IDA SCIENCE AND TECHNOLOGY POLICY INSTITUTE

November 09, 2020

MEMORANDUM

To: Ravi Basavappa and Rebecca Miller
Office of Strategic Coordination, National Institutes of Health

From: Sally S. Tinkle, Xueying Han, Lara L. Rubinyi, Irina Liu
Science and Technology Policy Institute (STPI)

Through: Kristen M. Kulinowski
Director, STPI

Subject: Final Report of the Evaluation of the NIH Early Independence Award Initiative

---

The National Institutes of Health Office of Strategic Coordination (NIH/OSC) supports high-risk, high-reward research through targeted research programs, one of which is the Early Independence Award. This award enables exceptional junior scientists to accelerate their independent research career by forgoing traditional post-doctoral training. NIH/OSC asked STPI to evaluate the impact of this acceleration on their research and career trajectories. STPI developed and implemented a multi-modal assessment strategy, integrated the results, and provided recommendations to inform future NIH Director policy decisions. This final report contains details of methods, results, conclusions, and considerations.

The report of these findings is attached to this memo.

IDA SCIENCE AND TECHNOLOGY POLICY INSTITUTE

Evaluation of the NIH Early Independence Award Initiative

Sally S. Tinkle

Xueying “Shirley” Han

Lara L. Rubinyi

Irina Liu

November 9, 2020

Contents

Executive Summary

The NIH Director's Early Independence Award (EIA) initiative is one of four components of the NIH Common Fund's High-Risk, High-Reward Research (HRHR) program. Launched in 2011, the EIA initiative is designed to accelerate the entry of exceptional junior investigators (i.e., those who are within approximately 12 months of completion of their terminal degree, clinical residency, or clinical fellowship and in a mentored position) into independent research positions. The NIH Common Fund invested over $21 million in the initiative in FY 2018, and the awards offer $250,000 direct costs per year for up to 5 years.

The NIH Office of Strategic Coordination tasked the IDA Science and Technology Policy Institute (STPI) to evaluate the impacts, both positive and negative, the EIA initiative had on the careers of EIA awardees compared to NIH early stage investigators (ESIs) (i.e., individuals who have completed their terminal research degree or clinical training within the past 10 years and have not previously received a substantial NIH independent research award). Two primary study questions were defined for the study:

1. How do the *research outputs* from EIA awardees compare to the ESI awardees?
2. What are the *career impacts* of the EIA on awardees relative to the ESI awardees?

In addition, because EIA awardees have a shortened traditional post-doctoral mentoring period (i.e., less than 12 months of post-doctoral fellowship experience at the time of application), two secondary research questions were posed to assess the impact of this shortened mentoring period on the careers of EIA awardees. Specifically,

- Did EIA awardees have the scientific and administrative skills necessary to establish an independent laboratory and research program?
- Did bypassing the traditional multi-year post-doctoral fellowship impact the research outputs and career trajectories of EIA awardees?

To address these questions, STPI operationalized the research questions as categories through which to assess the awardees' *readiness* to establish an independent career, develop and direct a *research* program, and establish a positive *career* trajectory. These categories provide the organizational themes for the integration of the results presented in the report.

A multi-modal study design was developed for data collection, analysis, and integration. This included surveys of EIA and comparison ESI investigators and analyses

of bibliometric and altmetric data, NIH biosketch data, and follow-on funding awards. STPI identified four windows of time within which to frame the survey questions: at the time of application, transition to independence, first 2 years of the award, and across the entire award years.

Key Findings

Readiness to launch an independent career was similar for EIA and ESI awardees

- EIA and ESI survey respondents reported similar patterns of response for scientific readiness (e.g., understanding the complexities of establishing their own research lab, able to initiate and build new collaborations, having matured scientific thinking to be able to shape a research program) at the time of application.
- EIA survey respondents were more likely to report challenges with the complexities of establishing their laboratory and in their preparation to manage technical staff.
- EIA and ESI survey respondents reported similar difficulties in transitioning to independence such as experiencing unforeseen issues and transitioning to independence taking longer than anticipated.
- Survey findings of similar readiness for EIA awardees and the ESI comparison group are underscored by bibliometric analysis that showed no significant difference between the two groups in time to first research publication from project start date.

Research output was the same or higher for EIA awardees based on type of bibliometric data

- EIA awardees performed better than ESI awardees for all citation-based metrics (i.e., number of citations received per publication, number of citations received per publication per year, total direct cost spent per citation received, and relative citation ratio).
- Publication-based metrics were inconsistent, varying between EIA awardees having significantly higher results (i.e., number of publications produced per award), and EIA and ESI awardees not being statistically different (i.e., number of publications produced per award per year, and total direct cost spent per publication).

Career impact was similar for EIA and ESI awardees

- Using tenure as a proxy for career success, EIA and ESI survey respondents were similar in their ability to obtain a tenured academic position.
- EIA and ESI survey respondents were similar in their ability to obtain follow-on grant funding subsequent to their EIA and ESI awards.
- EIA survey respondents were significantly more likely to report that their research was featured in the popular press, a finding that is supported by EIA awardees having significantly higher Altmetric attention scores than ESI awardees.
- EIA and ESI survey respondents experienced comparable career milestones and recognition, such as invitations to present research findings or serve as a grant or journal reviewer, recognition both groups attribute to their respective awards.
- EIA and ESI survey respondents had similar responses and views on work-life balance (e.g., employment benefits, mentoring, balancing research and other responsibilities).
- The percent of EIA and ESI awardees who received NIH research or research scientist development follow-on awards was not significantly different from one another. In addition, the number of follow-on awards received per EIA awardee did not differ significantly from those received by ESI awardees.

Overall, the findings in this report indicate that 2011-2013 EIA awardees identified through the NIH EIA review process transitioned to early independence and established a research program and laboratory similar to ESI awardees without additional years of training. EIA awardees performed the same or better than their ESI counterparts with regards to publication and citation level metrics. Similarly, EIA and ESI awardees reported similar career milestones and work-life balance; and did not differ in their ability to receive additional NIH follow-on funding.

1. Introduction

A. Overview of the National Institutes of Health Director's Early Independence Award Initiative

The NIH Director's Early Independence Award (EIA) initiative is a component of the NIH Common Fund's High-Risk, High-Reward Research (HRHR) program. The HRHR program supports exceptionally creative scientists pursuing highly innovative research with the potential for broad impact in biomedical, biobehavioral, or social sciences within the NIH mission.[1] There are four components in the HRHR program that target specific constituencies of researchers. The first three components invite applications from scientists with a record of creative research and those proposing either innovative or transformative research. The fourth component, the EIA initiative, was launched in 2011 and is designed to accelerate the entry of exceptional junior investigators into independent research positions.[2] Researchers were considered junior investigators if they are within approximately 12 months of completion of their terminal degree, clinical residency, or clinical fellowship and in a mentored position. The EIA initiative places strong emphasis on the junior investigator's readiness for research independence in the context of a supportive advisory (as opposed to mentoring) environment at the host institution.[3] [4] NIH also developed the DP5 funding mechanism specifically to allow "exceptionally creative scientists to bypass the typical post-doctoral research training period in order to move rapidly to research independence." [5] The NIH Common Fund invested over $21 million in the initiative in FY 2018, and the awards are, on average $250,000 direct costs per year for up to 5 years. [6] [7]

B. Scope of the Evaluation

By 2018, three EIA cohorts had completed the initial 5-year grant period, and the NIH Office of Strategic Coordination tasked the IDA Science and Technology Policy Institute

---

1 https://commonfund.nih.gov/highrisk

2 2011 EIA FOA: https://grants.nih.gov/grants/guide/rfa-files/RFA-RM-10-019.html

3 https://commonfund.nih.gov/earlyindependence

4 2011 EIA FOA: https://grants.nih.gov/grants/guide/rfa-files/RFA-RM-10-019.html

5 https://grants.nih.gov/grants/funding/ac_search_results.htm?text_curr=dp5&Search_Type=Activity

6 https://commonfund.nih.gov/sites/default/files/CommonFundCongressionalJustificationFY2018.pdf

7 https://commonfund.nih.gov/earlyindependence

(STPI) to evaluate the research outputs and career impacts, both positive and negative, the award might have had for these awardees compared to appropriate comparison groups. Research career impacts are generally measured through research accomplishments and professional advancement. After consultation with NIH, STPI translated this question into two key study questions:

- How do the *research outputs* from EIA awardees compare to appropriate comparison groups?
- What are the *career impacts* of the EIA on awardees relative to appropriate comparison groups?

Acceleration from a mentored to independent position was defined in the NIH Funding Opportunity Announcement (FOA) as the individual having less than 12 months of post-doctoral fellowship experience at the time of application.[8] [9] [10] To examine the impact of acceleration, STPI identified two secondary questions to examine more carefully the impact of the shortened traditional post-doctoral mentoring period:

- Did EIA awardees have the scientific and administrative skills necessary to establish an independent laboratory and research program?
- Did bypassing the traditional multi-year post-doctoral fellowship impact the research outputs and career trajectories of EIA awardees?

The results of this evaluation, detailed here, are provided to the NIH Director for future EIA policy and investment decisions.

C. Study Design

To assess the multi-faceted questions outlined above, STPI conducted a retrospective cohort study using a multi-modal study design that included development of a logic model, comparison groups, survey of awardees, and bibliometric analyses. As data from these study components were analyzed, a biosketch analysis of research positions held between terminal degree/clinical residency and the EIA or ESI award, and assessment of NIH follow-on grants (those received subsequent to the EIA or ESI award date) were added to the study design.

The logic model and comparison groups are foundational to the subsequent analyses and presented here in detail. Brief descriptions of the survey and other analyses are also provided in this section to give a synthetic overview of the study design, with detailed methodologies in the appropriate sections of the report. STPI identified four windows of

[8] 2011 EIA FOA: https://grants.nih.gov/grants/guide/rfa-files/RFA-RM-10-019.html

[9] 2012 EIA FOA: https://grants.nih.gov/grants/guide/rfa-files/RFA-RM-11-007.html

[10] 2013 EIA FOA: https://grants.nih.gov/grants/guide/rfa-files/rfa-rm-13-009.html

time within which to frame the study questions: at the time of application, transition to independence, first 2 years of the award, and across the entire award years.

1. Logic Model

a. Developing the framework

A logic model is an evaluation tool that uses an implicit if-then construct to depict shared relationships among a program's resources, activities, outputs, and outcomes. The model is not intended to provide all details about a program, but instead focuses on those key aspects that are likely to influence observed outcomes.[11]

The primary components of an NIH logic model that organizes information pertaining to NIH and to the awardee are presented in Figure 1. A logic model often includes the rationale and assumptions that were inherent in the program's development.[12] STPI identified publicly available information and employed subject matter expertise to generate elements of a rationale (a set of reasons for a course of action) and assumptions (concepts and ideas accepted as true without proof) that might underlie EIA initiative development. This exercise creates a knowledge framework within which each of the logic model components can be examined.

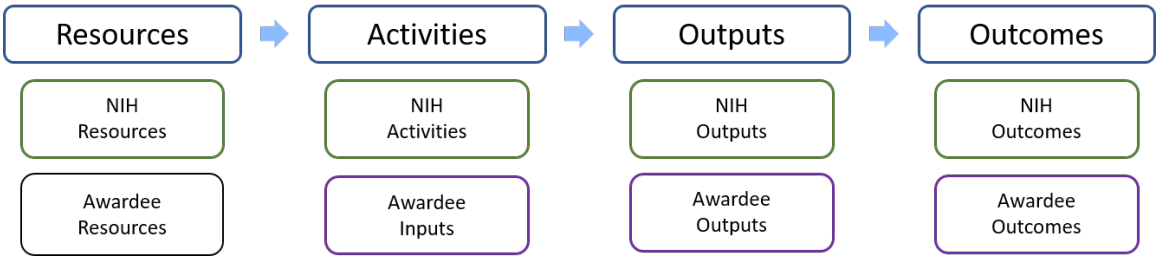


Figure 1. Primary Components of an NIH Logic Model

STPI identified high-level elements of a rationale for the development of the EIA initiative within the HRHR program. In the context of the STPI evaluation, retention of exceptional junior scientists in research settings is consistent with the overarching HRHR goal to promote exceptional, innovative biomedical research while simultaneously

---

[11] Innovation Network Logic Model Workbook http://www.pointk.org/client_docs/File/logic_model_workbook.pdf

[12] Frechtling, JA (2015). "Logic Models". *International Encyclopedia of the Social & Behavioral Sciences*. Elsevier. pp. 299–305.

addressing the trend among junior scientists to pursue non-academic careers.[13,14,15] As the average length of the post-doctoral fellowship is approximately 5 years,[16] this additional mentored training could be considered unnecessary for exceptional junior investigators, delaying independent research and academic progression, thus dis-incentivizing them from staying in biomedical research. This select group of junior investigators is thought to have already achieved during their graduate training the skills requisite for establishing an independent career: the ability to think scientifically and creatively about biomedical problems; write competitive grants; establish new collaborations; publish in highly respected, peer-reviewed journals; and manage a research program and technical staff. From the NIH perspective, the provision of opportunity for exceptional junior investigators to develop independent, innovative approaches to research problems through a significant NIH Director's award—one recognized by peers and universities as prestigious—is sufficient to retain talent in biomedical research.

To understand the assumptions underlying the rationale in the context of public information on the initiative and NIH processes and culture, STPI outlined a series of assumptions that would support this rationale. Several assumptions are related to observed characteristics of exceptional junior investigators: collectively they are viewed as being personally and scientifically mature such that additional training and mentoring would delay and not enhance their career development, perhaps even stifle their scientific creativity and innovative ideas. There is an assumption that exceptional junior investigators would remain in academia were they given early independence, a prestigious award with sufficient funding to help them acquire a tenure-track or equivalent academic appointment, and positioned for continued NIH funding. There is an overarching assumption that a permanent academic position would provide stability in their professional and personal lives and allow them to be highly innovative, productive researchers. Finally, NIH assumes it can create an application process to identify these exceptional young investigators.

Within this framework of rationale and assumptions, STPI first examined NIH and awardee resources, those elements within NIH that would support an EIA initiative. In the first column of Figure 2, the noteworthy resources are the Common Fund and the DP5 funding mechanism, which provide the reassurance of funding and an established

---

[13] Milojevic, S., Radicchi, F., Walsh, J.P. 2018. "Changing demographics of scientific careers: the rise of the temporary workforce." *PNAS* 115(50): 12616-12623.

