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Creativity in Research & Transformative Leadership:
A Need-Finding Study amongst Computer Science Assistant Professors in Establishing Lab Groups

OVERVIEW

Motivation. After reading “Epistemological Pluralism” by Sherry Turkle and Seymour Papert that describes how approaches in the context of computer science are reified through institutions and considering my own experience with the role of creativity in the context of adaptive leadership, I was curious about the manner in which new faculty interface with diversity in thought in terms of creativity as it applies to research and the challenges that are most pressing in establishing their lab groups. These incipient groups will go on to shape the research culture at their institution which, in turn, is likely to influence formative learning contexts. I was also motivated by an interest in the increasingly common paradigm of inter- and intra-disciplinary work and approaches to support work at the intersection of multiple areas. Finally, as a student of computer science with more familiarity regarding the domain and diversity and inclusion landscape surrounding it, my aim was to speak with faculty with appointments in or joint affiliations with the computer science department.

Summary. Three, half hour semi-structured interviews were conducted with Professors Jennifer Jacobs, Arpit Gupta and Michael Beyeler with appointments or joint affiliations in the Department of Computer Science at the University of California Santa Barbara (UCSB). Commonalities and differences in experience spanned research goals, processes for collaboration, and intended learning outcomes for students. Emergent themes include domain specificity in developing research ability, informal support from faculty, leveraging collaboration to explore or shape research ideas, and functionally distinct self-evaluation criteria.

METHOD

Interviews. Before conducting interviews, I outlined objectives as well as focus areas and sample questions in each. The aim was to conduct 30 min, semi-structured interviews with 3 new faculty members. I reached out to Professors Jennifer Jacobs (expressive computing, Dept. of Media, Arts & Technology and Computer Science), Arpit Gupta (networking, security, machine learning, Dept. of Computer Science) and Michael Beyeler (bionic vision, Dept. of Psychological & Brain Sciences and Computer Science) and received a favorable response from each of them. The questions were largely inspired by Prof. Jacob’s need-finding study for artists in visual arts and the full set of the questions I used as starting points can be found here [[interviews.md](#)]. The objectives were as follows:

- Formulate a better understanding of how new professors (years 1 - 3) contend with and apply their experience of creativity in research in forming their own research groups.

- Explore perspectives (including iteration within) process, learning and collaboration in newly formed lab groups through concrete examples.
- Learn how new professors measure productivity in the early stages of getting their labs off the ground.
- Learn what mechanisms they rely on to drive outcomes.

Analysis. For my analysis, I relied on notes taken and audio recordings of the interviews. Prof. Jacobs suggested conducting a pilot interview which revealed several themes that guided the focus of the analysis and provided the opportunity to iterate on my personal approach in interviewing. The data is presented by offering summaries of significant points in the discussion, and structure is re-introduced by blocking the representation into consistent categories across all of the interviews. Analysis is presented based on emergent themes and insight into the differences and similarities introduced amongst the interviews.

PROF. JENNIFER JACOBS

Background & Self-Learning.

- Jacobs encountered two distinct leadership styles in obtaining her doctorate and completing her postdoc. Prof. Mitch Resnick at MIT, perhaps given his focus on learning communities, fostered a lab build around consensus in decision making. Prof. Maneesha Agrawala's group placed priority on individual drivers of projects where the work was shared across the group. While Jacobs would like to emulate Resnick's group dynamic given her interest in learning communities from a research perspective, she is aware that her group is situated in a different context and that the culture will emerge overtime.

Collaboration.

- Trying to be as intentional as possible, Jacobs considers the composition in potential new students' interests along with the extent to which they might participate in collaborations with students already present and contribute to the culture of the group.
- Jacobs believes different styles of leadership and facilitation are effective in the context of a research group although her observation does not extend to explicit goal setting and people management which might be more universal. Her model for her group is to have an established vision and be open to diversifying projects or research goals based on the people she is working with including grad students, whom she is most excited to with in terms of listening to their objectives and supporting their goals. She points out the contrast to a more conventional apprenticeship approach where the PI has the overarching visions and projects that students are then able to take up.
- Ideally, she would select collaborators based on whose approach is best suited for the research question at hand and whose established track record supports the intended work. At the same

time, Jacobs is limited by time and finds that it's difficult to stick the right collaborations where it consistently works. Her approach is to continue working with people where it works and approach collaboration through the more informal lens of relationship building.

