WHAT'S IN IT FOR ME: IMPACTS FOR MENTORS OF SCHOLARLY CONCENTRATION PROGRAMS IN MEDICAL EDUCATION

A thesis submitted to the faculty of
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Master of Public Administration

by

Matthew Trojnar

San Francisco, California

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CERTIFICATION OF APPROVAL

I certify that I have read *What's In It for Me: Impacts for Mentors of Scholarly Concentration Programs* by Matthew Trojnar, and that in my opinion this work meets the criteria for approving a thesis submitted in partial fulfillment of the requirements for the degree: Master of Public Administration at San Francisco State University.

Qian Janey Wang, PhD
Associate Professor

Carol Silverman, PhD
Lecturer

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Matthew Trojnar
San Francisco, California
2015

The format of medical education has changed little in the last 100 years. In contrast, an unparalleled explosion in healthcare discovery has expanded the armamentarium of tools available to the 21st Century physician beyond the capacity of any single person to master. New pedagogical approaches are required that teach medical students how to critically analyze, incorporate, and advance the practice of medicine when all this data is right at their fingertips. Scholarly concentrations (SC) programs are one emerging strategy for engaging students in the process of discovery across medical disciplines. Yet the project-based component of SC programs relies heavily upon time inputs from already strained faculty mentors. Does project mentorship benefit faculty, or are SC programs a sunk cost? The following research investigates various impacts of SC project mentorship for faculty at the University of California, San Francisco to determine whether benefits exist beyond student outcomes.

I certify that the Abstract is a correct representation of the content of this thesis.

James Wang — 5/19/2015

Chair, Thesis Committee — Date

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INTRODUCTION

The current pace of contemporary biomedical advancement is breath-taking and unparalleled in history. As a result, graduates of western medical schools today are exceedingly well-armed with the tools for prevention, diagnosis, and treatment of disease (Lucey, 2013). Despite these advantages, overall U.S. healthcare has been ranked poorly in comparison to both industrialized and developing nations. A troubling report by the WHO in 2000 ranked the U.S. healthcare system 37^{th} in the world. In 2006 the U.S. was 39^{th} for infant mortality, 43^{rd} for adult female mortality, and 36^{th} for life expectancy, all while earning the topmost position as 1^{st} in health care spending (Murray, Phil, Frenk, & Ph, 2010). A growing body of evidence suggests that while physicians have jumped ahead in biomedical expertise, they are falling behind in the knowledge, attitudes, skills, and experience required to translate new information into healthcare that meets the increasingly complex needs of patients and communities (Lucey, 2013).

If individual expertise is not enough to meet the challenge of 21^{st} century healthcare, what is the alternative? Leadership, lifelong learning, an inquiry-based habit of mind, analytic problem-solving, and systems-based thinking, are just some of the prescriptions which help to meet these new demands (Ogunyemi et al., 2010). From the pedagogical perspective, this has translated into what are termed "scholarly concentrations" (SC) in medical education. Frequently these SC programs encourage basic science, clinical/translational, and medical humanities research resulting in a scholarly product, otherwise described as a "medical thesis" (Dyrbye, Davidson, & Cook, 2008). Unlike traditional medical education, the scholarly concentration approach aims to push students outside of didactic rhythms into inquiry-based paths. The goal is to nurture self-directed future leaders comfortable with taking an active role in shaping the practice of healthcare within complex and shifting environments.

At the same time as this burgeoning trend in medical education has approached the forefront, student interest in these research-focused paths has waivered. The rising cost of education, particularly in the U.S., disincentivizes the additional time required to pursue an academic course. Consequently, a growing number of medical schools are aiming to counteract this trend by requiring scholarly concentration (SC) within their standard medical school curriculum (Jacobs & Cross, 1995).

Unlike traditional large group didactics where medical students gain biomedical expertise, or mixed level clinical clerkships where they acquire patient care skills, scholarship activities tend to be individualized and frequently self-selected projects conducted under the tutelage of a seasoned mentor. As such, scholarly concentration work is fundamentally labor intensive, particularly so when layered atop medical education's notoriously intensive four-year format. If SC becomes a more ubiquitous component of our pedagogical approach to the 21st century physician, will there be enough resources in the form of willing volunteers ready to “sacrifice” their own career aspirations in the service of students?

Research Problem and Question

Previous research has investigated the value of scholarly concentrations for medical student professional development, however, no research has yet analyzed either the value of the activity for the institution or more specifically the value of medical student research for the mentors. Are student scholarship programs sunk costs for medical schools or do they contribute in some way? How are student projects helping or hindering the larger scope of faculty healthcare research? The following thesis evaluates an SC program at the University of California, San Francisco (UCSF) to better understand the impacts of a medical student scholarship program for mentors and by extension, other medical schools. By shifting focus away from student outcomes onto the outcomes and impacts for mentors, this research aims to answer the mentor’s unspoken question: “what’s in it for me?”

A novel survey of SC mentors at UCSF assessed the impacts of medical student research in order to determine affects in three keys areas: 1) mentor productivity, 2) mentor career furtherance, and 3) mentor scholarly direction. Moreover, three predictors including project area, project duration, and mentor contact frequency were statistically analyzed to postulate “success factors” associated with SC projects.

LITERATURE REVIEW

Context of Medical Education

The current western medical education model is primarily "one-size-fits-all" (Green et al., 2010). This standardized approach appears contradictory, particularly given the context of burgeoning sub-specializations (Cassel & Reuben, 2011). How is it possible to simultaneously provide the breadth of knowledge necessary for future physicians to practice effectively across biomedical, social, health system, and clinical domains while also providing enough of the increasingly technical sciences inherent to these fields?

The standardized approach to medical education began just over 100 years ago fueled by a ground-breaking report by Abraham Flexner in 1910 (Irby, 2011). After visiting all 155 medical schools then in the United States and Canada, Flexner described a fragmented, profit-oriented system of education lacking scientific rigor, adequate facilities, or clear standards of quality (Cooke, Irby, Sullivan, & Ludmerer, 2006). According to Flexner, most U.S. medical schools were ineffectual, particularly in contrast to the contemporary German medical school system which he deemed an exemplar of training. The German approach applied the scientific method meticulously, was located within a strictly academic context, and utilized systematic accreditation to maintain quality (Duffy, 2011). Flexner recommended a similarly coherent and rigorous system for U.S. medical schools. He espoused a program of study that integrated and assessed laboratory science and clinical skills. Doctors, according to Flexner, must be grounded in how to "think like a scientist," and also provided formal structures supporting the formation of their professional identity (Irby, 2011). While his views were neither new nor unbiased, Flexner's report spurred a sea change in American medical education that put many privately-operated schools out of business and entrenched uniformity into the training of physicians across the United States, for better and for worse (Ludmerer, 2010).

Today, medical education in the United States is strikingly uniform and demanding (Beck, 2004). For example, most medical schools adopted and still offer what is termed the Flexnarian "2+2" model for education. This lockstep approach begins with two years of biomedical sciences and foundational skills acquisition taught primarily through didactics. The period is characterized by intense knowledge acquisition, rote memorization, and frequent testing. At its conclusion, basic science understanding as well as clinical skill applications are systematically assessed via the United States Medical Licensing Exams (USMLE) Step I and Step II. The second phase of medical education is based on the "clinical apprenticeship" model touted by Flexner and encapsulated in the dictum "See one, do one, teach one" (Rodriguez-Paz et al., 2009). A sequence of clerkships in various specialties (e.g., medicine, surgery, pediatrics, obstetrics and gynecology) is required whereby students learn hands-on care of patients through shadowing on team assignments (Barzansky, 2000). This period generally concludes with time for advanced clerkship experiences, termed sub-internships, and electives rotations.

This divide between knowledge acquisition in the first two years and direct skill applications in the second two years is not just an artificial representation of the practice of medicine, it also has a number of significant drawbacks. First, it imposes a curriculum upon learners that disregards prior education and training, thus lengthening the experience for many. Second, the approach unnaturally disconnects "formal" knowledge from clinical experiences and results in what termed a "binge and purge" mentality amongst learners preparing for examinations. Finally, this method fails to teach "adaptive expertise" whereby physicians learn how to think critically, incorporate new scientific data directly into patient encounters and maybe most importantly, recognize knowledge gaps. It is humanly impossible for any one individual to attain a semblance of mastery in medical science, nor is it necessary (Schafer, 2010). Today all medical data is available at the fingertips of practitioners and laypeople alike, so the ability to synthesize knowledge and navigate the unknown is paramount. Despite the demand of these skills for effective lifelong practice, they are not yet systematically taught during the traditional "2 + 2" medical school curriculum.

Goals of Scholarly Concentration

Flexner saw the inculcation of scientific curiosity and the methods of investigation, as opposed to relying on rote memorization, as critical to medical education. To develop these "habits of mind," medical students must be educated to approach problems, devise strategies for change, implement their plans, and communicate meaningful results (Irby, 2011). Didactics and clerkship rotations do not inherently foster analytic reasoning, problem-solving, critical evaluative skills, and individualized decision-making. A small subset of medical schools have implemented a variety of optional and less frequently, required experiences to teach the challenge of inquiry. Summarized broadly by Bierer et al, these programs, generally termed "scholarly concentrations" (SC), share the following beliefs:

- Research experiences lead to better critical-thinking skills;
- Faculty can stimulate future research by sharing their passion with students;
- Medical practice is changing so fast that the ability to evaluate research is a critical skills for clinical practice;
- Research stimulates lifelong learning;
- An area of inquiry increases enthusiasm and leadership within a career in medicine (Bierer & Chen, 2010).

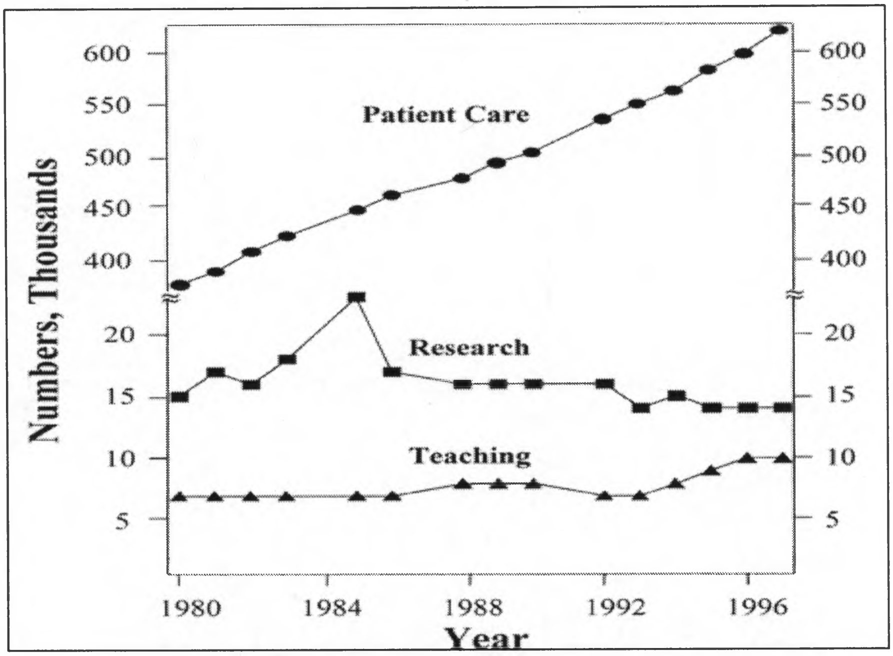
Scholarly concentration programs seek to shape the medical educational experience, provide rigor, and increase learner satisfaction around the skills of inquiry. In addition, they focus on providing career development opportunities and institutionalized mentorship. SC programs build on the knowledge and skills that students have already acquired in the traditional curriculum teach them how to apply them to their own multidisciplinary interests via a rigorous process of analytic, synthetic, and creative thought (Green et al., 2010).

History

Scholarly concentration programs are not new *per se*, but have seen limited adoption in the U.S. Optional dual degree programs such as MD-PhD and MD-MPH programs represent the most rigorous end of the spectrum of student scholarship. These programs often require written works that closely resemble the thesis or dissertation-style of products endemic to other graduate programs. Consequently, these programs frequently require an additional year or more of study. Less time intensive options exist. For example, many European medical schools require original research during the normal course of study in order to graduate (Salmi, Gana, & Mouillet, 2008). Similarly, Yale University has required what is termed a "medical thesis" of all graduates since 1839 as has Duke University beginning in 1966. Only nine schools out of 141 medical schools in the U.S. required a medical thesis according to Parsonnet's 2010 study (Parsonnet, 2010). He found, however, that 84 total schools reported "required research" to the American Academy of Medical Colleges oversight board. Yet, further investigation uncovered just 17 schools had dedicated research programs on their websites while 44 schools listed elective research as a possibility with the other 20 making no mention.