[14] Hendricks, M. 2012. "A reality check on the biomedical job market." Accessed July 15, 2020. Available at: https://www.hopkinsmedicine.org/research/advancements-in-research/fundamentals/in-depth/a-reality-check-on-the-biomedical-job-market.

[15] Sauermann, H., Roach, M. 2012. "Science PhD career preferences: levels, changes, and advisor encouragement." *PLoS One* 7(5): e36307.

[16] Kahn, S., Ginther, D.K. 2017. "The impact of postdoctoral training on early careers in biomedicine." *Nature Biotechnology* 35: 90-94.

application process. The HRHR program's goals are consistent with an emphasis on exceptional scientists and innovative biomedical research—both elements of the EIA initiative. The primary awardee resources are the creative problem solving that precedes innovative research and exceptional scientific maturity for a junior investigator.

The anticipated NIH activities follow the NIH grant award process—drafting the EIA FOA and developing a review process that identifies exceptional junior investigators. NIH also interacts with awardees informally through program officers and more formally through the annual HRHR research symposium, which brings together junior investigators and experienced HRHR awardees to build community and collaborations. Anticipated awardee activities are primarily directed towards establishing an independent research program, including space and staffing challenges, and balancing institutional responsibilities.

Near-term outputs from NIH focus on the traditional actions of refining the FOA, awardee selection criteria, and growing the size of the program, all of which would lead to the outcome of more robust support for exceptional junior investigators who are more likely to remain in biomedical research. These researchers are also considered more likely to produce innovative research and be incorporated into established scientific communities, outcomes that could lead to institutes within NIH adopting similar programs. Awardees' expected outputs would be devices or technologies, clinical trials, papers, patents, and citations—which would lead to career advancement, enhanced professional reputation, continued funding, dissemination of research results, and advances in the treatment of disease and improved public health.

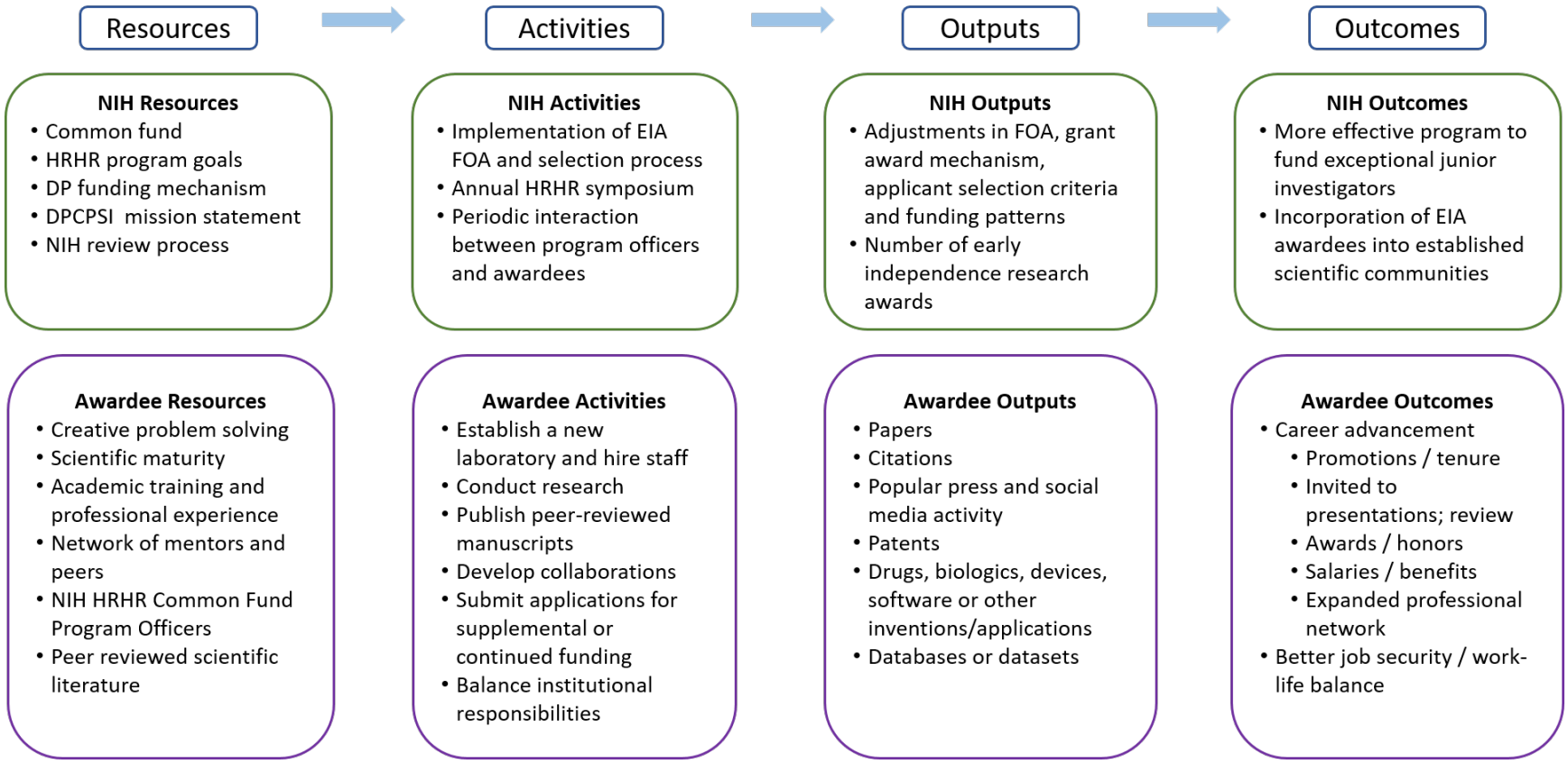


Figure 2. EIA Initiative Logic Model Displaying Near-term Outputs and Outcomes

b. Extending the logic model to evaluation metrics

Using the logic model constructs—resources, activities, outputs, and outcomes—STPI operationalized the study questions as categories through which to assess the awardees' *readiness* to establish an independent career, develop and direct a *research* program, and establish a positive *career* trajectory. These three categories provide the organizational themes for the survey design and the integration of findings at the close of the report. The secondary questions about the utility of a post-doctoral experience are woven into these categories. STPI acknowledges that there is overlap in some components of the categories but finds them a useful organizational tool for an assessment of this complexity. A full list of survey questions by category can be found in the methods section (Table 1, page 14).

2. Comparison Groups

As mentioned previously, the critical elements of the EIA FOA include readiness for independent research, including a research program and publication track record; and transition to independence within 12 months of receiving a terminal degree or completing a clinical residency or fellowship. Given these characteristics of exceptional junior investigators, the key study questions, and matching criteria, STPI identified two groups for comparison of research outputs and career trajectory. In developing these groups, STPI considered the 39 junior investigators who received an EIA during the FY 2011–2013 funding cycles. Ten grants were awarded in FY 2011, 14 grants in FY 2012, and 15 grants in FY 2013.

Through analysis of NIH data available for all awardees, STPI identified award year, award length, total funding, and area of science as comparison group matching criteria. An overview of the comparison groups is provided here, and detailed information on their development is located in Appendix A.

a. Private foundation comparison group

STPI first collected publicly available data to identify non-Federal programs that fund exceptional junior investigators. STPI identified 19 prestigious U.S.-based, private fellowship programs in the life sciences, 10 of which had funding criteria similar to the EIA initiative. Specifically, these 10 foundations solicited exceptional early career investigators with limited post-doctoral fellowship experience who demonstrated skills and abilities similar to the EIA criteria: research accomplishments, productivity, and readiness for independence.

Through interactions with program staff at NIH and the foundations, STPI curated a roster of 17 individuals who received a 5-year award from a private foundation from 2011 to 2013 with approximately the same amount of funding as an EIA award and who did not

receive an EIA award during the same time period. Only three individuals met the inclusion criteria, so a private fellowship comparison group sufficiently robust for this analysis could not be obtained.

b. NIH early stage investigator comparison group

STPI next identified an NIH cohort who were transitioning to independence, received funding through the traditional NIH R01 process, and had post-doctoral training. NIH early stage investigators (ESIs) are defined as having completed their terminal research degree or clinical training within the past 10 years and not having previously received a substantial NIH independent research award.[17] Additional characteristics of the ESI policy described by NIH Office of Extramural Research staff in their 2018 *Research Evaluations* paper that resonate with the EIA assessment include the purpose of the ESI policy (to increase the probability of new investigators receiving research support), that biomedical research benefits from youth and diversity, and that receipt of independent research support, in the case of ESI the first R01 award, is often viewed as an important milestone marking the transition to established investigator.[18]

There are two assumptions underlying the use of an ESI comparison group. First, it is generally assumed that ESIs were post-doctoral trainees for multiple years, often 5–8 years, and second, that this training is necessary for the development of the scientific problem-solving and productivity needed to transition to research independence. These years of post-doctoral (or equivalent research experience) place ESI awardees further along their research career trajectory; however, they remain at the start of an independent academic research career.[19] Additionally, ESI awardees develop funding applications for the well-established NIH R01 mechanism, and the R01 is generally equivalent to the EIA DP5 in funding amount and length of award (Figure 3).

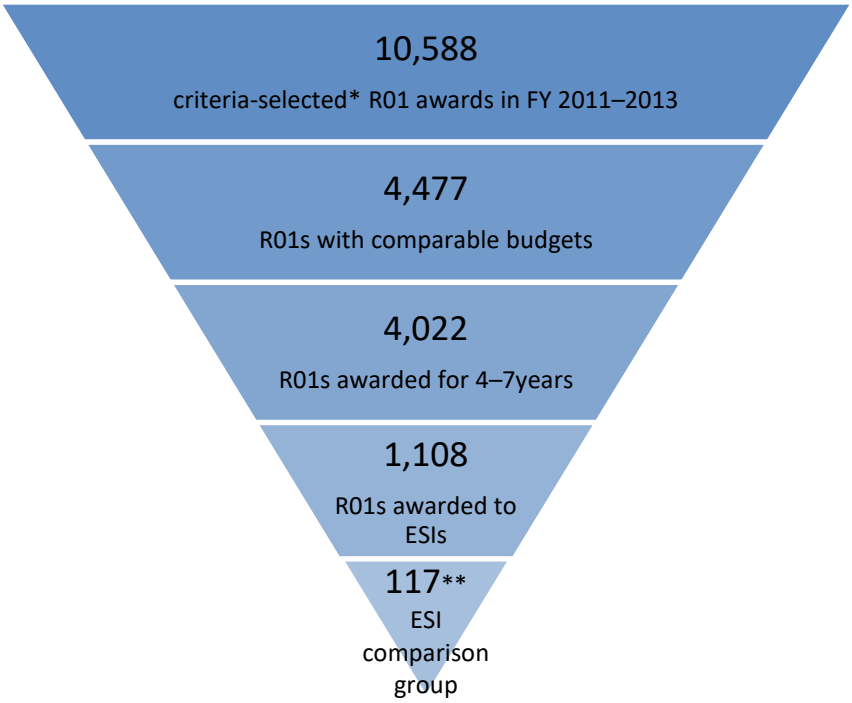
Because of the potential for ESI awardees to be less incentivized than EIA awardees to participate in an HRHR survey, 117 ESI awardees were identified so that, using an average response rate of 25%, the number of completed ESI surveys would approximate an incentivized EIA survey response.

---

[17] https://grants.nih.gov/policy/early-investigators/index.htm

[18] Walsh, R., Moore, R.F., Doyle, J.M. 2018. "An evaluation of the National Institutes of Health Early Stage Investigatory policy: using existing data to evaluate federal policy." *Research Evaluation* 27(4): 380-387.

[19] Ibid.



* QVR selection criteria: Type 1, R01, Primary/Administrative Projects Only, Awarded, Fiscal Year 2011, 2012, or 2013, and Competing Projects Only.

**Identified through Propensity Score Matching (detailed in survey methods section).

Figure 3. Strategy to Identify ESI Awardees

To address the final criterion, area of science, STPI performed a manual subject matter expert analysis of the abstracts for all EIA and ESI awardees selected through a propensity score matching analysis.[20] STPI determined that, at the level of biomedical research, biobehavioral research, tools, and therapy, the number of awards in each category is proportional for EIA and ESI award (analysis detailed in Appendix A).[21]

STPI notes that this study is challenged by small sample sizes and recommends caution when interpreting results, particularly those from the awardee surveys. Efforts were made to increase the awardee survey response rate, full details of which can be found in the awardee survey administration section 2.A.2. Limitations to the study as a result of small sample sizes can be found in full in section 2.D.

---

[20] STPI first analyzed areas of science in the EIA and ESI abstracts using the Pacific Northwest National Laboratory's INSPIRE software; however, the corpus was too small for this to be a successful approach.

[21] A chi-squared test of independence was used to assess whether EIA and ESI awards were similarly distributed across the different areas of science. Results indicated that the proportion of EIA and ESI awards for biomedical research, biobehavioral research, tools, and therapy were not significantly different from one another ($\chi_3^2 = 3.96, p = 0.41$).

3. Survey of Awardees

Surveys sample individuals from a population to make inferences about the population being studied. STPI designed the EIA survey to address the study questions using the concepts of readiness, research, and career—and developed a plan to maximize the survey response rate so that inferences about the EIA initiative and awardees in FY 2011–2013 might be considered even though they may not be statistically significant (Figure 4). The utility of additional training for exceptional junior investigators was addressed through questions about length of post-doctoral training and activities surrounding the transition to independence. The term *awardees* is used when the entire comparison group is being analyzed or discussed, and *respondents* is used to delineate analyses and discussions that pertain solely to those who completed the survey.

1) Readiness

The readiness metrics measure how prepared awardees were to establish an independent research laboratory and scientific program. Metrics used to assess readiness include the number of years of post-doctoral fellowship training and general measures querying the *transition to independence*. Additional survey questions explored readiness for the *activities* necessary to establish a research program and included the complexities of establishing a lab, managing staff, and initiating new collaborations. The next measure asked awardees to consider, *at the time of application*, whether they were in an independent research position, or whether they had received an offer for an independent position, both indicative of external validation of their readiness for independence.