- Even when collaborators share a common goal, differences in approaches or geographical or institutional limitations may hinder collaborative work.
- One current collaboration that is slowly building is with her masters advisors, Leah Buecheley.

Advising Students.

- Jacobs says a challenging aspect of working with students is examining why some students are better at self-driven learning and confident in taking on projects in areas that are new to them. According to Jacobs it is essential to research that students be able to “step into a new problem space” and this ability seems distinct from their skillset in any particular domain.
- Jacobs shared an example of a project on authoring in two different modalities where she is advising a student with experience in computational music and audio production. While he has a clear impression of the insufficiency of existing tools due to his innate experience in music making that he seeks to address, Jacobs finds it pressing to guide him to build the “right” thing. She defines this to be an artifact that is feasible, different and goes beyond design into the realm of research. Her aim is to help him articulate an “innate sense of the type of thing he wants to design” to concretize the research goals of the project.
- In general, she observes a tension between bottom up and top down development. Students are adept at building projects, but at the same time it's important to articulate the motivation for why the result is different from what currently exists. She believes that having a clearly delineated problem statement at the onset is not feasible for people whose processes rely on building first for exploration (consider the bricolage), but having her students cultivate the ability to identify and define and apply it in their work to build the “right” thing is critical. Specifically, she identifies a workflow where students make something and wait until the end to justify it, and this is the process that she hopes to teach students to iterate on.
- The biggest challenge Jacobs encounters in both being mentored and mentoring others is that people employ different working styles in how they make things. She shares that students who are planners are easy to mentor because they are skilled at expressing their internal state. Others are better suited to building things and using the process of making as a means to understand specific problems, domains, and interests. She seeks to learn how to avoid interrupting their process and simultaneously help them engage in periodic reflection. So far, she notes that showing them examples has been effective.
- Jacobs' structures her target outcomes for her students by considering their goals first. For instance, if they would like to stay in academia she wants to help them publish papers. If they are

interested in academia in the arts, she wants to help them unearth the right connections to obtain a position. Her perceived role of faculty is to connect given their broader reach and experience. The objective is to match outcomes with student's goals and help them get the research artifacts that will enable them to pursue the work that they want to do.

- Beyond having papers, students should develop their capacity for complex thinking. Jacobs wants to help students learn how to "think in new ways" by providing an environment for students to critically evaluate their assumptions and their ideas and consider how they contribute generalizable knowledge.

Other Goals & Challenges.

- One aim, to bring in 2 students who can work together and with existing students, is met with the challenge of considering the likelihood that existing projects will be taken up by incoming students and predicting how their interests may mesh with her own.
- Starting out as an assistant professor Jacobs shared the common feedback that the role is expected to have a demanding learning curve to the point where anyone starting out should expect to be bad at first. Her main challenges center around not knowing where to begin to address knowledge gaps ("What are the things I don't even know?") as well as attention gaps (tasks or considerations she must complete but is not currently addressing).
- Jacobs also faces the challenge of ensuring the output of her lab (the overarching theme is to build expressive tools for the arts) fulfills her own research goals to make contributions that go beyond broadening the reach of what is happening at the edge of the art world and making it more accessible to others. She investigates how to contribute to innovation in the art world by supporting emerging art forms rather than re-establishing previous ones.
- The main aspect of her role apart from advising students is to communicate her work and interests. The interdisciplinary nature of her work poses challenges as different forms of thought and values on language and expression differ for those with either traditional art or engineering backgrounds.
- In terms of advising students, the biggest challenge Jacobs faces is giving them a framework or feasible problem space to explore what they are interested in without overly constraining them.

PROF. ARPIT GUPTA

Background & Self-Learning.

- Gupta recalls observing the extent of intellectual freedom afforded by leading a research group while working on a research project at the India Institute of Science after his graduation. His resolve to seek an academic position was strengthened by the accolades earned by a publication

during his masters. He had internalized how difficult it is to obtain a faculty position and be a professor but felt the pathway had been opened to him. Even though he is still in his first year, he feels like he is doing what he wants to do. He has a great degree of intellectual freedom and the opportunity to pursue ideas that were on the backburner during grad school.

