Training Computational Social Science PhD Students for Academic and Non-Academic Careers

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ABSTRACT

Social scientists with data science skills increasingly are assuming positions as computational social scientists in academic and non-academic organizations. However, because computational social science (CSS) is still relatively new to the social sciences, it can feel like a hidden curriculum for many PhD students. To support social science PhD students, this article is an accessible guide to CSS training based on previous literature and our collective working experiences in academic, public-, and private-sector organizations. We contend that students should supplement their traditional social science training in research design and domain expertise with CSS training by focusing on three core areas: (1) learning data science skills, (2) building a portfolio that uses data science to answer social science questions, and (3) connecting with computational social scientists. We conclude with practical recommendations for departments and professional associations to better support PhD students.

As more social scientists have gained training and experience in data science during their graduate studies, an increasing number have assumed positions as computational social scientists in academic and non-academic organizations. We define computational social science (CSS) as a field that engages the social sciences and data science by applying novel digital and digitized data and computational methods to advance social scientific understanding of human behavior (Edelmann et al. 2020; Salganik 2019). What distinguishes computational social scientists from social scientists and data scientists is their ability to combine research design, domain knowledge, and computational methods to generate scientific knowledge about human behavior (Grimmer 2015).

Computational social scientists currently work in academic departments, professional schools, nonprofit organizations (e.g.,
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**Research Design and Domain Knowledge Expertise**

To conduct CSS research, social science PhD students first must learn how to effectively design and execute research designs and methodologies. We argue that effective CSS training begins—first and foremost—with strong training in two areas that social science PhD programs already focus on: research design and domain expertise. On that foundation, social science PhD students interested in CSS also should focus on learning a specific set of data science skills: programming fluency, data management, collaborative research skills, machine learning paradigms, and the ability to engage with ethical concerns unique to massive data and computational methods.
develop and apply domain knowledge expertise. Computational social scientists are expected to draw on their doctoral training to lead and carry out research projects from end to end. For example, in a non-academic organization, computational social scientists often work on teams with engineers and user experience (UX) designers in which they are responsible primarily for research design. Computational social scientists also are expected in academic and non-academic settings to hold expertise not on all computational methods but instead on specific substantive and methodological topics, such as natural language processing and public opinion. We emphasize research design and domain expertise to underscore that CSS training should not replace but rather supplement the traditional social science PhD curriculum.

**Programming Fluency**

Programming fluency—defined as the ability to write code to collect, manage, and analyze data in open-source programming languages commonly used for data science (e.g., R and Python)—is fundamental to CSS research. Social science PhD programs often provide some training during statistics courses on how to use commercial point-and-click software such as SPSS and Stata for quantitative analysis. However, CSS students should prioritize learning a programming language for three reasons (Kim and Ng 2022). First, several core computational methods (e.g., machine learning and natural language processing) currently rely on packages developed and maintained in Python and R. Second, many sources of massive digital and digitized data (e.g., Tweets and Facebook posts) are accessible only through application programming interfaces (APIs), which can be queried easily through R and Python. Third, because Python and R are the lingua franca of computational social scientists, being fluent in a programming language will enable students to collaborate on research projects (in academic and non-academic organizations) and contribute to the development and maintenance of software and other tools used more widely in the field.

**Data Management**

CSS research involves vast quantities of data and therefore requires strong data-management skills. In particular, there is a need for researchers who are well versed in working with large, messy, and often unstructured data. Many students are likely already familiar with the basics of spreadsheet software (e.g., Excel). They even may have practice with summarizing, aggregating, and manipulating data to perform basic calculations and visualizations. This knowledge is translated easily to the use of “DataFrames” in R and Python. Eventually, students may find that they need to work with increasingly larger datasets. In many cases, this involves using cloud computing resources (e.g., Amazon’s Web Services, Microsoft’s Azure, and Google’s BigQuery) for storing data or conducting analysis and learning how to query and manage relational databases using Structured Query Language (SQL). Indeed, many non-academic organizations store their data in large, relational databases, making proficiency in languages like SQL necessary for working in these settings.

Beyond familiarity with data structures, students interested in conducting CSS research are well served to develop good computing practices early, including developing clear workflows for data analysis and coding as well as setting procedures for documenting any changes to data and code. These practices ease ongoing individual or collaborative work and they maximize the usefulness of a dataset by making it legible to other users in the future. Learning version control also is key for ensuring that data are not easily destroyed or lost in a project that is long term and/or involves many collaborators.

**Collaborative Research Skills**

CSS research is a collaborative effort—especially in non-academic organizations. In collaborative research environments, familiarity with a version control framework such as git and GitHub is essential. We elaborate on this in the third section.