2) Research

Research metrics centered on the awardees' research accomplishments. These metrics included items relevant to research output and included questions that explored collaboration, expansion of scientific topic areas and their laboratory, and publishing research findings independent of their graduate or post-doctoral advisor.

3) Career

The career metrics collected information on important milestones and recognition the recipient may have received as a result of their award. Career metrics include questions of career advancement, public recognition, as well as any unintended consequences of their award. This construct also included questions that asked about institutional support, work-life balance, and measures of quality of life.

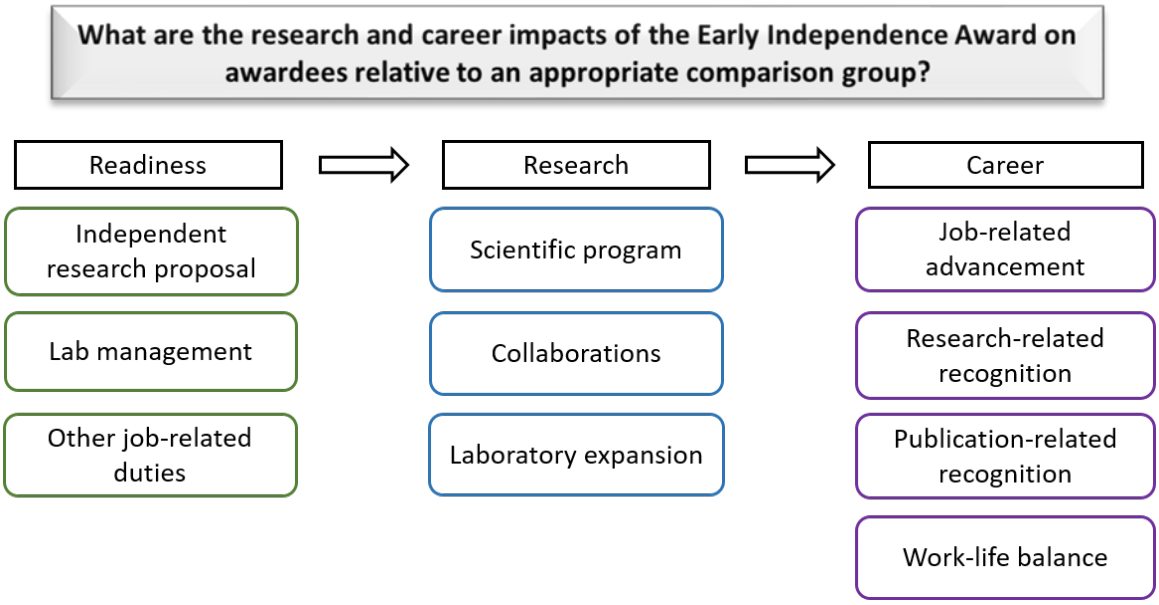


Figure 4. Survey Concepts Grouped by Readiness, Research, and Career

4. Bibliometric Analyses

Bibliometric analyses provide a qualitative measure of quantity, quality, and impact of published scientific articles.[22] STPI assessed well-established publication and citation metrics, as well as more recent, non-traditional article-level metrics. Altmetric collects data from citations on Wikipedia; public policy documents; discussions on research blogs; coverage in mainstream media; and mentions on social media such as Twitter and Facebook (Figure 5).[23] Although altmetrics are not accepted as a rigorous measure of quantity and quality on its own, it does provide an additional dimension to the understanding of scientific impact.

[22] https://library.leeds.ac.uk/info/1406/researcher_support/17/measuring_research_impact

[23] Altmetric. 2020. "What are Altmetrics? An Introduction." Accessed 21 May 2020. Available at: https://www.altmetric.com/about-altmetrics/what-are-altmetrics/.

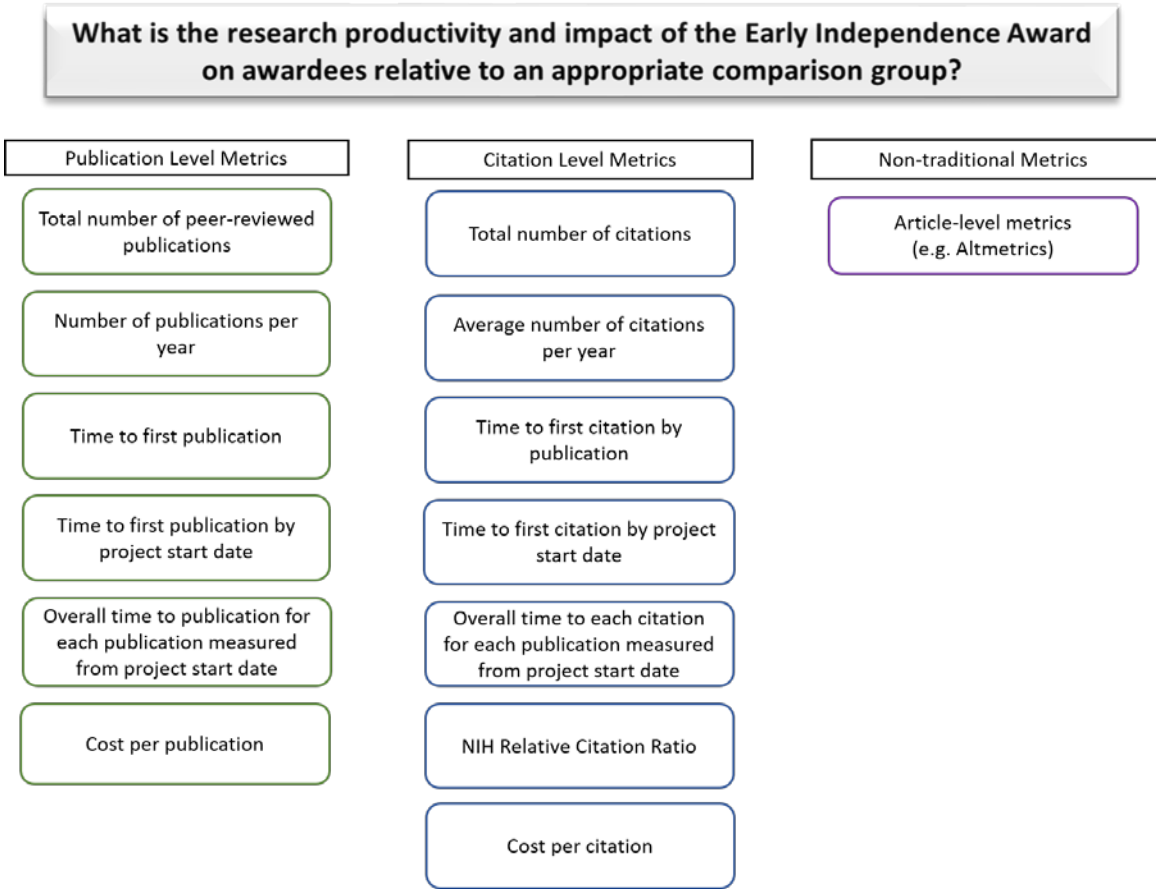


Figure 5. Metrics of Productivity and Impact

5. Biosketch Analysis

Results from the awardee survey identified a group of ESI awardees who reported 0-2 years of post-doctoral experience, a group selected for having had traditional post-doctoral training. Because 0-2 years of training is similar to that allowed for the EIA cohort, STPI assessed employment history between the year of the terminal degree and receipt of the EIA or ESI award as reported in the NIH biosketch for each of these applications.

6. Post-award Grant Analysis

A successful research career requires continual research funding, primarily through the receipt of NIH grants. To assess potential impact of the EIA award on an investigator's ability to obtain NIH grants after receiving the EIA or ESI award, STPI identified the NIH funding history for each EIA and ESI contact PI and analyzed the total number of NIH awards received, number of R01 awards received, and time to first follow-on award and first follow-on R01 award.

7. Organization of the Report

The remainder of this report is organized into the following sections: survey of awardees, bibliometric analyses, biosketch analysis, follow-on funding analysis, integration and context for the findings, and final considerations. Appendix A contains the methodology for comparison group development, Appendix B the survey questions, and Appendix C the survey data tables.

2. Survey of Awardees

A. Methodology

Using the readiness-research-career paradigm to assess EIA awardee impacts (Figure 6), STPI created an online survey to solicit awardees' perspectives on their EIA or ESI awards. The survey questions and survey administration were nearly identical for both EIA and ESI, and differences between the two surveys are discussed below. All survey materials can be found in Appendix B.

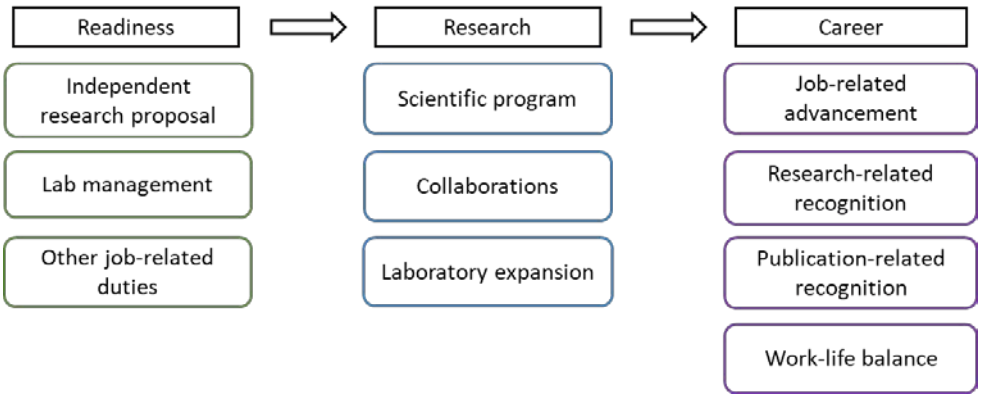


Figure 6. Survey Concepts Assessing Awardee Outputs and Outcomes

1. Survey Development

The STPI team developed survey questions that addressed the multiple aspects of readiness, research, and career. The survey items were iterated with the NIH HRHR team, and content and format were tested through a STPI focus group. A summary of the survey questions by readiness, research, and career categories is provided in Table 1.

Table 1. Survey Questions by Readiness, Research, and Career

Survey Questions	Response Choices (If Applicable)
Readiness	
Please indicate how long you were a post-doctoral fellow.	
Please select whether or not the following had occurred when you applied to your EIA/ESI.	I had already received an offer for an independent research position. I was already in an independent research position.
Please select the extent to which you agree/disagree to the following statements. When I applied for my EIA/ESI, my training had already provided me with the following:	I was able to initiate and build new collaborations. I understood the complexities of establishing my own research lab. My scientific thinking had matured to the point where I could shape a research program. I was prepared to manage technical staff.
When considering your transition to independent research, please select how strongly you agree or disagree with the following statements.	I was able to transition to independent research without significant difficulty. The transition to independence took longer than I expected and impacted my ability to generate research results. There were unforeseen issues in transitioning to independent research.
Think back to the first 2 years of your EIA/ESI. Considering the institution at which you were employed at the time, please select whether the following occurred/did not occur.	I was able to acquire equipment for my research lab. I expanded my lab personnel. My institution gave me adequate research lab space. My institution expanded my research lab space. My institution gave me, or gave me access to, the equipment I needed to conduct my research.

Research	
Below is a list of changes that may have occurred since receiving your EIA. Please select whether the following occurred or did not occur.	I was asked to present my EIA/ESI research findings to research groups in my institution but outside of my department. I was asked to collaborate by other researchers at my institution. I was asked to participate in an institution or department committee, for example the hiring or curriculum committee. I formed new research partnerships/collaborations. I published research findings independent of my graduate or post doc advisor. My EIA/ESI findings launched me into new topic areas. I have expanded my research aims/goals while remaining within my EIA/ESI topic area.
Career	
Below is a list of changes that may have occurred since receiving your EIA/ESI. Please select whether the following occurred or did not occur.	I received and accepted a tenure-track offer at the institution where I received my EIA/ESI award. I received and accepted a tenure-track offer at an institution other than the one at which I received my EIA/ESI award. I received a promotion within the institution where I received my EIA/ESI award. The EIA/ESI grant allowed me to apply for tenure. I was hired into a tenured position. I have the option to stay at my current institution for the next several years.
Please indicate whether or not the following took place for you once your EIA/ESI research was published. Please select all that apply.	My research has been featured on the cover of an academic journal. My research has been featured in the popular press/media. I have been invited to serve as a regular reviewer for a journal. I have been invited to present my research outside of my current institution. I have been invited to serve as a grant reviewer for NIH.

	I served as a grant reviewer for an institution other than NIH.
	I have been invited to serve as a journal reviewer.
	I have been invited to contribute to a technical book.
	I have received an unsolicited inquiry about interest in moving to another institution.
	Other
	NA
Please select how strongly you agree or disagree with the following aspects of your current position.	My institution colleagues are supportive of my early independence.
	My institution supports and values my research.
	The mentoring structure at my institution was supportive of my early independence.
	The health and other employee benefits I am receiving through my institution provide job security that benefits my research.
	My salary provides adequate compensation for my position.
	I have a good balance between research and other responsibilities.
Have you ever experienced any unintended consequences that negatively impacted your career from receiving your EIA/ESI?	Yes, I have experienced unintended consequences
	No, I have not experienced unintended consequences

2. Survey Administration

STPI developed and administered the surveys in SurveyGizmo, a web-based survey platform. Each awardee received a personalized invitation to take the survey; responses were kept confidential; and only aggregate results were provided to NIH. In tandem with the survey, EIA recipients received an email from HRHR staff underlining the importance of the study and asking them to participate in the survey. The survey was sent to the 39 EIA and 117 ESI awardees on January 22, 2020. The first reminder was sent 1 week later, on January 28, 2020, and the final reminder was sent 1 week after that, on February 4, 2020. The survey remained open until February 19, 2020.

3. Survey Analysis

Analysis was performed only on completed surveys. Descriptive statistics such as the number of responses for each question and the percentage of survey respondents selecting each answer choice are provided for each question. Free response questions were coded into a series of qualitative categories and are reported as counts for each category.

Two-sample proportion tests were used for questions with answer choices of *this occurred* and *this did not occur* to examine whether the percentage of survey respondents who selected *this occurred* differed between EIA and ESI awardees. Because there are only two answer choices, STPI did not perform a two-sample proportion test for those who selected *this did not occur* as it is simply the complement of those who selected *this occurred* and would result in the same statistical significance. For survey questions that had Likert scale response choices (e.g., *strongly disagree* to *strongly agree*), positive answer choices were summed and a two-sample proportion test was performed to compare whether the percentage of survey respondents who responded positively differed between EIA and ESI awardees. A two-sample proportion test was also performed for *select all that apply* questions to compare the percentage of EIA and ESI respondents who selected that item.