Required student inquiry has not been prioritized in contemporary medical education, a trend reflected by the decreasing number of physicians pursuing research-based careers. The decline in "physician-scientists," dedicated lab researchers, is partly attributed to the failure of our educational system to inspire or support the next generation of innovators. In 1990, Charlotte Jacobs pointed out that the MD-PhD investigator is considered an "endangered species" (Jacobs & Cross, 1995) and the numbers support this claim. Figure 1 from Zemlo's investigation into the decline shows steady increases in patient care practitioners as researchers declined.

Figure 1 – MD Career Trends 1980-1996



The trend is further complicated by an overall reduction in research funding available to support physicians-scientists compounded by an apparent drift in interest away from traditional bench science (Mirmira, 2014). Other commentators have explained that this decline in inquiry-based research correlates to increasing pressure on physicians to support themselves with revenue-producing clinical activities (Zemlo, Garrison, Partride, & Ley, 2000).

The pedagogical and practical value of research, inquiry, and structured scholarship is undisputed, despite these trends. Current medical education leaders have revived their support of these activities, broadly termed "scholarly," as a major part of the shift required to improve our educational system and by extension health in the

United States. Programs like the Pathways to Discovery program studied here, represent the small but growing continuum of SC programs available at medical schools today. Unlike the more time intensive dual degree tracks, SC programs are offered at the undergraduate level during the first four years of medical school. Scholarly concentration efforts support physicians in their lifelong engagement of inquiry as a habit of mind as proposed by Flexner in 1910.

Formats/Structures

Given the uniformity of medical education in the U.S. it is surprising to note the wide variability between schools offering these programs. A review of the limited literature on SC programs in the U.S. reveals a myriad of processes, definitions and formats. All reports identified in an extensive search provided anecdotal evidence, thus making generalizable statements about all SC programs problematic. This may be due in part to the newness of SC programs as compared to the more established medical thesis offerings. Nonetheless, a few characteristics of program formats and structures are shared across the majority of these offerings.

First, SC program programs tend to be elective, as is the case at UCSF. Another defining characteristic of SC programs is that they generally include domains of science beyond that of conventional biomedical or clinical translational approaches. Medical thesis programs tend to favor research in it strictest, most empirical sense including an hypothesis-driven approach and resultant manuscript ready for publication. In contrast, scholarly concentrations encourage more broadly defined academic pursuits. Appendix 3 provides an overview of the variation in these SC programs nationwide including their concentration areas. Some focus around "foundational" skills such as clinical research, bioengineering, community health, and education. Other programs are focused upon the area in which inquiry skills will be applied: cancer biology, international health, advocacy and activism, aging (Green et al., 2010). In his comparison of the programs of study at Stanford and Duke Universities, Laskowitz offers a useful grouping of these wide-ranging programs: 1) basic research, 2) clinical/community health, 3) epidemiology and health policy, 4) ethics and medical humanities). While variation in tracks are common, the overall distribution of student projects is strongly weighted to basic and clinical research is mirrored in most other SC programs (Laskowitz, Drucker, Parsonnet, Cross, & Gesundheit, 2010). At UCSF, there are five Pathways that fall into similar categories, shown in Table 1.

Table 1 – UCSF Pathways to Discovery Overview

PATHWAY NAME	DESCRIPTION
CTR: Clinical and Translational Research	provides training, mentorship, and professional development to learners who want to improve health through clinical research.
GH: Global Health	offers courses and educational opportunities to build a background understanding of the vocabulary, problems, and concepts in global health, and to develop tools for success in global health careers.

H&S: Health & Society	prepares UCSF learners to be scholars and leaders in health policy, health systems, health disparities, community engagement, advocacy, social science, and/or behavioral science.
HPE: Health Professions Education	trains leaders who can shape future health professional education as faculty, education leaders, and scholars.
MM: Molecular Medicine	provides training and a career-support framework to help students and residents envision a "career path forward" that combines clinical practice and disease-oriented laboratory research.

Three additional ingredients appear routinely in the literature around SC programs: coursework/skills acquisition, an academic product requirement, and capstone presentation. First, didactic courses teach the relevant technical skills to pursue projects within a given field. Wide variation appears in the literature around when these courses are offered. UCSF, for example, provides all SC coursework in the fourth year of medical school, while Duke University focuses these courses during the third year. Additional yearlong courses of study are also widely available as an extension to the medical school curriculum. While not required, most SC programs also support the generation of an academic product, such as a written manuscript. At the University of New Mexico, over 41% of written scholarly products received were published (Rhyne, 2000). Bierer et. al. assert that the written product is the defining characteristic of all scholarly concentration programs (Bierer & Chen, 2010). Finally, a capstone event, such as a research symposium, is offered at many of the institutions surveyed. At UCSF, a Student Research Symposium is also required for program completion. Students submit academic posters and present their scholarship findings to peers and faculty. Like other SC programs, UCSF's capstone event is modeled after scholarly dissemination in the field of medicine.

Mentorship in Medicine

Unlike didactics, the SC program format is primarily contingent upon on the interaction between mentor and learner working together to complete scholarly research. As such, SC programs require much higher levels of faculty time than traditional educational formats. Mentorship has an important historical precedent in medical education, however, it has not been financially supported in the same way as course or clerkship teaching. As Boniger notes, changing the level of faculty inputs at an academic medicine institution in support of SC projects requires a significant change in mindset (Boninger et al., 2010).

A frequently cited definition of mentorship in the scientific literature is: "A process whereby an experienced, highly regarded, empathetic person (the mentor) guides another (usually younger) individual (the mentee) in the development and re-examination of their own ideas, learning, and personal and professional development. The mentor, who often (but not necessarily) works in the same organization or field as the mentee, achieves this by listening or talking in confidence to the mentee." (Udare) Frei et. al. completed a comprehensive and global literature review on mentoring programs in medicine between 2000 and 2008. (Frei, Stamm, & Buddeberg-Fischer, 2010). Twenty-five articles met the authors' inclusion criteria and included the following main goals:

1. Career counseling
2. Professional development and personal growth
3. Increasing interest in research and academic careers
4. Fostering student interest in a specialty for which a shortage is projected

The surveyed literature revealed an appreciation for mentorship and a general sense that the relationship was reciprocal. Notably, however, mentorship programs in medicine have been very minimally implemented (Buddeberg-Fischer & Herta, 2006). This is despite the significant benefits for mentees described which include: productivity, self-confidence, number of publications, career guidance, and overall success (Sambunjak, Straus, & Marusić, 2006). A paucity of studies have reported the benefits of mentorship for mentors themselves, however. Coates looked beyond the medicine literature to create a broader portrait of the practice (Coates, 2012), listed in Table 2 below. Most research has explored the psychological and emotional rewards of the practice, however, Coates surveys literature outside of medicine to support the notion that mentorship can contribute to institutional goals as well.

Table 2 – Benefits of Mentorship Across Fields (Coates, 2012)

For the Mentor	For the Institution and Specialty
Belong to a network	Development of networks
Develop base of support via loyalty of protégés	Enhanced productivity
Higher salary and rate of promotion	External recognition
Immortality/legacy	Improved morale
Improved technical expertise	Improved skill of junior members
Less likely to burn out or plateau	Improved technological capability
Personal satisfaction	Institutional efficiency
Pride in developing the next generation	National collaborations
Recognition by superiors	Recruitment advantage
Renewed sense of purpose	Retention of senior members
Stronger perception of career success	
In addition to the benefits of mentorship to protégés, a formal mentorship program has distinct advantages for the mentors and their institutions and specialties.	

The Pathways to Discovery program studied here employs mentors from across the campus in support of student scholarship. These roles are unfunded and are not formally recorded for the purpose of advancement and promotion. As the critical component of programmatic and student success, the following research focuses on the benefits of SC project work for mentors in medical education.

RESEARCH METHODS, DATA & DESIGN

Study Design

This research utilized a quantitative design based upon data submitted in response to an original survey tool released in May 2014. Surveys are a powerful means of evaluating relationships between attitudes, reported behaviors, and intrinsic beliefs that may not be entirely knowable through direct measurement. Because the mentoring relationship includes *ad hoc* and informal communication, these encounters are seldomly assessed systematically (Sambunjak et al., 2006). The Pathways to Discovery program at UCSF has deployed annual evaluations of learners and mentor performance since its inception in 2009, primarily for the purposes of remediation. However, none of these data sources assessed impacts for the institution or mentors who supported projects. Instead, as the literature supports, the quality of learner outcomes and factors contributing to student success such as mentor availability, for example, have been the primary foci of previous efforts. Due to insufficient secondary data sources, it was determined that an original primary collection method was required to conduct this analysis.

Survey Design

The survey tool was designed after a thorough needs assessment and logic model was crafted in collaboration with program leadership at UCSF (Appendix 1). Through this process, a full portrait of program outcomes and impacts was developed and weighted. The logic model of the PTD program and proposed survey methods were presented to the Board of Directors in February 2014. Subsequent to Board approval at this meeting, the PTD program's five Directors were contacted independently to generate relevant questions pertaining to their domains of study. An extensive series of questions were developed by the researcher, over 50 in total, and culled for similarities and cross-cutting themes. Working with the Chair of the PTD Board of Directors, the question set was then modified and condensed so that every item was applicable across all five academic disciplines. The PTD Board of Directors was then presented the distilled tool, and a series of pilot surveys were released until a consensus on the final product was attained. In addition, program evaluation leaders at UCSF were consulted and aided in shaping and refining the question text and instructions. The final version, available in Appendix 2, was emailed as an online preview evaluation to this same group of stakeholders in March 2014. During this time the draft evaluation questions were reviewed by the UCSF Committee on Human Research and the SFSU Institutional Review Board. Given the limited risk of the data collected and the assured anonymity of the survey results, the study was granted "exempt" status by both University committees.

Sample

The PTD program has been offered in its current form at UCSF since 2009. Incomplete administrative records and hazy student classifications prevented a full retrospective analysis of all participants. Ideally, both learners who completed the program by meeting all requirements and those who were accepted yet dropped or were released due to low performance would have been included in this sample. Previous program administrative staff saved only the information of students and mentors who presented their posters at the capstone event. A master file of learners who completed the program was compiled over five years using archived documents from this event beginning in 2009 through the end of the Spring 2014 quarter. This final sample included the following fields: learner name, Pathway completed, year completed, project title, mentor name, and mentor email. The majority of mentor email addresses in this file were still active at the time of research and each inactive or missing email account was researched and verified prior to survey launch. In total, 381 unique learner/mentor pairs with associated SC product titles were used for the distribution of this research tool.

Distribution

After consensus on the final questions set was reached by the PTD Board of Directors and approval for research on human subjects was received, the survey was designed for email distribution in Qualtrics. This University-owned, cloud-based software is an industry standard tool for quantitative survey research. Qualtrics not only meets UCSF's strict data safety protocols for human research, it also enables output directly to SPSS and other statistical packages. Furthermore, Qualtrics includes a "panels" feature which enables distribution of individualized survey links. Respondents were tracked using their unique IP addresses, meaning that the system is not entirely anonymous. This feature was critical because each mentor in the sample was prompted with four custom pieces of data prior to beginning the survey: learner, project title, pathways, and year completed. The survey was programmed to allow a respondent to restart a questionnaire where they left off but also to lock out duplicate responses. Analysis of the total responses indicates that some UCSF faculty mentors responded multiple times, however, to different prompting data. Total unique responses, number of clicks to begin the survey, duration of time spent answering questions, and the total number of completed surveys is captured in Table 3.

Table 3 – Survey Reporting

ACTION	TOTAL	PERCENT
Sent	384	100%
Opened	221	58%
Started	108	28%
Completed	97	25%

The panels feature was also used to deliver customized reminders excluding mentors who had already completed the survey, thus minimizing duplicative email reminders and protecting data integrity. The first request for completion was emailed on May 2, 2014, followed by two subsequent reminders, and the final request was delivered October 21, 2014.

Variables

The original impact evaluation included 23 questions aimed at assessing outcomes and impacts of individual learner's scholarly concentration projects on multiple levels. This approach sought to maximize this research opportunity and paint the widest portrait of program impacts. For all variables, the unit of analysis was the individual mentor surveyed. The various levels of impact collected in the survey are detailed in Table 4 below.

Table 4 – Impact Metrics Surveyed

Project Metrics	Location of work Duration Project type (by Pathway)
Mentor Input	Frequency of contact
Productivity outcomes	Publications (peer-reviewed) Publications (non-peer-reviewed) Presentations Grant proposals Funded grants
Project outcomes	Adoption in academic area Mentor work furtherance Contribution to student scholarship Scholarly direction Sustainable change
Project impacts	Academic area impact Impact distance (individual person to global) Impact on mentor Impact at UCSF Impact outside UCSF

The following examination addresses only a subset of questions posed in the survey tool. The scope of analysis was narrowed to questions directly related to impacts pertinent to mentors, their teams, and their research. By narrowing focus, these data address an implicit and yet unanswered question posed by PTD project mentors:

"what's in it for me." One underlying assumption is that faculty members are an extension of institutional goals. Impacts for mentors are extendable to the larger UCSF enterprise. The following inferential analysis suggests optimal parameters for mentor/mentee contact to maximize benefit for them as well as for the institution. Dependent variables delineate direct impacts for mentors, while the independent variables are hypothesized to predict them.