**Machine Learning Paradigms**

Most social science PhD curricula provide quantitative research training in the form of statistical and causal inference. Whereas CSS research certainly uses these paradigms, it also relies heavily on machine learning paradigms that currently are not taught in most social science PhD programs. There are many different approaches to machine learning, with specific applications—for example—to causal inference (Athey 2015; Varian 2016); text analysis (Grimmer, Roberts, and Stewart 2021; Grimmer and Stewart 2013); and measurement (Lundberg, Johnson, and Stewart 2021). Being able to apply machine learning paradigms and adroitly navigate the relationships between machine learning and more traditional quantitative social science paradigms (e.g., inferential statistics and causal inference) is an important skill for computational social scientists and one that will set them apart from social scientists and data scientists.

**Research Ethics**

Computational social scientists can and should have an important role in generating conversations about ethics in CSS research, particularly as it relates to machine learning and artificial intelligence (Noble 2018). Increasingly, technological advancements in CSS research—in terms of computational tools and data collection—outpace public and scholarly discussions on how these advancements may affect society. For example, the fairly recent development of large language models such as ChatGPT raises ethical concerns about everything from plagiarism to data rights to the safety of open-access code (Bender et al. 2021). Computational social scientists have the ability and responsibility to apply their research ethics training to proactively anticipate ethical concerns related to their work, especially when it affects vulnerable populations.

**Learning Resources**

How can social science PhD students learn these data science skills for conducting CSS research? Ideally, they can gain programming fluency and other data science skills through coursework and research projects. Because few social science departments currently have formal CSS curriculum, we recommend that students supplement their coursework with courses on programming, data structures, machine learning, and other computational methods of interest if they are offered by other departments or if there are faculty available who can supervise independent study.

For students who may not have access to data science training at their home institution, there is a growing number of external CSS training opportunities. The Summer Institutes in CSS (https://sicss.io) are free and held every year in locations around the world. Each location provides participants with two weeks of...
training on various CSS topics. Because the Summer Institutes 
emphasize breadth of CSS topics, they are especially well suited
for early-stage PhD students. Participants are selected through a
competitive application process. Interested students should pre-
pare and submit an application—consisting of a curriculum vitae
(CV), a statement of interest, and a writing sample—by early
spring.

After students have gained programming fluency and a sense
of their research interests, they can pursue additional external
training on specific topics. The Inter-University Consortium for
Political and Social Research regularly offers short courses on CSS
topics including machine learning, network analysis, and agent-
based modeling. Moreover, students can continue to hone their
data science skills with free online tutorials and resources pro-
vided by groups such as Data Carpentry (https://datacarpentry.
org) and free in-person workshops and meetups organized by
groups such as R-Ladies (https://rladies.org).

BUILDING A CSS PORTFOLIO

A CSS portfolio, like a data science portfolio, includes projects and
outputs (Robinson and Nolis 2020) and is an integral part of data
science education (Nolan and Stoutd 2023) and career building
(Craig et al. 2018). Preparing a portfolio is especially critical for
pursuing a non-academic career in which publications are not the
only—and far from the most important—metric for performance.
Students do not need to take courses in everything related to CSS;
at some point, building a portfolio that demonstrates applied
knowledge will be a better use of their time and effort. One way
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It is helpful to first discuss how a CSS portfolio differs from a
CV. First, a CSS portfolio defines outcomes more broadly by
highlighting non-publication outputs, including open-source soft-
ware development, interactive maps, and dashboards, as indica-
tors of strong programming and public-engagement skills.
Second, a CSS portfolio focuses on processes, not only outputs.

Networking is as valuable to computational social scientists in terms of finding collaborators and jobs; however, it operates slightly differently in CSS because the opportunities to connect span more spaces across disciplines and sectors.

CSS Conferences

Social science PhD programs typically train and encourage students
to attend flagship academic conferences within their disciplines.
However, CSS PhD students can benefit from taking part in a broader
range of conferences. There are many cross-disciplinary conferences
focused on CSS topics where graduate students can meet other
scholars as well as share and receive feedback on their research.
Popular CSS conferences include the International Conference on

In particular, a strong CSS portfolio will demonstrate that a
researcher can write legible and reproducible code—a highly
valued skill in non-academic research settings, where code often
needs to be reproduced quickly and efficiently.

How does one create and share an effective CSS portfolio?
Graduate students should become familiar with version control
tools such as git and make frequent use of open-source coding
platforms such as GitHub. Git is a tool for managing and tracking
changes to a codebase, thereby allowing users to exercise control
CSS; the Association on Computing Machinery Conference on
Human Factors in Computing Systems; the International Confer-
ence on Web and Social Media; the Text as Data Conference; the
Network Science Society Conference; the International Social Net-
works Conference; the Politics and Computational Social Science
Conference; and the Association on Computing Machinery Confer-
ence on Fairness, Accountability, and Transparency.