All statistically significant findings in this analysis are significant at $p < 0.05$. Additional descriptive statistics such as counts and percentage of survey respondents responding to each answer choice are also included in the analysis. Complete data, including all statistical tests, can be found in Appendix C.

B. Survey Results

1. Response Rate

EIA awardees completed 25 surveys (39 eligible awardees; 64% response rate) and ESI awardees completed 39 surveys (117 eligible awardees; 33% response rate).[24] More ESI awardees than EIA awardees received an invitation to participate in the survey to obtain approximately the same number of ESI respondents as EIA respondents.

2. Descriptive Statistics

a. Readiness metrics

The post-doctoral fellowship that occurs after the receipt of a graduate degree is considered a training experience that matures the scientific thinking and laboratory management skills needed for research independence. Exceptional junior investigators are thought to possess these skills and abilities by the end of their graduate training, and the 2011–2013 EIA FOA stipulated that an awardee should be within 12 months of their terminal degree or clinical fellowship (EIA FOA hyperlinks listed in footnotes, page 2). STPI examined the relationship between the number of years of post-doctoral training and the transition to independence and, by extension, the first 2 years of the award, as reported by survey respondents.

For number of years spent as a post-doctoral fellow prior to receiving their EIA or ESI award, 44% of EIA survey respondents reported not having a post-doctoral fellowship; 40% indicated having one for less than a year; 16% reported being in a post-doctoral position for 1 to 2 years, and 0% reported spending more than 2 years as a post-doctoral fellow (Figure 7). Among ESI survey respondents, 18% reported no post-doctoral fellowship; 3% spent less than 1 year; 10% spent 1 to 2 years; 59% spent 2 to 5 years, and 10% spent 5 to 8 years as a post-doctoral fellow.

[24] There were four partial (i.e., incomplete) survey responses from both EIA and ESI R01 awardees. These eight partial survey responses were not included in any of the survey analyses.

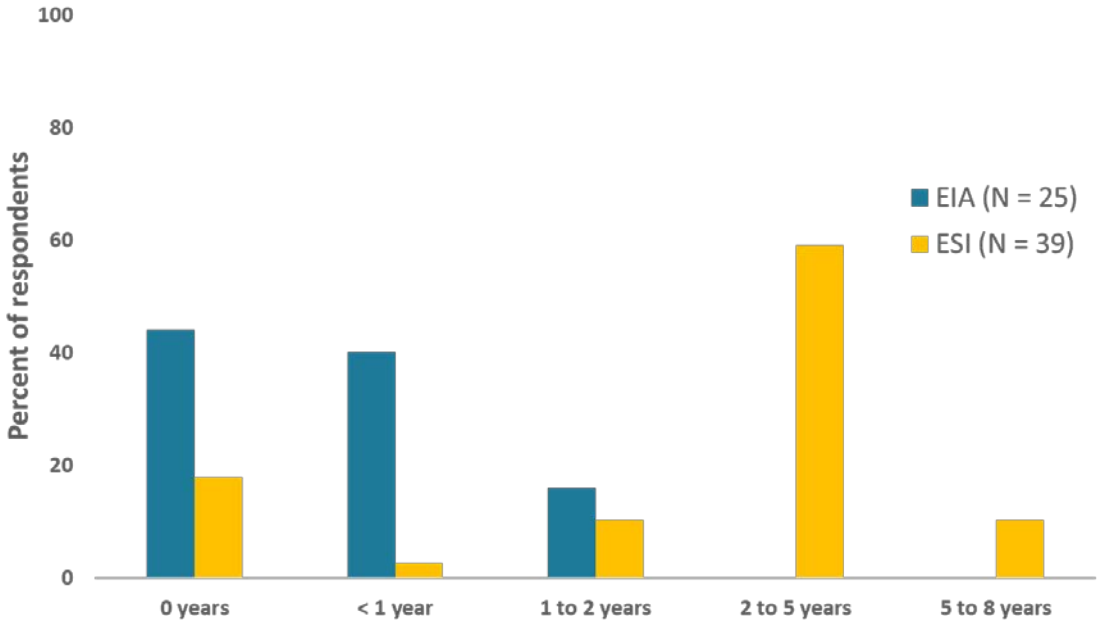


Figure 7. Number of Years Post-Doctoral Fellowship

When asked whether they had received an offer of an independent position at the time of application, 52% of EIA respondents and 60% of ESI respondents reported positively ($\chi_1^2 = 0.17$, $p = 0.68$). A significantly higher percentage of ESI respondents (82% vs. 44% of EIA respondents) indicated they were already in an independent research position at the time of application ($\chi_1^2 = 7.97$, $p < 0.01$; Figure 8).

Figure 8. Research Position at Time of Application

Note: * denotes significant differences (p < 0.05) between the percentage of EIA and ESI survey respondents who selected an answer item.

EIA survey respondents (48%) were significantly less likely than ESI survey respondents (77%) to report that they agreed or strongly agreed with the statement *I was prepared to manage technical staff* ($\chi^2_1 = 4.44, p = 0.04$; Figure 9).

No significant differences were detected between EIA and ESI survey respondents who agreed or strongly agreed with the following statements: *my scientific thinking had matured to the point where I could shape a research program* (88% and 87% for EIA and ESI survey respondents, respectively; ($\chi^2_1 < 0.001, p = 1$); *I understood the complexities of establishing my own research lab* (64% and 79%; $\chi^2_1 = 1.16, p = 0.28$); and *I was able to initiate and build new collaborations* (96% and 87%; $\chi^2_1 = .55, p = 0.46$).

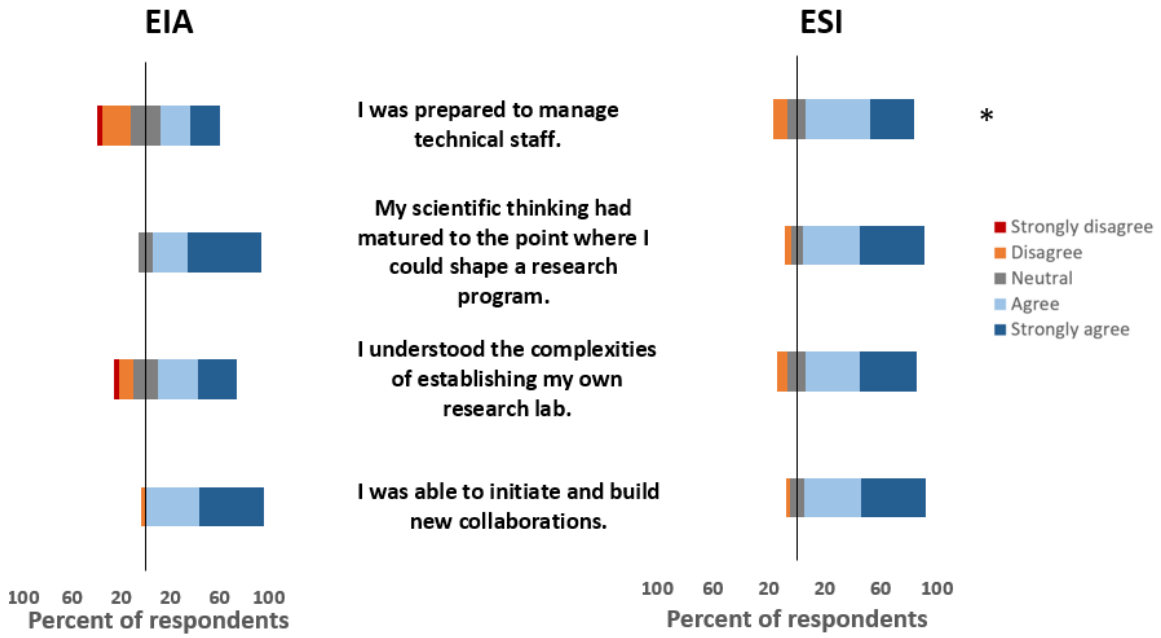


Figure 9. Readiness Metrics at the Time of Application

The next set of questions addressed the transition to independent research, including unforeseen issues, impacts to research results, and general difficulty (Figure 10). EIA and ESI survey respondents reported at similar levels that they agreed or strongly agreed with the statement *there were unforeseen issues in transitioning to independent research.*(40% and 41% for EIA and ESI survey respondents, respectively; $\chi_1^2 < 0.001$, $p = 1$); *the transition to independence took longer than I expected and impacted my ability to generate research results* (40% and 49% ; $\chi_1^2 = 1.49$, $p = .22$); and *I was able to transition to independent research without significant difficulty* (72% and 56% ; $\chi_1^2 = 0.98, p = 0.32$).

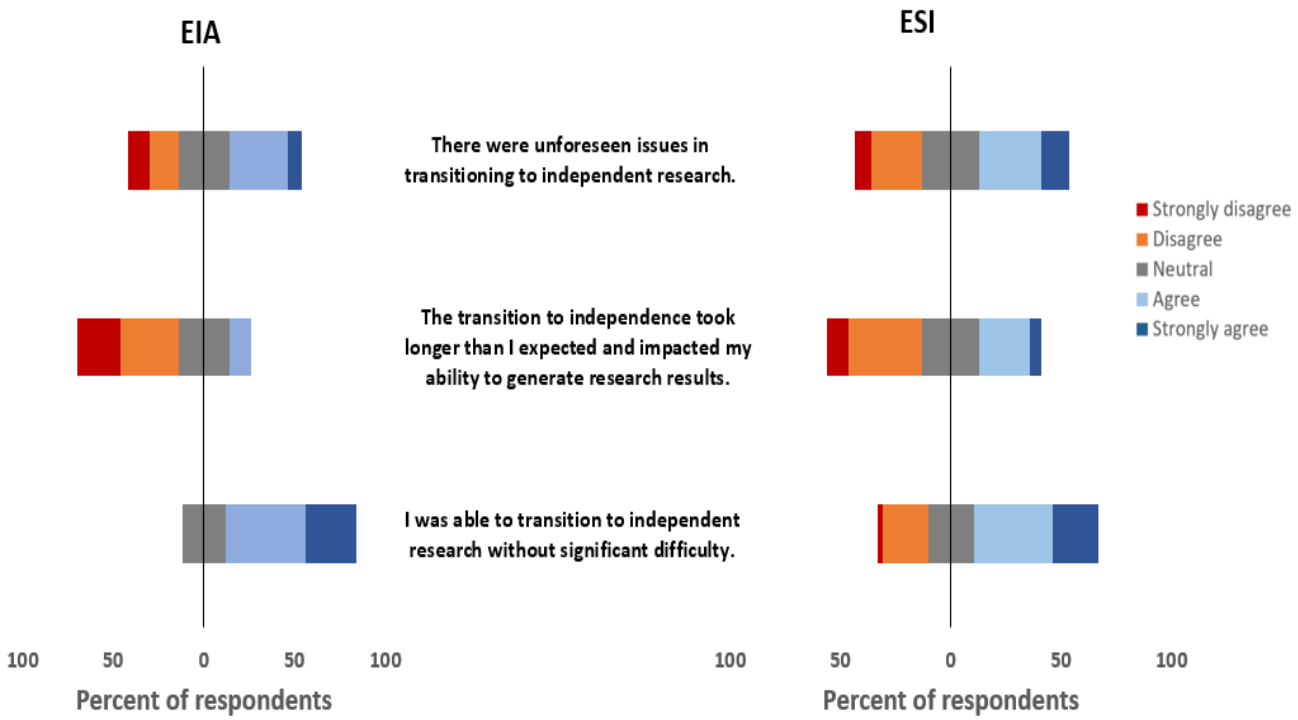


Figure 10. Difficulties in Transitioning to Independent Research

b. Research metrics

Research metrics examine the awardees experience *in the first 2 years* to establish a research program and lab space, and research productivity and impact *over the entire award period* of the award. The first block of questions in this section asked awardees about the first 2 years of their award (Figure 11). EIA survey respondents (100%) were significantly more likely than ESI survey respondents (77%) to report *my institution expanded my research lab space within the first 2 years* ($\chi_1^2 = 4.94, p = 0.03$).

The majority of both EIA (88%) and ESI (95%) respondents indicated *I was able to acquire equipment for my research lab* ($\chi_1^2 = 0.27, p = 0.6$). EIA (48%) and ESI (49%) survey respondents both reported *I expanded my lab personnel* at similar rates ($\chi_1^2 = 0, p = 1$). The rate at which EIA (100%) and ESI (77%) survey respondents reported *my institution gave me adequate research lab space* was not significantly different between the two groups ($\chi_1^2 = 0, p = 1$). In addition, there was no significant difference in the percentage of EIA (92%) and ESI (87%) survey respondents who indicated that *my institution gave me, or gave me access to, the equipment I needed to conduct my research* ($\chi_1^2 = 0.04, p = 0.85$).

