P11)*", another shared a more direct split:

> *Yeah, it's it's funny because it does sort of feel like I'm two different people sometimes where like, I'm doing like a programming or I'm doing work that's related to programming and- and then I'm like, being me. I think there's like a little bit of overlap there. But I wouldn't say like I was born to be a programmer (laughs) (P5)*

This conversation was part of a post-class interview where P5 wanted to discuss how they might approach their career, and in a previous class, they mentioned that they struggled to engage in learning that wasn't associated with a job. I asked what they were hoping to gain from their work:

> *in my classes and in like, my side projects and stuff and that, I haven't done like a lot of stuff that I found enjoyment from. It's just all sort of felt like work and I'm just doing this to make money and yeah, so I really want to find like a connection between my like, sort of like, outside passions and the work that I do. So that's something I feel like I haven't really had a chance to do a lot. I'm sort of, like, I'm sort of I've sort of like experienced it a little bit but yeah, ultimately, I feel like I really haven't had enough time to. (P5)*

Treating their "classes and side projects" as their disciplinary identity and their "outside passions" as their positional identity, I asked them to try to describe differences between them in computing and them outside of computing; they pointed to group work experiences. For them, approaching group work meant showing up "*very, like, outgoing and like enthusiastic*" wanting to "*make something that I'm proud of*", but found that inappropriate, as group members were often "*cold and, like, let's just get this done…I don't care*". They described an experience in the penultimate term of their senior year:

> *last quarter, I worked on like a front end like web, um, Like, app? No, it was like a full stack web app. But I was like working on the front end. And I was like, really excited about it and motivated at the start, but like, because of like the*

> *group dynamic and like, everything it sort of just like that motivation just like all went away, I was just like, doing the bare minimum. So yeah, that was really frustrating. And then like, at the end I like wasn't I didn't really feel like proud of what I had done. I just felt like something that I just like, I just did it to do it, to get the grade.*

For another, their positional identity just *"never came up"* in computing spaces. Despite spending *"hours of my life…writing code, working on projects, sitting in office hours, and agonizing over problems"*, they perceived a split between their *"true self"* and the identity they presented in computing. They identified as "Lesbian/Queer" in the initial survey, and in response to a pre-reflection asking to differentiate between identity within and outside of computing, they shared:

> *Honestly, the more I reflect on my identity and how I relate my identity (who I am) to computing (what I do), I realize I've almost separated the two completely in my mind. Computing is my future career…but when I think of what makes me who I am, I think of my hobbies, my friends, my family, and my likes and dislikes. I think of what I do in my free time, not what I do for work.…I'm not wearing a "programmer mask" or intentionally hiding part of my identity. The closest thing I can think of is how I'm not "out" to most people I know in computing, but that's just because there's no relevance to that part of my identity in the conversations I have with people in those spaces. (P3)*

As with P5, they noted that there was "*rarely a reflection of who I am going into the [computing project] work"*, and speculated that the lack of connection to their work might create feeling of detachment and fragmentation.

Others found that presenting a disciplinary identity that aligned with departmental norms was in their best interest, regardless of their feelings around fragmentation. Echoing findings from Chapter 3, one shared that course content seemed to be designed for employers:

> *very little of the content I've learned here has had any value to me; plenty of it has been valuable to a future potential employer. There are a few reasons for this, among them that…I didn't (and really still don't) have a solid idea of how my education here is going to translate into a tolerable capitalism-interfacing component of my life going forward [and] my advisor recommended starting courses which gave me skills that might someday be invaluable to an employer and which, to me, are not particularly interesting beyond the puzzle of learning them.*

At one point, I asked participants if they could distance themselves from dominant norms within computing; P5 replied that "*it's a question of how successful you want to be*"; others mentioned being told to pivot ideas in entrepreneurship classes because their idea *"wouldn't fit"* (P4, P9).

This separation between disciplinary content and positional identity wasn't canon within computing: some participants shared specific examples of how much they enjoyed pedagogical experiences where they could connect their positional identity to their work, though these experiences were rare. One, who identified as a South Asian cisgender woman shared that she felt closer to her true self when she was able to *"share anxieties about being able to work on something impactful, discuss issues that I'm passionate about solving [and] am open about my experiences in my racial and gender identity (P2)"*. Another noted that the course content they most enjoyed was *"courses that gave me room for creativity"* and that one where they could share their creative work with others was the *"most fun I ever had in a CS course, even though it was an online experience during the pandemic" (P4).* A third, who identified as a first generation Black woman described how she was still proud of a project that she did as part of a high school outreach program, despite the technical simplicity of the work:

> *…our final project, it was called black books. I mean, it was a small little static website, but (laughs) it was like supposed to, like help like, black youth find, like African American literature and stuff. Because at the time, like me, my friends, were just starting to get back into books, because we're like, Oh, wait. (laughs)*

> *this is kind of cool. So we decided to do a project on that. And like that, like, even though that was probably like, the least complicated project I've ever done, I feel like that's something I'm like, the most proud of even if it's just a static website.*

Struggling to Find Community

The absence of participants' positional identity from their coursework meant that fragmented students struggled to form authentic connections with peers. In some part, this reflected culture; participants described computing spaces as *"very work-centric"* (P3) and struggled to connect with others subjects that weren't work-related (P3, P6, P9). With their positional identities absent, most disciplinary connections were limited: students found themselves treating each other as *"'study buddies' or 'work acquaintances"'* which left little space for authentic connection (P9), or that relationships were *"transactional and never last outside of the class, or even fizzle out before the quarter ends"* (P7). One saw the only peer interactions built into classes as incredibly shallow, and left little space for forming new connections:

> *I have made zero friends in CS courses. All my friends in CS are either people I knew previously, or people I through in Q++ (the CSE queer RSO). Most of my closest friends aren't CS majors. Interacting with people in classes in general stresses me out, but it's 10x worse in CS classes. There's nothing built into the classes to make people interact in a meaningful way, and it generally just feels like people aren't interested in or able to engage on a more personal level. (P10)*

Others echoed that their friendships were predominantly outside their disciplinary space, either in other majors, outside of computing, or in affinity groups (P2, P7, P8, P10), one emphasized that computing's lack of collaborative learning left her feeling isolated, especially when trying to connect across shared values:

> *Computing has enabled me to find niche groups of people who want to radically help other people and who care about the humanities while also being interested*

> *in technology, but these groups seem rare. I have always had to seek them out because I don't know how to find these people in my classes, and I think it is almost impossible to find these people in industry. I enjoy coding, and I enjoy individual projects, but I often feel disillusioned when I think about the larger picture and what I will be able to apply coding towards. (P2)*

P5, who struggled to find work they were proud of, connected their lack of friendships with shared values to their experience in group projects.

> *some of my regrets of like, not like making more friends [is] because it's really hard to do things with like random people. So there's there's sort of like, you'd like to have to like get to know that and then but it's only for a quarter so you're not really like getting to know them. And also, some people just are not- don't have the same values as you and aren't approach work as- the same as you are. That's really- it's really challenging to work with people like that...yeah, so.*

Beyond struggling to form authentic connection, participants also experienced exhaustion and judgement when they signaled a positional identity that didn't fit norms within their disciplinary space, further signaling that fragmentation was in their best interest. One *"consistently felt this aura of elitism/judgement within the Allen School that I don't really feel in other departments (P10)"*, another, who identified as Peruvian shared that:

> *Even outside of being a URM, the "hustle/ grind culture" and the overall competition between students in CS and a lot of computing spaces is exhausting to me and something I don't usually play along with (P7).*

Despite the career-centricity of their institution, participants also came to avoid career discussions with peers because "*they're just so emotionally taxing*" (P1, P2) or because they felt judgement and comparison from others (P5). Others described learning that it was best to "test the waters" by asking for broad opinions about a topic before sharing their positional identity, and that generally, these "tests" didn't go well (P3, P7, P12). One, who self

reported their gender as "*Good question :/*" had mostly given up on bringing themself to computing spaces:

> *I don't think there's any point they're trying to explain nuances of gender, I don't know what's going to be accomplished. And I don't yeah- yeah I just don't feel like there's a way to bring all of myself and all of the complexity and yeah, messiness and the lack of surety and yeah, the ambiguity (P10)*

This judgement for fragmentation meant that sharing one's positional identity became a vulnerable act, yet students found vulnerability discouraged or or outright impossible within their disciplinary space. To fit institutional culture, "you're always at your best" and vulnerability only happened at "appropriate times" For several, this class was the only space within computing where they felt they could be vulnerable (P4, P11), and for one participant, this fit a larger pattern:

> *Other than [this course], it feels more like one-off interactions/relationships to me than any kind of specific space for vulnerability. A TA or professor happens to be particularly understanding, everybody at at the club meeting is feeling like sharing more of themselves than usual for some unknown reason, or you do a seminar for a quarter where space is made for vulnerability. Stuff like that.(P10)*

During a particularly emotional interview, one reflected that she often found herself wishing that she could work at *"the standard my peers are at"*, but realized that *"no one talks about their failures"*, and that by default, the narrative was that *"the class was hard, but I was able to do it anyway"* (P3). Another speculated that the institution's competitiveness contributed to the lack of vulnerable space, and that a competitive job search that prioritized prestige meant that *"people feel like they have to put up their best front constantly"* (P4). They also connected this to curricular content:

> *the emphasis on technical content and the so-called rigor in the curriculum design makes it very hard for people to have these space. You don't share your feelings*

> *when you are just talking about how to find the shortest path between two points. It is not something that could evoke thoughtful conversations or reflections on someone's identity (P4)*

Given the lack of vulnerability, another found themselves *"constantly flattening myself in computing spaces"*:

> *it's honestly suffocating. I don't know exactly what it is. Most people seem to present the most sterile version of themselves in computing spaces. Real vulnerability is rarely present in computing, and it's weird because I'd say I'm authentic to a fault in most other contexts. (P10)*

Consequences of Fragmentation

Parts Work describes fragmentation as a necessary state, but rarely a preferred one — circumstances demand fragmentation and individuals try to manage as best as they can. In this context, as students couldn't bring their positional identity to their coursework and struggled to form authentic connection within their disciplinary space, they tried to get their needs met elsewhere. This was particularly true of participants who had experienced racialization; one who identified as Peruvian shared that they were more vocal in the Latin Student Union, and that they had some friends who had "*shared identities as me, so they want to talk about these kinds of topics*", but that this was rare in computing:

> *like a lot of the time when I talk about, like, how much I hate the Allen School or something like that, it's not to like (laughs) my CS friends, it's like to all my friends who are like in other departments* (P7)

Another, who identified as Black, also shared that *"most of my close, like, close friends like are in other majors* and that she had her family for support, but no one in computing to share experiences of racialization:

> *With- like me not being able to talk about it in many spaces here it's like, I'm like oh my god Did you guys see that? Did nobody see that? Okay, no one's gonna talk about that* (P8)

Others used external connections to defend their lack of fit in computing: one told herself that vulnerable spaces *"don't need to be [in computing] because they exist in other places…at home, with friends, like, you know, the other parts of me"* (P3).

While many participants tried to form connections elsewhere, others prioritized minimizing the affect that fragmentation had on their positional identity: One, who identified as a transgender woman, found that she couldn't maintain an authentic and affirming voice while engaging in computing work:

> *Thinking in the vein that allowed me to handle bitwise operations or design processor pipelines made my voice drop, my tone flatten, my diction speed up - in short, I took on my old masculine voice again. Addressing it, keeping the voice I knew was mine when writing code, proved incredibly challenging; I still slip into "guy mode" when I return to that headspace quiet often. (P6)*

She noted that the way she learned to code, similar to many of her friends, required removing herself from nearly all other considerations:

> *It's practically impossible to stay in that state of effortless mechanical thought when I'm focusing on the sound of my voice. Or on where the silicon in the IC in front of me was mined. Or on what the companies who have demand for my skills might do with them. Or on any of the other myriad pieces of myself that, having found my identity in the interval since I started my undergrad, I find matter to me a great deal more than the code in front of me. I don't know if this mentality is necessary for me to write code. All I can say is that it took me six months to figure out how to keep my voice my own when explaining code and coding practices to students as a TA, let alone when I'm the one designing the solution or writing the functions. (P6)*

Another recognized that she didn't fit in computing, and in our member checking meeting, shared that *"The way that I had to be in computing was masking how you had to be in general"* and that she found herself *"exaggerating parts of myself that were opposite to computing in computing spaces to...maybe to prove to myself and others that that identity could exist in computing."* or because she was *"afraid of losing them by being in computer science"* (P2). She wanted to use computing for social good, but failed to find community to engage in this work:

> *I see some computing spaces devoted to social good. I have been interested in these spaces before but they often seem isolated, saviorist, and disconnected from the real problem, which is the structure of the tech industry. I feel like no one (or maybe just me) knows what to do on a systemic level, and participating in this institution while understanding that it is oppressive can be depressing. So I see people around me either ignoring the harm or joining the cult of tech bros who believe that capitalism is bringing about revolutionary progress, and sometimes wish I could do the same. (P2)*

6.4.2 Reconciliation

Parts work, as with any therapeutic context, emphasizes the role of trusting relationships (Rogers, 1957) to surface experiences that justified a fragmented identity (typically traumatic) (Schwartz and Sweezy, 2019), and the role of the clinician as a psychologically congruent relationship (Rogers, 1957)to scaffold the creation of congruent relationships within a client's internal landscape (Schwartz and Sweezy, 2019)[12]. Largely, this work was no different: I found that for reconciliation to occur, participants needed to 1) experience and

[12]If you'd like to be especially specific, Rogers argues that "the client perceives, to a minimal degree, the acceptance and empathy which the therapist experiences for [them]" (Rogers, 1957). The "necessary and sufficient conditions" are both seminal within social work, and also have received extensive critique and commentary in the past 70 years. I shorthand: 1) the clinician is integrated, congruent, 2) the client incongruent, 3) the clinician displays unconditional positive regard and empathy for the client, which 4) the client perceives.

recognize a fragmented self (as discussed in the previous section), 2) exist within a safe and vulnerable pedagogical environment to bring fragmented identities into a disciplinary context where they had been discouraged, 3) centering students' shared fragmentation over their positionality helped form a community, and 4) reconciliation was often a painful process that required recognizing why incorporating one's positional identity was discouraged. I present these conditions through data from participants, my own reflections, and a vignette of a particularly impactful class.

A Safe and Vulnerable Space

As surfacing participants' positional identity was a vulnerable act within their disciplinary space, incorporating their positional identity required a safe and vulnerable pedagogical space. My intention at the course's onset was not identity reconciliation (parts work emerged during analysis), but I assumed that the process of deconstructing cultural norms would require trust and sensitivity regardless as even previous discussions around careers had proven emotional for students (Chapter 3). This was a primary concern when the course began, especially as the course structure was unlike what most students had experienced in computing; from my pre-reflection for the first class:

> *Mostly, I'm nervous that they won't see me, or this space, or this experience as legitimate. That I'll break their trust before we even have an opportunity to build it. That I need to be prepared for everything…It's all just scary, I think I'll feel better after the first class, but this is a whole new thing and I really don't know what I'm doing.*

However, through analysis, I found that the more important to reconciliation than *"being prepared for everything"* was a space for students to share their experiences, vulnerably, and in community with others. In reflections and interviews, many students shared that they had never experienced a safe space like this in computing. One, mirroring psychological safety (Newman et al., 2017), shared that they could *"share with no judgement and never*

felt worried about being vulnerable" (P5), another noted that could be *"safe and honest in a way that I rarely am comfortable being within computing"* (P2). As the course largely attracted students who felt a lack of cultural fit within computing, this safety meant that feelings of fragmentation could surface many of which students hadn't fully processed. These typically started internally; after the fifth class, one shared that *"starting to write about these things and talk about them has brought up so many (stammers)" (P10)* During a check-in after the third class, another started crying because he realized that he regretted how he spent his time in college, and how he would be graduating soon without finding substantial community (P5).

I anticipated that the course would involve students sharing personal narratives, and used three techniques to facilitate that. First, I sought to primarily center student voice in discussions, but used my own vulnerability to signal safety within the pedagogical space. This began on the first day — I shared my nervousness, uncertainty and inexperience around facilitating such a different pedagogical space — but continued throughout the course. Pivotally, at the end of our discussion on normativity (class 4), I shared my own narrative around shaping my identity to fit expectations which led several others to share similar experiences: reshaping themselves after moving to the U.S (P4), reading comics solely for the purpose of making friends (P11), and other, markedly deeper reflections than had been shared previously. Second, students co-constructed shared expectations for discussions, which included keeping conversations confidential by default; in a member-checking meeting, one students shared that *"Knowing that nothing would leave the room, not worried about what other students would think, I didn't feel the need to hide" (P6).* And third, I tried to make myself emotionally available: students could use my office if they needed a space after class, I checked in with students who, either during a class or a reflection, signaled they were struggling. Even with these, one student shared that, diversity and representation helped make a space feel safe, but it was sometimes more ephemeral:

it's never just one thing, it's the vibe, it's the aura, it's how you feel when you

walk in a room (P8)

With these, the course became particularly emotional, often in ways that participants found unexpected — many hadn't realized how much harm was caused by fragmentation. One framed her participation during the second class fairly matter-of-fact as "*I just exist in this space, and I'm trying to be as much of myself as I can*", but realized that she would need a space to process her feelings within the first five minutes of the fifth class:

> *And then I was like, Okay, I'm gonna need this space, you know? Where do you go? And, you know, you mentioned at the start, that [your office] existed in case if we need it, so I knew I was gonna use. But I'm glad it was available.* (P3)

In her initial reflection, she didn't feel like she was intentionally hiding part of her identity, but in our conversation, she realized how much it hurt to not feel known with anyone in computing. Working as a teaching assistant (TA) was one of the most valuable parts of her degree; she described reaching out to a faculty member after personal issues began to affect her work:

> *(voice breaking) she was understanding, asked me if I needed anything from her, but then it's like where else do you take that conversation (laughs)…a professor that, well this was a bummer, a professor that I have worked (voice raising) for four quarters. I've worked for [FACULTY] for four quarters. And I could not tell you one personal aspect of her life. I don't know anything about that woman other than the context of what she does in this department (P3)*

As this was a particularly emotional conversation, I asked if she felt like was opting into a course that surfaced so much, she replied:

> *I would, I mean, I knew I was getting into, and I also know, I would not be here, if it was someone other than you doing this. (P3)*

I stayed nearly an hour after the first few classes processing with students; after the pattern continued, I started to shift my goals for the course:

> *Right now, this isn't even a space to process hurt, it's just a space to be hurt. And that doesn't exist anywhere, that's so far outside the norm of CS, but it needs to happen, it needs to be present.*

This was mirrored in member checking; participants generally agreed that incorporating their positional identity into their disciplinary space was a vulnerable act that required trust; one shared that the course was an odd moment where everyone was actively trying to wrestle with the tensions between themselves and CS (P6).