- He has several ideas for interdisciplinary research pursuits. For instance, in the first year of his PhD he wrote a paper on internet measurements (he later went on to work with the same professor for his postdoc). Now he is able to revisit the idea of using internet measurements to inform his work in full. He also wants to apply natural language processing (NLP) to networks research.
- As a graduate student, Gupta observed processes that facilitated collaboration amongst his students. Not only did they work together in a shared open space, but they also had a Center for Information & Technology Policy (CITP) that had a wide variety of offerings to help students engage in their domain at a deeper level. CITP had weekly seminars that “triggered a lot of discussions about what are the interesting problems, helped identify where [his] skill set could be applied effectively, promoted collaboration.”

Collaboration.

- Earlier Gupta felt hesitant to explore NLP in the context of networks because of his lack of formal knowledge surrounding NLP. However, after speaking to faculty at UCSB who encouraged his ideas around leveraging NLP, he feels more confident in pursuing that research direction in his group.
- In general, he feels the Computer Science department at UCSB has a collaborative culture. Everyone he has reached out to has been receptive to the collaboration. He also feels opportunities for collaboration will help him prioritize different projects as he can identify which skill sets amongst the faculty will compliment his own and lead to compelling work.
- Gupta relies on collaborators’ senior students. New students in his own group are paired to have direct contact for peer learning which helps them come to speed. The collaboration also may help them obtain a publication where, even if they are not the first author, they get the satisfaction of having tangible outcomes of their work and experience the process.
- Gupta has also started a collaboration with his undergraduate university Indian Institute of Technology (IIT) Roorkee which was in part facilitated by Prof. Subash Suri another alumnus and CS faculty member at UCSB who recently received IIT Roorkee’s Distinguished Alumni award. Students from IIT Roorkee are able to complete their undergraduate thesis at another institute. He hosted two undergraduates as visiting students through this program which gave him the opportunity to work with them in the context of his group and see if they were a good fit. He has extended offers that they will likely accept and has another student who will be visiting from May - December. Prof. Giovanni Vigna also shared that he has adopted this approach in the past where

students work with him for 3 to 4 months to mutually gauge the efficacy and fit of the collaboration.

Advising Students.

- Based on his experience with CITP, Gupta wants to create systems that will benefit his students. One concrete objective is to create a regular systems and machine learning reading group to discuss papers and possible research projects and understand what problems are pressing in this space. His goal is to create a community that can discuss cross-discipline research projects and how “a kernel of skills can be transferred from one research area to the other.” While the first step is to develop a smaller, local community, the eventual goal is to invite expert speakers to avoid a saturation of ideas.
- One challenge Gupta identifies is to motivate students to pursue research in his own area. Systems research requires rigorous work and up to 2 to 3 years before publishing a tier 1 paper as a first author. The nature of the work and the timeline can be discouraging. His approach is to motivate students by sharing his research vision in terms of how it aligns with their research goals. Working with students interests in different facets of the work, he mentions a specific example of how one student only wanted to focus on applying machine learning (ML) algorithms at the beginning but overtime with clarification of the bigger picture to contextualize the work was motivated to read other papers and better situate themselves.
- Gupta acknowledges that his students have to simultaneously develop multiple skills. He aims to provide more exposure to them by providing a number of papers, communicating differences in research areas and also getting students onboard who are driven enough to learn. Students must have the capacity to develop the right skill set overtime.
- Gupta thinks it’s important for students to develop a core skill set in a particular technical domain. For example, he knows networking inside and out. This enables students to build intellectual capital and they are then better suited to venture out in the process needed to develop a complimentary skill set.
- His requirements are that students have some basic networking expertise and that they take time to develop core skills (which he helps to facilitate through network specific reading groups). While he doesn’t expect expertise in ML, he expects them to be experts in networks and to understand deep concepts in ML and learn how to apply them in the context of networks. He estimates it takes 6 to 7 months to develop this knowledge but it’s not necessarily sequential and students can explore other areas.
- Gupta encourages his students to develop their research ability. These more general skills include how to conceptualize an idea, evaluate it before investing resources, develop tools & techniques to critically assess the potential of the research direction. He hopes to train students to the point where they are able to evaluate their own ideas.