CSS conferences mostly operate like any other academic confer-
ence but differ in that they tend to (i) include participants not
only from academia but also from industry, (2) use blinded review processes to select papers and sometimes publish papers as part of conference proceedings, and (3) organize well-attended poster sessions. These unique aspects of CSS conferences provide excellent opportunities for students to learn about research trends and professionalization norms across different disciplines and sectors. CSS conferences also are great places to meet and connect with peers (Kim, Lebovits, and Shugars 2022), many of whom may be seeking a cross-disciplinary collaborator or may provide helpful information about private- and public-sector internships.

In addition to the increasing number of CSS conferences, many disciplinary conferences recently have added preconferences focused on CSS topics. For example, the political networks section of the American Political Science Association also convenes PolNet, an annual convening that consists of workshops and panels. In recent years, the American Sociological Association also has organized a computational sociology preconference ahead of its annual conference.

**Internships**

Social science PhD students often spend their summers preparing for program milestones and conducting research. For CSS PhD students, these may serve as especially opportune periods to pursue additional training and engage in career exploration through internships. Whereas summer internships have long been a common part of the undergraduate experience and PhD training in the information and computer sciences, they also are increasingly an important part of the graduate experience for CSS PhD students. Participating in an internship—especially early in their PhD program—can help students to understand whether they want to remain in academia or pursue a career in the private or public sector.

Several organizations now offer internships to CSS PhD students. Many tech and social media companies, including Meta, X, Google, Amazon, and Microsoft Research, have internship programs. Some public agencies and nonprofit organizations also have internship programs, such as the Civic Digital Fellowship and the Data Science for Social Good Fellowship. Moreover, there are internship and job opportunities in the private and public sectors for social science PhD students who use mixed or qualitative methods; their ability to conduct interviews and focus groups are valued in—for example—UX and community-oriented research.

Internships may vary in their structure, length, residency requirements, and compensation, but they all typically provide opportunities for students to engage in research in an applied and often team-based setting. Students should be aware that internships are highly competitive and dedicate a minimum of several weeks to apply and prepare for multiple rounds of interviews. Interviews generally include aptitude assessments in research design, statistical methods, and coding. We encourage students to reach out to former interns to learn about their interviewing and internship experiences. Recruitment for internships in the private sector typically occurs in the fall, with most internships transpiring throughout the summer months. However, many companies offer internships year round, so students should request a time that works best for their academic schedule. Deadlines for public-sector internship applications are less clustered and often are set closer to internship start dates.

**Online Networking Tools**

CSS PhD students also can use online tools to connect with other scholars. For example, LinkedIn is a useful platform for connecting with CSS researchers who are working on similar topics in the private or public sector. LinkedIn may be especially useful if students are interested in connecting with CSS researchers who are working in nonprofit organizations and think tanks because they may be less likely to attend CSS conferences compared to industry researchers. Other useful platforms for connecting with computational social scientists currently include Slack and X. There are many groups and organizations such as Black in AI, Women in Machine Learning, and R-Ladies in which CSS PhD students may find community. In general, we encourage graduate students to reach out to CSS scholars, particularly those working in non-academic organizations, because they often have important insight about the aims, needs, and priorities of their organization.

**CONCLUSION**

CSS creates many new career opportunities for social scientists. This article shares advice and resources to provide PhD students a guide for navigating these emerging career paths in academic and non-academic job markets. We encourage PhD students interested in pursuing a career as a computational social scientist to build on their research design skills and domain expertise by (1) learning data science skills, (2) building a CSS portfolio, and (3) connecting with computational social scientists.

As the field of CSS continues to grow, departments and professional associations likely will need to assume a more coordinated and proactive role in supporting graduate students. For now, we draw on recent work on social science PhD training and job placement (Berda, Malloy, and Young 2020) to suggest the following changes that departments may consider adopting to better support PhD students who are interested in CSS. Notably, these same changes are likely to attract and retain CSS faculty:

- provide information on non-academic career opportunities, including internships, to students at the beginning of PhD training
- integrate data science skills building into existing curriculum (e.g., integrating R or Python in introductory statistics courses)
- offer new courses on computational methods and data management
- identify relevant data science coursework in other departments and recognize earned credits
- identify relevant data science faculty in other departments who can serve on dissertation committees
- offer options for students to substitute a program requirement (e.g., one field exam) for an internship or advanced CSS training
- provide support for current faculty to pursue CSS training
- hire more CSS faculty and recruit computational social scientists from industry and nonprofit organizations for faculty and visiting-scholar positions
- evolve publication standards to increasingly value CSS conference proceedings, journals, and the value of collaborative CSS project work

Surfacing the hidden curriculum is an important step toward democratizing access to CSS and supporting all students who consider themselves a computational social scientist in achieving their goals. We do not claim to have the final word on what makes
a computational social scientist or a CSS curriculum; instead, we hope that this guide generates important and necessary conversations about the long-term development of this field.

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CONFLICTS OF INTEREST

The authors declare that there are no ethical issues or conflicts of interest in this research.

REFERENCES