Community through Shared Cultural Fragmentation

With a safe and vulnerable space to share experiences of fragmentation – a space to be hurt – the course also became a space to share community. Rather than constructing community around an aspect of positional identity, this community formed around participants shared cultural fragmentation, and in my reflection, this community seemed to outweigh other benefits:

> *Seemingly, the most important thing seems to be a community where folks can be honest about not fitting? That seems to be most of the benefit that I'm providing, other pieces feel topical, but not nearly as necessary.*

In part, this was through the design of the course: I hypothesized that dominant disciplinary norms would be more accessible to students than broader societal ones, especially those with primarily dominant identities. Largely, students agreed: during member checking, I presented a theme that dominant disciplinary norms were more accessible than dominant norms broadly, and could be used to built trust; students shared that discussing identity always required vulnerability, and computing-specific norms were easier (P8), and that getting

to societal norms would've taken more than 10 weeks (P6). Two students, in their end-of-course survey, shared similar sentiments: one reflected that the course demonstrated that their struggles over the past few years were shared (P5), or quite common (anonymous).

However, beyond accessibility of cultural norms, this space offered students to see their experiences of fragmentation reflected among their peers. Reflecting the lack of community that they'd found in CS, one student's mid-quarter feedback shared that the class made them feel like they could be *"safe and honest in a way that I rarely am comfortable being within computing"* as well as *"less alone with the struggles I've had in computing."*. They expanded on this in one of our interviews:

> *it's just really hard to find spaces in computer science that have been like this. And it just feels like, like, you've created a very safe space…it feels like our group is able to be really honest and connect on a lot of things…And it's just like very refreshing to see us talk about all these issues, and like struggles with computer science that we haven't really been able to bring up….um, outside of this class really like, I guess I can bring it up with like, the one or two friends I have in computer science. But, outside of that, I feel like I haven't been able to talk about these things like that.* (P2)

For P2, this community was a space for much needed discussions, for another, it was a space to see if her thoughts were shared within computing:

> *I guess, what I'm looking for is just like seeing different perspectives like outside of mine; I like I have my opinions on but like, what do other people think about it? Like, I guess getting that other perspective is something that I'm hoping to get at. And just seeing if like, are these thoughts my- like, am I alone in these thoughts? (P7)*

Vignette: Masking

This community of shared cultural fragmentation culminated when discussing masking, about two thirds through the course. Up to this point, our focus had been disciplinary norms and computing culture; our previous class began with masculinity, but ended with students sharing how they felt they were *"faking passion"* (P2, P3, P5, P8); The topic focused on neurodivergent masking, but I clarified that masking occurs in race, gender, sexuality, and a variety of other spaces, which led students to start sharing their own experiences. Our discussion began with one student sharing her experiences of code switching since middle school, *"becoming so many things that you barely know yourself"* and seeing parts of herself contradict each other (P8). Another agreed, and pivoted to her sexuality, *"My extended family, they're all super successful, lots of christian, catholic; they don't know I'm gay. So there's this tension around sharing parts of myself. Like, at weddings, my uncle's asking me 'when are you going to get a boyfriend'; I say 'oh, I'm just really focused on schoool'. But in CS and industry, I don't really hide it, but it doesn't really come up" (P3).* Several others added aspects of their own identity, bringing in gender (P10), language barriers (P4, P9, P10, P13), and mirroring others to strengthen connections at the expense of their own authenticity (P11).

I asked students about CS specifically; P8 shared how people will see her as a Black woman and *"think I'm stupid"*, so she tries to compensate and prove her legitimacy. Others shared similar struggles: how they didn't ask for clarifications around career-specific vocabulary (P11) and, before asking a question, triple-checked if a question was safe to ask because of how they might be seen. P10 related, that they found there were *"correct ways to struggle, and if you fall outside those, you really won't belong"*. Then, after a pause, looking directly at me, came out to the group as ADHD, and shared her frustrations in computing:

> *Professors say how "just show up and pay attention" is like 95% of doing well in the class, and that's bullshit (stammers)…there's no experience with anyone that has attention issues, and there's no understanding of all the extra work.* (P10)

There was a pause, and then P8 timidly said "*I have another I'd like to share, if no one else has one*", I asked her to continue, and she reflected that *"we feel like different people because we can't talk about real world things, we have to leave our real world selves somewhere else"*. Then, as an example, shared how last quarter she saw another students' project that correlated the population of Black people and violent crime in cities. She started crying, and remembered, as a Black woman how she wondered "*is this how people see me? Is this how they might see me? I assumed that the TAs or someone would do something about that, but I didn't talk about it to anyone, I didn't talk about it with friends, no one*". The group paused while she collected herself, then P7 shared how she and a friend, both Latin, were working to organize an event for student-led organization when they were accused of stealing raffle tickets. Her experience was the same: she wondered why she was accused, why she was being racialized in computing, and how others might see her, at which point I realized we had run over time, and paused the conversation to give some space for resolution before class ended.

From parts work, a key component of reconciliation parts is to witness the experiences of fragmented parts, experiences that typically clarified why fragmentation was in their best interest. At this point, participants had shared experiences where their positional identity was discouraged with me (Section 6.4.2); in this, they shared with each other. For P8, despite having friends and family for emotional support, it was relieving to talk about painful experiences in the space where they occurred:

> *I'm never able to, like talk directly about these things…I feel like this this class, I've been able to get so much stuff off my chest that I have not been able to…[After] I get out of class. I'm like, wow, that was good. I shared a lot. And then like, it's able to kind of just like leave my head. It's…also like hearing other people's experiences too. I'm like, okay, like, I'm not crazy. Like this is like, like common experiences with other people too. So that feels good, but I feel like, like, even like I would like I'll tell my friends and my sister or whatever, like, oh, yeah, like I talked about, I shared this in class today. Like, and they're like, oh, like, I'm*

> *happy to shared that. You've been talking about that for like, a year now. It just feels good to put it out there.*

The significance here was that with a community of peers, the course space could become a disciplinary space for students to begin reconciling their positional and disciplinary identities. Parts work describes reconciliation as relational — fragmented parts slowly rebuilding trust — another shared that, as part of that rebuilding, there needed be to an acknowledgement that "*this didn't have to happen, why did this happen*" for the fragmentation to resolve (P3). Here, though, the safety built into the pedagogical space meant that participants had a disciplinary context where they could bring their positional identities, even pieces that had experienced systemic marginalization. This was a collaborative effort, from P8:

> *I like having a space where we can, like, just talk and talk about our experiences. And I feel like, I appreciate you for making the space very, like open and welcome. Like, I know, like, okay, even though like yesterday I did get a little emotional, like, I still knew if I wanted to, like I can leave and like, it'd be okay. Because I feel like, you've helped- and everyone in the class too like, help to make it like a really safe space. (P8)*

6.4.3 Effects of Reconciliation

As students reconciled their positional and disciplinary identities within the course context, I was curious to explore the degree to which students sought to integrate their positional identity into other aspects of their disciplinary space. Culturally-responsive and culturally-sustaining pedagogies position student agency, including activism, as a crucial outcome (Ryoo et al., 2022, 2020; Vakil and McKinney de Royston, 2022), but many students were reluctant to invest effort into their institution as they neared graduation (P3), needed to prioritize other commitments (P4, P12) and were unsure if their efforts would be worthwhile within their institution (P6). Though, through the last few weeks of the course, I found that those who had reconciled their positional and disciplinary identities were able to surface

additional disciplinary norms through their own experience, as well as consider activism in their disciplinary space.

We began gently, and as I asked students to consider why others in their disciplinary space didn't engage in action, they began to deconstruct norms on their own, drawing from their peers' experiences throughout the process. One mentioned that computing students are taught to view computing as separate from anything political (P8), another, mirroring conversations earlier in the course, replied how the normalization of internal ache made it easier to *"grind and avoid conflict"* than speak out (P9). Students shared that the curriculum in the CS department was biased towards individualism and isolation, *"one's own space, one's own work"*, and that discouraged community building (P6) and that computing's individualism biased students towards seeing issues as personal, rather than systemic (P10). Students also began re-authoring their relationship to disciplinary norms: one student who struggled with course staff policing legitimacy reflected that those who caused harm were probably *"blind to social structures"* and benefited from them (P1), another affirmed and reflected how industry mentors who belittled them for not knowing certain pieces of content hadn't considered that *"what you're supposed to know is socially constructed"* (P3), to which P1 agreed. Others found that through contextualizing their struggles in computing as shared, they could ascribe less fault to themselves (P5), or they had been insulated from hostility within the departmental space (P4, P5). For one, reauthoring spanned several contexts: in her end-of-course feedback, she shared:

> *this course has had me think about the ways in which I use computing (along with other things) to escape from my own anxieties and depression. It has also made me reflect on masculinity and femininity and how I express (or don't express) those in computing spaces. I've also extended some forgiveness to myself for the "failures" I feel like I've experienced within computing, and started to understand why those "failures" happened or why I feel like they are failures in the first place.*

In addition to independently deconstructing norms and reauthoring their own narratives

around computing's norms, several students began utilizing more of their agency. Part of this was a willingness to consider possibility: students utilized the penultimate class to brainstorm nearly fifty desired changes in thirty minutes, with nearly every student contributing. More substantively, students also began to consider their future work: one shared wanting to know how to use information from the course to change industry, felt that their work should be a proponent for good, and felt that they had more say in the what work they did (P1), another felt that they would be more mindful of naming norms in new computing spaces and had a *"clearer sense of direction on where to go next or how I should be more vocal of the changes I want to see"* (P4), and a third was still pondering what actions might bring a more *"human like"* space in computing after the course ended (P9). Students also changed how they saw computing spaces: one, who at the start of class felt that she had to either *"ignore the harm or [join] the cult of tech bros"*, shared that she had more hope for her future:

> *I've been thinking about it for like many years (laughs) But yeah, it's finally coming to like, I guess I've been like, trying to figure out what actually to do with everything for so long. I'm finally getting some getting out of my jadedness. And into like, I think I can visualize for me what I want to do...going forward. (P2)*

Others found ways to engage in action: during member-checking meetings, one shared that she brought up norms from class in her internship, shared readings on the social implications of technology, and facilitated a discussion with coworkers and felt that, despite being relatively superficial, *"it was super cool to be able to do that" (P8).* Another, who struggled with not feeling known by others in computing, started trying to have more personal connections with coworkers by initiating personal conversations and building relationships (P3).