Table 5 – Dependent and Independent Variables

	Variable Name	Description	Operationalization	Type
	Dependent Variables			
Productivity	**# peer-reviewed publication**	Manuscripts accepted to print in peer-review journals resulting from the learners SC project	Text entry	Continuous
Productivity	**# NON peer-reviewed publication**	Manuscripts accepted to print in NON peer-review journals resulting from the learners SC project	Text entry	Continuous
Productivity	**# presentations**	Poster or oral presentations given at academic conferences resulting from learners SC project	Text entry	Continuous
Productivity	**Contribution to grant proposal**	Likert scale regarding student SC project contribution towards a grant proposal	Agreement scale	Dichotomous
Furtherance	**Career furtherance**	Likert scales assessing student SC project's contribution to the career goals of the mentor	Agreement scale	Dichotomous
Furtherance	**Movement forward**	Likert scale assessing whether the work would have been completed without the learner	Agreement scale	Dichotomous
Direction	**Scholarly direction - mentor**	Likert scale assessing student SC project's contribution to a new scholarly direction for a mentor, their team, or their lab	Agreement scale	Dichotomous
Direction	**Scholarly direction - lab**	Likert scale assessing student SC project's contribution to a new scholarly direction for a mentor's team/lab	Agreement scale	Dichotomous
	Independent Variables			
Predictiv	**Pathway**	Type of project student undertook	Select list	Dichotomous
Predictiv	**Project duration**	Total length of time the learner and mentor spent	Text entry	Continuous

		working together on the project		
	Frequency of contact	Number of times a mentor/learner pair made contact per month	Text entry	Continuous

Research Questions and Hypotheses

The following six research questions were distilled from the full data set for purposes of this analysis. Because mentorship is such a critical component of the SC program, relevant outcomes were selected. The following hypotheses were generated based upon previous literature regarding the benefits of mentorship and the extension of those benefits in the context of medical education.

1. Do scholarly concentration projects by medical students support mentor productivity?
    a. **Hypothesis**: A majority of mentors report dissemination of articles, presentations by their learners, and contributions to grant applications
    b. **Data availability:** Original survey data
2. Does student scholarship further mentor careers?
    a. **Hypothesis**: The majority of mentors report a personal career benefit due to scholarly concentration work
    b. **Data availability:** Original survey data
3. What impact does student project work have on a mentor's scholarly direction?
    a. **Hypothesis**: The majority of mentors agree that student project work advanced a new scholarly direction for themselves directly or their lab
    b. **Data availability:** Original survey data

4. Which scholarly areas (Pathways) are correlated with the most significant benefits?
    a. **Hypothesis**: All Pathway types show similar benefits for mentors.
    b. **Data availability:** Original survey data
5. How frequently should mentors and learners be in contact to gain benefits?
    a. **Hypothesis**: A positive correlation exists between contact and mentorship benefits.
    b. **Data availability:** Original survey data
6. What is the ideal project duration to maximize benefits to mentors?
    a. **Hypothesis**: Longer duration projects are correlated with the greatest benefits to mentors
    b. **Data availability:** Original survey data

RESULTS

The survey was distributed 381 unique times. Each instance included different learner and project data as a prompt for the mentor's completion. 221 of these requests were opened, 108 surveys were started, and 104 complete responses were received and used for the analysis below. The total response rate for this research was 27% and is consistent with other academic medical research efforts at UCSF. The sample was not proportional to the total number of projects in each Pathway over the given period. Instead, this research included all eligible projects from all Pathways during the 2009-2014 timeframe. Student participation numbers vary greatly between these scholarly concentration tracks. Molecular Medicine learners are consistently fewer in number than those in the other four Pathways, for example, and that is reflected in the total number of responses by Pathway shown in Table 6. The Clinical Translational Research Pathway, on the other hand, has been the most popular track since its inception and comprised 31% of the total mentor/learner pairs sampled here. Interestingly, however, both of these groups, Molecular Medicine and Clinical and Translational research showed the lowest response rates with just 16% of surveyed mentors responding.

Table 6 – Summary of Response Rates

	Sent	Completed	% of Total	% Response
CTR	117	19	31%	16%
HPE	77	37	20%	48%
H&S	82	23	22%	28%
GH	80	20	21%	25%
MM	25	4	7%	16%

The greatest proportion of responses was elicited from mentors in the Health Professions Education pathway, 48 percent total. This imbalance may be attributable to those mentors recognition of the survey's focus on education and it's relevance to their field of practice and own research interests.

Project duration was collected as a continuous variable in three categories: number of total months, number of weeks, and number of days. These responses were recoded into monthly equivalence during analysis. Responses that included text entries such as "one month" were converted into numeric data. Of the total 104 completed surveys, 87 included valid information for project duration analysis. Overall, just one response showed a project duration of 30 days or less and the maximum project duration reported was 48 months. A frequency analysis for all project durations can be found in Appendix 4. The mean for PTD projects was 9.32 months in total duration with a standard deviation of 7.262. This finding is consistent with the current program policy whereby the majority of learners complete their scholarship during the fourth year of study. Because of the significant skewness in the data, these data were converted into five categories: 0-3 months, 4-6 months, 7-9 months, 10-12 months, 13 months or more. Eighty-three percent of all projects were under 12 months. The highest representation of projects was between 10 and 12 months, a total of 31 percent. Almost the same number of projects lasted less than three months (24.1 percent) or between 4 and 9 months – a total of 28.7 percent. This split is notable as it suggests that despite program policy and dedicated project time in the curriculum, a majority of learners during this sample period used less than one year to work with their mentor.

Table 7 – Project Duration

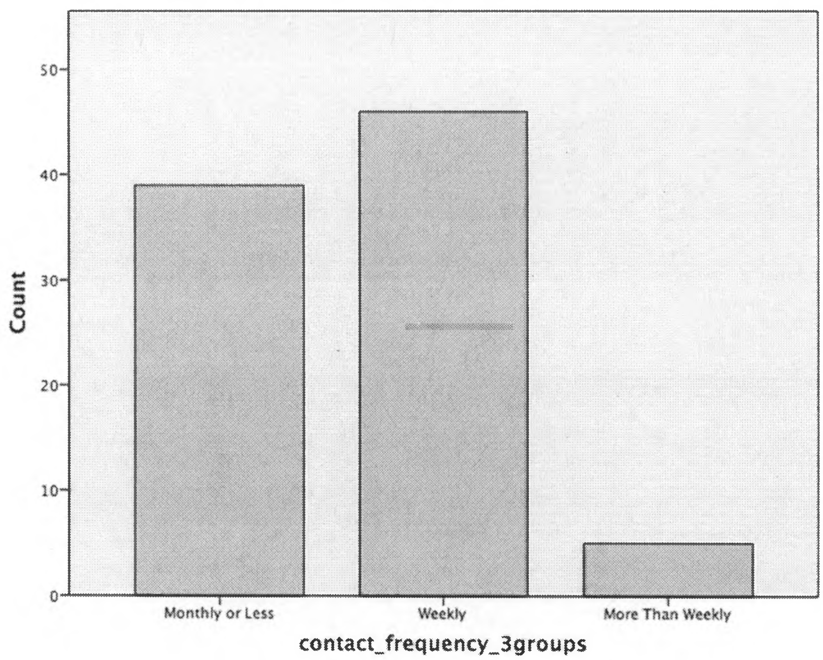
Project Duration Categories

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 through 3	21	20.2	24.1	24.1
	4 through 6	16	15.4	18.4	42.5
	7 through 9	9	8.7	10.3	52.9
	10 through 12	27	26.0	31.0	83.9
	13+	14	13.5	16.1	100.0
	Total	87	83.7	100.0	
Missing	System	17	16.3		
Total		104	100.0		

A similar methodology was employed to portray the frequency of contact between learners and mentors. Frequency, or the amount of contact between mentor and learner, was assessed as a categorical variable as follows: annually, quarterly, monthly, daily, and "too varied to say." Mentors provided a numeric value for each relevant category of contact frequency. For example, if the mentor selected that they maintained contact with their mentee on a weekly basis, the subsequent branch of the survey requested the estimated number of weekly contact points during the mentorship period. No categories were required fields. These data are reported as frequencies in Appendix 5. In addition, these results were collapsed into three categories: monthly or less, weekly, and more than weekly.

Most mentors, 51.1 percent, reported contact with their learner on a weekly basis. Only 5.6 percent or five total mentors indicated meetings, phone calls, emails, or other forms of contact more often than weekly. On the other hand, 43.3 percent of all mentor/mentee pairs maintained contact on a monthly or less basis as summarized below in Figure 2.

Figure 2 – Total Contact Frequency Reported



Research Question #1

Productivity in academic medicine, similar to other milieus, is associated with scholarly dissemination and the acquisition of research funding. Academic medical faculty are differentiated from clinical faculty at UCSF by their collection, analysis, publication, and sharing of data. Traditional dissemination is primarily focused on the frequency and impact of publications in peer-reviewed journals. Recently, however, non-peer-reviewed, otherwise termed "grey" literature or open-source publications have taken a larger role in academic dissemination (Laakso et al., 2011). Additionally, presentations at conferences, symposia, and within educational settings are markers of productivity that are often measured during career advancement reviews. For the purposes of this analysis, student dissemination is correlated with mentor productivity. If a learner publishes a manuscript, the lead mentor is routinely cited, thus adding to the mentor's productivity.

Overall, the scholarly projects overseen by mentors in the PTD program showed strong numbers in each of the three categories of dissemination. The mean number of peer-reviewed publications across all responses was .71, with 37.8 percent of learner projects resulting in one or more publications in a peer-reviewed journal. Surprisingly, fourteen mentors, or 14.2 percent, indicated that two or more publications resulted from their learners' project. This, however, was not the majority, as 62.2 percent of learners did not publish whatsoever, as detailed in Table 8 below. Because this question was largely skewed towards zero publications, it was also converted into a dichotomous variable of "yes = published" or "no = did not publish" for future analyses.

Table 8 – Peer Reviewed Publications

Peer Reviewed Publications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	61	58.7	62.2	62.2
	1+	37	35.6	37.8	100.0
	Total	98	94.2	100.0	
Missing	System	6	5.8		
Total		104	100.0		

A minority of learners shared their results in a non peer-reviewed publication, 13.5 percent total, or 14 of the 98 analyzed. On the contrary, 91.9 percent of learners completed an oral or poster presentation at an academic conference based on their scholarly project, shown in Table 9.

Table 9 – Non Peer-Reviewed Publications

Oral/Poster Presentations

		Frequency	*Percent*	*Valid Percent*	*Cumulative Percent*
Valid	0	8	*7.7*	*8.1*	*8.1*
	1	32	*30.8*	*32.3*	*40.4*
	2	28	*26.9*	*28.3*	*68.7*
	3	21	*20.2*	*21.2*	*89.9*
	4	8	*7.7*	*8.1*	*98.0*
	8	1	*1.0*	*1.0*	*99.0*
	10	1	*1.0*	*1.0*	*100.0*
	Total	99	*95.2*	*100.0*	
Missing	System	5	*4.8*		
Total		104	*100.0*		

Representation at regional or national meetings is an important marker of academic activity, however, this data may be a less powerful marker of productivity than originally imagined when the survey was released. The question is phrased: "How many presentations, (e.g. poster/oral presentations) were given at an academic conference by this learner related to his/her project?" As noted above, presentation at the capstone event for PTD is required for student completion, therefore these figures may be skewed or biased. The phrasing of the question differentiates between participation in this student-centric event from other academic opportunities, however, respondents may have missed that instruction. Nonetheless, the average number of presentations reported by mentors overall was 2.03, indicating that a majority of learners presented perhaps at least once more outside of the student capstone. These data support the hypothesis that SC mentorship resulted in an increase in productivity for the faculty. A similar finding was shared by Svider and colleagues where corresponding authors, such as faculty, who collaborated with students had measurably higher scholarly impact (Svider et al., 2014).

In addition to dissemination of findings, UCSF faculty are tasked with funding their research endeavors with grant support provided by a variety of governmental, non-profit, and industry sources. In 2013, the UCSF School of Medicine was the second highest recipient of funds from the National Institute of Health after Johns Hopkins

Medical School, receiving $439.6 million in funding. Time spent pursing grant dollars for academic researchers is significant and funding is a marker of productivity (Pololi, Knight, & Dunn, 2004). This research assessed whether student projects contributed to grant applications submitted by UCSF faculty. Nearly thirty-five percent of projects completed by learners in the PTD program contributed to grant applications as demonstrated in Table 10.

