RESEARCH-ARTICLE

Fears and Confidence amongst Incarcerated Adult CS1 Students

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Abstract

Understanding incarcerated adult (IA) students' fears upon entering a CS1 course and how their confidence changes throughout the course can help us understand how well IA students' fears are being addressed, and help future instructors of CS1 in prison address them better. Building on recent work on non-CS majors' fears and confidence in introductory CS, we surveyed 45 IA students across two offerings of a CS1 course in prison on their fears going into the course, and confidence in their ability to succeed. We present a phenomenographic analysis of fears amongst IA students in CS1, and analyze relationships between these fears and change in confidence. In addition, we compare the fears expressed by IA students to those of non-CS majors from prior work. Findings include many IA students reporting no fears, but an overall decrease in confidence across both offerings of the course which was mostly accounted for by students who did express initial fears. We found 9 fears overlapping with those found in a prior study outside of the prison context (e.g., *getting a bad grade*), and 7 fears only identified in our study (e.g., *interference from circumstances beyond my control*).

CCS Concepts

• **Social and professional topics** → **Computing Education**; **CS1**; **Adult education**.

Keywords

Adult Learners, Prison Education, CS1, Fears, Confidence

1 Introduction

Fears and confidence regarding the use of technology are of particular significance to individuals released from prison: although digital literacy is critical to successful re-entry [15], low self-efficacy is a major barrier [18]. Prior work has identified fears of non-CS majors entering introductory CS courses (e.g., coding, lack of technical fluency) [9]. However, no prior work has investigated the fears of incarcerated adult (IA) students in CS, or sought to identify fears that may be unique to this context. Likewise, prior work has investigated connections between student fears and confidence [9], but not yet in the prison context. To fill these gaps in knowledge and add to a growing understanding of IA student experiences in CS [10, 14], we asked the following research questions:

(1) *What are the fears of incarcerated adult students taking CS1?*
(2) *How do confidence levels of incarcerated adult students change throughout a CS1 course?*
(3) *Is there a relationship between fears expressed and change in confidence of incarcerated adult students in CS1?*
(4) *How do fears and confidence in CS1 differ between incarcerated vs. non-incarcerated students?*

Building awareness of IA student fears, and finding ways to mitigate them and increase their confidence in their CS abilities, may have benefits that extend well beyond the CS1 course to greater success post-release [15, 18]. Furthermore, as computing courses become more available through higher education in prison programs, addressing student concerns could be critical to broadening participation in computing amongst incarcerated adults [1, 11].

2 Positionality

None of the authors have lived experience of incarceration. Thus, we have engaged in a process of reflexivity including a) group discussions and independent reflection on how our own identities influence our research perspectives; b) consistent consideration of how our research may impact incarcerated adults; and c) collaborative preparation of this positionality statement [12]. The first five authors are all women and young adults. The research team is racially and economically diverse, an asset to perceiving the full range of experiences of incarcerated adults in our phenomenographic analysis. We also draw upon experiences of engaging with justice-impacted people such as teaching in prisons, and work experience with formerly-incarcerated coworkers.

3 Background

3.1 Fears and Confidence in Introductory CS

Previous work on fears of non–CS majors in introductory CS exposed a variety of fears (e.g., being left behind and workload), and explored connections between fears and change in confidence [9]. Non-CS majors in CS1 who initially feared coding experienced the greatest increase in confidence compared to students with other fears, and students who initially expressed no fear experienced a decrease in confidence on average [9]. Some of the fears (e.g., of coding and technical fluency) were related to prior experience (PE), which has been studied particularly within the context of CS1 [19, 20]. PE has also been linked to confidence [20] and the related concept of self-efficacy [19]. Fears identified amongst non-CS majors in introductory CS also overlapped with those found in an international study of high school students entering engineering degree programs [23]. While these works give valuable insight into the fears of introductory CS students, this work has not yet been extended to adult or incarcerated populations.