For some, however, reconstituting their identity made the dissonance between themselves and computing more noticeable. One felt that articulating their agency had a dual affect of being able to *"see more solutions"* but also *"the problems become a lot more present, and it's hard to paper over them"* (P10). Another *"felt more ways I couldn't be present here"* and that it was *"more obvious when I hide parts of myself, it's more stressful"*, leading them

to seek community outside of computing (P6). In a member-checking meeting she shared that addressing the split between their positional and disciplinary identities *"helps with the pain"*, but didn't give strategies, though she recognized that getting those strategies require more time than the course had.

Others articulated little change: one was grateful for the courses insights, but hadn't changed career paths (P9), another felt that he had sunk enough time and effort into his current career trajectory that he was less willing to reconsider his options:

> In the sense of like, am I happy what I'm doing? No, not really. But there's also this feeling of like I've come this far and I've like spent this amount of time and energy and also like it's sort of like I've sort of like narrowed into this this path and it feels like if there is a way out it would be sort of like starting over and I'm not really like willing to do that

Notably, one student was already engaged with some forms activism before the course began and felt that the class didn't change her thoughts and feelings on computing (P7). In an interview, she wanted strategies to share insights with the broader computing community:

> *I feel like a lot of people who like do these classes and like do these seminars, like I recognize a lot of the same people (laughs) Like it's a lot of the same people because I like- We all care about the same things, but it's like, what about the majority? Like, the CS majority I guess (P7)*

6.4.4 Emotional Work

Centering students' experience, this course was a space to voice fragmentation between one's disciplinary and positional identities, find community around that fragmentation in a safe and vulnerable environment, and for some, explore expressions of their positional identity in their disciplinary space. Centering mine, this course was unlike anything I'd participated in professionally, let alone facilitated, and required a considerable amount of emotional work to teach.

In some part, this was an expected component of creating a new pedagogical space. I was building my skills as a facilitator, making sure that students shared the conversational space, as well as experimenting with a variety of novel approaches: teaching students to interview each other, surfacing practices of self-compassion, and engaging in activism. Among skill building, I had a variety of concerns: that students wouldn't see the space as legitimate, that some might feel threatened by discussing students who fit disciplinary or societal norms, that I wouldn't balance students' varied comfort for emotional depth, and, in service of this thesis, concerned that the results would be insufficient for me to complete my degree. But throughout the course, I found several strategies: I aimed for an emotionally accessible course and I positioned my past experiences in computing as "when I was pretending to be a tech bro" to build empathy with students, amidst my own self-soothing.

Nevertheless, given the course's emotionality, I found myself frequently giving care, and providing a container for students to process whatever came up. After the fourth class, I found myself struggling to step away from a conversation with a student who had few routes for support, and reflected:

> *I need to be able to both 1) hold the pain of 20 people at once, and 2) basically be able to give an impromptu therapy session immediately after a class, where someone's going to start crying, nearly guaranteed. And, I don't know what to do besides to sit with their hurt.*

Similarly, after the fifth class, I found myself counting my remaining capacity while supporting one student, so I would have space to support another afterwards. The course was *"still nourishing, but goodness, this is all a lot"*. This continued for several weeks; I tried to set boundaries with students and minimize the amount of out-of-class support, but still found myself overwhelmed. Before our class on masculinity, for instance, I was struggling to give so much active care, and didn't see a way to lessen it:

> *I feel like I don't have a great sense of how to lessen my role here. And, today, I'm feeling overdrawn and overwhelmed and I needed to lay down for half an hour*

> *to avoid a meltdown 30 minutes before class. But, I'm worried about causing harm for folks in this space, and I can facilitate and monitor and ask for pauses, but I don't know if there's a way to make this space any less; that's what makes me feel like I can't do it. It's fine until I'm having a bad week, and then it's just too much to hold all together.*

This continued for most of the course, I kept answering *"what do I need to feel prepared for this class"* in my pre-reflections with *"more spoons"* (Miserandino, 2017) [13]; I was burnt out, emotionally exhausted, and between requirements for graduation and the course direction, saw few alternatives.

But context is important here; my teaching experiences, somewhat consistently, have forgone sustainability in service of maximizing what's accomplished in a ten week course, and this one existed among a myriad of personal challenges that detracted from what I might give students. Nevertheless, I felt pushed to explore what was possible within the limited timeframe, and often found myself needed to let go of expectations around outcomes. It helped to frame the course as an experiment, that *"We might hang out in this space for a whole quarter to learn that exposure to critical theory works better, we might learn something entirely unexpected, but I can't expect students to end up anywhere specific."* This was particularly true when engaging students in action; I was feeling pressure to *"'get somewhere' by the end of the course"*, but tried to approach the class *"curiously, not try to push into any particular space, more just discussing where we're all at."*.

Broadly, I found that I needed to prioritize students' experiences with computing culture as well students' process in deconstructing it, over my own experience, and struggled when the topic was particularly personal. For instance, at one point a student shared that they didn't feel that computer scientists knew how to be human, and I, drawing parallels to

[13]The citation describes Spoon Theory sufficiently — "spoons" has been a shorthand for one's capacity, especially among disabled & crip communities. As in "writing an explanation of spoon theory in the Year Of Our Lord 2024 definitely takes more spoons than I have right now".

harmful stereotypes around my own neurodivergence[14], struggled to balance my desire to hold a curious container and advocate for others who might be feeling threatened. Similarly, one class centered escapism: I started the conversation by sharing how computing was a convenient way to escape my body, and the dysphoria I associated with it, which left the class in a tension that was interrupted by a student sharing how computing was the thing she was trying to escape from. I reflected afterwards that I was *"learning to make space for students, which means leaving the pieces that most resonate with me somewhere else, and letting them come up organically, or not at all."*. This wasn't always possible: after our class on masking (Section 6.4.2) and students' disclosure of racialized experiences in computing, I felt fiercely protective and angry, *"angry enough that I wasn't sure how to leave it all behind"*, and struggled with how to approach encouraging students' agency:

> *I guess, I don't know how to make the world hurt less, that's the main piece. And maybe that's not the point, like, I don't know, none of them should have to be activists here. Maybe just little life, little pieces, small nourishments that keep possibility? But, like, we can cover more topics and we won't really get anywhere with the hurt…The shared community and support is something, no doubt, but it's not enough, by any means? It doesn't make their world better, it's just here, and then it'll be gone. Maybe I'm just burned out?*

A week after our class on masking, I decided to dedicate a class to rest: I figured that the course had accomplished enough and students seemed reluctant to propose more topics, so we sat outside for a session. I gave students three headers: 1) officially, rest is necessary for justice work, the world will keep hurting as we try to shift and change it, 2) faculty often cancel a class to attend to other professional commitments, and that 3) I was pretty achy, low on spoons, and still happy to help, but just needed a space to pause. In hindsight, a more sustainable version of this course would have incorporated more classes as "breaks", the next class began our engagement with activism; seemingly both students and I needed

[14]Autistic stereotypes as "robots", to be specific

a break. But, even as the course ended, I felt the same tension: I was excited about what we had accomplished, excited about what might happen if the course continued, and wished we had more time:

> *We're ending on a point that totally makes sense, we're ending on action that's possible, but I think we could've gone to action a bit sooner, maybe skipping some topics that didn't particularly resonate. But still, going from folks being pretty quiet with each other to building trust in a group to having activism is still super cool, just not everything that I'd wish for.*

6.5 Discussion

Returning to my research questions, this work contributes several findings. I found that students whose personal narratives failed to fit within computing's dominant disciplinary narratives fragmented their identity, as fragmentation was in their best interest (RQ2). This fragmentation was maintained as participants' experienced that their positional identity, and personal narratives, were largely absent from coursework, leading them to struggle to find community in computing, lose their voice, become jaded about their future, and flatten themselves in their disciplinary spaces. For those that desired a more unified self, the identity work of reconciling disciplinary and positional identities could be fostered by safe, trusting, and vulnerable disciplinary spaces that welcomed participants' positional identity and centered students' shared fragmentation over specific aspects of their positional identity (RQ1). Though reconciliation was often a painful and emotional process, those that engaged in the identity work of reconciliation were able to surface additional disciplinary norms through their own experience, as well as consider activism in their disciplinary space (RQ3).

The context surrounding this work, however, meant that these findings contribute a limited snapshot into the landscape of identity work. In surfacing the pedagogical conditions that foster identity work, I note that, methodologically, I surfaced these conditions from an analysis of my own observations and reflections within a space that I was facilitating. This

approach creates data that is exceptionally proximal and necessarily personal, but provides less separation and clarity than might be offered by an external observer. Extant literature within social work necessitates trusting relationships for identity work to occur (Rogers, 1957); in creating a pedagogically that prioritized students' psychological safety, my primary concern was that external observers might jeopardize this safety based on their perceived status within the institution. I utilized member-checking to triangulate these conditions with students, but nevertheless, I recognize that my approach to this course was intertwined with the ways that I approach building and maintaining relationships broadly.

