

Appendix A: Data and Methods

The topic of mentorship was arbitrarily selected based on its convenience and its sufficiency for exploring continuity mechanisms and modeling with pixels and flows. It is a study of faculty members' memories of their mentorship experiences as doctoral students.

Part I: Faculty Interviews

The data collection consisted of two parts. Part I consisted of interviews with faculty members regarding their doctoral student mentorship experiences. Faculty member participation was solicited from hard and social science departments at a university in the American Southwest. The recruitment email was composed as follows:

To all tenure-track faculty,

I'm performing a preliminary study on the way relationships are remembered. I'm seeking faculty who would be willing to meet with me briefly to discuss their past and present experiences with their graduate school mentors. The interview will last about an hour. There is no follow-up.

An Institutional Review Board responsible for human subjects research at The University of Arizona reviewed this research project and found it to be acceptable, according to applicable state and federal regulations and University policies designed to protect the rights and welfare of participants in research. Your participation is voluntary and confidential.

If you're able to participate, please let me know and we can set up a time that is convenient for you.

Sincerely,

Approximately 1,446 faculty members received invitations to participate. Prelaw, premed, and military-based departments were excluded from the study because these are traditionally dominated by doctors of practice, rather than PhDs. Faculty members were recruited via email and 49 successfully completed the interviews. Interviews were semi-structured and about one hour in length. Many participants expressed an interest in contributing to research on mentorship. There were a mix of positive and negative

experiences in the sample. I interviewed the subjects in person or by phone/video chat. The audio recordings were subsequently transcribed and coded. The names of mentors were coded in the transcripts to help prevent researcher bias. However, there is always a possibility that the researcher or the subjects could have preexisting personal or institutional biases that affect their responses during the interviews.

During the semi-structured interviews, I asked faculty members about their memories from graduate school, how those memories changed over time, and how they envisioned the future at different points in time. The questions were focused on determining how faculty members perceived their relationships and why they constructed relationships in particular ways. The structured portion of the interview is as follows:

Interview Schedule

Thank you for participating in my study. I'm doing interviews with faculty members in various hard and social science departments about their mentorship experiences during graduate school. The purpose of the study is to learn how and why relationships are remembered over time. This study has been approved by the IRB at the University of Arizona. All responses are confidential and you are free to stop the interview and exit the study at any time. If you don't mind, please take a moment to review and sign the consent and confidentiality form.

First, I have a few initial questions:

What is your age?

In what year did you receive your doctorate?

What did you receive your doctorate in?

In what state or country did you receive your doctorate?

What is your gender identity?

Do you identify with any particular ethnic group – Latino/Hispanic, Jewish, etc?

What is your racial identity?

Can you tell me about your mentorship experience when you were in graduate school? (How many mentors did you have? Who was/were your primary mentors? Did these relationships change over time? Who was your primary mentor when you graduated?)

What was your mentor's gender? Race/ethnicity? Academic title (junior or senior faculty)?

People have different social network compositions. In graduate school, did you have many mentors that you relied on for specific things? Did you have a few mentors that you were particularly reliant on?

Now, I would like to ask you about your mentorship experience with your primary mentor(s):

Is your mentor deceased?

Has your understanding of your relationship with your mentor changed in hindsight?

Did you enter grad school with a vision of what your mentorship relations would be like? What did you envision?

Did you leave grad school with a vision of what your future relationship with your mentor would be like?

Have you continued to stay in touch with your mentor after graduate school? (Or did you, if the mentor is deceased?) How did you stay in touch?

Why did you choose to maintain this level of contact?

What do you think was your mentor's opinion of you?

What did you get out of the relationship during graduate school? (What kind of social or professional resources did your mentor provide? Examples might include: providing feedback on paper drafts, hiring you as a research assistant, working with you as a coauthor, connections to other scholars or job opportunities, working with you on a grant or research project, etc.) How important were these resources to you?

What did you get out of the relationship after you graduated, if anything?

Do you think about your mentor often?

What things stand out most in your mind when you think of your mentor?

Did you ever perceive your relationship as ending at any particular point?

How did you begin the transition from a graduate student to a colleague/faculty member?

Do you feel like your mentor has become a part of you in any way?

How would you rate the vividness of your memory on a scale of 1–5?

[If deceased:]

When your mentor died, did you think about your mentor any more or any less than before?

Did your feelings or opinions change after he/she died?

On a scale of 1–5, 1 being “not close at all,” how close were you with your primary mentor during graduate school?