Table 10 – Contribution to Grant Applications

Contributed to Grant

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	29	27.9	29.6	29.6
	Disagree	25	24.0	25.5	55.1
	Neither Agree nor Disagree	10	9.6	10.2	65.3
	Agree	23	22.1	23.5	88.8
	Strongly Agree	11	10.6	11.2	100.0
	Total	98	94.2	100.0	
Missing	System	6	5.8		
Total		104	100.0		

The majority of projects did not support faculty in their grant writing. A total of 55.1 percent of mentors disagreed or disagreed strongly that their learner's project added to their grant applications. This finding corresponds to what we know about scholarly projects completed overall at UCSF. For example, work in health policy, advocacy, or education may be less likely to correlate to grant-supported research by faculty. Scholarly projects were shown to contribute to grants in this analysis, yet, the trend did not constitute a majority. These data support the hypothesis that student projects do in fact aid mentor productivity to a limited degree.

Research Question #2

Publications, presentations, and grants are discrete learner output measures. This survey tool also assessed mentor perceptions of learner impact using two questions. First, overall impact on mentor career goals using an agreement scale paired with the prompt: "This learner helped to further my own personal career goals" was analyzed. Over 59 percent of mentors agreed that the learner helped further their own career, more than 14 percent of those affirming that learners supported their careers reported "strong" agreement with that statement as shown in Table 11.

Table 11 – Learner Furtherance of Mentor Career Goals

Career Furtherance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	1.9	2.0	2.0
	Disagree	3	2.9	3.0	5.1
	Neither Agree nor Disagree	35	33.7	35.4	40.4
	Agree	44	42.3	44.4	84.8

	Strongly Agree	15	14.4	15.2	100.0
	Total	99	95.2	100.0	
Missing	System	5	4.8		
Total		104	100.0		

Only 5 percent of faculty, five total respondents, indicated that the learner did not support their career furtherance. Notably, 35.4 percent neither agreed nor disagreed with this statement regarding career furtherance. This high neutral response rate may indicate a sensitivity issue with the question or inherent concept. The question was not phrased as specifically related to the learner project and may have therefore been somewhat ambiguous. On the other hand, the survey instructions requested feedback on the learners project as shown in Figure 3. While the report of career furtherance was very strong on this item, additional research could benefit from an expanded definition of career furtherance.

Figure 3 – Survey Instruction

INSTRUCTIONS:

This survey assesses the impact of the individual learner's project listed below. Please respond to the following questions regarding the Pathways to Discovery work of this learner only.

LEARNER NAME:
PROJECT TITLE:
PATHWAY:
YEAR COMPLETED:

Learner contribution to mentor career furtherance was also measured by how critical the student was to completing the project. Did learners add to the mentors' resource pool? Would the work have been completed without the learner? Item 14 asked "Without the learner, this project, intervention, policy, or research would not have moved forward" using a five-point Likert agreement scale. As shown below in Table 12, 78.8 percent of mentors considered learner effort essential to the forward momentum of the project. Only 9 percent reported that a project may have continued without the learner. Overall these two items solidly support the hypothesis that PTD scholarship furthers mentor careers. Not only did SC project work contribute towards the furtherance of mentor careers at UCSF, the majority of the work learners completed to provide that career benefit for mentors would not have been completed without them.

Table 12 – Learner Contribution to Project Advancement

Learner Moved Project Forward

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	4	3.8	4.0	4.0
	Disagree	5	4.8	5.1	9.1
	Neither Agree nor Disagree	12	11.5	12.1	21.2
	Agree	37	35.6	37.4	58.6
	Strongly Agree	41	39.4	41.4	100.0
	Total	99	95.2	100.0	
Missing	System	5	4.8		
Total		104	100.0		

Research Question #3

In addition to the way learners aided mentors in productivity and overall career furtherance, this research also identified "scholarly direction" advancement as a possible impact area. The question "This project resulted in a new scholarly direction in the following area(s)" was used to ascertain how the SC project could be differentiated from existing scholarly activity. Did PTD learners complete projects that were novel, advance study in a previously unaddressed area, or otherwise move science forward for mentors? The full survey assessed agreement on this item for multiple levels, including new directions in:

1. My own work (mentor's scholarly direction)
2. Work of my team
3. Work in my lab
4. Work in the clinic
5. Work in the community
6. Work in other labs

This analysis looks at the impact on scholarly direction for the mentor's direction and direction of work in the mentor's lab. The "team" variable was not used because it was not differentiated enough from the lab's effort. The other three variables were not directly relevant to the mentor, the focus of this manuscript.

Thirty-seven percent of mentors reported that the project resulted in a new direction for them, while over 63 percent reported neutral or disagreement to this item (Table 13). Learner projects were even less effective in advancing a new scholarly direction for a mentor's lab with over 82.9 percent of mentors stating neutral or disagreement with this item (Table 14). These results suggest that SC projects impact a mentor's personal scholarly direction to a limited degree but that projects did not break new ground.

Table 13 – Learner Project Affect on Mentor's Scholarly Direction

Mentor Direction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	20	19.2	21.3	21.3
	Disagree	21	20.2	22.3	43.6
	Neither Agree nor Disagree	18	17.3	19.1	62.8
	Agree	25	24.0	26.6	89.4
	Strongly Agree	10	9.6	10.6	100.0
	Total	94	90.4	100.0	
Missing	System	10	9.6		
Total		104	100.0		

Table 14 – Learner Project Affect on Lab Scholarly Direction

Lab Direction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	28	26.9	34.1	34.1
	Disagree	21	20.2	25.6	59.8
	Neither Agree nor Disagree	19	18.3	23.2	82.9
	Agree	10	9.6	12.2	95.1
	Strongly Agree	4	3.8	4.9	100.0

	Total	82	78.8	100.0	
Missing	System	22	21.2		
Total		104	100.0		

Table 15 –Peer-Reviewed Publication by Pathway (Number and % of Pathway)

			Peer Reviewed Publications		Total
			None	1+	
PATHWAY	Health & Society	Count	18	2	20
		% within PATHWAY	90.0%	10.0%	100.0%
		% of Total	18.6%	2.1%	20.6%
	Global Health	Count	10	8	18
		% within PATHWAY	55.6%	44.4%	100.0%
		% of Total	10.3%	8.2%	18.6%
	Health Professions Education	Count	25	11	36
		% within PATHWAY	69.4%	30.6%	
		% of Total	25.8%	11.3%	37.1%
	Molecular Medicine	Count	0	4	4
		% within PATHWAY	0.0%	100.0%	100.0%
		% of Total	0.0%	4.1%	4.1%
	Clinical Translation	Count	7	12	19
		% within PATHWAY	36.8%	63.2%	100.0%
		% of Total	7.2%	12.4%	19.6%
Total		Count	60	37	97
		% within PATHWAY	61.9%	38.1%	100.0%
		% of Total	61.9%	38.1%	100.0%

Research Question #4

In addition to capturing the impacts of SC project work across all of the PTD program tracks, this analysis identified variations in impacts between the five tracks. Do certain Pathways predict different outcomes? Because the publication variable collected was converted into a nominal category of "no publications" and "+ 1 publication", the Chi-squared analysis for independence was used. The result was $\chi^2(4) = 19.42$, $p = .001$ indicating that there are significant differences between pathways in rate of publication as seen in Appendix 6. According to the analysis, 20% of the cells have an expected count of less than 5, decreasing the reliability of the statistic or result.

All four projects in the Molecular Medicine Pathway were published (100% of total), followed by 63.2 percent in the Clinical Translational Research Pathway (Table 15). The least amount of publications occurred in the Health and Society Pathway (only 2 publications), or only 10% of the responses from this Pathway. Number of publications per pathway and percent within each pathway are presented in Figures 4 and 5.

Figures 4 – Total Number of Publications within each Pathway

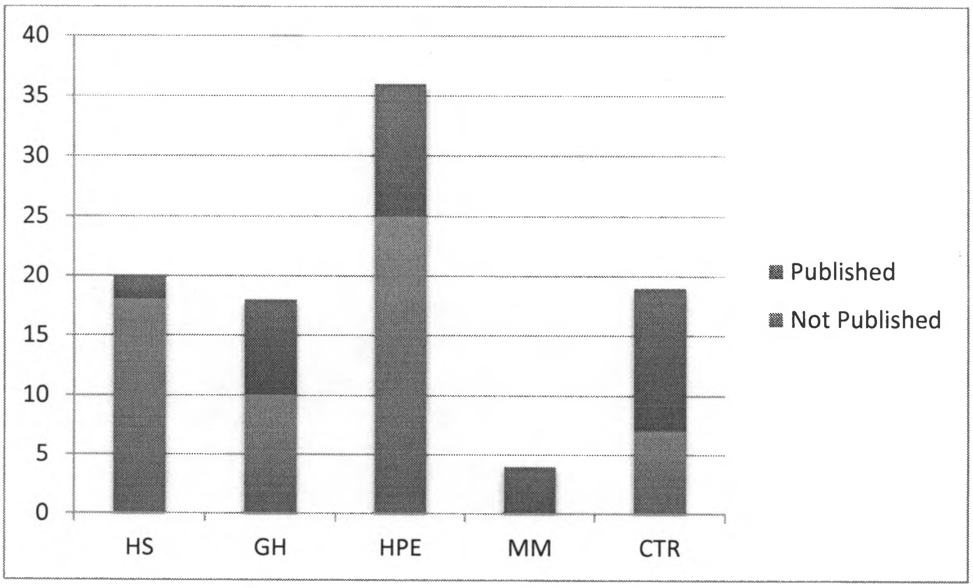
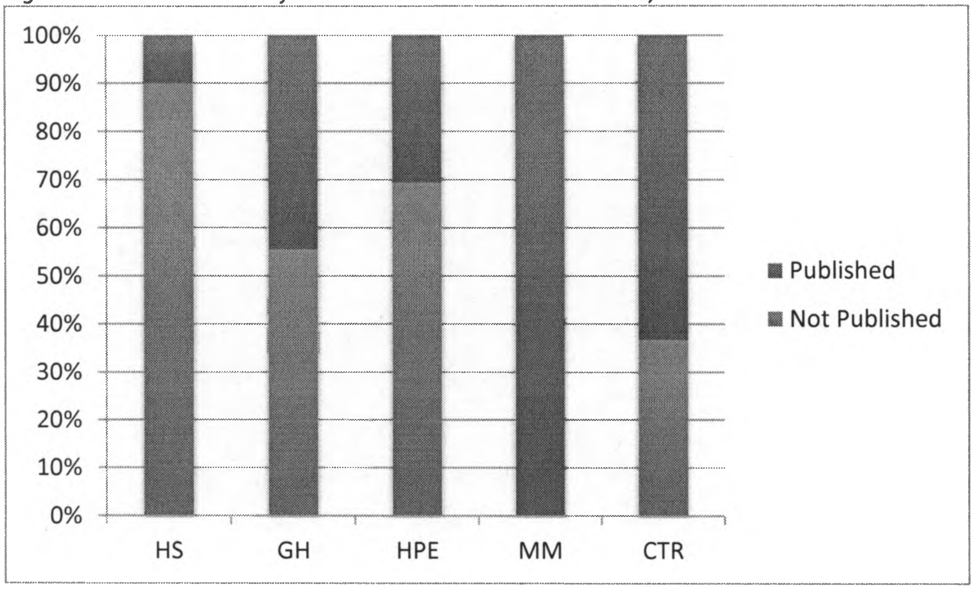


Figure 5 – Total Percent of Publications within each Pathway



Similarly, though less powerful, these data illustrate a difference between Pathways for non peer-reviewed publications, $\chi^2(4) = 10.53$, $p = .04$. See Appendix 6 for the chi-squared analysis results for non peer-reviewed publications. According to the analysis, 60% of the cells have an expected count of less than 5, significantly decreasing the strength of the result. These results indicate that Global Health Pathway has the highest percentage of non peer-reviewed publications for its pathway with 37.5% of responses indicating the affirmative of a non peer-reviewed publication, whereas Health and Society had nearly 15% of the responses indicating a non peer-reviewed publication and the remaining three Pathways less than 10%. In fact, Molecular Medicine Pathway had no non peer-reviewed publications reported, or 0% of the sample.

Table 16 – Significant Difference in Non Peer-Review Publication by Pathway

Non Peer-Review Publications

			Non-Peer Reviewed Publications		
			None	1+	Total
PATHWAY	Health & Society	Count	18	3	21
		% within PATHWAY	85.7%	14.3%	100.0%
		% of Total	19.1%	3.2%	22.3%
	Global Health	Count	10	6	16
		% within PATHWAY	62.5%	37.5%	100.0%
		% of Total	10.6%	6.4%	17.0%
	Health Professions Education	Count	31	3	34
		% within PATHWAY	91.2%	8.8%	100.0%
		% of Total	33.0%	3.2%	36.2%
	Molecular Medicine	Count	4	0	4
		% within PATHWAY	100.0%	0.0%	100.0%
		% of Total	4.3%	0.0%	4.3%
	Clinical Translation	Count	18	1	19
		% within PATHWAY	94.7%	5.3%	100.0%
		% of Total	19.1%	1.1%	20.2%
Total		Count	81	13	94
		% within PATHWAY	86.2%	13.8%	100.0%
		% of Total	86.2%	13.8%	100.0%

The other seven variables including oral presentations, contribution to grant, mentor and lab direction, career furtherance, and whether a student moved a project forward were tested using analysis of variance (ANOVA). This test allows the means of these samples to be compared for differences between the groups. The results showed that meaningful differences between groups exist as summarized in Appendix 7. Projects varied on their contribution to a grant, mentor and lab direction. As might be expected, the least variation was found in career furtherance with a p value of .918 – not surprising since the overwhelming majority of mentors found SC projects helpful to their own advancement. Molecular Medicine only had four responses, making the results for these analyses less powerful than hoped for.