Furthermore, while the course title, description, and modality offered a mechanism for potential students to experience a triggered situational interest (Hidi and Renninger, 2006), they also created a selection bias. In my view, the outcomes from this study would be unlikely to transfer to students who had little experience of fragmentation or students with less capacity to address their fragmentation and engage in identity work. Additionally, the course was offered synchronously and in-person, it is unclear if these findings would replicate within remote instruction. One student, for instance, was eager to engage with the course material, but personal circumstances only allowed them to engage remotely and asynchronously; they filled out the first several reflection prompts, but disengaged after a few weeks in the course.

Nevertheless, these findings, specifically identity fragmentation, allow for a reframing of prior work: in particular, ethics education and justice-centered computing. With ethics education, though embeddings of sociotechnical content may be incidental throughout a curricula, any inclusion may trigger a situational interest in students to explore further, either through course descriptions, titles, and syllabi text, or through the course environment itself. However, even if ethics education goes beyond individualistic framings to structural critiques (Vakil, 2018), and beyond structural critiques to students engaging in justice projects (Ryoo et al., 2022), identity fragmentation may still prevent students from engaging in activism. This work is one case, but students' connection with their positional identity within their disciplinary space appears to be a limiting factor – it remains unclear whether students will

engage in justice work without first resolving identity fragmentation.

In contrast, the success of justice-centered computing in engaging students might result from these interventions occurring before any potential fragmentation could occur, that is, before learners experience computing culture. Justice-centered computing has typically situated as an initial computing experience for students with strong, existing connections to their positional identity, some of whom describe established deviations from dominant narratives (Chapter 2). These approaches continuously and authentically intertwine students' positional identity with curricular content and with the disciplinary identity that they form within computing — the sort of identity fragmentation that I describe here would be unlikely to occur.

This means, however, that many pedagogical strategies from justice-centered computing are unlikely to transfer to postsecondary ethics education. Even with an ethics-centric curricular overhaul that prior work suggests (Kirdani-Ryan and Ko, 2022; Fiesler et al., 2020, 2021; Grosz et al., 2019), students still might translate their experiences with computing culture into a determination that identity fragmentation is their best interest. It is unclear if learners are able to authentically engage in activism without a strong connection to their positional identity — it appeared to be a prerequisite in this work — but approaches to engage learners in ethics that fail to critically engage computing culture will likely do little to address students' fragmentation. Prior work has argued the need for ethics interventions to consider computing's position within societal structures of oppression, and that these considerations are necessary for developing learners' agency (Vakil, 2018; Miller et al., 2020), I argue that these approaches must also consider that 1) no individual's walks a linear path towards justice work, 2) witnessing cultural harm and reconstituting one's identity, for some, may be necessary components of that path, and that 3) ethics approaches must also engage how computing culture manifests and replicates this harm across a wide spectrum of positional identities. Restorying methods (Shaw et al., 2023) are necessary for everyone, and in service of this, some techniques do transfer — my approach to discussing masking (Section 6.4.2) mirrors "shifting the spotlight" described in prior work (Ashcraft et al., 2017) — but

ethics education beyond initial computing experiences ought to consider how students have learned to "show up" in the classroom.

Broadly though, this reframing of prior work gives two strategies: either give individuals the tools to inoculate themselves against computing culture (e.g. through authentic disciplinary experiences where individuals can incorporate their positional identity) or change culture so that fragmentation stops occurring. As cultural change is rarely a timely endeavor, the former may mitigate some harm (though, participants with these experiences still experienced fragmentation), but with the latter, a particularly compelling approach would be to utilize the reconciliation methodologies that I describe so that learners can begin to engage in activism towards cultural change in their disciplinary space. At a baseline, learners could recognize the cultural harms that led them to fragmentation and build projects to ensure that those harms stop replicating [15]. Projects that activism would be beneficial — utilizing sociotechnical understandings in professional organizations is likely to be an activist act (Snider, 2024) — but, following approaches within critical pedagogy (Freire et al., 2018), these must be within students' consent. For those willing, future approaches would benefit from longer timelines, attempts to minimized instructor's emotional burden, and other tools for "practicing without a licence" (Hirsch, 2020); ideally, prioritizing a balance between the emotional labor of facilitating and students' engagement with identity work.

What compels me about this direction, though, is how those with power might view student advocacy and activism within their own institutions. Despite several decades of change (Ensmenger, 2010, 2015; Rankin, 2018) computing culture still causes harm, and following parts work, I wonder the degree that individuals with deeply established disciplinary identities might experience or maintain identity fragmentation. Furthermore, when considered alongside findings in Chapter 4, I wonder the degree to which the fear and distrust that manifests alongside change and activism might be intertwined with this fragmentation.

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[15] As described in Section 1.4, I position this thesis as my approach to that work

Chapter 7

CONCLUSION

In this dissertation, I positioned four studies within the landscape of critical computing education, with a focus on normative expectations. I centered dominant disciplinary narratives: narratives uniquely situated within computing that magnify and contradict broader societal norms. Drawing from critical pedagogy, my aim was to surface nuanced understandings of these narratives to inform interventions, which I then utilized in Chapter 6 to explore how dominant disciplinary narratives might be pedagogically addressed in service of bolstering student agency.

This chapter reinterprets the findings of my work within the context of this intervention and within computing education literature. I begin by reiterating my thesis statement and framing this dissertation's work in its' support; I then present my contributions to the field of computing education, this work's limitations, and offer some remarks, expectations, and guidance for future scholarship.

> Individuals who experience dissonance between computing culture and their identity frequently fragment their disciplinary identity from their positional identity. While this can occur when computing contexts reify societal marginalization, it can also occur through discipline-specific cultural norms that both mirror and contradict societal legitimization. This fragmentation can be resolved independently, but reconciliation can be accelerated and scaffolded through safe and vulnerable spaces that welcome individuals' positional identity. Furthermore, when these communities develop around mutual fragmentation, they can be become intersectional coalitions that encourage students towards activism.

7.1 Career Norms in Computing Education

In Chapter 3, I described a study examining normative career practice in post-secondary computing education. Career prospects are one of the primary reasons to study computing (Carter, 2006), and at the time of this study, prior work had primarily centered students entry into computing spaces, rather than their exit from them (Alexander et al., 2011; Choi et al., 2012; Alshahrani et al., 2018b; Lewis et al., 2019; Teague, 2002; Fouad and Byars-Winston, 2005; Margolis, 2008; Diekman et al., 2010). As I discussed in Chapter 2, theories of learning intertwine disciplinary learning and participation, leaving students' choices, and their career choices in particular, tied up with dominant norms and narratives in computing. Adopting a sociological perspective informed by Bourdieu's Field Theory (Bourdieu, 1977), this study sought to deeply understand the career norms within a single CS department. Centering our inquiry around the CS department at our own institution, I posed three research questions: (1) what norms of career practice exist within this CS department, (2) how are these norms reinforced by members of the department, and (3) how are these norms experienced by students.

Through a qualitative study examining perspectives of students, graduates, advice-givers, and program leaders, the only career norm that I found legitimized was for students to pursue work at highly selective, prestigious firms, primarily Microsoft, Google, Amazon, and Facebook. Students learned to prioritize these companies over others and to delineate between forms of future work, based on the work's affinity to prestige. (RQ1) Unquestioned norms have a tendency to become self-reinforcing; within this case I found three mechanisms of reinforcement (RQ2). First organizations with established capital utilized that capital to create recruiting footholds within the department to "win at recruiting". Second, departmental career advising assumed alignment between students' habitus and departmentally legitimized career capital, leaving little space for students to explore alternative modes of career success. And third, courses and curricular objectives emphasized preparation for departmental career norms at a pace that left students little space to consider alternatives.

Bourdieu argues that a crisis is necessary to adopt a reflexive stance with which to examine established norms, along with a critical discourse to demarcate between norms and opinion (Bourdieu, 1977). For students whose career aspirations were aligned with departmentally legitimized career capital, crises were largely absent: students chose prestige to alleviate uncertainty around changing future interests, for the perceived potential for growth that prestigious firms offered, and because work with greater personal alignment felt inaccessible without gaining capital from prestigious work first (RQ3). Those that experienced crises were able articulate career goals independent of departmental norms, but only if they engaged in critical discourse and found space for the considerable work required to resolve a crisis (RQ3). I found no official space for critical discourse within our CS department: the combination of norms and reinforcement left many students to endorse prestigious work, despite more pro-social career aspirations.

This study identified a dominant disciplinary narrative that, while present in other spaces (Binder et al., 2016; Daoust, 2020), is uniquely situated within computing. As aligning with dominant disciplinary narratives is a component of legitimacy within CS, normative CS career practice likely discourages students who lack alignment with norms from participating in CS. Furthermore, the prestige-centricity of career norms aligned with agentic goal orientations (which emphasize performance or achievement), but left little space for communal goal orientations (which emphasize collaboration and helping others). Given that (1) communal goal orientations tend to be higher in cisgender women and racially minoritized learners within computing (Lewis et al., 2019), (2) students who seek social-impact oriented careers tend to not study computing (Wang et al., 2015) and (3) cisgender women introduced to CS in school have been found to be less likely to choose CS careers (Ross et al., 2020), it is unlikely that broadening participation efforts in computing will be successful without broadening what constitutes legitimate computing practice to make space for students' diverse aspirations.

Positioning normative career practice as a component of computing culture, my findings around fragmentation offer a reinterpretation of this work in support of my thesis statement.