How often did you have substantial in-person conversations or interactions with your mentor during the last 2–3 years of graduate school? [(1) once or twice per year or less; (2) 3–5 times per year; (3) monthly; (4) several times per month; (5) several times per week or more.]

How often did you exchange written correspondence with your mentor during the last 2–3 years of graduate school? [(1) once or twice per year or less; (2) 3–5 times per year; (3) monthly; (4) several times per month; (5) several times per week or more.]

I’d like to know the different capacities with which you worked with your mentor. The roles need not have been adopted simultaneously. I’m looking at the accumulation of roles over time, both before you graduated and afterwards.

Was your mentor ever: (1) an adviser or committee member; (2) a confidant on sensitive or personal issues; (3) someone you worked as an RA for during graduate school; (4) someone you worked as a TA for during graduate school; (5) someone you did personal favors for (e.g., babysat, housesat, running personal errands, etc); (6) a friend of the family or family member; (7) a next door neighbor; and (8) anything else?

Did you ever talk to a mutual acquaintance about your mentor during graduate school?

[If yes:] How often? And what kind of things did you talk about?

Can you rate the extent to which you feel that your mentor was unique as an individual compared to other people in your professional life? On a scale of 1–5, 1 being “not unique at all”.

Which qualities did you view as unique?

Can you rate the extent to which you feel that your mentor was relatable to you compared to other individuals in your professional life? On a scale of 1–5, 1 being “not relatable at all.”

Which qualities did you find relatable?

Did you feel like any of those unique or relatable qualities were difficult to find?

Can you rate the extent to which you had negative versus positive experiences with your mentor? On a scale of 1–5, 1 being “strongly negative” and 5 being “strongly positive”.

How many people (students, faculty, staff, or professionals outside the department) reported to your mentor compared to other mentors in the department? On a scale of 1–5, 1 being “far fewer than other mentors” and 5 being “far more than other mentors.”

How critical was the mentor as a central point of contact to other outside institutions compared to other mentors in the department? On a scale of 1–5, 1 being “far less critical” and 5 being “far more critical.”

To what extent do you feel your mentor made (or is making) an important impact on your subfield now that you have left graduate school? On a scale of 1–5, 1 being “almost no important impact” and 5 being “a very important impact.”

A summary and discussion of the Part I data will be discussed in due course.

Part II: Field Observations

Part II consisted of field observations and unstructured interviews with an agricultural research team ($n = 13$) at a publicly funded university in the American Northeast. The observational component was included for the purpose of identifying specific discursive or material mechanisms of relationship construction.

I performed approximately 45 hours of field work. The research team was led and funded by a tenured faculty member. The team included three paid research technicians, several doctoral students, a postgraduate student, and four paid undergraduate research assistants. I gathered data using audio recordings and by taking field notes in a notebook. I often observed and listened to conversations without participating. Sometimes I asked questions either casually or as part of a focused conversation. On occasion, I engaged in participant observation during the team’s normal activities.

The demographics for the agricultural team are displayed in Table 5. Some team members were not present at the time of the study. All observed members of the research team were white except for one indigenous student. The principal investigator (PI) of the research team was a tenured male faculty member. The research technicians consisted of two males and one female. The postgraduate student was female. The graduate students included three males and one female. The undergraduates included two males and two females.

The team was fully aware of my role as a researcher and my institutional affiliation. All team members consented willingly and were very open to being observed and interviewed. They occasionally inquired about the study. There were some signs of low-level anxiety among some individuals about the possibility of me using their private conversations against them. I answered all questions they posed, explained the intention of the study, and discussed their human subject rights when these anxieties surfaced. This seemed to put some of the team members at ease. The research team and I maintained amicable relations throughout the study.

The study took place during late spring/early summer of 2019, the beginning of planting season. Faculty, staff, and students could be found working outdoors in crop fields, laboratory greenhouses, and/or indoor laboratories, depending on the research they were involved in. The research team occasionally had meetings in a warehouse building. Undergraduate students were likely to be found laboring in the barn under the guidance of one or more staff members. The PI was out of town attending a conference for over a week, but was very accommodating of my research study. Many of the graduate/postgraduate students and one of the staff members in charge of the indoor laboratory had offices that they actively worked in on the main campus, away from the barn and warehouse.

I chose to study a research team in plant science because the research generally involves interactions with material things and larger teams of researchers working together on projects. This increases the chances of witnessing the material and discursive mechanisms during the observation period.

Table 5. Demographics for Part II.