- Concretely, students become better researchers in his group by reading recent research papers. In addition to teaching them how to dissect papers non-linearly, he challenges them by asking how they would have solved the problem and what other approaches they might have considered. He says this process improves their intellectual analysis and also plays an important role in building students' confidence.
- Gupta wants to avoid standardizing his approach to onboarding students, as he recognizes that different students have different preferred learning styles. He aims to provide multiple mechanisms for them to learn including pointing them to online / external material. For instance, he had a student who wanted a more formal understanding and encouraged him to take his course. Another student wanted to learn on his own time and Gupta directed him to the reading list Advanced Networking course at Princeton and noted the students contributions to the group have increased overtime.
- Gupta also tries to share the breadth of his knowledge with the group. Two days a week he holds sessions where he shares everything he has been considering, his perspective about research problems and trends, funding opportunities, who he has been communicating with and communications and what their responses have been. His goal in this manner is to give the students more data points regarding what work is being prioritized in the field and develop a sense for what work will have an impact. He also hosts weekly scrum sessions to check in with his group.
- Gupta feels fortunate to have had adaptive students to date who've onboarded in a few months as opposed to the full year he had planned out. At the same time, he says starting a new project from idea to execution will take two years and on the first set of projects he wants to share as much feedback as possible in the sense that a student will take an established idea and work on it.

Other Goals & Challenges.

- While Gupta does have a vision for what his group should look like, at the moment it's too early for him to tell if it's headed in the right direction. Also, so far nothing has been unexpected. He is motivated by the goal of building a big group and engaging more students.
- Being on a tenure track adds its own internal pressure. Gupta clarifies that he relies on his own internal metrics for success. It's a stressful process and striking the right balance in terms of how to allocate time requires fine-tuning.
- Contrary to his experience of being a graduate student or postdoc where the aim is to focus on one problem at a time, he feels he has a lot of ideas that he wants people to participate in executing on and spends a lot of time writing proposals. This personal goal and the reality of the work introduces significant communication overhead.

- With a one year old at home, it's important for Gupta to optimize his time to support a work / life balance. Over time, he has developed strategies to do this including no communication in the morning so he can focus on deep work. He also only works set hours which adds a set of constraints to his workday resulting in an optimization of how he allocates his time at work.

PROF. MICHAEL BEYELER

Background & Self-Learning.

- Beyeler's motivation for being a professor stemmed from his desire to have a significant impact in his field. He learned about the field after switching between multiple disciplines and coming to the realization that bionic vision combines vision, computer science and neuroscience in a way that aligns well with his background and interests. Moreover, most of the work happening in this emergent field is happening in industry. By dedicating the group to this field, his aim is to have the greatest impact by studying longer term questions and not being tied to more commercial constraints and short term goals.
- He found that UCSB was very receptive to the interdisciplinary pursuit he suggested. It was critical for him to find the right environment to be able to develop this group to reach its potential and have impact beyond a single discipline which is necessary in this exact field.

Collaboration.

- Some tools that have been effective for managing the lab include Trello for project management (only when there are more than 2 collaborators on a project), Slack for communication, Github, Drive.. He has to motivate students to use Trello and other resources. He tries to outsource specific tasks to different apps.
- Trello is used for milestones, big steps and assigning people to specific tasks to avoid the situation where multiple people are working on the same aspect of the project.
- Drive is used for internal lab resources for instance the key papers to read and data that cannot be shared beyond the group. Github is used for code.
- Creativity feels like a "blackbox" in terms of how to transfer that to the students.
- Creativity in ML is very specific -- it requires a very structured approach of building on a framework and changing a specific aspect to apply it to a new problem. Neuroscience is more focused on asking big questions and designing the right experiment to study or identify a particular effect.
- To date, the challenges faced have centered on engineering. His project is to create a VR experience of what it would be like to have a bionic eye to enable several user studies (for

instance, changing the encoding of the stimulus). A big challenge of this work is making the system run in realtime. To address this project, Beyeler has paired a graduate student in neuroscience with an expert computer science undergraduate with experience in VR and HCI. So one student will have the technical question and insight and the other will have the bigger picture model and questions.