Not all individuals experienced fragmentation from departmental career norms, but for those that did, they felt that their work was at odds with their identity, and when this remained unresolved, felt distress around the lack of positional identity (or personal values) embedded in their work – this supports the first claim in my thesis statement. Prestige-centric norms mirror societal legitimization, while uniquely situating in computing — this supports the second claim in my thesis statement. Through considerable work, some resolved this fragmentation independently, but some participants reported that this work was scaffolded by an advice-giver outside their disciplinary space, supporting the third claim in my thesis statement.

7.2 Neurotypic Legitimacy

In Chapter 4, I described a study examining neurotypic legitimacy in computing spaces. Prior work has primarily attended to neurodivergence through a "corrective" lens (Spiel et al., 2019; Begel et al., 2021; Ymous et al., 2020; Williams and Gilbert, 2020; Williams, 2021), though societal narratives are clear that some neurotypes are privileged over others (Leadbitter et al., 2021; Hull et al., 2017; Legault et al., 2021; Norbury and Sparks, 2013; Silberman, 2016). As journalistic narratives around neurodivergence in computing point an increased prevalence of divergent neurotypes, I sought to investigate which aspects of neurodivergence are legitimized in computing spaces. I asked three research questions: (1) what prevalence of neurotype expressions are perceived in computing spaces, (2) what neurotype expressions are perceived as legitimate in computing spaces, and (3) how members of computing spaces relate their own experiences to their perception of those with legitimized neurotype expressions.

To answer these questions, given the problematic nature of existing diagnostic profiles and instruments that assess neurodivergence (Dinishak, 2016; Kras, 2010; Crompton et al., 2020b; Rifai et al., 2022; Chapple et al., 2022; Crompton et al., 2021; Rumball et al., 2021; Rumball, 2019; Folger and Phelps, 2018; Gargaro et al., 2011; Meadows, 2021b; Jack, 2014), I developed my own framings for neurodivergence and embedded theses as a conversational probe within a semi-structured interview study. After conducting and analyzing interviews

with neurodivergent and non-neurodivergent identifying faculty members, students, and industry professionals, I found that computing spaces tended to legitimize hyper-focus, passionate interests, and high organization. Though not specifically legitimized, participants also reported a greater prevalence of neurotype expressions preferring details, routines, and non-speech communication. Given this, I would hesitate to claim that computing spaces are autistic-dominant (especially given problematizations around existing diagnosis), nevertheless, my results demonstrate some cohesion between neurotype expressions within computing (as perceived and experienced by our participants) and diagnostic profiles of "normative" autism (a socially constructed and arbitrary standard that few autistic people meet completely and many non-autistic people meet partially (Maenner et al., 2020)).

For those that fit the expectations of the field, computing was a rare space of safety and expression, but by no means a safe space for neurodivergent people broadly, nor for any others who do not fit expectations present within the space. Much has been written about gendered (Margolis and Fisher, 2002) and racial violence (Rankin et al., 2021) within computing; the ability for computing to be a shelter for some aspects of neurodivergence by no means negates other aspects of structural violence. Femme-identifying autistic people, individuals that identified as neurodivergent but not autistic, racialized neurodivergent people, or even autistic cisgender men that were too far towards hyper-focus were unlikely to be fully supported within computing.

Positioning neurotypic legitimacy as an additional component of computing culture, my findings around fragmentation offer a broader frame through which to view individuals' "masking" both neurodivergent and neuronormative expressions to fit within computing. This supports the first claim of my thesis statement, additionally, computing culture's role as both a force of oppression and a space of refuge supports the second claim. Culturally however, I found that, despite egregious hegemonic oppression and repression, those dominant within computing may have aspects of self that are marginalized outside of computing — this raises implications for inclusion efforts into computing. For decades, computing stereotypes (often with neurotypic implications) have been demonstrated to discourage minoritized in-

dividuals from participation in computing. These stereotypes are not canon, but for some, they might signal a rare safe space for self-expression; I wonder what might inclusion efforts look like that also seek to maintain this kernel of safety? Efforts, for instance, that solely look to dismantle and rebuild might break the aspects of computing that create refuge for individuals that need it, efforts lacking a neurotypic lens might cause harm, perhaps by eliminating neurodivergent safety in favor of inclusion, only to produce computer scientists that, for one participant, "can't even find solace in the work".

7.3 Challenging Disciplinary Norms

In Chapter 6, building on my existing work surfacing dominant disciplinary norms, I opted for an intervention to challenge these norms. This, as with prior work, was born out of a desire to change computing culture, and within the scope of pedagogical approaches towards cultural change that center students' learning, I drew upon ethics education and justice-computing approaches. Both bring merits to this work: ethics education meets students' technical engagements with sociotechnical content and justice-centered approaches foster rich computing engagements with primarily minoritized learners. However, these approaches differ with respect to identity work, with justice-centered approaches seeking to foster strong disciplinary skills that are intertwined with students' existing identities, while ethics education rarely considers students' identity. Furthermore, with respect to identity work (Section 2.4), prior justice-centered approaches describes students with prior experience with identity work; at the time of this study, it was unclear if these approaches would translate to postsecondary education. Thus, I sought to engage identity work directly, asking 1) how identity work could be fostered in post-secondary computing education, 2) what existed connections between students personal narratives and computing's dominant disciplinary narratives, and 3) what changes in student identity and perceptions of students' manifest when dominant disciplinary narratives are addressed through identity work.

In service of these research questions, I developed and facilitated a seminar in deconstructing dominant disciplinary norms, and gathered four forms of data: course notes, instructor

reflections, student reflections, and interviews with several students. Through analysis of these data, several themes surfaced. First, students whose personal narratives failed to fit within computing's dominant disciplinary narratives fragmented their identity, as fragmentation was in their best interest (RQ2). This fragmentation was maintained as participants' experienced that their positional identity and personal narratives were largely absent from coursework, leading them to struggle to find community in computing, lose their voice, become jaded about their future, and flatten themselves in their disciplinary spaces. For those that desired a more unified self, the identity work of reconciling disciplinary and positional identities could be fostered by safe, trusting, and vulnerable disciplinary spaces that welcomed participants' positional identity and centered students' shared fragmentation over specific aspects of their positional identity (RQ1). Though reconciliation was often a painful and emotional process, those that engaged in the identity work of reconciliation were able to surface additional disciplinary norms through their own experience, as well as consider activism in their disciplinary space (RQ3).

These findings offer reframes of ethics education, namely, that even approaches that integrate structural critique might still fail justice-centered computing's goal of engaging students in activism due to the identity fragmentation that students experience. Additionally, justice-centered computing's success may be attributed to students' lack of disciplinary identity, and lack of fragmentation, thus these approaches are unlikely to transfer to post-secondary contexts. This, alongside reinterpretations of Chapter 3 and Chapter 4, supports the first claim in my thesis statement. Given, however, that this course offered a space for students to reconcile their disciplinary and positional identities, this work supports the third and fourth claims in my thesis statement.

7.4 Contributions

In light of these reinterpretations and my thesis statement, this body of work makes several contributions to computing education, especially critical computing education. First, this thesis clarifies that identity fragmentation occurs through dominant disciplinary norms in

computing. Prior work has thoroughly established that individuals mask and code-switch (Rankin et al., 2021; Margolis and Fisher, 2002) their presentations to persist in marginalizing environments, I contribute that the same behavior can occur through a lack of cultural fit. In Chapter 6, I utilized parts work as a theoretical framing to describe this fragmentation and in my review of other work within this dissertation, parts work appears to explain individuals' interactions with cultural phenomena. This was not canon — some individuals described relatively little friction or affirmation by cultural norms in computing — but those that experienced it had few official routes for resolution. Furthermore, given that parts work, a framework for working with individuals traumatic experiences, fit as a theoretical framing, it may be best to consider the effects of computing culture described here as traumatic. This is reflected in recent work clarifying the effect of structural racism in computing (Rankin et al., 2021; Erete et al., 2021a), but, with this work, appears to occur independent of students' positionality.

Second, just as individuals are not beholden to a lifetime of replication, individuals that experienced cultural dissonance within computing did not unilaterally fragment their identities. In Chapter 3, I described a few potential trajectories: those with relatively little dissonance typically rationalized their alignment, those with more dissonance either 1) felt jaded about their career prospects, or 2) engaged in critical discourse, independently or through a mentor external to their disciplinary space. Additionally, in Chapter 4 many individuals described mechanisms for self-preservation and persistence, bolstering their self-concept to counteract disciplinary norms. It appears that individuals with "strong identities" (i.e. those with previous engagements with identity work) are somewhat inoculated from normative expectations and more able to sustain themselves without fragmenting, which aligns with my interpretations of prior work in justice-centered computing.

Third, as suggested by justice-centered computing, engaging students who have experienced fragmentation in activism is messy, non-linear, and individual. Counternarratives, which I utilized heavily in this thesis, describe an iterative process for building critical engagements whereby learners critique dominant narratives, personally conceptualize those

critiques, then build those conceptualizations into projects towards social change (Miller et al., 2020). Drawing from Chapter 6, however, those who experience fragmentation may be limited in both their capacity to personalize cultural critiques and to build those critiques into action. Therefore, when engaging students in justice-centered pedagogical approaches, it may be necessary to consider both 1) students conceptualization of dominant narratives, and 2) the relative integration and fragmentation between students' aspects of identity. With this, as stated in Chapter 6, barring a curricular overhaul, justice-centered computing approaches may not transfer to students with fragmentation between their disciplinary and positional identities.

7.5 Limitations and Future Work

The work I present within this thesis contributes several findings to the field of computing education, however, the context that generated these findings create limitations towards generalizability. Each study was exploratory: I sought to investigate new territory rather than interrogate minutia of an established landscape, thus I both qualify the contributions I present above and offer opportunities for future exploration.