Demographic	Total Count
Gender	Women = 5; Men = 8
Role	Full-time employee = 5; Full-time Student = 8
Team members present for observation	13 out of 17

The PI volunteered for the study when I sent a recruitment email to members of the department. The recruitment email was composed as follows:

Dear Faculty,

I'm performing a study on processes by which relationships are remembered and imagined in social networks. My focus is on doctoral student mentorship. I'm looking for a lab or office that I can observe for 2–4 weeks sometime between April and June of 2019. Observations may also include some informal conversations and interviews.

If you're willing to volunteer your lab or office for the study, please let me know and we can set up a time that is convenient for you.

Specifically, I would be: hanging around the lab/office; taking notes or audio recording informal conversations; listening in on private conversations; and informally asking questions. I will make every effort to make my presence as unobtrusive as possible. We can discuss your preferences for privacy and consent before beginning the study.

An Institutional Review Board responsible for human subjects research at The University of Arizona reviewed this research project and found it to be acceptable, according to applicable state and federal regulations and University policies designed to protect the rights and welfare of participants in research. Your participation is voluntary and confidential.

If you wish to verify the legitimacy of the study, you may contact the Institutional Review Board at 520-626-6721 or <vpr-irb@email.arizona.edu>.

Sincerely,

Once I received consent from the PI of the research team, I sent a second email to the research team with the consent and confidentiality form attached. Members of the team were informed that they could choose not to participate at any time or to be excluded from the study in general if they desired. This email was composed as follows:

Dear Lab/Office Students, Faculty, and Staff,

I'm performing a study on processes by which relationships are remembered and imagined. My focus is on doctoral student mentorship.

I want to inform you that I will be observing your lab/office between X/X/XX and X/X/XX.

Specifically, I will be: hanging around the lab/office areas; taking notes or audio recording informal conversations; listening in on private conversations; and informally asking questions. I will make every effort to make my presence as unobtrusive as possible.

If you do NOT wish to participate in the study, please let me know and you will be excluded from all written reports. You must notify me either orally or in writing if you wish to be excluded.

You can find a confidentiality/consent form attached. Please review it and let me know if you have any questions or concerns. You are free to withdraw from the entire study at any time without penalty. Alternatively, you may also decline to participate in specific interviews or conversations at any time.

An Institutional Review Board responsible for human subjects research at The University of Arizona reviewed this research project and found it to be acceptable, according to applicable state and federal regulations and University policies designed to protect the rights and welfare of participants in research. Your participation is voluntary and confidential.

If you wish to verify the legitimacy of the study, you may contact the Institutional Review Board at 520-626-6721 or <vpri-irb@email.arizona.edu>.

Sincerely,

Parts I and II of the study are complete. There is no scheduled follow-up. The subjects have been given copies of the written report.

Discussion of Part I Mentorship Data

Due to the small sample size of Part II, I am only providing an extended discussion for the statistics of Part I. The descriptive characteristics of the sample are listed in Table 6. The representation largely reflects the broader demographics of the population of professors in academia. The sample is predominantly white and nearly all minorities are of Asian descent. Among white participants, the largest ethnic affiliation is Jewish. Social/behavioral scientists outnumber hard/life scientists in the sample by nine people. Men only slightly outnumber women.

Participant Age, Gender, Race, and Ethnicity. There is considerable diversity in the age of the participants. The raw age data are bracketed by generational cohort for Baby Boomers (ages 54–72 as of 2018); Generation X

Table 6. Demographics for Part I.

Demographic	Total Count (Percentage)
Gender	Women = 22 (44.9% of sample); Men = 27 (55.1%)
Degree	Hard science = 20 (40.8% of sample); Social science = 29 (59.2%)
Age cohort	Baby Boomers = 13 (26.5% of sample); Generation X = 21 (42.9%); Millennials = 14 (28.6%)
Location of doctoral program	Midwest = 10 (20.4% of sample); Northeast = 9 (18.4%); Southeast = 8 (16.3%); Southwest = 5 (10.2%); West = 16 (32.7%); International = 1 (2%)
Race	White = 38 (77.6%); Asian = 6 (12.2%); Mixed White-Asian = 3 (6.1%); Indigenous = 1 (2%)
Ethnicity	None = 33 (67.3% of sample); Jewish = 7 (14.3%); East Asian = 4 (8.2%); South/Southeast Asian = 2 (4.1%); European = 2 (4.1%); Indigenous = 1 (2%)
Women by degree	Women with hard science PhD = 6 (27.3% of women); Women with social science PhD = 15 (71.4%)
Men by degree	Men with hard science PhD = 15 (53.6% of men); Men with social science degree = 13 (48.1%)
Women by cohort	Women Baby Boomers = 5 (22.7% of women); Women Generation X = 9 (40.9%); Women Millennials 7 (31.8%)
Men by cohort	Men Baby Boomers = 9 (32.1% of men); Men Generation X = 12 (44.4%); Men Millennials = 7 (25.9%)