3.2 Digital Literacy and Self-efficacy Amongst Incarcerated Adult Students

Lack of access to adequate technology limits incarcerated college students' learning experience, particularly in CS courses [5, 10, 11, 21]. It also creates a digital divide, adding to challenges faced by people released from prisons [15–17]. The high rate of technology development and society's increasing reliance on technology exacerbates these impacts [15, 18]. Even if facilities provide access to computers or tablets, issues persist, including requiring payment for services and accessible design of devices available in prisons [16, 21]. These barriers leave many incarcerated and formerly-incarcerated individuals feeling left behind in regards to digital literacy, the negative consequences of which are only increasing [2, 15, 16].

3.3 CS in Prison

In addition to the many benefits of higher education in prison (HEP) in general (e.g., opportunities to develop a positive self-identity, creating less violent communities in prison, reducing recidivism), CS education may increase the impact on social mobility for incarcerated individuals and their families [1, 11]. Due to recent policy changes, HEP programs are at a critical moment for rebuilding in order to advance racial and economic justice [6, 11]. Across the nearly 400 HEP programs operating in the U.S., no programs currently offer computer science degrees [1, 8, 11]. Furthermore, while engaging in HEP has been shown to increase self-efficacy [3], the impacts of computing courses within these programs and specifically regarding confidence in one's CS abilities are less known. So far, one mixed-methods study of incarcerated people participating in a virtual web design course (not part of an HEP program) reported qualitative results that the course had a "predominantly positive impact" on self-efficacy, but results of quantitative analyses using pre- and post-tests of general self-efficacy and computer programming self-efficacy were not statistically significant [14]. Thus, more CS education research to understand experiences of incarcerated students and support both their success in the course and increased confidence in digital fluency is in great need [10, 11].

4 Study Context

Participants in this study are students at a research-intensive public university, currently incarcerated in a medium-maximum security adult male prison in the U.S. Before applying to transfer to the university, students complete an Associate's degree through a community college operating in the same prison. Their applications are judged by the same standards as other transfer applicants, and their incarceration status is not taken into account. All courses in the prison are taught in person, by professors, lecturers, and qualified graduate students from the university. Currently a B.A. in Sociology is the only degree offered.

4.1 Course Context

Data was collected in two offerings of a CS1 course, which fulfilled a technology requirement towards the B.A. degree. Both courses were taught by the first author. The first offering was in Fall 2022, and the second was in Fall 2023. All students in the university's prison program were required to take the CS1 course.

The course was a traditional CS1 course using Python, and used similar course materials to those used on main campus. However, students in the prison had drastically different access to resources as compared to their main campus counterparts: while the university students in prison were given prison-issued laptops, internet access was limited to only the prison-hosted Canvas LMS, and code interpreters of any kind were disallowed. With no ability to run their own code, students completed their labs and programming assignments with the option of submitting drafts on Canvas up to once-daily. Course staff ran the code and returned the output to them.

4.2 Student Demographics

This study includes N=45 students across two offerings of a CS1 course, N=25 from Fall 2022 and N=20 from Fall 2023. All of the students were IA men, ranging in age from early 30s to 65 and older. Most students had been incarcerated for over a decade at the time of enrolling in the course and were serving long-term or life sentences. Also, the students were more racially diverse than students on the university's main campus, especially within computing. Students in the Fall 2023 course self-reported racial identities[1] as 30% Chicanx or Latinx, 30% White, 30% African American or Black, 15% American Indian or Alaska Native, 5% Asian or Asian American, 10% Other: Mexican, 5% Other: African, and 5% Other: Cuban American.

5 Methods

5.1 Data Collection

5.1.1 Survey Distribution. All data used for this research was collected in the form of weekly reflection assignments, which were distributed to students in both iterations of the CS1 course. In both years, the reflections were graded for completeness and accounted for a small percentage of the final grade. Students were told explicitly during the first lecture by the instructor, as well as in the text instructions at the top of the reflections, that their anonymized responses may be used for research related to course improvement.

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[1]The sum of the percentages for student racial identities exceed 100, as students could select all that applied.