Post-hoc analyses (Appendix 7) of these categories explicated further differences between groups. For mentor direction, the data revealed that Molecular Medicine pathway learners had greater impacts on the direction of their mentors than Health & Society pathway learners ($p = .04$). Clinical Translational Research pathway learners also showed greater impact on mentor direction than Health & Society pathway learners ($p=.015$). Clinical Translational Research pathway learners also marginally contributed to grants more frequently than HPE learners with a $p=.10$. Finally, a number of differences between groups were detected for the perceived contribution towards lab direction. Although this research does not indicate that a majority of mentors believed SC research created a new direction for their labs, the biomedically-focused Pathways (CTR and MM) were more likely than the other three pathways to advance a new area (all p's less than .05).

Research Question #5

Learner projects can benefit mentors, as these data support. Was there an ideal frequency of contact between mentor/learner pairs in the PTD project team between

2009-2014? Which frequency of contact resulted in significant differences? In order to assess this relationship, a Chi-square test was again performed for the peer and non peer-review publication categories. Results indicated a p=.001 for both peer and non-peer reviewed publications, $\chi^2(2) = 14.39$. Frequency of contact does predict publication in a peer-review journal. As shown in the crosstab in Table 17, only 18.9 percent of learners who met with their mentors monthly or less published, compared to 42.2 percent who met weekly. All 100% of learners who met more than weekly published, though only 5 mentors reported meeting more than weekly.

Table 17 – Contact Frequency Predicts Differences in Peer Reviewed Publications

Crosstab

			Peer Reviewed Publications		
			None	1+	Total
Contact Frequency	Monthly or Less	Count	30	7	37
		% within	81.1%	18.9%	100.0%
		% of Total	34.5%	8.0%	42.5%
	Weekly	Count	26	19	45
		% within	57.8%	42.2%	100.0%
		% of Total	29.9%	21.8%	51.7%
	More Than Weekly	Count	0	5	5
		% within	0.0%	100.0%	100.0%
		% of Total	0.0%	5.7%	5.7%
Total		Count	56	31	87
		% within	64.4%	35.6%	100.0%
		% of Total	64.4%	35.6%	100.0%

A similar finding was uncovered for non peer-reviewed publications as illustrated in Table 18. Results indicated a p=.02 for both peer and non-peer reviewed publications, $\chi^2(2) = 7.87$. At least 20% of mentors who met weekly and more than weekly meetings with their mentees reported publishing non peer-reviewed publications, whereas only 2.8% of those who met monthly or less reported similarly.

Table 18 - Contact Frequency Predicts Differences in Non-Peer Reviewed Publications

Crosstab

			Non-Peer Reviewed Publications		
			None	1+	Total
Contact Frequency	Monthly or Less	Count	35	1	36
		% within contact_frequency_3groups	97.2%	2.8%	100.0%
		% of Total	41.7%	1.2%	42.9%
	Weekly	Count	32	11	43
		% within contact_frequency_3groups	74.4%	25.6%	100.0%
		% of Total	38.1%	13.1%	51.2%
	More Than Weekly	Count	4	1	5
		% within contact_frequency_3groups	80.0%	20.0%	100.0%
		% of Total	4.8%	1.2%	6.0%
Total		Count	71	13	84
		% within contact_frequency_3groups	84.5%	15.5%	100.0%
		% of Total	84.5%	15.5%	100.0%

Again, an ANOVA test was performed to compare frequency of contact with the categorical variables. Significance was found for contributions to grants, mentor direction, lab direction, and career furtherance (Table 19).

Table 19 - Contact Frequency Predicts Differences in Contributions to Grants, Mentor Direction, Lab Direction, and Career Furtherance

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Oral/Poster	Between Groups	9.626	2	4.813	2.157	.122
	Within Groups	189.647	85	2.231		
	Total	199.273	87			
Contributed to Grant	Between Groups	22.430	2	11.215	6.175	.003
	Within Groups	152.559	84	1.816		
	Total	174.989	86			
Mentor Direction	Between Groups	12.752	2	6.376	3.772	.027
	Within Groups	136.915	81	1.690		
	Total	149.667	83			
Lab Direction	Between Groups	16.262	2	8.131	6.252	.003
	Within Groups	89.738	69	1.301		
	Total	106.000	71			
Career Furtherance	Between Groups	7.959	2	3.979	6.717	.002
	Within Groups	50.359	85	.592		
	Total	58.318	87			
Learner moved Project Forward	Between Groups	.619	2	.309	.284	.754
	Within Groups	92.654	85	1.090		
	Total	93.273	87			

Post-Hoc analyses are presented in Appendix 8. These tests reveal that more frequent contact predicts positive mentor outcomes. Consistent contact on a more than weekly basis provides the most benefit to the mentor and the learner compared to monthly or less, in terms of all these domains: contributions to grants ($p = .004$), mentor direction ($p = .027$), lab direction ($p = .002$), and career furtherance ($p = .02$). Furthermore, more than weekly contact provided added benefit to lab direction (p = .045) and contributions to grant (p = .008) compared to even weekly contact. And finally, weekly contact significantly contributed to the mentors' careers more than monthly contacts (p = .01). Of interest, however, no significant difference was found among contact frequency and oral presentations/posters or the amount that a learner moved a project forward. Frequency of contact does not seem to predict these two outcomes, possibly because they were both reported so highly for all project studied. Overall, the null hypothesis can be rejected for this research question since more contact does predict better impacts for mentors.

Research Question #6

For this final question, project duration was investigated as a predictor of mentor impacts. Respondents indicated a wide range of project time spent with a mentor – all of which were converted to total months worked – as previously described. Could this research evoke an ideal range of time spent working together that might be helpful to future mentors or programmatic leadership? In this case, the null hypothesis could not be rejected. Longer project duration in the program did not translate into better outcomes for any of the dissemination characteristics. For publications, both reviewed and non peer-reviewed, a Chi-square test was performed and results indicated $\chi^2(4) = 5.62$, p = =.229 and $\chi^2(4) = 6.10$, p=.192, respectively. Tables 21 and 22 show the %

affirmative responses of peer-reviewed and non peer-reviewed publications by category of length. For peer-reviewed publications, the range of percent of responses in the affirmative that the mentee's projects led to a publication was 22.2% for projects of 7 to 9 months in duration through 55.6% for projects of 10 to 12 months in duration, but these differences are apparently not significantly different from one another. The range of percent of responses in the affirmative that the mentee's projects led to a non-peer reviewed publication was 7.1% for projects that were more than a year in duration through 33.3% for projects of 4 to 6 months in duration, but these differences are, again, apparently not significantly different from one another.

Table 20 – Project Duration Does Not Predict Differences in Peer Reviewed Publications

Crosstab

			Peer Reviewed Publications		
			None	1+	Total
Project Duration	0 through 3	Count	15	6	21
		% within	71.4%	28.6%	100.0%
		% of Total	17.2%	6.9%	24.1%
	4 through 6	Count	11	5	16
		% within	68.8%	31.3%	100.0%
		% of Total	12.6%	5.7%	18.4%
	7 through 9	Count	7	2	9
			77.8%	22.2%	100.0%
		% of Total	8.0%	2.3%	10.3%
	10 through 12	Count	12	15	27
		% within	44.4%	55.6%	100.0%
		% of Total	13.8%	17.2%	31.0%
	13+	Count	8	6	14
		% within	57.1%	42.9%	100.0%

	% of Total	9.2%	6.9%	16.1%
Total	Count	53	34	87
	% within	60.9%	39.1%	100.0%
	% of Total	60.9%	39.1%	100.0%

Table 21 – Project Duration Does Not Predict Differences in Non Peer Reviewed Publications

Crosstab

			Non-Peer Reviewed Publications		
			None	1+	Total
Project Duration	0 through 3	Count	17	3	20
		% within	85.0%	15.0%	100.0%
		% of Total	20.5%	3.6%	24.1%
	4 through 6	Count	10	5	15
		% within	66.7%	33.3%	100.0%
		% of Total	12.0%	6.0%	18.1%
	7 through 9	Count	6	2	8
		% within	75.0%	25.0%	100.0%
		% of Total	7.2%	2.4%	9.6%
	10 through 12	Count	24	2	26
		% within	92.3%	7.7%	100.0%
		% of Total	28.9%	2.4%	31.3%
	13+	Count	13	1	14
		% within	92.9%	7.1%	100.0%
		% of Total	15.7%	1.2%	16.9%
Total		Count	70	13	83
		% within	84.3%	15.7%	100.0%
		% of Total	84.3%	15.7%	100.0%

In addition, an ANOVA, reported below in Table 22, showed that different project durations may effect outcomes for contributions to a grant and mentor direction with p=.080 for the former and p=.027 for the latter.

Table 22 – Project Duration Predicts Differences in Mentor Direction and Contributions to a Grant

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Oral/Poster Presentations	Between Groups	15.814	4	3.954	1.701	.158
	Within Groups	190.623	82	2.325		
	Total	206.437	86			
Contributed to Grant	Between Groups	16.161	4	4.040	2.166	.080
	Within Groups	151.060	81	1.865		
	Total	167.221	85			
Mentor Direction	Between Groups	18.774	4	4.694	2.905	.027
	Within Groups	129.273	80	1.616		
	Total	148.047	84			
Lab Direction	Between Groups	4.017	4	1.004	.668	.616
	Within Groups	106.760	71	1.504		
	Total	110.776	75			
Career Furtherance	Between Groups	2.698	4	.675	1.012	.406
	Within Groups	54.681	82	.667		
	Total	57.379	86			
Learner moved Project Forward	Between Groups	3.906	4	.977	.908	.463
	Within Groups	88.163	82	1.075		
	Total	92.069	86			

Post hoc analysis, presented in Appendix 9, however revealed that there were actually no significant differences in grant contributions between the categories of project duration, though projects lasting 10 or more months may be contribute more than those of 0 to 3 months in length (p's < .20). Similarly, while post-hoc analyses revealed that no significant differences existed for project duration impacting the direction of the mentor's research, projects that last more than a year were seemingly more impactful than those that lasted 6 months or less (p's < .20).

DISCUSSION

Limitations

The data presented here may not reflect the full diversity of learner/mentor pairs who participated in the PTD program. The sample population reached in this study was limited by incomplete administrative records kept over the last five years. First, the sample did not include mentors who participated in student projects that were not completed, therefore this research is skewed toward projects with positive outcomes. Faculty who participated on incomplete projects may very well be dissatisfied with their experience as a mentor and could have even experienced impeded career furtherance, for instance? The sample limitation also excluded mentors who might have left the University. In addition, those who did respond were likely biased in their self-selection into the study. As previously noted, for example, mentors in the Health Professions Education pathway were much more highly represented than other faculty. This sampling bias is significant as it may not capture naïve faculty, those who are not familiar with the types of methods of research completed on educational outcomes. The sample mentors analyzed here may have an investment in the outcomes of the program being reported positively, which limits the power of this works' generalizability. Results on these impact measures could be attributable to these significant sampling errors and are therefore offered with caution. A more rigorous procedure for inclusion with a representative sample of mentors from each pathway should be considered for future research.

The PTD program includes five distinct domains of study: clinical and translational research, molecular medicine, health professions education, health and society, and global health. Data presented does not provide detail into the exact project work completed by learners, which in actuality is quite varied. For example, clinical research may involve long-term, lab-based team work, whereas an education project may have engaged the learner in independent curriculum development. This information may be a critical differentiator for accurately interpreting the impacts assessed here. The amount to which a learner "moved a project forward" is not generalizable with the limited understanding provided by the "Pathway" category. This is further complicated by the wide variation in project durations reported here, the lowest less than one month and the highest 48 months. This lack of sensitivity for project duration and type of work could contribute to the murky findings on research question #2. In order to better understand the effect that total time spent working on a SC project has on mentor impacts, future research should intentionally sample learners who participated in various courses of study and be very specific in collecting details about the type of work that was completed for the mentor.

Similarly, all of these findings are tempered by the inherent ambiguity of the terminology used. “Career furtherance” was not operationalized on the evaluation tool, for example. As such, it enables only a broad understanding of the mentor’s impression. The notion of “scholarly direction” is open enough to provide a sense of the impact, but may not be sufficient for guidance of program goals in the future. Some mentors in the PTD program are almost exclusively “teachers” of medical students, whereas others work primarily within international dental clinics, for example. What does “career furtherance” or “scholarly direction” truly mean across the wide array of academic disciplines? Future research should focus on using multiples measures to capture the impacts in these areas. Career furtherance should be further operationalized to include details about the type of work completed. Qualitative research could provide useful information for the operationalization of these impact concepts.