First, and perhaps most simply, while the work that I present was not exclusively tied to my own university context, the majority of this thesis directly situated within it. Culture is contextual, and though aspects of this work likely generalize to computing education broadly, the specifics of, for instance, normative career practice within an elite R1 institution, may not transfer to other modalities. This need not be an exclusive replication, rather, I would recommend future scholars use this dissertation as a framework to assess the nuances of culture at their own institutions. My work largely lacked the epistemological distance historically held within sociological work, but to encourage others, my position gave phenomenal access and perspective that enabled both an inquiry into culture and an intervention against it on a much shorter timeline than any other context would have provided.

Second, as with any qualitative study, these findings may be specific to the participants who contributed to the work. Each chapter addresses this limitation, but I note here that this

may be particularly true for the findings in Chapter 6 — the course, departmental context, and students were all unique circumstances that contributed to the work's direction and the resulting effect on students' agency. Broadly, I sought to position the components of this course with an eye towards generalizability, and presented these pieces as themes, but future endeavors would be well-served to consider the administrative and operational constraints that would bring about a consistent pedagogical space, rather than a one-off seminar. In this vein, a long-term dedicated space varying students and instructors might better surface necessary components to engage students in identity work, perhaps whereby students would develop primary ownership and instructors would act more as partners that enable students' practice (Farrell and Penuel, 2021). Additionally, I was by no means an impartial observer and much of my personal approach towards relationships and teaching was tied up in this context; future work might consider how instructors with different dispositions, motivations, and personalities might approach identity work while remaining committed to centering justice.

Third, the pedagogical context in which I explored identity work and identity fragmentation was somewhat idealized — under direct control of an advocate (Brown, 1992) and within a context where exploring identity work was the primary focus. I offered Chapter 5 as an intervention within an existing course context, but as with other approaches towards ethics education (Section 2.5.2), this intervention only incidentally attended to students' identities, and thus was unlikely to foster identity work. Prior work has thoroughly dichotomized between dedicated and embedded approaches to critically engage postsecondary computing students (Hoffmann and Cross, 2021a; Fiesler et al., 2021; Vakil, 2018; Cech, 2014; Garrett et al., 2020), but many of these approaches continue to utilize banking models of education (Freire et al., 2018) towards sociotechnical content, including my own. Thus, drawing from culturally responsive approaches, what might it mean to engage computing students in identity work as part of their disciplinary instruction? As with ethics education, the benefits of students intertwining their technical understandings with critical, reflexive engagements with computing culture might transfer to their professional work. Concretely

though, the master's tools are unlikely to bring about cultural change, and I am unsure how approaches that build sociotechnical understandings without prioritizing students' agency and self-development might contribute to future critical engagements.

Finally, this thesis centered students throughout each of the studies that I described. This was due to ease of access and the amenability between my research questions and student populations, but computing education shares this bias towards postsecondary education (Fincher and Robins, 2019); future work could examine these findings in other contexts. For instance, this thesis primarily focused on identity fragmentation among students who had yet to fully cement their computing identity, yet felt *"jaded"* towards pursing a computing career. With professional contexts in mind, how might these findings situate among gradates experiencing some degree of disillusionment with their professional trajectories, or alternately, what conditions might help foster identity work among individuals who have spent over a decade cementing their computing identity? Furthermore, with the aspects of neurodivergent legitimacy that I surfaced within Chapter 4, I wonder how future work might to engage individuals with established computing identities in considering (and reconsidering) links between their neurotype expression and their success within computing.

7.6 Concluding Remarks

I positioned my role in this work as passionate, present, and reflective, as I sought to translate my own experiences of reconciliation into collective engagements. This is community work through a single-author thesis: meaning made manifest with the many who have lent their energy and attention to clarifying and challenging the narratives I present here. And, necessarily so, from Van Der Kolk's wonderful writing:

> *All of us…need…confidence that others will know, affirm, and cherish us. Without that, we can't develop a sense of agency that will enable us to assert: 'This is what I believe in; this is what I stand for; this is what I will devote myself to'.* (Van der Kolk, 2015).

Lest this work fall victim to the callousness of the academy (Kimmerer, 2013), let me be clear: this was an act of love. Much of this thesis grounds in critique, and prior work positions justice within computing as necessity to mitigate computing's role in societal harm, but even with the cultural impositions I describe, I remain committed that there is something worth saving here. This was the first space where I made friends easily, where collaboration nourished me, and remains one of the precious few spaces where I do not need to bend my back to be understood. And so, I came with love and restoration, that all might benefit from what this space has to offer. I love what we do here. So much is inextricably intertwined with the twisted traumas of our fragile world, but I hold in this writing, as throughout my endeavors, that we are so much more than how we have been told to be.

I note, though, that most moves towards agency come with fear, and this was no exception. In my personal experience, authentic positionings that counter an established course of action are deeply liberating, but accompany a profound expanse of possibility. This thesis, an echo of my personal work, offered an opportunity for my own professional redefinition, a privilege I sought to utilize to the fullest extent that I could. I recognize the uniqueness of my position and the layered generosity that afforded it, and chose work that, while within my enthusiastic consent, left me terrified of the possibility that might be created.

Thus, I end with an ask. There is nothing more that I want than to be in a space, where, within their own agency, consent, and capacity, people choose to turn towards love and build their work around it. This is well beyond any single professional endeavor, I hold that those who create knowledge have a responsibility to address all the parts of their experience [1], but I ask that the work we do continuously challenges our conceptions of what is possible. We have little time with this precious world, and even less with those within it, but with what we have, I align myself with this vision, held with love, and position myself so I might continue catching glimpses of how the world might be. One day, may we only know how to be free.

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[1] Or, put simply, go to therapy.

Appendices

A Neurotypes: Recruiting Materials

Below is the recruiting statement sent to students, similar statements were used for faculty and industry professionals. Identifying information has been omitted. The form we used collected contact information, demographics, and degree information so we could confirm that potential participants met our inclusion criteria.

> Broadly, I want the act of learning computer science to be something that's deeply inclusive, something that folks don't need to compromise their identity to participate in. I want spaces for folks to learn CS where everyone can learn more about themselves, but also spaces where everyone can bring who they are, now, and feel like they belong. As it stands, there's a whole host of ways that computing spaces seek to exclude students; right now I'm focusing on neurotypes (ways of thinking and being, cognitive profiles) and how folks experience their neurotype fitting or not fitting in these spaces. As part of this work, I'm looking for students' experiences of their own neurotype in computing spaces (that's y'all!). It's entirely ok if you don't have the deepest sense of your own neurotype; we'll work through it as we go.
>
> Ideally, this would be an hour-long conversation, but I'm happy to schedule whatever time works for you (even if it's just 30 minutes). This also doesn't need to happen now! I know that end-of-semester time is precious, and I'm happy to talk after the semester's over. We'd talk about your experiences in computing spaces broadly, in (our institution) specifically, how you see your neurotype right now, and how you perceive others. My hope is that you'll come away with a better understanding of yourself, the spaces that you're in, and just how different brains can be.
>
> I'll note, since we'd be talking about who you are and how you fit/don't fit, this definitely has the potential to be a hard conversation. I take full responsibility for

this space: if you want to have this conversation, I'm so happy to be supportive however I can. This is likely a sensitive space professionally as well, so, if we end up talking, no one will know who you are but me, not even my advisor.

I'm looking to represent some breadth of perspectives. I'm sure that y'all have a wide breadth of experiences in computing spaces; I'm looking to focus on folks who fit one (or more) of these bullets:

- You've always felt that computing spaces fit you, maybe this is where you first really made friends, made connections; I'd love to hear more about what it felt like to arrive here.
- You've felt like you need to be a different person inside of computing spaces and outside of them. Part of you fits in computing, but there's a good chunk of you that doesn't, and reconciling those is challenging.
- You've considered leaving computing because there just weren't enough people that felt like "your people", and you've struggled to accept that.
- You identify as neurodivergent (I identify this way myself). Or, you don't, but it's something that you've wondered about for yourself.

I'll note that folks in (institution) have widely varying experiences; if one of these resonates with you, there might not be anyone else that shares that experience.

Fill out this form if you're interested! I know it's a bit impersonal, but everything gets really messy using other mechanisms; it should be less than 5 minutes to fill out (do let me know if it takes longer than that). If you have any questions or anything that you'd like to change/need to change so that this conversation feels more comfortable, send me an email! Again, if this is too busy of a time, I'm happy to chat after the semester's over.

B Challenging Norms

B.1 Course Advertisement

The following was distributed out to students:

> **New course, CSE 492D: You can find purpose by knowing who you are, first.**
>
> Spring Quarter: Tuesday/Thursday 1:30 - 2:20 (CSE 403, 21479)
>
> Hi, I'm Mara, 5th year CSE PhD student, advised by the fabulous Amy Ko! Generally, it's awfully hard to find your purpose/know what you want to work on/know what job you want unless you have a good idea of who you are first. So to try to help that, I'm teaching an undergrad seminar on computing culture next quarter! We'll be In-person, doing oodles of reading and discussion, plus some writing and reflecting about our own experiences. If you're interested, I'd love to have you join!
>
> Broadly, we'll be looking at "norms" within CS spaces (for instance, the Allen School) and deconstructing how those norms affect our identities, how we exist in computing, and how we share stories around our computing experiences. I've got a good bit of experience here (it's my PhD thesis), but I want to make space for the stories, experiences, and techniques that y'all bring. We'll be constructing this learning space together: I'll bring some prior work that I've done in this space around careers, critical theory, and neurodivergence, y'all will bring your lived experience being within computing spaces and prior experiences deconstructing norms (if you've done some of this before). To note, you don't need experience doing unpacking or norm deconstruction to join. My hope is that there'll be some variation in how much work we've done, and we'll be building some skills and strategies along the way as we try to better understand ourselves and the

spaces that we exist within. Skepticism is totally welcome, as long as you're open to exploring where that skepticism might come from.