After each course, all handwritten weekly reflection responses were transcribed by the research team and then anonymized by a third-party in accordance with our institutional Human Subjects Review Board approval under protocol #[806658], which determined this project to be not human subjects research. For Fall 2022 course data, all identifiers were removed from the data with no ability to link different reflections to the same student. For Fall 2023 course data, submissions for all reflections were first grouped by student before all identifiers were removed, which allowed us to pair responses for initial and final confidence, and link these to initial fears.

5.1.2   Survey Design. The reflections for the Fall 2022 course were initially based off of weekly surveys given in our introductory CS courses offered on main campus, and then modified to reflect any current issues arising or relevant topics at any point in the course as a source of immediate feedback for the instructor. For the purposes of comparison, some of the questions were kept identical in wording to those used in our surveys on main campus or in prior studies. The two questions used in this study are identical to those used in prior work on fears and confidence amongst non-CS majors [9].

Fears: The first weekly reflection assignment was identical for both iterations of the course, including the following open-ended question: *What do you fear the most about taking this class?*

Confidence: Confidence was measured using the following five point Likert scale question: *On a scale of 1 to 5, how confident are you about your ability to do well in this course?* Although this was a Likert scale question, some students' handwritten responses created a new option to indicate halfway between two options (e.g., 4.5). In these cases, we rounded down their response to the nearest option as the data was ordinal.

Initial and Final Confidence: Initial confidence was measured using student responses to this question during the first week of the course for Fall 2023, and during the second week for Fall 2022 (as nearly half of students missed the first lecture due to Covid 19). Final confidence was measured for both courses in the weekly reflection from the last week of the course.

5.2   Data Analysis

5.2.1   Fears of Incarcerated Adult CS1 Students. All N=45 students responded to the question on the first weekly reflection on fears, and were thus included in our analysis. While we used the same survey questions as were used in prior work [9], we decided not to start with the code book from this prior study: Starting with a pre-defined set of categories can bias researchers "so that features of the world immanent in the data will be overlooked" [22]. We chose phenomenography as our qualitative methodology, which focuses on the range of experiences of a phenomenon [13, 22].

For our phenomenography process, the first five authors followed the four-phase process outlined by Kinnunen and Simon [13]. In phase 1, the authors individually read through all of the data and refined the associated research question. In phase 2, we each read a portion of the data, highlighting words and phrases that captured a theme in the responses. If a response had multiple phrases or parts, each phrase could only correspond to one theme, but the overall response could have multiple themes applied to it. We then displayed our highlighted themes to each other, noted similarities and differences, and compiled them into a tentative list of themes

with corresponding descriptions and examples from the data. This was followed by another individual reading to confirm our tentative list of themes. In phase 3, we divided our tentative themes amongst the research team. Each researcher looked through all of the data for their assigned themes, and refined the theme descriptions based on observation of the data. At the end of this process, we had 16 unique themes. For the final phase, the collaborative process of grouping the themes began with discussing connections between themes, and which more general themes may encompass others. In the process of visually grouping categories, we noticed a pattern that some were internal (e.g., concerns related to age in *My time has passed*), while others were external (e.g., time pressure from outside commitments in *Outside time pressure*). Within this internal vs. external sorting, we also distinguished between factors contributing to course struggle (e.g., *Not having enough resources* as an external factor) and outcomes (e.g., *Getting a bad grade*).

5.2.2   Confidence Amongst IA CS1 Students. To investigate the change in confidence, we calculated descriptive statistics and created distributions of initial vs. final confidence. For the students from Fall 2023, we used a Wilcoxon signed-rank test to determine statistical significance of the change in confidence since we had paired ordinal data.

5.2.3   Relationship Between Fears and Confidence. To explore possible relationships between fears and change in confidence, we disaggregated the average change in confidence by the themes of fears expressed by students. This only included data from the second cohort of students, as we were unable to link confidence with fears reported by students for the first cohort. We categorized changes in confidence using an interval, based on [9]. Replicating the process used in prior work, students who reported multiple fears were included in all groups that applied when computing the average change in confidence by fear [9].