New Insights

This research is a first foray into quantifying impacts for mentors in medical education at UCSF and beyond. As such, the data offers a great opportunity for shaping future program evaluations which account for not only learner outcomes but also outcomes and impacts for the larger institution. Assessing learner outcomes alone disregards the needs of UCSF faculty in the coproduction of these projects and blinds the institution to the substantial opportunity represented by this workforce. Unlike other types of programs in medical school, SC programs are individualized courses of study established between mentors and learners. This data proves that SC mentors are not entirely at the service of students in the same way as course instructors, for example, deliver content routinely. The SC projects studied here produce tangible outcomes, both publications and presentations, which transcend the academic environment at UCSF. Furthermore, over 59 percent of projects aided a grant submission. If SC projects can contribute to grant applications at this level without intentional framing, it stands to reason that the effect could be improved with coaching of mentors and learners in the future.

In addition to productivity outcomes, this survey uncovers that the overwhelming majority of UCSF faculty working with SC learners were themselves personally aided by the projects students completed. Pathways learners appear to be an invaluable and largely untapped resource in completing faculty scholarship that may not occur otherwise. This shift in thinking is also occurring in other areas of the medical school curriculums. Students are being placed into working clinical environments with the expectation of making meaningful contributions to their operations (Mann, 2011). UCSF is working to change the perception of students as "lurkers" who shadow master clinicians to actual influencers in the healthcare environment. Just medical students school can contribute to production in clinical settings, so too can they contribute in other academic environments such a scholarship, research, advocacy and systems care. Moreover, programs of scholarly concentration have the added benefit of teaching students the critical inquiry skills necessary for a career in the complex and demanding healthcare environment of the 21s century.

Shaping mentor expectations may be the most significant consequence of this research. First, recognizing that there are benefits to mentors can aid in the recruitment of faculty for these roles who may be otherwise neutral. If the completion of projects and career furtherance are offered as benefits of student scholarship, more faculty are certain to participate. Moreover, the explicit valuation of these mentor-specific outcomes by programmatic leadership can enhance this outcome in the future. What mentors can get is just as important as what mentors cannot expect to get from SC learner projects. Not all SC tracks are suited to manuscript generation, as shown by previous PTD learners, for example. These findings can inform future discussions about authorship expectations versus oral presentations. This information will be useful in delineating work plans for student projects. Similarly, the current policies for PTD learners do not result in strong reports by mentors for new scholarly directions. Instead, impacts on scholarly direction appear limited to a small subset of mentors. Knowing this may improve project selection and clarify expectations about magnitude and scope of work for learners and mentors in the future. Mentors can select work for students more strategically with this knowledge and avoid unnecessary disappointment or frustration.

Finally, these findings offer an important and previously unknown recommendation regarding the ideal amount of contact between mentor/learner pairs. Interaction on a weekly basis significantly predicts benefits for mentors. Regardless of project duration, greater frequency of contact correlates to increased positive outcomes. This finding is counterintuitive to current policies at UCSF and other medical schools. For example, MD-PhD programs offer greater total time to achieve more impactful research. At UCSF the MD with Distinction program offers an additional full year of time. However, while policies are in place that mandate total duration, no similar guidelines are employed to guide frequency of contact. These findings may help improve impacts not only for SC project mentors but also those in more rigorous research tracks. Frequency of contact can now be added as another metric of successful SC projects. Setting this level of contact at the outset of a project is valuable for pacing both learners and faculty.

CONCLUSION

Policy Implications

The assumption of mentorship burden is not justified, according to these data. While mentoring learners at UCSF remains an informal and voluntary activity, the notion that this additional teaching time takes away from faculty productivity appears to be false. Instead, the main conclusion of this research is that mentorship in the PTD program is more akin to a mutually beneficial work exchange. Time spent between the learner and mentor is likely spent advancing faculty career goals versus furthering mentee subject knowledge alone. Moving forward, benefits to not only faculty but also the University by extension should be highlighted. This recognition can shift the way that labs and research teams are resourced. For example, the SC program could be reframed as a work exchange opportunity. This would necessitate a shift in thinking away from the "soft" outcomes of mentorship such as engagement and satisfaction, and strengthen the supervisory element. Making this potential more explicit at the outset of the program, or moreover, making work exchange a required component of "menteeship" may help to promote positive impacts for faculty while minimizing the stigma of time burden. In other words, this data could help the organization plan for the institutional input of "faculty mentorship."

Scholarly Concentration programs are an increasingly popular educational strategy. At UCSF alone, the PTD program is shifting from an optional to required component of the curriculum. Beginning in 2016, every medical student will be required to complete a SC project. Beginning in 2017, all Pharmacy students at UCSF will begin enrolling in this program as well. By 2020 the total number of learners working on projects at UCSF will increase from 75 per year to over 900. After the first four years of program implementation, over 1200 SC projects will have been completed at UCSF. UCSF and similar SC programs have the unique opportunity shape student experiences which contribute to positive benefits not just for learners but also for the institution. These data establish the baseline of SC program benefits and lay the groundwork for their thoughtful expansion in the future.

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APPENDICES

APPENDIX 1 – Logic Model

INPUTS	ACTIVITIES	PROXIMAL OUTCOMES
MENTOR: <u>Time:</u> • Teaching • Advising • Tracking/Administration <u>Resources:</u> • Funding • Space • Data • Contacts • **Unanticipated Inputs?** **LEARNER:** • legacy product work • mentor work • mentor/institutional-affiliated org work • Funds (travel or supplies) **INSTITUTIONAL:** • Curricular/classes • Independent study • Salary support • Administrative staff • Project/Student grants • Events/Symposium costs • Leadership time • **Unanticipated Inputs?**	• Mentor matching • Independent Study Periods • Meetings with mentor • Student work duration • Domestic/International research time • Works in Progress sessions • Campus symposia • Peer-to-peer learning time (labs, clinics, community organizations) • **Unanticipated Activities?**	"productivity measures" • Project status • Publications (#) • Presentations • Poster/Abstract • New curriculum • Clinical practice improvements • Local, national, federal, international policies • Scientific discovery • Teaching opportunities • **Other?**

DISTAL OUTCOMES	IMPACTS
• Learner Expertise • Academic recognition • Continuance of research • Grants • Fellowship in field • Match into corresponding trainee program • Job offers • Awards/Recognition • Media coverage • Leadership opportunities (local, state, fed, international) • Social capital (improved network) • **Unanticipated Outcomes?**	**MENTOR:** • Enjoyment/Satisfaction • Productivity of faculty • Work completed • Publications • Grants • Awards/recognition • Media coverage • Academic recognition • Relationship with mentee • Social capital (improved network) **SYSTEM/UNIVERSITY CHANGE:** • Contribution to missions • Clinical process • Clinical effectiveness • Teaching practice • Curriculum • Others who worked with learner **SOCIAL/COMMUNITY:** • Equity • Wellness • Engagement • Patient outcomes • Safety **ACADEMIC/RESEARCH AREA:** • Discovery/Innovation • Basic science contribution • Significance for medical education • Impact on academic literature (other research) • **Unanticipated Impacts in each category?**

APPENDIX 2 – Survey Tool

UNIVERSITY OF CALIFORNIA, SAN FRANCISCO
CONSENT TO BE IN RESEARCH

Study Title: *Institutional Impacts of a Scholarly Concentration Program in Medical Education*

We are asking you to take part in a research study being done by Huiju Carrie Chen, MD, MSEd and Matthew Trojnar at the University of California, San Francisco.

Being in this study is optional.

If you choose to be in this study, you will complete a survey. The researchers are assessing what types of outcomes and corresponding levels of impact resulted from the legacy project work completed by Pathways to Discovery learners.

The Pathways to Discovery Program will use data from this study to better understand the institutional impacts of the legacy projects and to improve the program.

This survey will take about **ten minutes** to complete.

Are there any risks to me or my privacy?

You are free to skip any questions that you do not want to answer or stop the survey at any time.

We keep all information collected from you confidential. Information which identifies you and the UCSF learner with whom you worked will only be used to contact you and will be kept secure.

The survey itself does not include details which directly identify you, such as your name or address. Please do not enter this information onto your survey. Only two researchers will have direct access to completed surveys. All data will be de-identified prior to analysis and reported in de-identified aggregate format. If this study is published or presented at scientific meetings, no identifying information will be used.

Are there benefits?
There is no benefit to you. The survey results will be used for research and programmatic improvement.

Can I say "No"?
Yes, you do not have to complete this survey. If you choose not to be in this study you will not lose any of your regular benefits. It will not impact your position as a faculty member or Pathways to Discovery mentor.

Are there any payments or costs?

You will not be paid for completing the survey. There are no costs to you.

Who can answer my questions about the study?
Please contact H. Carrie Chen at (415) 502-2972
or Matt Trojnar at (415) 476-4534.

If you have questions or concerns about your rights as a research participant, you can call the UCSF Committee on Human Research at 415-476-1814.

CONSENT
If you want to participate in this study, please click the Start button below to begin the survey.

INSTRUCTIONS:

This survey assesses the impact of the individual learner's project listed below. Please respond to the following questions regarding the Pathways to Discovery work of this learner only.

LEARNER NAME:
PROJECT TITLE:
PATHWAY:
YEAR COMPLETED:

MENTOR SHIP CONTACT:

1. Estimate how frequently were you in contact (i.e., in person, by phone, over email) with the learner regarding their project? (click one)

    - Never
    - Once per year
    - Quarterly
    - Monthly
    - Weekly
    - Daily

    FOR QUARTERLY
    On average, how many times per quarter were you in contact with the learner?

    FOR MONTHLY
    On average, how many times per month were you in contact with the learner?

    FOR WEEKLY

On average, how many times per week were you in contact with the learner?

FOR DAILY

On average, how many times per day were you in contact with the learner?

2. I was satisfied with the overall mentorship experience of this learner.
   1= Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree , 4 = Agree, 5 = Strongly Agree

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PROJECT TYPE, LOCATION, AND DURATION:

3. How would you categorize the type of project undertaken by this learner? (select all that apply)
   - Bench research
   - Clinical translational research
   - Educational project
   - Community project
   - Health equity
   - Health system improvement
   - International project
   - Social and behavioral science research
   - Other [INSERT OTHER]

4. The primary work location for this project was: (click all that apply)
   - On-campus
   - Local community
   - Bay area
   - California
   - United States
   - International

5. Estimate the total length of time the learner spent working on the project in [PIPED TEXT FROM #6].
   [INSERT NUMBER] total months
   [INSERT NUMBER] total weeks
   [INSERT NUMBER] total days

6. Was it a UCSF site?
   Yes/No

PROJECT OUTCOMES:

7. How many peer-reviewed publications resulted from the learner's work?

[INSERT NUMBER]

8. How many non peer-reviewed publications resulted from the learner's work?
   [INSERT NUMBER]

9. How many presentations (e.g. poster/oral presentations) were given at academic conferences by this learner related to his/her project?
   [INSERT NUMBER]

10. This learner's project contributed to a grant proposal at UCSF.
    1= Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree , 4 = Agree, 5 = Strongly Agree

11. Was the grant funded?
    Yes, No, Decision pending, unknown

12. The product of this learner's project work. (e.g., policy, research finding, clinical protocol, tool, curricular module) was fully adopted in the following academic area(s).
    1= Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree , 4 = Agree, 5 = Strongly Agree

    MATRIX:
    - Academic specialty
    - Practices in field
    - Patient outcomes
    - Population health
    - Social welfare
    - Community health
    - Health equity
    - Health systems
    - Other [INSERT OTHER]

13. The learner helped to further my own personal career goals.
    1= Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree , 4 = Agree, 5 = Strongly Agree

14. Without the learner, this project, intervention, policy, or research would not have moved forward.
    1= Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree , 4 = Agree, 5 = Strongly Agree

15. The learner's project helped to develop groundwork for other learners doing similar projects outside of UCSF (e.g. in the San Francisco community, regionally, at a domestic site, at an international site).

1= Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree , 4 = Agree, 5 = Strongly Agree

16. This project resulted in a new scholarly direction in the following area(s):
    1= Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree , 4 = Agree, 5 = Strongly Agree

    MATRIX:
    - My own work
    - Work of my team
    - Work in my lab
    - Work in a clinic
    - Work in the community
    - Work of other labs

"Sustainable change" is defined by the likelihood that an intervention(s) related to the learner's work continues without their direct influence.

17. The learner's project resulted in longterm, sustainable change in the following areas:
    1= Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree , 4 = Agree, 5 = Strongly Agree

    MATRIX:
    - Individual unit (e.g., within a
    - clinic, a lab, a classroom)
    - At institution (UCSF)
    - Locally in San Francisco
    - Regionally (Bay Area)
    - Within the State (California)
    - Nationally
    - Internationally

PROJECT IMPACTS:

The following questions asses the various types of impacts the learners project may have had. Impact is defined by the changes that can be attributed to the particular project under consideration.