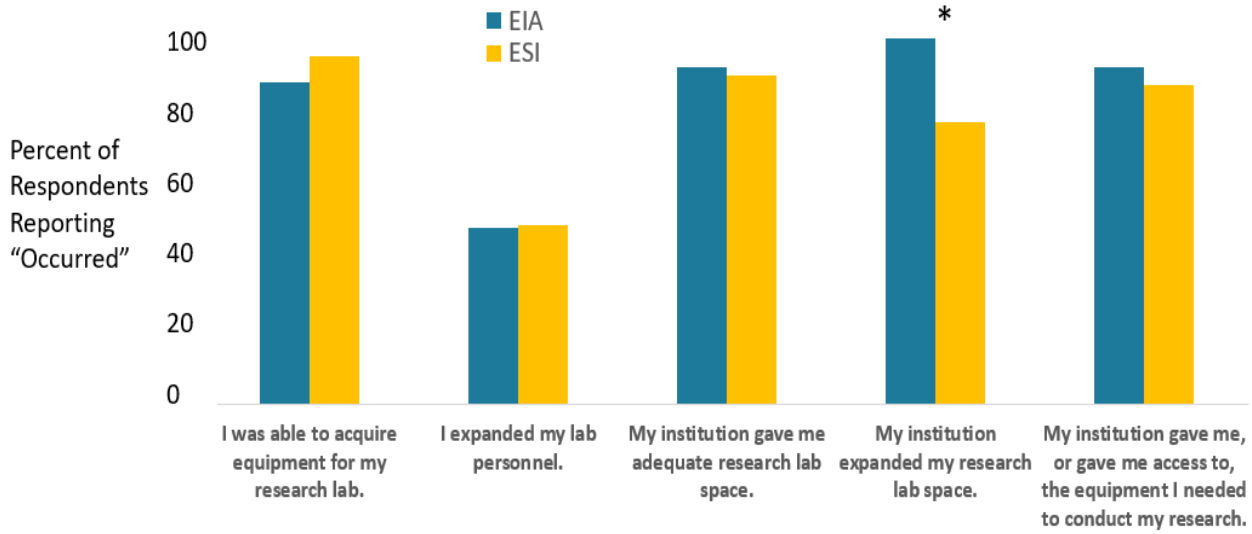
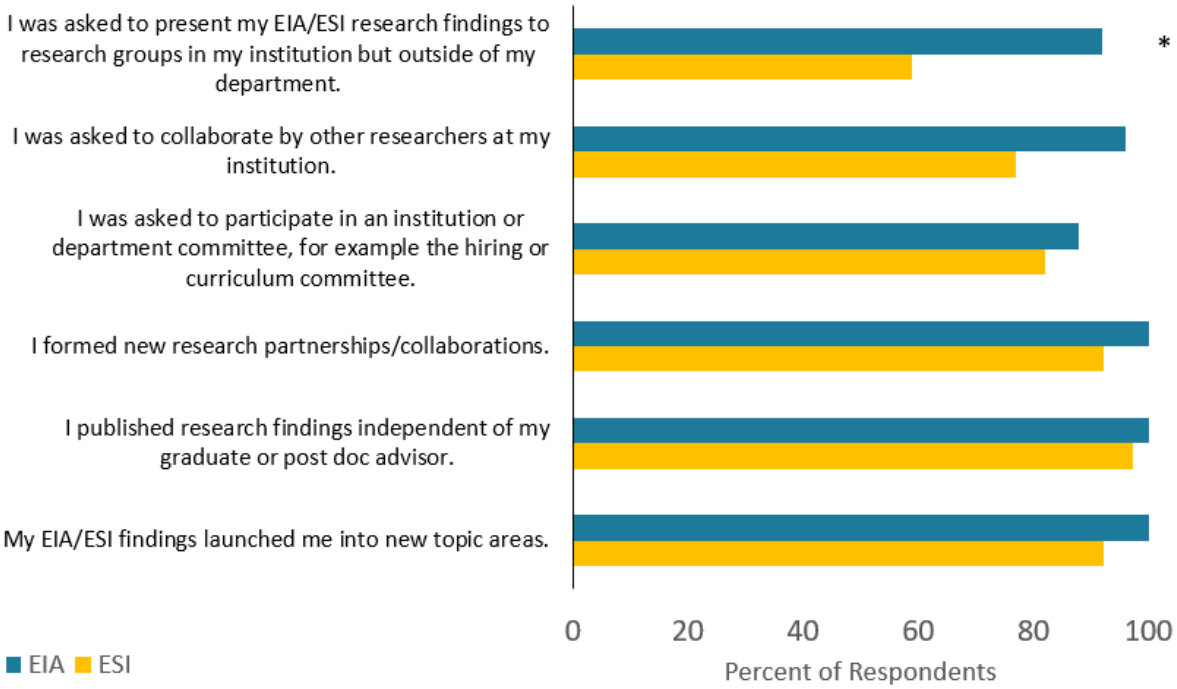


Figure 11. Research Metrics During the First 2 Years of the Grant Period

Note: * denotes significant differences ($p < 0.05$) between the percentage of EIA and ESI survey respondents who selected an answer item.

EIA survey respondents (92%) were significantly more likely than ESI survey respondents (59%) to indicate that they had been *asked to present my EIA/ESI research findings to research groups in my institution but outside of my department* ($\chi^2_1 = 6.67$, $p = 0.01$; Figure 12).

When queried about experiences establishing scientific presence in their departments or institutions, no significant differences were detected between EIA and ESI survey respondents who selected *this occurred* to *I was asked to collaborate by other researchers at my institution* (96% and 77% for EIA and ESI survey respondents, respectively; $\chi^2_1 = 2.88, p = 0.09$); *I was asked to participate in an institution or department committee, for example the hiring or curriculum committee* (88% and 82%; $\chi^2_1 = 0.08, p = 0.77$); *I formed new research partnerships/collaboration* (100% and 97%; $\chi^2_1 = 0.66, p = 0.42$); *I published research findings independent of my graduate or post doc advisor* (100% and 97%: $\chi^2_1 = 0, p = 1$); and *my EIA/ESI findings launched me into new topic areas* (100% and 92%; $\chi^2_1 = 0.66, p = 0.42$).



Asterisks denotes significant differences ($p < 0.05$) between the percentage of EIA and ESI survey respondents who selected an answer item.

Figure 12. Research Metrics

c. Career metrics

In addition to research accomplishments, the ability to retain investigators in biomedical research requires professional recognition and work-life balance. Career metrics collected information on important milestones and accomplishments the recipient may have experienced as a result of their award.

EIA survey respondents (56%) were significantly less likely to respond *I received a promotion within the institution where I received my EIA/ESI award* than ESI survey respondents (90%; $\chi^2_1 = 7.88$, $p = 0.01$; Figure 13). Inversely, EIA respondents (64%) were significantly more likely to select *I received and accepted a tenure-track offer at an institution other than the one at which I received my EIA/ESI award* (13%; $\chi^2_1 = 15.85, p < 0.001$).

No significant differences were detected between EIA and ESI survey respondents who selected *this occurred* to *I have the option to stay at my current institution for the next several years* (92% and 85% for EIA and ESI survey respondents, respectively; $\chi^2_1 = 0.23$, $p = 0.63$); *I was hired into a tenured position* (40% and 28%; $\chi^2_1 = 0.5, p = 0.48$); *the EIA/ESI grant allowed me to apply for tenure* (48% and 61%; $\chi^2_1 = 0.65, p = 0.42$); and *I received and accepted a tenure-track offer at the institution where I received my EIA/ESI award* (44% and 56%; $\chi^2_1 = 0.51, p = 0.48$).

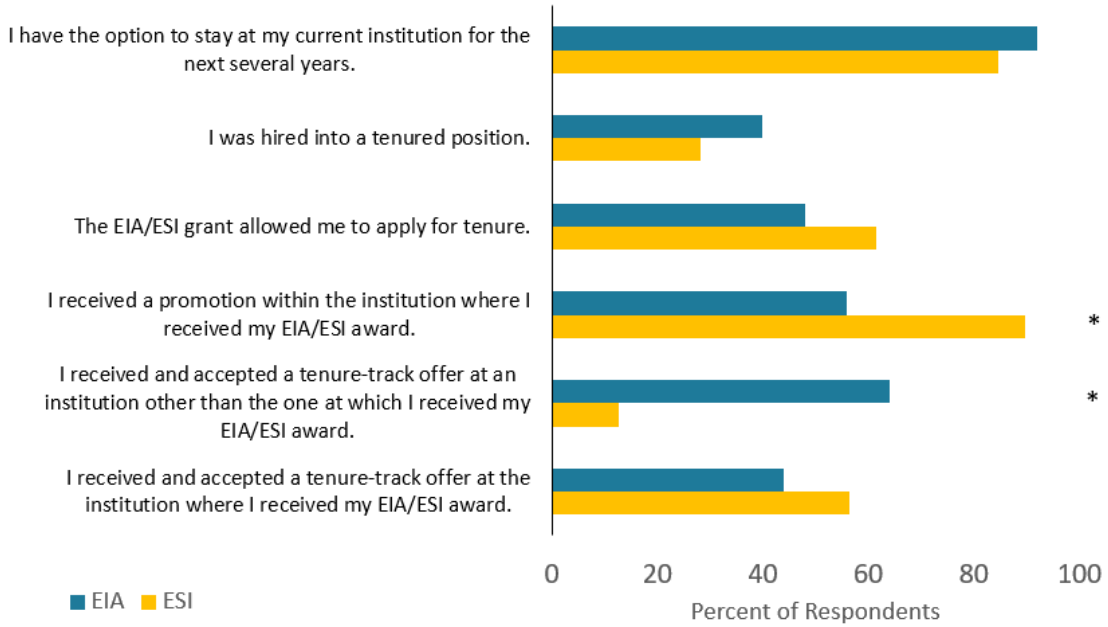


Figure 13. Career Advancement Metrics

Note: * denotes significant differences (p < 0.05) between the percentage of EIA and ESI survey respondents who selected an answer item.

EIA respondents were significantly more likely to respond that their research has been featured in the popular press or media, with about 80% of EIA respondents saying that occurred, versus only 51% of ESI respondents responding that this had occurred ($\chi_1^2 = 4.21, p = 0.04$).

No statistically significant differences were detected between EIA and ESI survey respondents who selected *I have been invited to serve as a journal reviewer* (100% and 100% for EIA and ESI, respectively; $\chi_1^2 =$ NA, $p = NA$); *I have been invited to present my research outside of my current institution* (100% and 90%; $\chi_1^2 = 1.26, p = 0.26$); *I served as a grant reviewer for an institution other than NIH* (88% and 79%; $\chi_1^2 = 0.29, p = 0.59$); *I have been invited to serve as a grant reviewer for NIH* (88% and 85%; $\chi_1^2 < 0.001, p = 0.99$); *I have been invited to serve as a regular reviewer for a journal* (80% and 77%; $\chi_1^2 = 0, p = 1$) ; *I have received an unsolicited inquiry about interest in moving to another institution* (72% and 54%; $\chi_1^2 = 1.42, p = 0.23$); *I ha ve be en in vited to contribute to a technical book* (60% and 54%; $\chi_1^2 = 0.05, p = 0.82$); and *My research has been featured on the cover of an academic journal* (32% and 26%; $\chi_1^2 = 0.07, p = 0.79$; Figure 14).

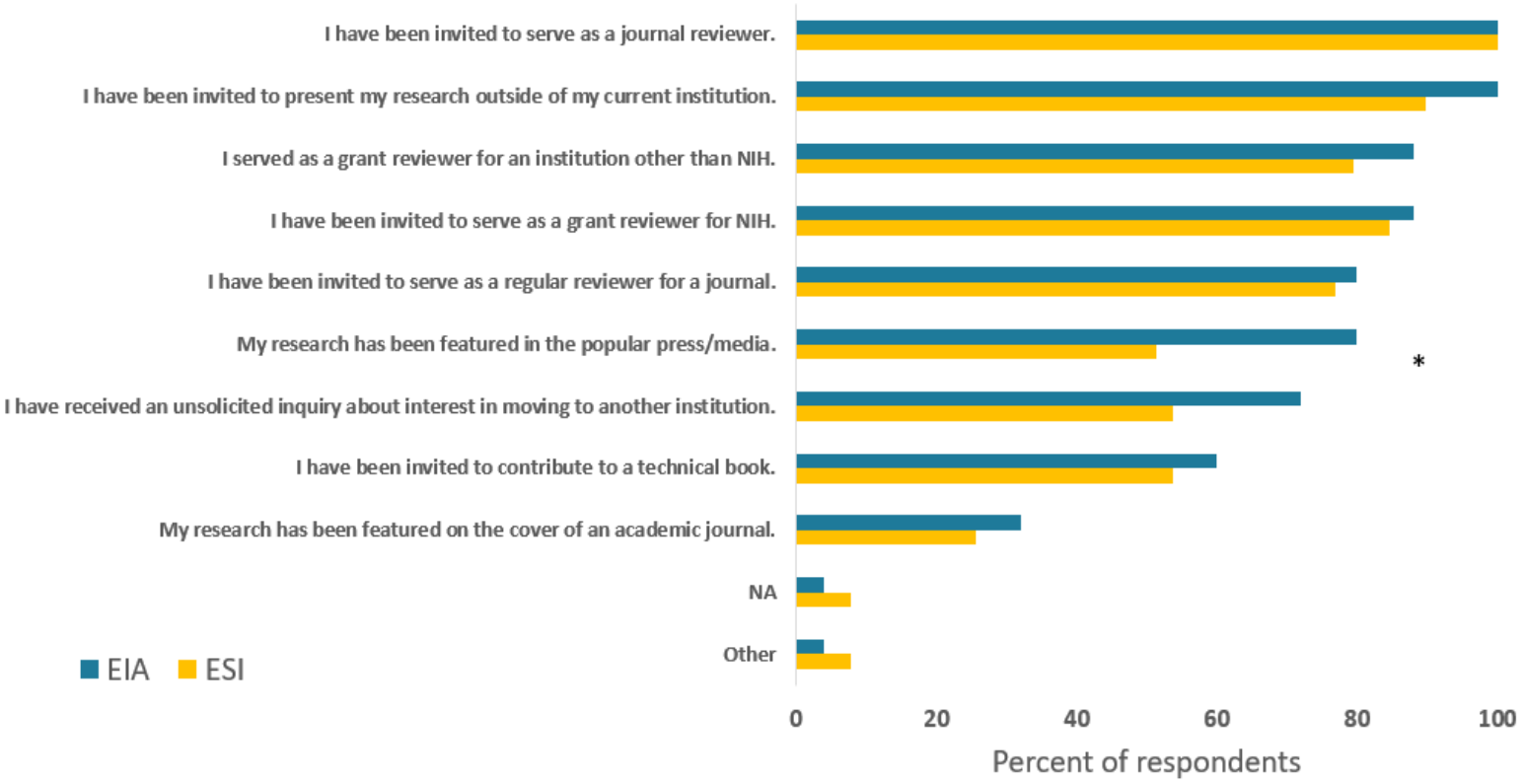


Figure 14. Recognition Metrics

Note: This question was select all that apply. Asterisks denotes significant differences (at $p < 0.05$) between the percentage of EIA and ESI survey respondents who selected an answer item.