5.2.4   CS1 Student Fears: Prison vs. Main Campus. To assess similarities and differences between the fears of IA students and those of introductory CS students on main campus, we used identical questions on our reflection assignments as were used in prior work [9]. Phenomenography was more appropriate in the context of our study given our smaller sample size, due to its emphasis on identifying the range of experiences of a phenomenon [13, 22], whereas the prior work employing qualitative coding leveraged a larger sample size to quantify which fears were most salient [9]. While this difference in methodology limited our ability to directly compare the fears of IA students to the non-IA students, we obtained a copy of the detailed codebook from the prior study that was used to define the larger categories presented in the paper [9]. This included the open codes, corresponding descriptions, and selected representative quotes for each code. After we completed our phenomenographic analysis, we compared our code book to the open codes from the prior work [9]. Similar categories were identified based on the descriptions and representative quotes.

Category	Internal	External
Factors	No fears	Not having enough resources
	My time has passed	Terminology
	Numbers I can do, but not CS	Outside time pressure
	Foreign language	Interference from circumstances beyond my control
	Math	
	Being behind technologically	
	Learning style	
Outcomes	Staying lost	Getting a bad grade
	Becoming overwhelmed	Python will be archaic
	Not understanding	

Table 1: Fears organized by category

6 Results

6.1 Fears of Incarcerated Adult CS1 Students

Our phenomenographic analysis of students' open-ended responses about their fears going into the course yielded sixteen distinct themes, shown in Table 1 and described in detail below.

No fears: Students express having no fears, usually in brief statements (e.g., *"Nothing!"*). Some students add to these responses by reporting interest or excitement about taking the course.

My time has passed: Students mention their age as a concern, fearing that their time to learn computing has passed: *"I am almost 50. (Feeling like my time has passed.)"*.

Numbers I can do, but not CS: Other students are apprehensive about CS, although they feel confident in math: *"Math, Algebra, expressions, numbers I can do, but I am totally confuse at this beginning stage about everything."*.

Foreign language: Students make connections to past experiences with struggling to learn a new language, such as *"That it is going to be like learning a foreign language."*.

Math: Students express general anxiety related to math: *"Math"*.

Being behind technologically: Students express feeling behind with modern technologies or a lack of computer literacy. For example, *"No experience with computers"*.

Learning style: Students fear that they will struggle in the course due to their particular learning style: *"I am a tactile learner I don't do as well with auditory forms of learning"*.

Staying lost: Students fear being in a perpetual state of being lost in the course, or falling behind to the point that they are not able to catch up: *"Staying lost + confused"*.

Becoming overwhelmed: Students express fears of experiencing negative emotions in response to the class, or using emotionally charged language such as anticipating *"maddening frustration"*, becoming overwhelmed, and letting other people down.

Not understanding: Students fear not being able to understand course concepts, including general, short statements such as *"Getting lost"*, and *"not understanding"*.

Not having enough resources: Students fear not being able to understand the material fully due to a lack of resources, including limited lecture time, no access to a code interpreter, insufficient examples, limited access to the instructor or peers, and not having spaces to hold study groups: *"Not ... having the ability to get a understanding from the professor or even other classmates because we don't have an area to conduct study groups..."*.

Terminology: Students are concerned about terminology on exams: *"Hoping terminology is not a big part of testing"*.

Outside time pressure: Students fear not being able to succeed due to outside commitments: *"I'm afraid the class will require more of my time than I can afford given my course load and job."*.

Interference from circumstances beyond my control: Students fear that things outside of the their control will interfere with their success in the course, including prison staff or Covid-19: *"I fear that this uncertain Covid 19 pandemic will cause another lockdown that will prevent me from attending class."*.

Getting a bad grade: Students fear failing the course, not doing well, or getting a low grade, for example *"Failing..."*.

Python will be archaic: Students fear that the skills they learn in the course will not be relevant by the time they are released from prison: *"That Python will be archaic before I ever return to society and am allowed to use it"*.