(38–53); and Millennials (<37). The highest percentage of faculty of either gender were Generation X. There was a slightly higher percentage of Baby Boomer men than Millennial men, and the reverse was true for women. This is consistent with general trends age and gender workforce participation.

The gender of faculty members' self-determined primary mentor(s) is described in Table 7. Of the 49 faculty members interviewed, 26 mentioned multiple primary mentors. The interview questions were posed for each primary mentor, as time allowed. Overall, a large proportion of women (45.5% of women in the sample) have at least one woman as a primary mentor compared to men (7.4% of men). However, men were the primary mentors for both genders. None of the men in the sample relied solely on women as primary mentors, and only 13.6% of women in the sample did so. All of the men and nearly all of the women (86.4% of women) had at least one primary

Table 7. Mentorship Statistics by Gender.

Women: Gender of Mentor(s)	Percentage of Women	Men: Gender of Mentor(s)	Percentage of Men
At least 1 woman mentor	45.5	At least 1 woman mentor	7.4
At least 1 man mentor	86.4	At least 1 man mentor	100
Primary mentor(s) were only women	13.6	Primary mentor(s) were only women	0
Primary mentor(s) were only men	54.5	Primary mentor(s) were only men	92.6
At least 1 woman mentor, given hard science degree	16.7	At least 1 woman mentor, given hard science degree	7.1
At least 1 woman mentor, given social science degree	56.3	At least 1 woman mentor, given social science degree	7.7

mentor who was a man. Both genders were heavily reliant upon men for mentorship, but women were slightly more heterogeneous in their mentor selection.

The racial composition of faculty members was not diverse enough to provide a meaningful analysis of race-based mentorship. Faculty members noted a lack of racial diversity in their academic disciplines, particularly in the hard sciences. In spite of recent active attempts to recruit racial and ethnic minorities into academia, there seems to be a lack of cultural interest or pregraduate school opportunity structures. This study did not consistently collect demographic data on socioeconomic class, but conversations with faculty about class suggest that low-income faculty have cultural struggles with pursuing a PhD, not just financial obstacles. It is possible that cultural struggles could carry across racial and ethnic lines as well as class lines. Academia requires faculty to take on a workload that may exceed 40 hours per week and salaries are lower than those offered outside of academia. This could be less appealing or feasible as a job prospect for individuals from pragmatic or materialist cultures and low-income households. Future studies should give more attention to cultural and economic factors for not choosing careers in academia.

Mentorship Networks. Some individuals listed multiple mentors as their primary mentors, while others only listed a single mentor as their primary mentor during the study. Even among those who chose single mentors, some of them explained that they received mentorship from other people as well.

Some mentorship networks evolved throughout graduate school. The questions in the survey focused on mentorship during the last couple years of graduate school.

Although some faculty members lacked a dense mentorship network or community of complex socialization ties, it was sometimes problematic to expect the faculty members to choose a single primary mentor. The faculty members discussed several reasons for not considering any single mentor to be the “primary” mentor. First, mentors within some of these networks played different roles, worked in different capacities, or provided different resources:

- 106:** One was more a personal advisor and very much involved in getting me to – Helping me to learn how to ask good questions and how to succeed. The other was technical, more a technical advisor. So, I did stuff in my lab that nobody had done before... So that’s sort of why I needed two.
- 142:** I had two mentors. I had one at my university, and then I did my research at a national lab, and so I had a different mentor at the national lab. So the mentor at the university was supportive, but not a close relationship. And the one at the lab was more of a daily working relationship.
- 146:** And then I chose a different faculty member for my dissertation chair who then became my PhD advisor, and that was based a little more on his research. And then, there was another faculty member who – it matters to me because she was female, and she ran a research group... We did different types of studies together, but they weren’t a dissertation. She was also kind of an informal mentor because she was never my advisor, but I became a participant in her research group... for a few years. There was... also a woman who was a faculty member... She was also an informal mentor at times. A lot of us sought her out for advice, just informal advice.