When asked which of the recognition items that respondents selected in the previous question that they attributed to their award (Figure 15), the item indicating whether their award was featured in the popular press or media was no longer significant.[25]

No significant differences were detected between EIA and ESI survey respondents who selected the any of the following question items: *I have been invited to serve as a journal reviewer* (56% and 54% for EIA and ESI survey respondents, respectively; $\chi^2_1 < 0.001, p = 1$); *I have been invited to present my research outside of my current institution* (68% and 69%; $\chi^2_1 < 0.001, p = 1$); *I served as a grant reviewer for an institution other than NIH* (54% and 68%; $\chi^2_1 = 0.47, p = 0.49$); *I have been invited to serve as a grant reviewer for NIH* (77% and 79%; $\chi^2_1 < 0.001, p = 1$); *I have been invited to serve as a regular reviewer for a journal* (50% and 37%; $\chi^2_1 = 0.41, p = 0.52$); *I have received an unsolicited inquiry about interest in moving to another institution* (72% and 57%; $\chi^2_1 = 0.41, p = 0.52$); *I have been invited to contribute to a technical book* (40% and 29%; $\chi^2_1 = 0.13, p = 0.72$); and *my research has been featured on the cover of an academic journal* (62% and 60%; $\chi^2_1 < 0.001, p = 1$).

[25] Please note the very low number of respondents in this question.

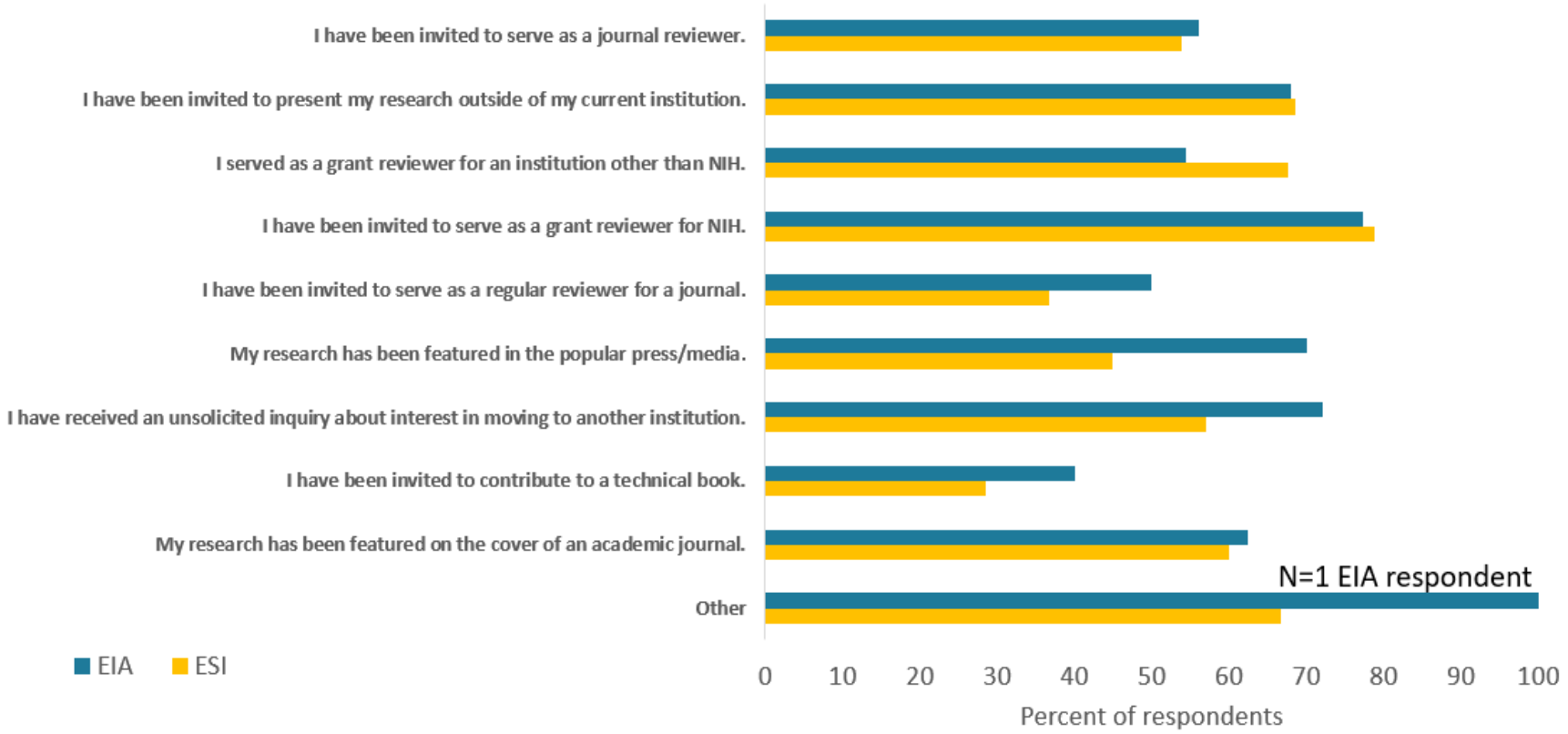


Figure 15. Recognition Metrics Attributed to EIA/ESI

Note: This question was select all that apply, and was only asked of individuals who responded to the previous question, displayed in the previous figure.

EIA survey respondents were significantly more likely to agree or strongly agree to the statements *my salary provides adequate compensation for my position* (92% and 51% for EIA and ESI survey respondents, respectively; $\chi_1^2 = 9.68$, $p = 0.002$); *my institution supports and values my research* (92% and 61%; $\chi_1^2 = 5.77, p = 0.02$); and *my institution colleagues are supportive of my early independence* (100% and 77%; $\chi_1^2 = 4.94$ $p = 0.03$; Figure 16).

No significant differences were detected between EIA and ESI survey respondents who agreed or strongly agreed to *the mentoring structure at my institution was supportive of my early independence* (96% and 79% for EIA and ESI survey respondents, respectively; $\chi_1^2 = 2.21, p = 0.14$); *the health and other employee benefits I am receiving through my institution provide job security that benefits my research* (88% and 67%; $\chi_1^2 = 2.65$ $p = 0.1$); and *I have a good balance between research and other responsibilities* (96% and 74%; $\chi_1^2 = 3.61$ $p = 0.06$).

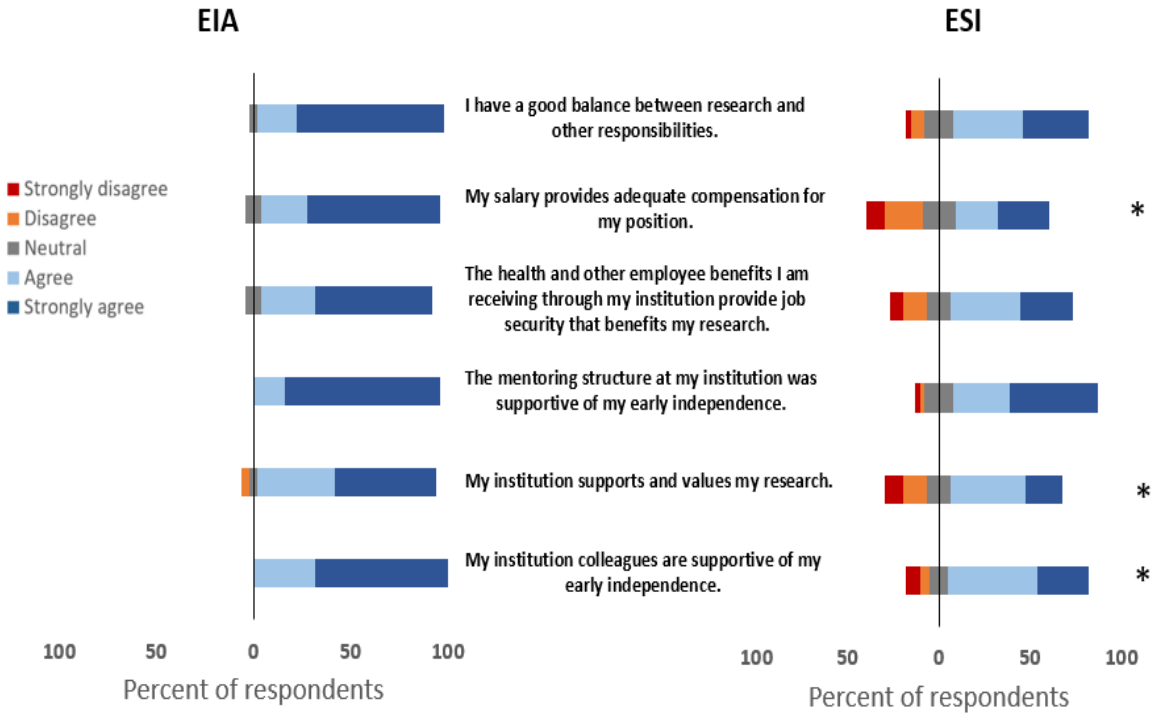


Figure 16. Research, Career, and Personal Balance

Lastly, respondents were asked whether they experienced any unintended consequences as a result of receiving their award. Five EIA survey respondents (20%) responded *yes, I have experienced unintended consequences* as a result of their award, as

well as four ESI survey respondents (10%), which was not significantly different ($\chi^2_1 = 0.53, p = 0.47$; Figure 17). Those who indicated that they experienced unintended consequences were given the opportunity to share their experiences, which are highlighted in the assessment of qualitative data section below.

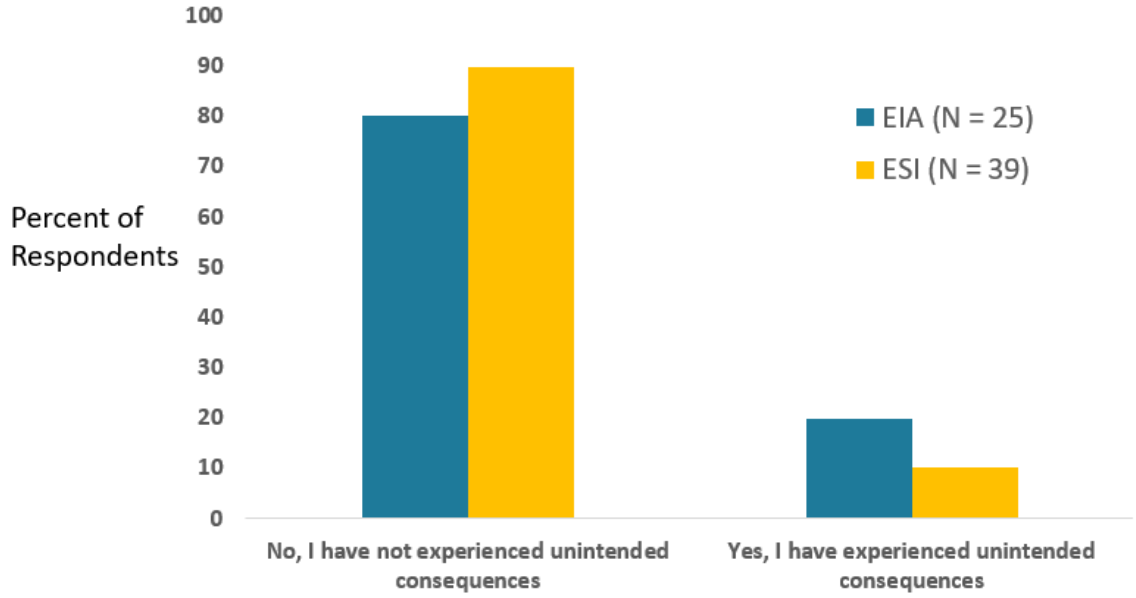


Figure 17. Unintended Consequences as a Result of EIA/ESI

C. Qualitative Analysis of Free Response Questions

In addition to the survey questions asked and examined in the above section, respondents were asked to give their thoughts in free response at various stages of the survey. To analyze these data, STPI inductively coded responses, creating a codebook and then re-coded based on discussions within the research team. Below is an examination of responses separated into questions addressing readiness and questions addressing career trajectory.

1. Readiness

Respondents were given the opportunity to respond to the prompt *you indicated that you experienced difficulty in transitioning to independent research. Please describe what difficulties you encountered,* after answering a series of questions that indicated they experienced difficulties transitioning to independent research—such as the transition to independence took longer than expected, which impacted their ability to generate research results; there were unforeseen issues in transitioning to independence research; or they transitioned to independence with difficulty.

Ten EIA recipients and 15 ESI awardees responded to this question. The results of the qualitative assessment below are presented as three themes: institutional, NIH, and personal difficulties.

a. Institutional difficulties

Half of EIA survey respondents who answered this question indicated that hindrances at their institutions led to difficulty transitioning to independent research (Figure 18). Examples included issues such as inadequate space being provided, general lack of support from their institution, and negative pressure from faculty in senior positions. Both ESI and EIA survey respondents, three from each group, said that they experienced difficulty in setting up their labs. These difficulties included trial and error in finding post-doctoral trainees, a shortage of labor, lab assignment delays, and administrative red tape.

The lack of a mentorship structure built into the ESI/EIA was mentioned as a hindrance and a barrier to getting institutional support. One EIA respondent stated that

> The EIA emphasizes independence while failing to recognize the critical need for mentorship at ALL stages of an academic career. Without a mentorship structure built into/required by the EIA and with the strong emphasis on independence, it was difficult to convince my institution and colleagues that the need for mentorship during this transition period was very critical. It is possible to both promote and advocate for independent research and a mentored career transition period at the same time. It took several years for me to obtain the scale of mentorship I needed, not to identify research questions or pursue my research aims, but to learn how to establish my research group, to mentor students/staff/post-doc, and to balance research/teaching/other responsibilities.

An ESI respondent had a similar comment, reporting that it was difficult to establish independence when you need a mentor.