6.2 Confidence Amongst IA CS1 Students

As shown in Table 2, the average final confidence reported by students is lower than the average initial confidence in both iterations of the course. Results of our analysis of the change in distribution of initial and final confidence values reported by students in the first and second cohorts is shown in Figure 1. In Cohort 1, we found an increase in students reporting the highest level of confidence (5) by the end of the course, and slightly fewer students reporting the lowest level (1). In Cohort 2, we found an increase in students who report the lower confidence levels (1, 2, and 3), and a decrease in students who report high confidence levels (4 and 5). While all IA students in both courses responded to the confidence question on the initial survey, only n=21 (Fall 2022) and n=19 (Fall 2023) students responded in the final survey. All students who responded to either survey are included in the calculation of descriptive statistics in Table 2 and distribution in Figure 1. For Cohort 2, since this data was paired, we performed a Wilcoxon signed-rank test to test for change in confidence amongst the 19 students who responded to both surveys, returning a median of -1, mean of -0.7, with p=0.045, significant at $p < 0.05$.

6.3 Relationship Between Fears and Confidence

Figure 2 shows the average change in confidence amongst Fall 2023 students for each fear. Students who initially express the fear *Numbers I can do, but not CS* report the highest increase in confidence, and students expressing *General not Understanding* and *Becoming Overwhelmed* demonstrate a low increase in confidence as well. Students who fear *Terminology* or *Foreign Language* report the greatest decrease in confidence, with declines of -2 and -1.33 points respectively. Students who cite the fears *Staying Lost, No Fears, Getting a Bad Grade*, and *Outside Time Pressure* experience a moderate (-0.5 to -1 point) decrease in confidence level, while students who cite *Lack of Resources* report a slight decrease in confidence of -0.25 points on average. Students who report fears related to *Learning Style* report no change.

6.4 CS1 Student Fears: Prison vs. Main Campus

Of the 16 fears identified in Section 6.1, 9 (56.25%) are similar to fears of non-CS majors in introductory CS identified in [9]. These themes
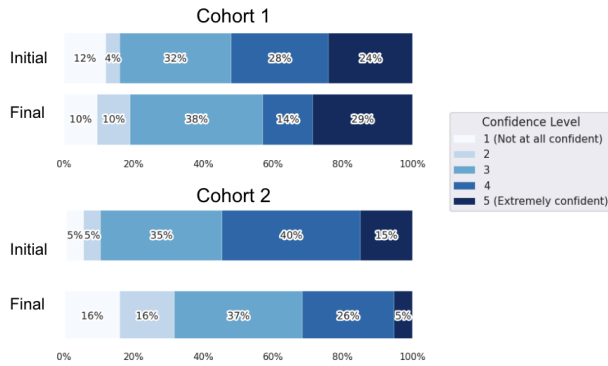
Figure 1: Distributions of Initial and Final Confidence

are displayed in the Venn Diagram Figure 3, with the common fears in the middle and unique fears from each group on either side. For categories that have an equivalent in both IA (incarcerated adults) and MC (main campus) the names displayed are those from the IA fears. The 7 fears we identified of IA students that are not identified in [9] were: *Terminology, Learning style, Foreign language, My time has passed, Numbers I can do, but not CS, Interference from circumstances beyond my control* and *Python will be archaic.* One fear of IA students, *Not having enough resources* is only partially captured by the code *help* identified in [9], but is still included in the 9 similarities (see Section 7.1.3).

Pop	Conf	n	Avg	Mdn	SD
F22	initial	25	3.5	4.0	1.26
	final	21	3.4	3.0	1.29
F23	initial	20	3.5	4.0	1.00
	final	19	2.9	3.0	1.15

Table 2: Initial and final confidence amongst IA students
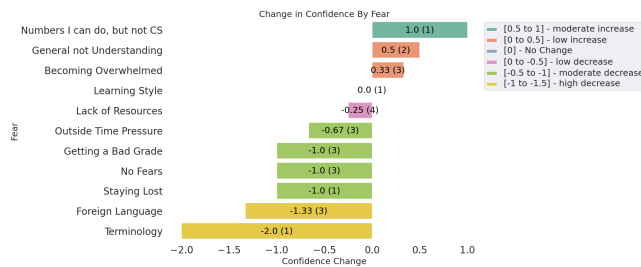