- His hope is that in collaborating with students in multiple disciplines that they will keep up with their own interests and bring the state of the art to the group so that they can crowdsource information on multiple fronts. So far, he has shared state of the art in bionic vision. Beyeler is setting up his group so that the students take over the journal club.
- Beyeler is trying to set up a formal collaborative partnership with two companies that manufacture bionic eyes. To date, the initiative has been an administrative challenge. His desire to work with these companies is motivated by his prior experience working with them and that the collaboration will help present the problems in the field from a different vantage point (i.e. what can the group do to make a difference given the devices that exist and are feasible at the moment). He wants to see the ideas of the group implemented in the real world.

To date, there is no community of interdisciplinary assistant professors that Beyeler interfaces with. His collaborators are largely adjacent to either one field or the other. The idea of “being the outsider wherever you go” resonated with others at UCSB. For instance, one suggested starting a workshop in his specific subfield and growing that into a large conference. Specifically, Beyeler shares that Prof. Tobias Hollerer faced similar challenges given his interests in HCI before it was articulated and prominent as a field of its own.

Advising Students.

- Contrary to the notion of T-shaped people in creative domains, Beyeler seeks “pi-shaped people.” His field requires methodologies in computer science, so he seeks to find students who have strong backgrounds in computer science methods and have a strong interest in the applications in neuroscience.
- Given the distinct backgrounds of his students, Beyeler hosts a weekly journal club that helps establish a common basis. He has observed students hesitating or struggling to grasp concepts given the different terminology used in multiple disciplines but overtime their confidence grows and they become more accustomed to multiple domains.
- Beyeler also leads tutorials. He may formalize the structure for these in the following year. For now, they are as needed and center on either cementing knowledge of key topics or working with commonly used tools. For instance, he gave a tutorial on the visual cortex. These help “level the playing field” so everyone can contribute significantly and have a baseline understanding to facilitate discussion.

- Beyeler was not anticipating the lab growing so quickly but has accommodated the interest of several students drawn in by the research vision of the group.
- Projects are determined by his grant that identifies clear goals for his work and ideas that he wants to revisit or still address generated from his time as a postdoc. He also aims to match the background and interest of the student to the work that he suggests.
- He has paired his PhD student and Masters student with one undergrad each to assist in their work. He has also paired two undergraduate researchers with one another and given them a more directed project.
- Beyeler finds more than facilitating learning at different levels of expertise, scoping work to meet the research bandwidth afforded by students' programs to result in more distinct projects. To clarify, his Masters student must have a project with a well defined plan to execute on within the time afforded by their graduation timeline. On the other hand, his PhD student is given a general research direction and more freedom to develop their own ideas. Lastly the undergraduates need more direction and structure since it's less clear what they will accomplish in the course of a quarter.
- Beyeler is interested in supporting a plurality of approaches. He thinks each student is different and if he can see "how the wheels are turning" and is confident they will begin to arrive at their own destinations he grants them more flexibility in their work.

Other Goals & Challenges.

- His goal is to form a truly interdisciplinary group. Rather than being the connector who knows the bigger picture and bringing in specialists to solve specific sub-problems, Beyeler's goal is to find people interested in one field but also interested in branching out, collaborating and developing a skill set in both with the primary fields of expertise being computer science and psychological science.
- Beyeler has a deadline and deliverable driven mentality. He has a clear picture for where he wants to be in six months time, so he knows where the group needs to be at the end of the quarter. To elaborate, he has 3 years left on his grant. Given he knows his long term goals, in the first year he has to take care of a lot of set-up including IRB approval for working with human subjects and the system that will be used in trials.
- The grant has helped him in defining his 5 year goals and also in "hitting the ground running."
- Going from postdoc to assistant professor "has been a radical shift." After extensive training in how to do research, the research itself is outsourced. "Now you have to be a manager and administrator and a teacher. The biggest challenge has been not only adjusting to the workload but also how different it is -- switching contexts real quick."