18. To what extent did the learner's project impact the following academic area(s):
    1 = Not impactful , 2 = Of little impact, 3 = Moderately impactful, 4 = Impactful , 5 = Very Impactful

    MATRIX:
    - Knowledge in academic

- specialty
- Practices in field
- Patient outcomes
- Population health
- Social welfare
- Community health
- Health equity
- Health systems

19. How impactful was this learner's project in the following areas:
    1 = Not impactful , 2 = Of little impact, 3 = Moderately impactful, 4 = Impactful , 5 = Very Impactful

    MATRIX:
    - Individual unit (e.g., within a
    - clinic, a lab, a classroom)
    - At institution (UCSF)
    - Locally in San Francisco
    - Regionally (Bay Area)
    - Within the State (California)
    - Nationally
    - Internationally

20. Rate the impact of the learner's project on your own work (e.g., grant applications, direction of inquiry, dissemination)
    1 = Not impactful , 2 = Of little impact, 3 = Moderately impactful, 4 = Impactful , 5 = Very Impactful

21. Rate the level of impact the learner's project had on the research/work of others at UCSF.
    1 = Not impactful , 2 = Of little impact, 3 = Moderately impactful, 4 = Impactful , 5 = Very Impactful

22. Rate the level of impact the learner's project had on the research/work of others at another institution.
    1 = Not impactful , 2 = Of little impact, 3 = Moderately impactful, 4 = Impactful , 5 = Very Impactful

23. Please describe any other additional impacts, anticipated or unanticipated, of the learner's project.

APPENDIX 3 – Scholarly Concentration Summary

SCHOOL	DURATION	CAPSTONE	CONCENTRATION AREAS
Baylor College of Medicine	Longitudinal across four years of medical school	Written report submitted in Year 4	Basic, clinical, or translational research as well as humanities, business, ethics, and health policy
Case Western Reserve	Sixteen-week research block during Years 3 or 4; Voluntary fifth-year option	Thesis manuscript due in February of Year 4; literature reviews not acceptable	No set concentration areas; pursuit of new knowledge in basic, social, or clinical sciences
Cleveland Clinic Lerner / Case Western Reserve	Two research blocks in preclinical years; seminar series Years 1–5; one-year research thesis project completed consecutively or alternate with clinical electives in Years 3–5	Master-level thesis due by January of Year 5; the thesis is a graduation requirement	Basic science, translational research, or clinical research
Duke University School of Medicine	10–12 months comprising Year 3	Thesis with quantitative analysis (except in Medical Humanities track) or first author paper submission or grant proposal—due at the end of Year 3	Anesthesiology, Surgery, and Environmental Physiology; Behavioral Neurosciences; Biomedical Engineering; Biomedical Imaging and Medical Physics; Cancer Biology; Cardiovascular Study; Clinical Research; Epidemiology and Public Health/Dual Degree; Global Health; Human Genetics and Genomics; Medical Humanities; Microbiology, Infectious Diseases, Immunology; Molecular Medicine; Neurosciences;

			Ophthalmology and Visual Science
University of Pittsburgh	Longitudinal across three years of medical school	Final report submitted Year 4	Disabilities Medicine; Geriatric Medicine; Global Health; Medical Humanities; Neuroscience; Patient Safety; Service Learning: Underserved Populations; Women's Health
Stanford University	Multiyear program to be completed by Year 4	Presentation of scholarly project at a venue approved by the SC director due by the end of Year 4	Required "Foundation" areas: Bioengineering; Biomedical Ethics and Medical Humanities; Biomedical Informatics; Clinical Research; Community Health; Health Services and Policy Research; Medical Education; Molecular Basis of Medicine Elective "Application" areas: Cancer Biology; Cardiovascular/Pulmonary; Immunology; International Health; Neuroscience, Behavior and Cognition; Women's Health (List 4)
Vanderbilt	Longitudinal across Years 1 and 2	Abstract of the student's work submitted in Year 2	Laboratory-based research, patient-oriented research, health services research, medical humanities, law and medicine, global medicine, biomedical informatics,

			medical education, and community health initiatives
Yale	Longitudinal across four years of medical school; optional fifth year	Required thesis submitted Year 4	Basic, clinical, epidemiologic, or sociologic (including medicine and humanities) topics
Alpert Medical School of Brown University	Longitudinal across the four years of medical school	Final scholarly product submitted in Year 4	Advocacy and Activism; Aging; Contemplative Studies; Disaster Medicine and Response; Global Health; Informatics; Medical Education; Medical Ethics; Medical Humanities; Medical Technology and Innovation; Physician as Communicator; Women's Reproductive Health, Freedom, and Rights
Louisiana State University School of Medicine at New Orleans	Longitudinal beginning at the end of Year 1	Publishable paper submitted in Year 4	Basic science or clinical research
Sanford Medical School of the University of South Dakota	Longitudinal across four years of medical school; eight-week summer externship; an additional four weeks of pathway time required in Year 4	Final scholarly product submitted in Year 4	Education, research, or service
University of California, San Francisco	Longitudinal across four years of medical school	Required submission of an abstract and presentation of results due in Year 4	Molecular Medicine, Clinical and Translational Research, Health Professions Education, Health and Society, and Global Health

University of Cincinnati College of Medicine	Longitudinal across four years of medical school; students enter concentration early Year 1	None, but most students present the results of a summer research project	Child Health, Poverty and Justice; Nutrition; Art of Family Medicine; Geriatrics; Neuroscience
University of Nebraska	Longitudinal with admission in January of Year 1 and completion before March of Year 4	Manuscript, conference presentation, or other scholarly publication due in Year 4	Aging and Integrative Medicine; Autoimmune Diseases, Care of the Underserved; HIV Medicine; Preventative Medicine; Medical Humanities and Arts
University of South Florida	Longitudinal across four years of medical school	Required final scholarly "Legacy Project" submission in Year 4	Business and Entrepreneurship; Health Disparities; Health; Systems Engineering; Law and Medicine; Medical Education; Medical Humanities; Public Health/Global Medicine; Research

APPENDIX 4 – Frequency Count of Project Duration

Months Worked (raw data)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	1	1.0	1.1	1.1
	1	5	4.8	5.7	6.9
	2	7	6.7	8.0	14.9
	3	8	7.7	9.2	24.1
	4	5	4.8	5.7	29.9
	5	3	2.9	3.4	33.3
	6	8	7.7	9.2	42.5
	7	1	1.0	1.1	43.7
	8	3	2.9	3.4	47.1
	9	5	4.8	5.7	52.9
	10	5	4.8	5.7	58.6
	11	2	1.9	2.3	60.9
	12	20	19.2	23.0	83.9
	14	1	1.0	1.1	85.1
	15	2	1.9	2.3	87.4
	16	1	1.0	1.1	88.5
	18	4	3.8	4.6	93.1
	20	1	1.0	1.1	94.3
	21	1	1.0	1.1	95.4
	24	2	1.9	2.3	97.7
	28	1	1.0	1.1	98.9
	48	1	1.0	1.1	100.0
	Total	87	83.7	100.0	
Missing	System	17	16.3		
Total		104	100.0		

Project Duration (transformed data)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 through 3	21	20.2	24.1	24.1
	4 through 6	16	15.4	18.4	42.5
	7 through 9	9	8.7	10.3	52.9
	10 through 12	27	26.0	31.0	83.9

	13+	14	13.5	16.1	100.0
	Total	87	83.7	100.0	
Missing	System	17	16.3		
Total		104	100.0		

APPENDIX 5 – Contact Frequency

Contact Frequency

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Once per year	1	1.0	1.0	1.0
	Quarterly	8	7.7	7.9	8.9
	Monthly	30	28.8	29.7	38.6
	Weekly	46	44.2	45.5	84.2
	Daily	5	4.8	5.0	89.1
	Varies too much to say	11	10.6	10.9	100.0
	Total	101	97.1	100.0	
Missing	System	3	2.9		
Total		104	100.0		

Contact Frequency – Three Groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Monthly or Less	39	37.5	43.3	43.3
	Weekly	46	44.2	51.1	94.4
	More Than Weekly	5	4.8	5.6	100.0
	Total	90	86.5	100.0	
Missing	System	14	13.5		
Total		104	100.0		

APPENDIX 6 – Publication Differences by Pathway

Peer Reviewed Publications

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.421[a]	4	.001
Likelihood Ratio	21.907	4	.000
Linear-by-Linear Association	11.686	1	.001
N of Valid Cases	97		

a. 2 cells (20.0%) have expected count less than 5. The minimum expected count is 1.53.

Non-Peer Reviewed Publications

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.053[a]	4	.040
Likelihood Ratio	9.026	4	.060
Linear-by-Linear Association	2.840	1	.092
N of Valid Cases	94		

a. 6 cells (60.0%) have expected count less than 5. The minimum expected count is .55.

APPENDIX 7 – ANOVA by Pathway Predictor

ANOVA

		Sum of Squares	df	F	Sig.
Oral/Poster Presentations	Between Groups	3.176	4	.415	.797
	Within Groups	177.732	93		
	Total	180.908	97		
Contributed to Grant	Between Groups	19.283	4	2.578	**.043**
	Within Groups	172.037	92		
	Total	191.320	96		
Mentor Direction	Between Groups	26.245	4	4.257	**.003**
	Within Groups	135.647	88		
	Total	161.892	92		
Lab Direction	Between Groups	33.764	4	7.799	**.000**
	Within Groups	82.261	76		
	Total	116.025	80		
Career Furtherance	Between Groups	.696	4	.235	.918
	Within Groups	68.855	93		
	Total	69.551	97		
Learner moved Project Forward	Between Groups	8.209	4	1.925	.113
	Within Groups	99.138	93		
	Total	107.347	97		

Multiple Comparisons

Bonferroni

Dependent Variable	(I) PATHWAY	(J) PATHWAY	Mean Diff. (I-J)	S.E.	Sig.
Oral/Poster Presentations	Health & Society	Global Health	-.143	.444	1.000
		Health Professions Education	-.004	.380	1.000
		Molecular Medicine	.107	.754	1.000
		Clinical Translation	-.459	.438	1.000
	Global Health	Health & Society	.143	.444	1.000
		Health Professions Education	.139	.399	1.000
		Molecular Medicine	.250	.764	1.000
		Clinical Translation	-.316	.455	1.000
	Health Professions Education	Health & Society	.004	.380	1.000
		Global Health	-.139	.399	1.000
		Molecular Medicine	.111	.729	1.000
		Clinical Translation	-.455	.392	1.000
	Molecular Medicine	Health & Society	-.107	.754	1.000
		Global Health	-.250	.764	1.000
		Health Professions Education	-.111	.729	1.000
		Clinical Translation	-.566	.760	1.000
	Clinical Translation	Health & Society	.459	.438	1.000
		Global Health	.316	.455	1.000
		Health Professions Education	.455	.392	1.000
		Molecular Medicine	.566	.760	1.000
Contributed to Grant	Health & Society	Global Health	-.159	.439	1.000
		Health Professions Education	-.057	.377	1.000
		Molecular Medicine	-1.214	.746	1.000
		Clinical Translation	-1.083	.433	**.142**
	Global Health	Health & Society	.159	.439	1.000
		Health Professions Education	.102	.397	1.000
		Molecular Medicine	-1.056	.756	1.000
		Clinical Translation	-.924	.450	.428
	Health Professions Education	Health & Society	.057	.377	1.000
		Global Health	-.102	.397	1.000
		Molecular Medicine	-1.157	.722	1.000
		Clinical Translation	-1.026	.390	.100

	Molecular Medicine	Health & Society	1.214	.746	1.000
		Global Health	1.056	.756	1.000
		Health Professions Education	1.157	.722	1.000
		Clinical Translation	.132	.752	1.000
	Clinical Translation	Health & Society	1.083	.433	.142
		Global Health	.924	.450	.428
		Health Professions Education	1.026	.390	.100
		Molecular Medicine	-.132	.752	1.000
Mentor Direction	Health & Society	Global Health	-.295	.420	1.000
		Health Professions Education	-.497	.345	1.000
		Molecular Medicine	-2.012*	.677	**.038**
		Clinical Translation	-1.288*	.393	**.015**
	Global Health	Health & Society	.295	.420	1.000
		Health Professions Education	-.202	.385	1.000
		Molecular Medicine	-1.717	.699	.160
		Clinical Translation	-.993	.429	.229
	Health Professions Education	Health & Society	.497	.345	1.000
		Global Health	.202	.385	1.000
		Molecular Medicine	-1.515	.656	.233
		Clinical Translation	-.791	.356	.287
	Molecular Medicine	Health & Society	2.012*	.677	.038
		Global Health	1.717	.699	.160
		Health Professions Education	1.515	.656	.233
		Clinical Translation	.724	.683	1.000
	Clinical Translation	Health & Society	1.288*	.393	.015
		Global Health	.993	.429	.229
		Health Professions Education	.791	.356	.287
		Molecular Medicine	-.724	.683	1.000
Lab Direction	Health & Society	Global Health	-.028	.374	1.000
		Health Professions Education	-.034	.309	1.000
		Molecular Medicine	-2.355*	.572	**.001**
		Clinical Translation	-1.164*	.347	**.013**
	Global Health	Health & Society	.028	.374	1.000
		Health Professions Education	-.005	.349	1.000
		Molecular Medicine	-2.327*	.595	.002
		Clinical Translation	-1.136*	.383	.041
	Health Professions	Health & Society	.034	.309	1.000