Figure 2: Average change in confidence by fear, Fall 2023

7 Discussion

7.1 Interpretation of Results

7.1.1 Many IA Students Report No Fears. While the objective of phenomenography is to capture the range of experiences of a phenomena as opposed to focusing on those most salient, we note that
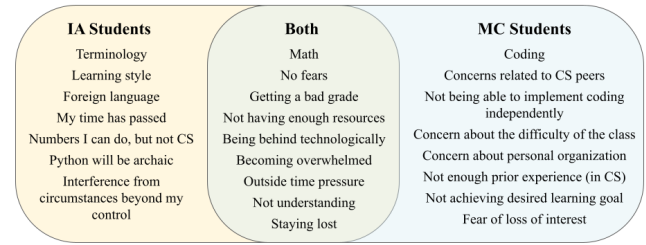

Figure 3: Overlap between fears of IA students and fears of non-CS majors identified in prior work [9]

the most popular reported fear of the IA students is no fear. The IA students in our study and the non-incarcerated students in Hogan et al.'s study experienced drastically different circumstances (e.g., access to resources, choice of major, etc.), which supported our choice of not beginning our analysis using the same codebook [22]. However, the category of *no fear* may be an exception in our ability to more directly compare due to its lack of ambiguity. In contrast to 17.78% of the IA students, prior work found that only 3.35% of non-CS majors on main campus report no fears [9].

One initial hypothesis could be that this reflects overconfidence amongst IA students, especially given that students in the second cohort reported a decrease in confidence on average. However, if this were the case, we would expect that students who initially reported no fears would account for more of this decrease in confidence than students who expressed other fears. Our analysis in Section 6.3 relating fears and confidence shows that students expressing no fears report a relatively mild decrease in confidence compared to students with other fears. Thus, we do not believe this to be the case. While most of our data in this theme was characteristically short, two responses expand on why they have no fear: *"I don't have any fear, I'm interested in the subject, so there is no reason for me to fear."*, and *"...since I have prepared myself mentally for this class, there really isn't any fear. As long as I stay focused and on top of the course load I'll be okay."* Drawing also on Conway's application of an andragogy lens in HEP and prior works' observation of IA CS students as skilled independent learners [4, 10], these responses may reflect intrinsic motivation and self-sufficiency as potential reasons that more IA students report having no fears. However, future work is needed to develop a more complete understanding of why many IA students report no fears upon entering a CS1 course.

7.1.2 Decrease in Confidence. One of the major takeaways from this analysis was the decrease in confidence shown in both iterations of the CS1 course in prison, with a statistically significant decrease in the second cohort. We expected that students in the second offering of the CS1 course on the same prison yard may show a difference in initial confidence, either increased due to seeing the first cohort of students complete the course successfully under similar conditions or decreased due to hearing about the course's difficulty from the previous students. However, the mean initial confidence is similar for both courses (M=3.5), which may indicate that there was neither a positive or negative impact on overall student confidence. That being said, as the collection of confidence scores in Week 1 was compromised in the first iteration of
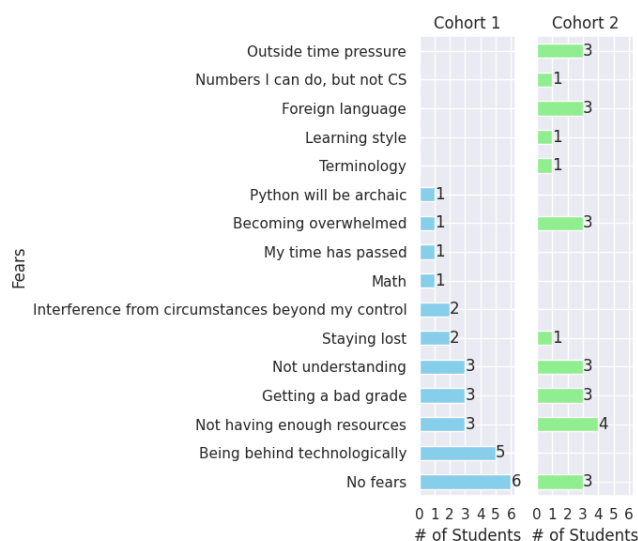
Figure 4: Count of Fears Expressed by Cohort

the course due to absences from Covid and we used a measurement from Week 2 in its place, future work is needed to confirm these results.