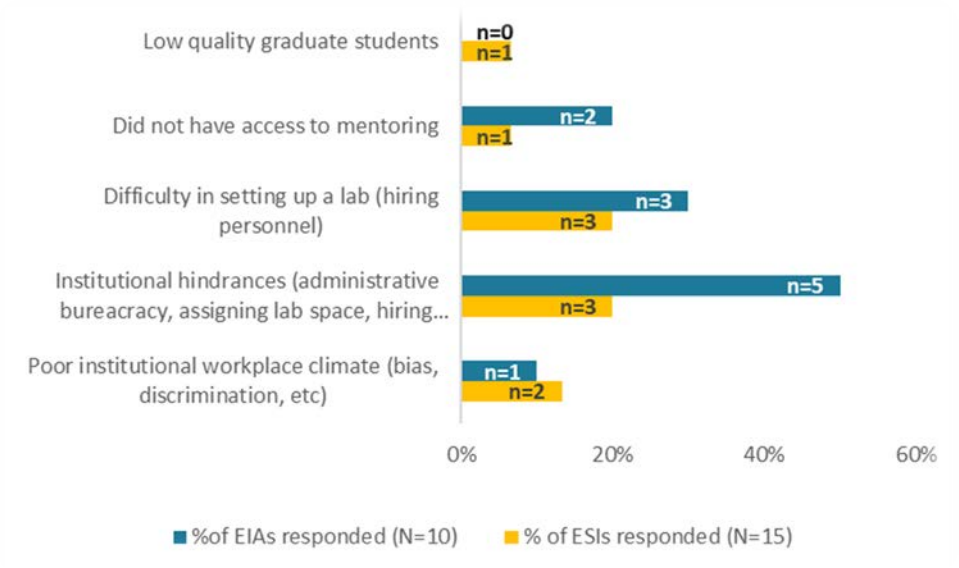


Figure 18. Institutional Difficulties

*This question was only asked of those that indicated they experienced difficulty transitioning to independent research.

** Individuals could have provided feedback in multiple areas; totals may not equal 100%

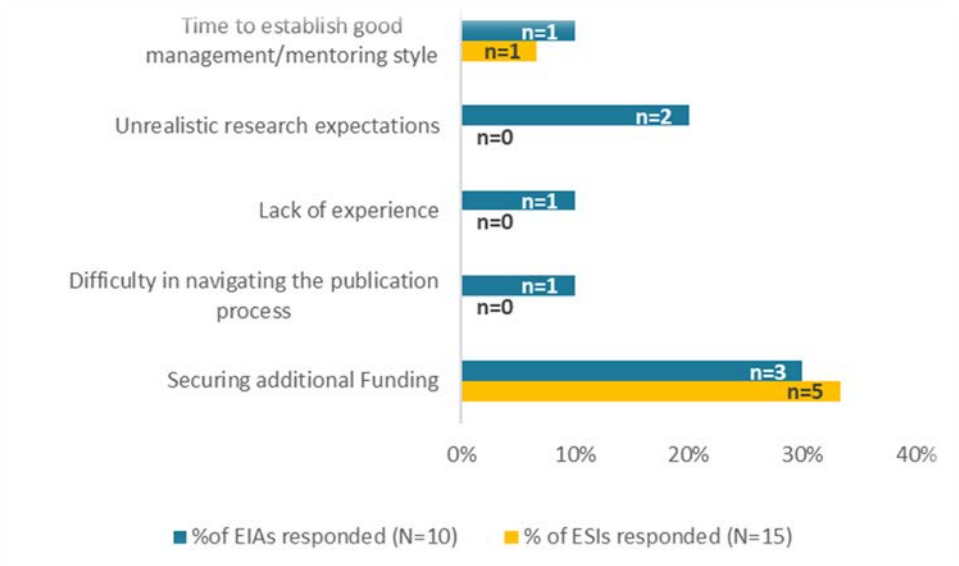
b. NIH difficulties

Another category of difficulties identified were those regarding NIH. These difficulties included securing additional funding, unrealistic research expectations, and lack of mentoring (Figure 19). Five ESI and three EIA survey respondents indicated that securing additional funding was a source of difficulty. One EIA respondent indicated,

> I feel that I may not have gained momentum quickly enough to generate enough preliminary data for an R01, given we lose new investigator status. So, there is some turbulence 5 years later: certainly survivable, but not optimal.

Another EIA respondent described their unrealistic research expectations, saying

> Many of the things I proposed in my EIA application proved to be difficult, wrong, or not worth doing. However, the ability to fail and take risks was instrumental to the research I am doing today, which I believe to be very high impact.



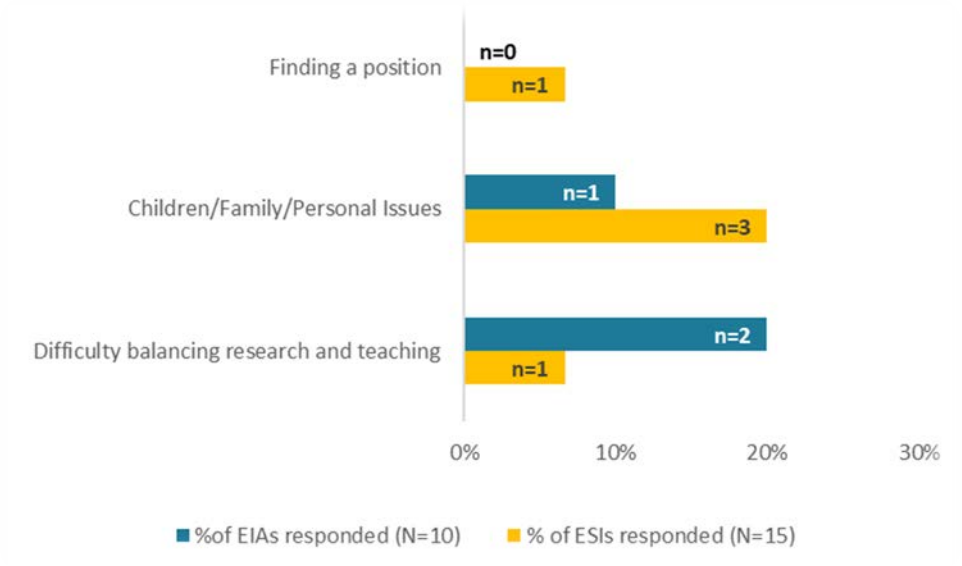
*This question was only asked of those that indicated they experienced difficulty transitioning to independent research.

** Individuals could have provided feedback in multiple areas; totals may not equal 100%

Figure 19. NIH Difficulties

c. Personal difficulties

This last category, personal difficulties, encompassed some of the more intangible measures (Figure 20). These reasons have been identified as why the transition to independent research may have been difficult, but fall outside responsibilities for which institutions or NIH are traditionally responsible. They included difficulties balancing research and teaching and responsibilities for children or family. One ESI respondent indicated difficulty in becoming completely independent from their post-doctoral mentor.



*This question was only asked of those that indicated they experienced difficulty transitioning to independent research.

** Individuals could have provided feedback in multiple areas; totals may not equal 100%

Figure 20. Personal Difficulties

2. Career Direction

The question *what is your current job title? Please include academic rank, if applicable,* gave survey respondents the opportunity to provide their title as of the time they filled out the survey. No ESI survey respondents reported having the title of assistant professor (Figure 21). Only one EIA survey respondent reported having the title of full professor. Roughly a similar percentage reported having the title of associate professor, or equivalent. The distribution across academic rank appears to be similar but delayed between EIA versus ESI survey respondents.

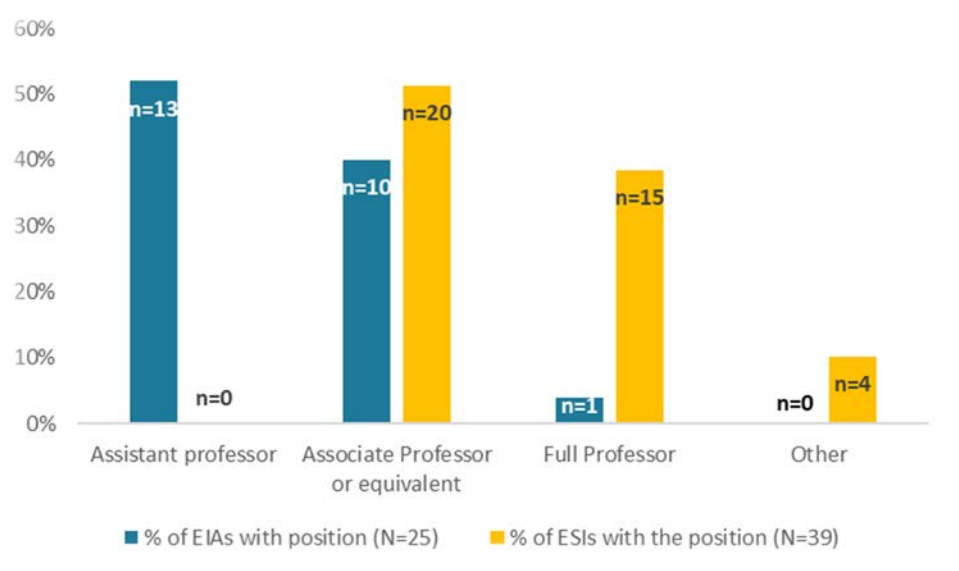
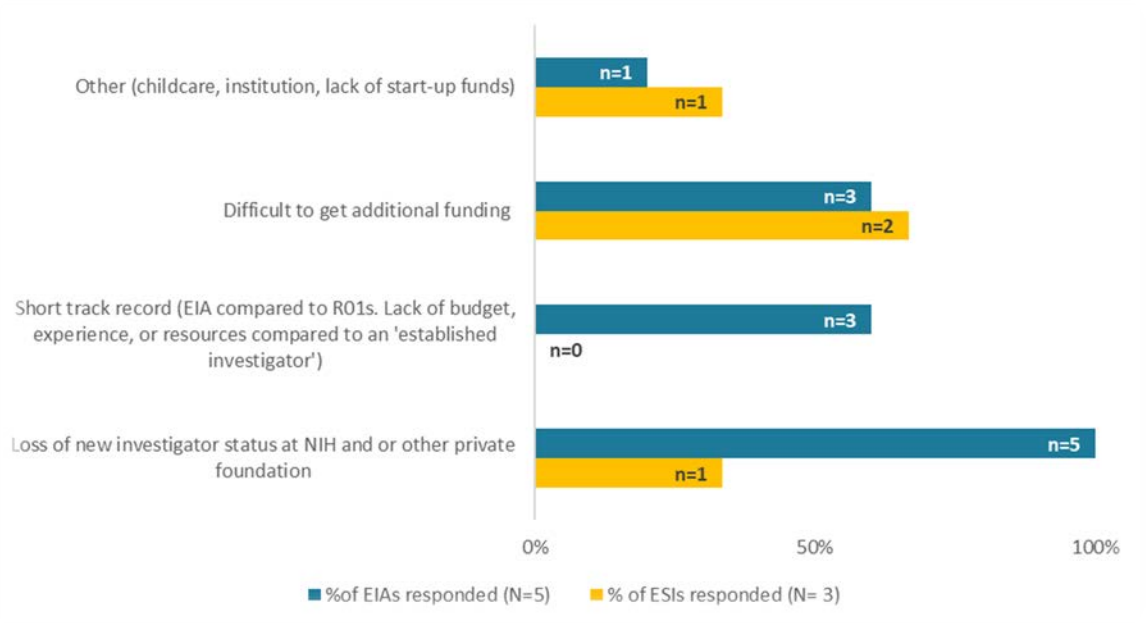


Figure 21. Current Job Title

* This question was asked of those that indicated they had experienced unintended consequences as a result of receiving their award.

** Individuals could have provided feedback in multiple areas; totals may not equal 100%

Survey participants were shown the question *please describe briefly what those consequences have been* if they responded that they had experienced unintended consequences as a result of their award. The loss of new investigator status, with five EIA and one ESI survey respondents noted, was the largest source of unintended consequences, and was observed throughout the qualitative responses (Figure 22). Three EIA and two ESI survey respondents also indicated that it was difficult to get additional funding.

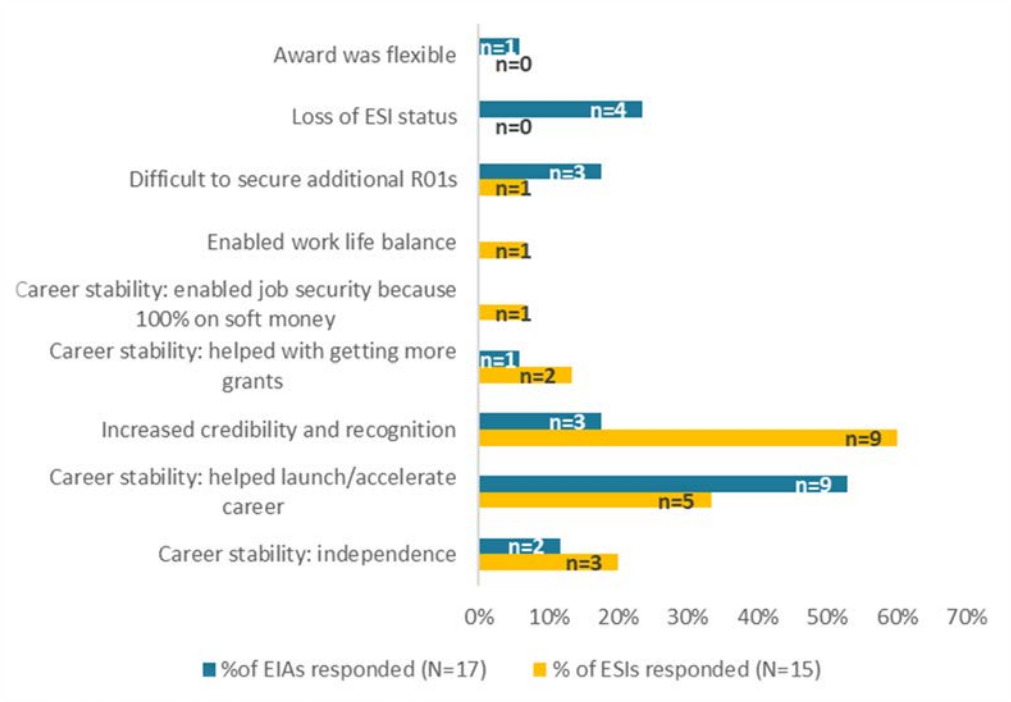


* This question was asked of those that indicated they had experienced unintended consequences as a result of receiving their award.