- Starting a lab group feels like starting your own company “a one-man show.” At the same time, there is a strong support system and other faculty are able and willing to provide guidance. Managing people also means being responsible for their success in addition to your own but so far that has been a more rewarding aspect of the work.
- Another challenge is how to represent the research output. Computer science is driven by publishing in conferences whereas neuroscience is focused on journals. Both fields expect a high volume of output in their category of interest. Advice that he has found helpful is that what is important is impact more than where the work is showcased.
- Beyeler notes that there is a lot of administrative work that has become central to his role. He mentions that it's interesting that the administrative workload is not a part of how assistant professors are evaluated. While guidance is provided, a lot of systems are outmoded or a lot of parties are involved. He shares the departmental staff will help. He wishes either for additional administrative support or that the onboarding was facilitated to a greater degree.

ANALYSIS

Supporting Multiple, Reliable Modes of Collaboration.

In working with students, Jacobs, Gupta and Beyeler highlighted the need to adjust to specific learning and working styles. In addition to observing differences amongst working styles, they each felt motivated to accommodate and facilitate learning in terms of whatever yields the most effective outcome for a particular student. At the same time, each professor has a distinct approach to their overall group dynamic. Jacobs and Gupta both rely on models that they encountered. One of Jacobs' goals is to emulate the lab style of making decisions through consensus of her Ph.D. adviser Prof. Mitch Resnick at MIT. Gupta recalls the Center for Information Technology Policy (CITP) at Princeton that provided access and exposure and which, in addition to the open working space used by systems grad students, facilitated a peer-learning environment. Beyeler's approach also emphasizes that students must learn from each other. He sets up projects tailored to each student's experience and interests in addition to their ability to work together. For instance, he noted one project with a grad student with neuroscience training and an undergraduate with experience in virtual reality (VR) and human computer interaction and how effective the collaboration has been to date.

In addition to managing student collaborations with one another and each other, all three faculty members are keen on growing external collaborations in variegated contexts. For instance, Jacobs mentions that collaborations emerge overtime and often she focuses on working with those who she has successfully worked with before. In her point of view, collaboration is not only about effective output but also about relationship building. She notes both geographic and institutional challenges in setting up these collaborative efforts. Gupta too relies on past collaborators. He sets up an additional layer of collaboration by pairing students with his collaborators' more senior students. Gupta is also focused on local faculty collaborations and the key driver for setting up projects seems to be a mutual match of finding

complementary skills to approach a specific problem. Beyeler, given that the work in his field is largely being conducted in industry, is trying to establish partnerships with two corporations both of which he also has experience working with in the past. Beyeler adds that collaborations with industry provide a useful vantage point to support work that will be compatible with extant devices or those in the developmental pipeline. He also notes institutional and administrative hurdles. While all three are keen on shaping collaborations based on previous experience and must manage multiple forms of collaboration, each has a different strategy or motivation driving that collaboration. Additionally, two out of three shared facing similar logistical challenges in establishing their partnerships.

Facilitating Dialogue & Multifaceted Learning for Students.

Jacobs, Beyeler and Gupta all underscore that learning is two-fold for their students. A large part of developing their research capability constitutes their capacity for intellectual analysis which may, to a certain extent, include domain specific expertise. Jacobs stresses that identifying or building the capacity for self-driven learning and confidence in taking on a project in a new problem space where the student may have is critical to their ability to do research. One of her learning outcomes for students is to improve their ability to evaluate their assumptions and the means by which they contribute generalizable knowledge. Gupta has a similar learning outcome for his students -- that they develop the capability to evaluate their own ideas. Beyeler is also interested in fostering a truly interdisciplinary group where each member is a “Pi-shaped” (as opposed to the “T-shaped” model of creativity found in literature) where they are able to apply methodologies from computer science to the domain of neuroscience.