Both groups report a lower final confidence than initial confidence on average, and this final confidence is lower for Fall 2023 (M=2.9) than Fall 2022 (M=3.4). In addition, we find that the decrease in confidence is statistically significant in Fall 2023. There was a lower survey response rate for the final reflection in Fall 2022 than Fall 2023 (21/25 compared to 19/20, respectively), which could explain the difference between the two groups since students in Fall 2022 who had low confidence may have been less likely to submit the final reflection. Recent work has also shown decreases in self-efficacy amongst students on main campus using pre-post surveys in CS1, finding that while both men and women reported a decrease, there was a "more pronounced post-course decline" for women [19]. While all of the IA students in our study were men, they likely had less prior experience (PE) than both men and women in this prior work, which also found that "disparities in self-efficacy appear more strongly associated with PE than gender identity" [19]. As was recommended in this prior work, interventions prior to the CS1 course where students could gain formal experience could be effective in lowering IA student fears regarding technical competence and improve confidence.

7.1.3 Several Fears Unique to the Prison Context, Many Not. Over half the fears identified in our phenomenographic analysis are similar to fears identified of non-CS majors in introductory computing on main campus [9], as shown in Figure 3. Several fears of IA students are also similar to those found in an international survey of students transitioning into engineering degrees [23]. Among the most highly ranked concerns in Zarb et al. are "The possibility of failing, and any repercussions", "Workload expectation", and "Feeling prepared" [23], which correspond to "Getting a bad grade", "Outside time pressure", and "Being behind technologically". While future work may achieve a more comparable group of non-incarcerated

CS1 students and a larger sample size to allow more accurate comparison, this preliminary result reflects the wisdom of poet Maya Angelou: "We are more alike... than we are unalike."

Fears of IA students not identified in prior work include fears more directly relating to the circumstance of being incarcerated (*Interference from circumstances beyond my control, Python will be archaic*), older age (*My time has passed*), and personal learning characteristics (*Terminology, Learning style, Foreign language, Numbers I can do, but not CS*). In addition, the IA student fear *Not having enough resources* is only partially captured in prior work: non-CS majors on main campus expressed fear that they would not have access to sufficient help from course staff [9], whereas students in the prison fear limited access to course staff in addition to limited access to peers, lack of technology infrastructure, and insufficient resources. The fears related to personal learning characteristics may have been identified only in our study due to the differing emphasis of our methodology on the range of experiences, whereas the prior study identified more general themes [9]. Interestingly, the three unique fears related to incarceration and older age were reported only in the first iteration of the course, as shown in Figure 4. This may indicate that as more iterations of the course are offered (and the HEP program becomes more well-established), IA students' fears unique to the prison setting may lessen.

7.2 Limitations and Future Work

The inherently unpredictable nature of teaching in prison impacts the extent of our control for research purposes. For example, the unexpected confiscation of student laptops during some weeks of both courses could impact their reported confidence in their ability to succeed in the course during the final measurement, which is unrelated to many of the initial fears expressed. In future work, we plan to pursue more comprehensive measures of student fears, particularly surrounding digital literacy and preparation, as well as confidence and self-efficacy. In addition, it will be critical to replicate this work in more HEP settings (e.g., womens' prisons) to encompass a wider range of IA student perspectives.

8 Conclusion

This paper contributes novel insights on fears and confidence amongst incarcerated adult students in CS1. In particular:

- *No fear* was the most highly reported fear, whereas the identical prompt in prior work outside of prison found *No fear* to be the least prevalent.
- Confidence in their ability to succeed in CS1 decreased by the end of the course.
- Over half of the fears overlap with those of students outside the prison context, including feeling behind technologically.
- Several fears were unique, such as the programming language learned being archaic by the time they were released.

These findings provide future CS instructors in prisons with insights into students' experience that can be used to design interventions to address student fears and increase student confidence.

Acknowledgments

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