Second, some individuals switched primary mentors during graduate school or made special arrangements to acquire a new, more relevant mentor while keeping the old mentor:

- 101:** My primary mentor was my chair – dissertation chair, and she – within the first year, I switched chairs and she became, you know, my primary mentor.
- 108:** I got into a dilemma so I went to the grad director and said, “What the hell should I do? I don’t wanna piss off my current advisor, but – And I don’t want to piss off Ernie either who really should be... my new

advisor"... And she said, "Why don't you just have both of them as co-advisors."

109: I had three mentors, one for my masters, and then I started with one for my PhD and then I switched to another one during my PhD.

Third, the mentors sometimes made different contributions in the same role capacity or offset the each other's weaknesses. For instance, they might have offered different intellectual perspectives, different types of emotional support, or offer different types of help on a paper.

113: I think, one of the important things that I had to figure out, that was important for me to be successful, was to find people who could help mentor in things that weren't his strengths... He was very good at big picture. But, sitting down and going through minute details of things, he wasn't quite as good at, I think... But the postdoc was really very good at being able to sit down with somebody else's problem and look at the incredibly minute details of something numeric and just go through the math with me when I was having trouble.

132: So right before my last year as a graduate student, the summer before, he started coming on to me in a way that was completely unacceptable... And it pretty much devastated me because I thought that we had this positive working relationship and I thought he respected my ability to get the [science] done, and it became clear that that wasn't why he was interested in talking to me.

...

So I told [a woman mentor] right before I left, and I don't think we were particularly close until I told her... I feel like we could kind of bond over "we've had this experience," and she was sad to hear that it was still going on, but she was super supportive of me, and also willing to listen and watch, but not do anything, which is what I wanted at that point.

141: So broadly, I talk about management style. So my first advisor was a micro-manager. Like, he knew where everybody was all the time and you were meant to be in your desk or at the lab... And then, my other advisor was a real hands-off person and he was the kind of person where if you needed him, you could set up an appointment and otherwise you wouldn't necessarily see him. [chuckle] And so, certainly like the two totally opposite ends.

Fourth, the mentors were sometimes differentiated by technical differences in status or by structural factors. For example, one mentor might have left the department or went on sabbatical, forcing the student to rely more on a

different mentor. Or sometimes the official mentor was different than the person who provided the most mentorship, or was not the only person who provided mentorship. Some academic environments had communal mentorship cultures or persons who shared mentorship responsibility.

116: They're pretty much both primary. Just because for the dissertation sake, I had to pick one and then it ended up being that one of them moved to a different university, kind of halfway through my grad school career. Then, one who remained became my primary mentor, but the relationship really didn't change, because... it was just a subway away to see him.

120: So, I had a number of mentors. My dissertation committee had five members, and my dissertation chair was from my primary mentor in graduate school, but two of the other five committee members were also very big mentors for me and then probably about three others in my graduate program over the course of my PhD.

...

So, some of it was formal in the sense that he was the primary person who was required to sign off on paperwork and things like that, and the person from whom I needed to get recommendation letters when I was applying for things, like fellowship to do field work for my dissertation, and they were usually requirements of the fellowship programs or applications.

147: The lab where I did my graduate studies was a very interesting set-up with – Which he really encouraged a lot of cross-mentorship among the students. Of course, the professors were mentors, so those are the two main ones. We had two professors running the lab, and this was cool in the sense that they have a lot of experience, but they're also extremely busy, right. They weren't as available as would have been optimal. So, as a result, the lab really developed this sort of mentorship model internally. For me, I had peers that would take on mentorship capacity sometimes – you know, two I would say, main ones.

Finally, some faculty mentors considered more than one mentor to be noteworthy, even though one person was more significant to them. Many faculty members had their own conceptualizations of what it meant to be a mentor.

131: So certainly, Clarence in all the ways that I think you're thinking about mentorship. But there were other faculty along the way that I either took several classes with or otherwise identified with or spent time with. Principally, I mean, I think of Stewart... as being helpful to me. He was on my dissertation committee. So I don't know that he – I don't know

if “mentor” would be the right word, but provided more than average sort of interaction and feedback to me in my graduate career. But as far as mentor, Clarence fits that description.

- 135:** I identified with one mentor. I had other senior – I had other faculty members that I worked with, but none of them were mentors.
- 143:** There was another professor who was on my thesis committee who I also interacted with a good bit. He was enjoyable to deal with, but I don’t know that I would call that mentoring. I would say a teacher.
- 149:** I had other professors who were on my committee that were also instrumental in my progress and my success.