	Education	Global Health	.005	.349	1.000
		Molecular Medicine	-2.321*	.556	.001
		Clinical Translation	-1.130*	.320	.007
	Molecular Medicine	Health & Society	2.355*	.572	.001
		Global Health	2.327*	.595	.002
		Health Professions Education	2.321*	.556	.001
		Clinical Translation	1.191	.578	.428
	Clinical Translation	Health & Society	1.164*	.347	.013
		Global Health	1.136*	.383	.041
		Health Professions Education	1.130*	.320	.007
		Molecular Medicine	-1.191	.578	.428
Career Furtherance	Health & Society	Global Health	.111	.276	1.000
		Health Professions Education	-.028	.236	1.000
		Molecular Medicine	-.333	.469	1.000
		Clinical Translation	-.018	.272	1.000
	Global Health	Health & Society	-.111	.276	1.000
		Health Professions Education	-.139	.248	1.000
		Molecular Medicine	-.444	.476	1.000
		Clinical Translation	-.129	.283	1.000
	Health Professions Education	Health & Society	.028	.236	1.000
		Global Health	.139	.248	1.000
		Molecular Medicine	-.306	.453	1.000
		Clinical Translation	.010	.244	1.000
	Molecular Medicine	Health & Society	.333	.469	1.000
		Global Health	.444	.476	1.000
		Health Professions Education	.306	.453	1.000
		Clinical Translation	.316	.473	1.000
	Clinical Translation	Health & Society	.018	.272	1.000
		Global Health	.129	.283	1.000
		Health Professions Education	-.010	.244	1.000
		Molecular Medicine	-.316	.473	1.000
Learner moved Project Forward	Health & Society	Global Health	.230	.332	1.000
		Health Professions Education	.036	.284	1.000
		Molecular Medicine	1.286	.563	.247
		Clinical Translation	.496	.327	1.000
	Global Health	Health & Society	-.230	.332	1.000
		Health Professions Education	-.194	.298	1.000

		Molecular Medicine	1.056	.571	.676
		Clinical Translation	.266	.340	1.000
	Health Professions Education	Health & Society	-.036	.284	1.000
		Global Health	.194	.298	1.000
		Molecular Medicine	1.250	.544	.239
		Clinical Translation	.461	.293	1.000
	Molecular Medicine	Health & Society	-1.286	.563	.247
		Global Health	-1.056	.571	.676
		Health Professions Education	-1.250	.544	.239
		Clinical Translation	-.789	.568	1.000
	Clinical Translation	Health & Society	-.496	.327	1.000
		Global Health	-.266	.340	1.000
		Health Professions Education	-.461	.293	1.000
		Molecular Medicine	.789	.568	1.000

*. The mean difference is significant at the 0.05 level.

Descriptives

		N	Mean	Std. Deviation
Oral/Poster Presentations	Health & Society	21	1.86	1.014
	Global Health	18	2.00	.840
	Health Professions Education	36	1.86	1.199
	Molecular Medicine	4	1.75	.500
	Clinical Translation	19	2.32	2.286
	Total	98	1.97	1.366
Contributed to Grant	Health & Society	21	2.29	1.419
	Global Health	18	2.44	.984
	Health Professions Education	35	2.34	1.413
	Molecular Medicine	4	3.50	1.732
	Clinical Translation	19	3.37	1.461
	Total	97	2.60	1.412
Mentor Direction	Health & Society	21	2.24	1.091
	Global Health	15	2.53	1.060
	Health Professions Education	34	2.74	1.399
	Molecular Medicine	4	4.25	.500
	Clinical Translation	19	3.53	1.307
	Total	93	2.82	1.327

Lab Direction	Health & Society	19	1.89	.809
	Global Health	13	1.92	.954
	Health Professions Education	28	1.93	1.184
	Molecular Medicine	4	4.25	.500
	Clinical Translation	17	3.06	1.144
	Total	81	2.27	1.204
Career Furtherance	Health & Society	21	3.67	.658
	Global Health	18	3.56	.511
	Health Professions Education	36	3.69	.920
	Molecular Medicine	4	4.00	.816
	Clinical Translation	19	3.68	1.157
	Total	98	3.67	.847
Learner moved Project Forward	Health & Society	21	4.29	.845
	Global Health	18	4.06	.725
	Health Professions Education	36	4.25	.967
	Molecular Medicine	4	3.00	1.155
	Clinical Translation	19	3.79	1.475
	Total	98	4.08	1.052

APPENDIX 8 – Post Hoc Analyses for Contact Frequency

Multiple Comparisons

Bonferroni

Dependent Variable	(I) Contact Frequency	(J) Contact Frequency	Mean Diff (I-J)	Std. Error	Sig.
Oral/Poster Presentations	Monthly or Less	Weekly	-.667	.330	.139
		More Than Weekly	-.697	.712	.990
	Weekly	Monthly or Less	.667	.330	.139
		More Than Weekly	-.030	.703	1.000
	More Than Weekly	Monthly or Less	.697	.712	.990
		Weekly	.030	.703	1.000
Contributed to Grant	Monthly or Less	Weekly	-.576	.300	.174
		More Than Weekly	-2.150*	.643	.004
	Weekly	Monthly or Less	.576	.300	.174
		More Than Weekly	-1.574*	.635	.045
	More Than Weekly	Monthly or Less	2.150*	.643	.004
		Weekly	1.574*	.635	.045
Mentor Direction	Monthly or Less	Weekly	-.382	.295	.600
		More Than Weekly	-1.671*	.623	.027
	Weekly	Monthly or Less	.382	.295	.600
		More Than Weekly	-1.289	.613	.116
	More Than Weekly	Monthly or Less	1.671*	.623	.027
		Weekly	1.289	.613	.116
Lab Direction	Monthly or Less	Weekly	-.288	.284	.943
		More Than Weekly	-1.963*	.555	.002
	Weekly	Monthly or Less	.288	.284	.943
		More Than Weekly	-1.675*	.541	.008
	More Than Weekly	Monthly or Less	1.963*	.555	.002
		Weekly	1.675*	.541	.008
Career Furtherance	Monthly or Less	Weekly	-.513*	.170	.010
		More Than Weekly	-1.022*	.367	.020
	Weekly	Monthly or Less	.513*	.170	.010
		More Than Weekly	-.509	.362	.492
	More Than Weekly	Monthly or Less	1.022*	.367	.020
		Weekly	.509	.362	.492
Learner moved Project Forward	Monthly or Less	Weekly	.167	.231	1.000
		More Than Weekly	.189	.497	1.000
	Weekly	Monthly or Less	-.167	.231	1.000
		More Than Weekly	.022	.492	1.000
	More Than Weekly	Monthly or Less	-.189	.497	1.000
		Weekly	-.022	.492	1.000

APPENDIX 9 – Post-Hoc Analyses for Project Duration

Bonferroni

Dependent Variable	(I) Months Worked	(J) Months Worked	Mean Difference (I-J)	Std. Error	Sig.
Oral/Poster Presentations	0 thru 3	4 thru 6	-.598	.506	1.000
		7 thru 9	.270	.607	1.000
		10 thru 12	-.323	.444	1.000
		13+	-1.143	.526	.327
	4 thru 6	0 thru 3	.598	.506	1.000
		7 thru 9	.868	.635	1.000
		10 thru 12	.275	.481	1.000
		13+	-.545	.558	1.000
	7 thru 9	0 thru 3	-.270	.607	1.000
		4 thru 6	-.868	.635	1.000
		10 thru 12	-.593	.587	1.000
		13+	-1.413	.651	.330
	10 thru 12	0 thru 3	.323	.444	1.000
		4 thru 6	-.275	.481	1.000
		7 thru 9	.593	.587	1.000
		13+	-.820	.502	1.000
	13+	0 thru 3	1.143	.526	.327
		4 thru 6	.545	.558	1.000
		7 thru 9	1.413	.651	.330
		10 thru 12	.820	.502	1.000
Contributed to Grant	0 thru 3	4 thru 6	-.577	.453	1.000
		7 thru 9	-.286	.544	1.000
		10 thru 12	-.952	.401	.198
		13+	-1.167	.471	.154
	4 thru 6	0 thru 3	.577	.453	1.000
		7 thru 9	.292	.569	1.000
		10 thru 12	-.375	.434	1.000
		13+	-.589	.500	1.000
	7 thru 9	0 thru 3	.286	.544	1.000
		4 thru 6	-.292	.569	1.000
		10 thru 12	-.667	.528	1.000
		13+	-.881	.583	1.000
	10 thru 12	0 thru 3	.952	.401	.198
		4 thru 6	.375	.434	1.000
		7 thru 9	.667	.528	1.000
		13+	-.214	.453	1.000
	13+	0 thru 3	1.167	.471	.154
		4 thru 6	.589	.500	1.000

		7 thru 9	.881	.583	1.000
		10 thru 12	.214	.453	1.000
Mentor Direction	0 thru 3	4 thru 6	-.009	.422	1.000
		7 thru 9	-.238	.506	1.000
		10 thru 12	-.841	.373	.269
		13+	-1.187	.449	.098
	4 thru 6	0 thru 3	.009	.422	1.000
		7 thru 9	-.229	.530	1.000
		10 thru 12	-.832	.404	.427
		13+	-1.178	.475	.152
	7 thru 9	0 thru 3	.238	.506	1.000
		4 thru 6	.229	.530	1.000
		10 thru 12	-.603	.492	1.000
		13+	-.949	.551	.891
	10 thru 12	0 thru 3	.841	.373	.269
		4 thru 6	.832	.404	.427
		7 thru 9	.603	.492	1.000
		13+	-.346	.432	1.000
	13+	0 thru 3	1.187	.449	.098
		4 thru 6	1.178	.475	.152
		7 thru 9	.949	.551	.891
		10 thru 12	.346	.432	1.000
Lab Direction	0 thru 3	4 thru 6	-.250	.411	1.000
		7 thru 9	-.429	.539	1.000
		10 thru 12	-.591	.379	1.000
		13+	-.455	.460	1.000
	4 thru 6	0 thru 3	.250	.411	1.000
		7 thru 9	-.179	.556	1.000
		10 thru 12	-.341	.403	1.000
		13+	-.205	.480	1.000
	7 thru 9	0 thru 3	.429	.539	1.000
		4 thru 6	.179	.556	1.000
		10 thru 12	-.162	.532	1.000
		13+	-.026	.593	1.000
	10 thru 12	0 thru 3	.591	.379	1.000
		4 thru 6	.341	.403	1.000
		7 thru 9	.162	.532	1.000
		13+	.136	.453	1.000
	13+	0 thru 3	.455	.460	1.000
		4 thru 6	.205	.480	1.000
		7 thru 9	.026	.593	1.000
		10 thru 12	-.136	.453	1.000
Career Furtherance	0 thru 3	4 thru 6	.387	.271	1.000
		7 thru 9	.095	.325	1.000

		10 thru 12	-.090	.238	1.000
		13+	-.095	.282	1.000
	4 thru 6	0 thru 3	-.387	.271	1.000
		7 thru 9	-.292	.340	1.000
		10 thru 12	-.477	.258	.678
		13+	-.482	.299	1.000
	7 thru 9	0 thru 3	-.095	.325	1.000
		4 thru 6	.292	.340	1.000
		10 thru 12	-.185	.314	1.000
		13+	-.190	.349	1.000
	10 thru 12	0 thru 3	.090	.238	1.000
		4 thru 6	.477	.258	.678
		7 thru 9	.185	.314	1.000
		13+	-.005	.269	1.000
	13+	0 thru 3	.095	.282	1.000
		4 thru 6	.482	.299	1.000
		7 thru 9	.190	.349	1.000
		10 thru 12	.005	.269	1.000
Learner moved Project Forward	0 thru 3	4 thru 6	.125	.344	1.000
		7 thru 9	.222	.413	1.000
		10 thru 12	-.333	.302	1.000
		13+	-.286	.358	1.000
	4 thru 6	0 thru 3	-.125	.344	1.000
		7 thru 9	.097	.432	1.000
		10 thru 12	-.458	.327	1.000
		13+	-.411	.379	1.000
	7 thru 9	0 thru 3	-.222	.413	1.000
		4 thru 6	-.097	.432	1.000
		10 thru 12	-.556	.399	1.000
		13+	-.508	.443	1.000
	10 thru 12	0 thru 3	.333	.302	1.000
		4 thru 6	.458	.327	1.000
		7 thru 9	.556	.399	1.000
		13+	.048	.341	1.000
	13+	0 thru 3	.286	.358	1.000
		4 thru 6	.411	.379	1.000
		7 thru 9	.508	.443	1.000
		10 thru 12	-.048	.341	1.000