While some aspects of this motivational goal of creating better researchers can be seen as domain agnostic, a key part of this training involves domain specific coaching and development. Consider the means by which Jacobs, Beyeler, and Gupta bring their students up to speed. Jacobs works with students interested in career paths in arts and computer science academia. She teaches them to find the justification for their work by situating it in the expressive, aesthetic, cultural and social implications of technology. In addition to weekly journal clubs for both machine learning / systems and his core area of networking, Gupta relies on hosting weekly scrum sessions and twice a week shares his thinking on his research, his conversations with collaborators, and what they are focusing on. He teaches students about the research landscape to provide data regarding what problems and approaches are important and why but they are specific to his primary domain, networking. Beyeler also shares the state of the art with his students by leading an interdisciplinary journal club and tutorial. His aim is to equip students in both disciplines and “to level the playing field” in his group. This line of thinking is also reiterated in looking at the journal clubs run by Gupta and Beyeler. Both see students’ confidence increase in approaching papers in problem spaces where they have less familiarity and focus on teaching students how to break down ideas in the specific disciplines (or sub-disciplines) that are relevant to the work at hand.

Lastly, it’s worth noting that all three have similar conceptions of their role as faculty. Jacobs sees herself as a connector with broader reach and experience than her students and to teach them to effectively position their work and build the “right” thing. Gupta wants to give his students more data to understand a compelling problem space and find good matches for their skills. Beyeler wants to leverage his expertise and research vision to enable an interdisciplinary group of researchers addressing bionic vision. All three

want to utilize their higher level perspective and insight to enable their students to drive compelling outcomes in their respective research areas.

Interfacing with a Plurality of Approaches with a Definite Research Vision.

All three faculty members indicated interest in supporting multiple approaches and learning styles. Jacobs focuses on an established vision but she is open to diversifying specific goals based on students and others that she collaborates with. She notes that students with a penchant for planning are more comfortable expressing their internal state so it is often easier to work with them, but she wants to also effectively support people who learn by making. Gupta also wants to avoid standardizing his approach to onboarding and one way he contends with this is by providing multiple mechanisms for them to get up to speed. Beyeler acknowledges how distinctly creativity manifests in the fields his group relies on and to some extent relies on students' demonstrated interest & proficiency in helping him give them more intellectual freedom in guiding their projects.

Different Strategies for Impact & Self-Evaluation.

Jacobs, Gupta, and Beyeler each seem to have different underlying motivations guiding their work. They may not be mutually exclusive but are functionally distinct. Jacob's goal is to support emerging art forms by building expressive tools for creative computation. One of her key concerns is that the work produced by her lab should contribute beyond broadening the reach of what is happening at the edge of the art world and to instead contribute to novel forms of expression. Gupta underscores the importance to him of intellectual freedom, the ability to work on multiple problems. One of his criteria is to build a big group and match skills and developing skills to solving specific problems with an interdisciplinary approach. Beyeler is piloting bionic vision research in academia and finds it challenging to understand what is the best venue for his work. His focus is on the impact of his work, the number of references or concrete results implemented in practice. He also mentions that the system his lab is building, an embedded simulation of a bionic eye in VR, should not only run in real-time but be sufficiently versatile to conduct a broad set of experiments. Beyeler also mentions that his grant has helped him establish benchmarks for his group as well as set their research direction.

Getting Informal Support from Faculty.

Jacobs, Gupta, and Beyeler all mention how informal support from faculty either at UCSB or elsewhere has helped them set their expectations and helped them shape their work. Jacobs received common feedback to expect to be bad at being an assistant professor given how demanding the job is which helped her frame her expectations and timeline for self-learning. Gupta mentions relying on Prof. Subash Suri and Prof. Giovanni Vigna at UCSB to enable and emulate, respectively, having visiting students to determine if they might be a good fit for the group. Beyeler notes the openness of faculty in providing guidance and advice when sought out. One faculty member suggested starting a workshop centered on the bionic vision and eventually grow the workshop into a large conference. In particular, advice from Prof. Tobias Hollerer who pioneered HCI research before it was commonly delineated has been helpful as his experience aligns with Beyeler's in working in an emergent domain.

Building Collaborations that will Shape Research Direction.