B.2 Course Long Description

I offered a short description to recruit students towards participating in the course, this longer description was utilized to justify the course to administration within CS.

> Just as norms govern behavior within society broadly, norms govern behavior within computer science spaces. These norms are often invisible, the quiet "rhythms of the world", wholly assumed and without question. Fitting norms, and the expectations that come with them, often grants privilege, power, and access, thus many individuals consciously and unconsciously constrict themselves to fit. Those who cannot, or those for whom the weight of constraint is too great to bear, are often disadvantaged, disenfranchised, and marginalized. In this course, we'll look at some norms in society broadly and how they reinforce systems of oppression, then lower into computing spaces and computer science to examine the norms within computer science learning spaces (for instance, the Allen School) and beyond.
>
> Naturally, this won't be like other courses within the Allen School, Informatics, or other computing majors, deconstructing norms is often emotional work, especially if you haven't encountered them before. So, as we surface norms within computing, we'll be doing some unpacking! Norms often have systemic ramifications beyond individual behavior, and (perhaps more importantly) often become personal, intertwined with our own tangled histories and experiences. You won't be doing this work alone (unless you really want to) — we'll be utilizing strategies for untangling ourselves as we work together to cultivate alternative courses of practice and action. Deconstructing norms and our responses to them is an exceedingly valuable skill, the usefulness of which extends well beyond our work

as technologists and into our "collective vocation to become more fully human" (to quote Paulo Freire).

I have some expertise here (it's my PhD thesis), so we'll be building on some work that I've done around careers, critical theory, and neurodivergence, as well as strategies that I've employed: deep attention, radical listening, situating care, metaphor modeling, and embodied practice. That said, some of you might come with practices, tools, stories, and experiences that have served you well; I'm excited for this to be a space of collaborative learning.

You might ask, is this ethics? Kind of! But, not really. Ethics is more concerned with what decision is "right", within some decision-making framework. Ethics is incredibly useful, especially when incorporating critical and anti-racist framings — CSE 480 does a great job here. There's a tendency, however, for ethics to center intellectualization: viewing decisions through structured frameworks of reasoning, rather than centering feelings, personhood, and identity (which is more of our focus here). Ethics philosophies are helpful and critical theory can be a wonderful guide, but navigating ethically-nebulous decisions without a deep self-knowledge probably isn't going to suddenly create space for critical action.I'd argue that's more likely to come from disentangling who you are from how others expect you to be.

B.3 Member Checking Email

Below is the message I sent to a subset of students in the course as an invitation to member-check themes.

Hiya! I hope fall quarter started without too much tumult :)

I've just finished up a phase of data analysis for the course we shared in spring (amidst a bunch of other things); thanks again for being willing to try something

that's so different from other spaces in CSE! There's some delightfully interesting results that I've found so far, but all the analysis has exclusively been based in my experience of the course and my perspective on what happened. Which is *fine*, but incomplete: how y'all saw the space is missing.

So, given that, I'd love to chat for a bit (probably around 30 minutes, maybe less) about what I've found so far, and check whether that matches your experience! This is totally opt-in, it's so totally ok if you don't want to, or you don't have space, but I'd so so appreciate getting to hear your thoughts :)

So, let me know! And, let me know if you have any questions about this. I'd love to do these before autumn quarter gets too too busy, if that works for you (and, I'm happy to adjust if it doesn't).

Mara

p.s. I didn't send this out to everyone enrolled; you're getting this because I felt you were 1) reasonably engaged with the course (and showed up when you could) and 2) that you could comfortably process relationships between the course, CS, and your identity while hearing emergent themes. I might send this out to more folks in the future, but, for now, I'd appreciate treating this as a private conversation.

B.4 Student Demands

In one of the final classes, I asked students to brainstorm what they wanted within their disciplinary space, independent of feasibility. I present those ideas, largely unmodified, though with some organization for readability.

Courses & Teaching

- Have a response to faculty dragging their feet on DRS accommodations
- Require that students take ethics

- Focus on disability & access in systems we design, and make that focus a core part of the curriculum

- More HCI/accessibility classes, there's only two

- There's a huge gap between assignments and class content. Some folks do fine learning on their own, some of us need a lot more time. So, we shouldn't have huge expectations around self-learning, and, also, not making assignments and exams where the average is 20

- Changing class structures, making classes with more collaboration, classes where you can come away with friends, classes where you actually know the professor

- There should be more space for professors to do their own thing with the course that they're teaching, more space to "wax poetic", be infectiously enthusiastic, like we'd see in the humanities.

- I'm sick of powerpoint, it's just awful, it's such a bad way to communicate information

- Generally, it's such a waste for section to be taught with powerpoint when there's 5 folks here (though, this might be an aftereffect of COVID)

- Require/encourage CSE faculty to talk with faculty from other departments so that they learn how to teach better

- Stop motivating courses through assumptions of working at big tech (distributed, for instance, motivates content by saying "this is what Amazon & Facebook are doing", but if that's not you, the material's irrelevant)

Physical Spaces

- Physical layout of labs isn't conducive to group work, labs are in a super corporate layout, just work at your desk alone without talking to anyone. It's hard to collaborate with people, the space seems designed so that you don't.

- Most spaces for collaboration with folks are underground with no sunlight. There's lots of space in this building, the pavilion is nearly never in use, and undergrads are in a basement.

- Zillow's really nice, but we can't get up past 5pm. I'd like to study up there more, instead of the basement. At least the main floor of CSE2 has windows.

- The Diversity and Access lounge should be bigger, and a bunch of folks don't know about it.

Careers

- Actively reach out to non-industry partners (e.g. not-for-profits, CS teaching programs) and give them a platform to recruit students

- There's currently an assumption that everyone wants to climb the corporate hierarchy (junior dev -> senior dev -> program manager), where do we go for advice if we don't want that?

Finding Resources, CSE's Website

- Generally, it seems like there's a ton of resources, people just don't know about them because the information's buried somewhere. Maybe it's that there's a lot that's happened in the last few years, but students aren't really getting briefed on it.

- There should be better documentation on what events are going on. There's a discussion board with 10 posts a day, but it's hard to keep up with, maybe just make a website? Student spaces often get buried.

- I was on a project redesigning CSE's website (which, as an aside, why was that given to the outreach team?) And, there were so many barriers to redesigning the website, it's not clear why they haven't improved it nor why it's so complicated to find resources. We tried to do a redesign, but there were lots of limitations on what we could and couldn't do, and it wasn't clear why restrictions were there.

- CSE's website's seems like more of an advertisement than a resource, I haven't been on it since looking at schools

- Finding information in general is really tough, things are so decentralized

- Course selection is super outdated, you know the teaching schedule's out there, but there's lots of googling to find it

- Half the listed CE courses straight up don't exist, they're so old that there's no listing at all.

- CSE advisors don't know what CE majors are, I've gotten recommended towards Data Science.

- Maybe there should be a giant bulletin board in Allen Atrium, or use Ed for this

- Maybe there should be an RSO fair for Allen folks? There's one that's mostly for freshman, RSOs are advertised in the DA seminar, but lots of folks still don't know about them.

- I have no idea what parts of my coursework correspond to ABET accreditations, and, I didn't know about who's in charge and who I could make demands to until we got a list

Getting Help

- The structure for office hours in breakouts is ok, but smaller rooms can get really tight. Smaller spaces aren't conducive to groups, collaborative learning, or even just sitting and working near other folks working on the same thing.

- CS advisors should have more communication with general UW advisors, general advisors never know what's going on.

- It's be cool if, as freshman/first joining, your advisors was required to meet with you, just to check in, what are you worried about, what's going on. I didn't know who my advisor was until this 4th year.

- There's lots of "don't worry, you'll figure it out" from faculty, advising, and leadership in response to student concerns. I usually don't.

- I did startup during COVID, and I somehow fell through all the cracks. Everyone's said that "you'll figure it out", and I didn't. And now I'm a junior. I had plans to graduate in 2 years (running start), but with everything so unstructured, I dragged my feet, going into 4th year, and I still don't know what I'm doing.

Advocacy & Culture

- Generally, website and DEI stuff has lots of bureaucracy around changing anything, which is super frustrating. There's lots of tasks that could be assigned to people that they hire to do them, folks that work here, but they don't allocate resources towards that. One advisor who was working on that was totally overwhelmed, she basically got all the extraneous things put on her instead of hiring another person. What's leadership doing, if not for undergrads?

- DEIA committee has monthly meetings, but who knows about this?

- No transparency, students don't know what's happening, some student groups get information from CSE advisors, but there's not much clarity otherwise, and there's not much clarity to students who aren't in RSOs or who aren't in the right meeting at the right time.

- Maybe have a recurring digest, for advisors to send what they're working on? Students had demands, got formulated into a giant document, easier just to say "here's what we're working on this quarter". (we could even call it "patch notes" and be cute)

- On admissions, I don't know what they do with budget and capacity constraints, but it seems like we mostly just select from 3 high schools in Washington and it seems like lots of culture problems go back to that.

Larger Restructurings

- Make course registration less terrible (I noted the ableism and classism in a system that requires you to wake up at 6am)

- Paraphrasing Kurt Vonnegut, break up CS into smaller majors so they can't hurt anyone again

- Remove money as a barrier to accessing education

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