From speaking with Jacobs, Gupta and Beyeler, it is evident that their groups' external collaborations will shape their research direction. For Jacobs she underscores that ideas emerge from projects and collaborations over time citing her incipient collaboration on computational ceramics with her masters adviser Prof. Leah Buechley now at the University of New Mexico. Gupta stresses that given he has so many ideas, the work that he prioritizes will be shaped by faculty collaborations at UCSB. Specifically, he is seeking to work with faculty skill sets complementary to his own. Gupta also hosted and plans to host undergraduate students from IIT Roorkee who will complete their undergraduate theses with him. Through that collaboration, he has extended offers to students who he has already had the experience of working with. Beyeler notes that his industry partnerships will help drive the research direction of his group and provide a different vantage point focused on shorter term delivery and manufacturing feasibility. While the nature of the collaborations discussed is varied, it is evident that these external collaborations will, to a significant degree, shape the course of the work conducted in each group.

Balancing Communication & Organization Overhead.

One commonality across all three new assistant professors is their newfound need to balance the communication and organization overhead introduced by their new professional goals. Jacobs mentions the challenges of grant writing and keeping track of important details like finding letter-writers for the process to obtain tenure. She notes not only do many aspects of her role demand her attention, but that it is also unclear at times what she should be paying attention to or what aspects of the work may be unnoticed. Gupta shares specific parts of his daily routine that have contributed to work life balance including doing deep work in the morning and time limiting his working hours which helps him optimize his workday. Gupta also shares that he is moving away from the approach taken in grad school and most postdocs of focusing on one problem at a time. Since he wants several people to participate in working on the ideas and approaches he is interested in, this necessitates a writing and communication overhead. Beyeler shares "now you have to be a manager and administrator. The biggest challenge is not only adjusting to the workload but also how different it is -- switching contexts." To that end, he outsources different tasks to different applications including Trello for project management, Google Drive for internal lab resources, Slack for communication, and Github for code. Jacobs, Gupta and Beyeler are all facing challenges in organizing a vastly different type of work and coming up to speed in addressing all aspects of their role.

Motivating & Validating the Production of Interdisciplinary Work.

Jacobs, Gupta, and Beyeler each face challenges in motivating and validating the specific interdisciplinary work that they are doing. Jacobs notes students in her department are very successful at building artifacts and systems but they cannot wait until the end to justify their work. As she is interested in authoring systems in multiple modalities, her concern is not only to build a productive system but to build the "right" thing. Her group's work requires interdisciplinary pursuit and a specific form of entangled

motivation and validation that justifies the systems built and analysed in the course of her research. On the other hand, Gupta finds it challenging to convince students of the importance of building a strong base in networking since there is a long publication horizon in systems research. He has to situate the work in alignment with students' initial interests and finds they often develop the motion themselves once the depth of their understanding grows. He also shares his confidence in pursuing methods in networking that apply natural language processing (NLP) increased when his ideas were validated by a machine learning professor at UCSB who focuses on NLP. He seeks to create a systems and machine learning journal club to encourage and understand cross-discipline research and methods. Gupta too has to pilot motivating his work and creating a space to allow for this process of cyclic motivation and validation. Beyeler also shares that UCSB was receptive to the interdisciplinary nature of his research. In addition to making the case for his work, he has to consider how to distribute the output of his multidisciplinary work as neuroscience emphasizes journal publications and computer science relies more heavily on publishing in conferences.

Setting Constraints on Open-Ended Development.

Jacobs, Beyeler, and Gupta all constrain the open-ended goals of their groups by setting specific requirements for students entering the group. Jacobs, in looking for two students to join her group next year, considers who will collaborate well with her current group members and to what degree incoming students' interests will mesh with her own. Gupta expects his students to have a strong foundation and basis in networking. Not only will they join his group with some initial expertise in networks, but they are expected to prioritize developing their in-depth knowledge and research capability in computer networks. Beyeler expects students to keep up with their own discipline to bring in insights about discipline specific work so as to support interdisciplinary research that relies on keeping up with multiple research fronts. He also scopes his projects differently based on student experience. In this manner, all three are able to foster productive learning environments focused on open-ended development that are aligned with and rooted in their research areas.

CONCLUSION

This work showcases the opportunity to document the experience of becoming an assistant professor. The observations and analysis may help indicate what aspects of the role or strategies to approach it are and are not successful as well as how to provide scaffolding to support establishing research culture and new lab groups. Overall this information may help reveal ways to build higher learning communities, structure onboarding for assistant professors and inform hiring processes. Insights regarding effective production, through processes and collaboration, may translate to more formative educational contexts.

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