** Individuals could have provided feedback in multiple areas; totals may not equal 100%

Figure 22. Unintended Consequences

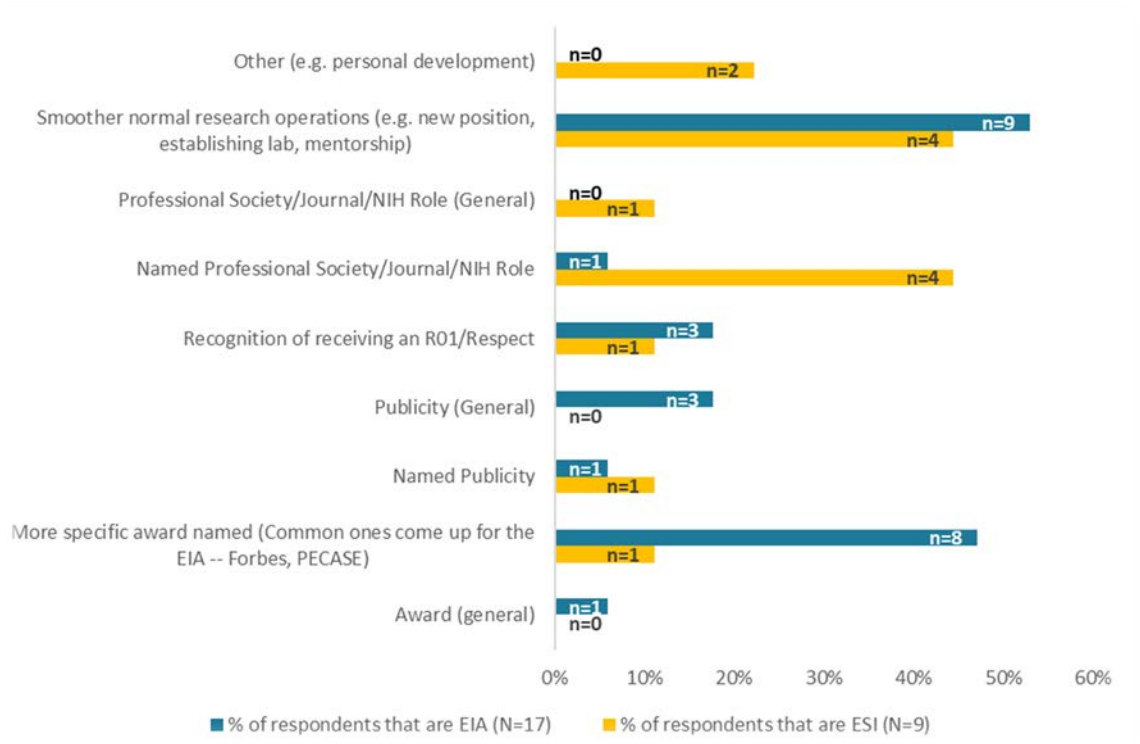
For the request *please share any additional information with regard to the impact that your first R01/EIA has had on your career*, the majority of ESI survey respondents who answered the question indicated that their ESI helped increase their credibility and recognition (Figure 23). However, more than half of EIA survey respondents indicated that their award helped launch or accelerated their career. Four EIA survey respondents indicated that the loss of their ESI status had an impact on their career, a theme we saw repeated throughout the qualitative responses.



*Individuals could have provided feedback in multiple areas; totals may not equal 100%

Figure 23. Impact on Career

For the most part, the request *describe any other recognition that may have resulted from your first R01/EIA and has had impact on your career path* provided an opportunity for survey respondents to more specifically identify additional awards that they have received (Figure 24). Many more EIA survey respondents (n = 17) answered this question than ESI survey respondents (n = 9). Many of the responses indicated smoother than normal research operations, which while not *recognition* do indicate a positive impact of the award. Comments included getting a new job, with one EIA respondent saying that their institution "hired me in part based on the recognition of my EIA."



*Individuals could have provided feedback in multiple areas; totals may not equal 100%

Figure 24. Additional Recognition

D. Limitations to the Data

As a reminder, 25 EIA and 39 ESI awardees responded to the survey. Based on these sample sizes, the estimated effect size for a two-tailed alternative hypothesis testing to detect mean differences in two independent groups is $d = 0.73$. With power set at 0.80, this means that STPI could only detect large differences between EIA and ESI survey responses. Consequently, caution should be taken when interpreting survey results. Small sample sizes result in large standard errors, which leads to imprecise estimates of the true effects between groups of interest, in this case, the EIA and ESI awardees. Therefore, the survey results described in this report should not be taken as firm conclusions representing the actual awardee populations. For instance, a lack of statistical significance does not mean there is no effect; it might be the case that there was insufficient power to detect the effect of interest. Similarly, small sample sizes can lead to false-positive results and an overestimation of the magnitude of the relationship between two variables. In other words, a result with statistical significance does not mean there is a true effect between the groups of interest. Overall, careful consideration should be taken not to make strong conclusions about the EIA and ESI awardees, regardless of whether survey results yielded statistical significance.

3. Bibliometric Analyses

Bibliometric analyses were performed on all publications attributed to each grant award and on the subset of publications for which the awardee was the first or last author. The methodology is common to both sets of analyses, and the results for all publications are presented first, followed by those for the first/last author subset.

A. Methodology for Bibliometric Analyses

To assess whether there are bibliometric differences between EIA and ESI outputs, STPI examined a variety of publication and citation level metrics, detailed in Figure 25 and text below. In addition, STPI used Altmetric data as a measure of professional recognition to complement our traditional, citation-based analyses to provide a more comprehensive understanding and assessment of early career research influence.

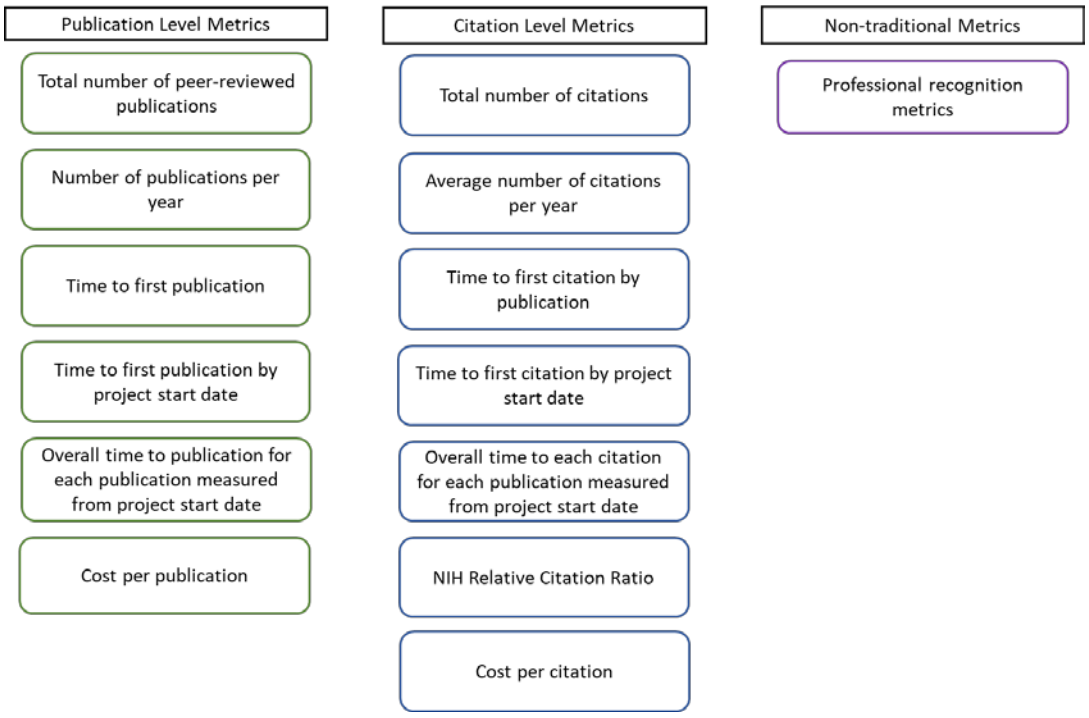


Figure 25. Bibliometric Analysis of Awardee Productivity and Impact

To acquire EIA and ESI bibliometric data (i.e., publications and citations), STPI entered EIA and ESI grant numbers acquired from NIH's Query, View, and Report (QVR)

system into NIH's Scientific Publication Information Retrieval and Evaluation System (SPIRES) and NIH iCite.[26] To obtain all publications associated with each grant, STPI entered grant numbers into SPIRES.[27] To obtain all the citations associated with each publication, STPI entered publication PMIDs from SPIREs into NIH iCite.

All 39 EIA and 117 ESI awardees were included in the bibliometric analyses. Only publications attributed to the EIA and ESI awards of interest, as designated in NIH's QVR system in SPIRES, are included in the following analyses. In addition, publications were limited to those that were published within 6 years of an award's project start date in order to standardize for the two active EIA grants that remain active in year six of their award.

Similarly, NIH's iCite database only contains citation data for articles published between 1980 and 2019, and has relative citation ratio (RCR)[28] data only for articles published between 1980 and 2018.

1. Publication Level Metrics

To assess whether publication output differed between EIA and ESI awards, STPI considered the following metrics:

- *total number of publications produced per award,*
- *mean rank of publications produced per award per year*, and
- *mean rank total direct cost spent per publication per award*.

To determine whether the *total number of publications produced per award* differed between EIA and ESI awards, a generalized linear model (GLM) with a Poisson distribution was used with *total number of publications produced per award* as the dependent variable, and *group* (EIA or ESI) as the explanatory variable. In addition, because there are other confounding variables that could influence the total number of publications produced for a given award, STPI performed a multi-variable GLM regression analysis to take into consideration the effects of the following confounds in addition to *group*:

- *award duration* (continuous variable, units in years),

---

[26] iCite can be accessed at https://icite.od.nih.gov/.

[27] SPIRES is a database that automatically maps PubMed publication records to NIH project numbers. As such, publications included in STPI's bibliometric analyses are based on their associations with NIH grant numbers and not the awardees themselves. Therefore, publications where the awardee is not listed as an author or co-author but cites the NIH grant number of interest as a funding source are included in our bibliometric analyses.

[28] Hutchins BI, Yuan X, Anderson JM, Santangelo GM. Relative citation ratio (RCR): a new metric that uses citation rates to measure influence at the article level. PLoS Biol. 2016 Sep 6;14(9):e1002541. doi: 10.1371/journal.pbio.1002541.

- *total direct cost* (continuous variable, units in dollars), and
- *area of science* (categorical variable consisting of behavioral research, biomedical research, therapy intervention, health care, and tool development).

A type-II sum of squares analysis of deviance was performed to assess which of the explanatory variables in the GLM significantly affected the *total number of publications produced per award*. To determine which areas of science are significantly different from one another, pairwise comparisons among the different areas of science were performed using a post-hoc Tukey test.[29,30,31] Awards with zero publications were included in both the single- and multi-variable regression analyses.

A non-parametric Kruskal-Wallis rank sum test[32] was used to assess whether the *mean rank of publications produced per award per year* and the *mean rank total direct cost spent per publication per award* differed by *group*. The number of publications produced per award per year was calculated by taking the total number of publications produced by an award divided by the award duration (in years). The total direct cost spent per publication per award was calculated by dividing the total direct cost for an award by the total number of publications produced by that award. Awards with zero publications were removed from both analyses.

Lastly, STPI assessed whether *time to first publication* as well as *overall time to publication* (i.e., the rate at which articles were published) were significantly different by *group*. Publications that provided at least the month and year for the publication date were included in this analysis. *Time to first publication* was calculated as the number of days between the project start date and the publication date for the first article attributed to an award. Articles published after the first publication were removed from this analysis. *Overall time to publication* was calculated as the number of days between the project start date and the publication date for each article attributed to an award. For publications in which only the month and year were provided, the *day* unit was set to the first of the month.

---

[29] Results from the GLM indicates which factors are significant overall but does not provide any information on how different groups within a factor differ from one another. A post-hoc Tukey test is a multiple comparison procedure that compares the mean of each treatment group to the mean of every other treatment group (i.e., all possible pairs of means are compared).

[30] The post-hoc Tukey test was conducted with the *glht* function from the *multcomp* package in R.

[31] Hothorn, T., Bretz, F., Westfall, P., Heiberger, R.M., Schuetzenmeister, A., Scheibe, S. 2020. "Package 'multcomp.' Simultaneous inference in general parametric models. Version 1.4-13." Available at http://multcomp.R-forge.R-project.org.

[32] The Kruskal-Wallis test is a non-parametric method used to compare whether two or more independent samples originate from the same distribution. STPI checked that both EIA and ESI data for *publications produced per award per year* had the same distribution. Similarly, STPI checked that EIA and ESI data for and *total direct cost spent per publication per award* came from the same distribution. It is commonly used when the assumptions of a one-way analysis of variance (ANOVA) are not met.

A Cox proportional hazard model was used to examine whether *group* was predictive of both *time to first publication* and *overall time to publication*. Awards with zero publications were removed from this analysis.

2. Citation Level Metrics

Differences between EIA and ESI awards were assessed for the following citation level metrics:

- *total number of citations received per publication*,
- *total number of citations received per award*,
- *average number of citations received per publication per year*,
- *average total direct cost spent per citation received per award*, and
- *average RCR*.

The total number of citations received per publication, average number of citations received per publication per year, and RCR are data provided by iCite. STPI calculated the average total direct cost spent per citation per award by dividing the total direct cost of an award by the total number of citations received across all publications that fell within the specified time frame described above for an award.

A GLM with a Poisson distribution was used to assess whether the *total number of citations received per publication* (dependent variable) differed by *group* (explanatory variable). Similarly, a GLM with a Poisson distribution was also used to assess whether the *total number of citations received per award* (dependent variable) differed by *group* (explanatory variable) at the grant level. STPI performed a multi-variable GLM regression analysis at the grant level to take into consideration the effects of the same confounders listed in the publication analysis (*group*, *award duration*, *total direct cost*, whether the award had *multi-PI*, and *area of science*). A separate multi-variable GLM regression analysis was performed at the publication level to account for *year of publication* (continuous variable) and *total number of authors* (continuous variable) as potential confounders on top of *group* and whether the award had *multi-PI*. A type-II sum of squares analysis of deviance was performed for each GLM to assess which explanatory variable(s) is predictive of the total number of citations received. To determine which areas of science differed significantly from one another, pairwise comparisons among the different areas of science were performed using a post-hoc Tukey test.[33,34]

---

[33] The post-hoc Tukey test was conducted with the *glht* function from the *multcomp* package in R.

[34] Hothorn, T., Bretz, F., Westfall, P., Heiberger, R.M., Schuetzenmeister, A., Scheibe, S. 2020. "Package 'multcomp.' Simultaneous inference in general parametric models. Version 1.4-13." Available at http://multcomp.R-forge.R-project.org.

A non-parametric Kruskal-Wallis rank sum test was used to assess whether the *average number of citations received per publication per year*, *average total direct cost spent per citation received per award*, and *average RCR* differed by *group*.

STPI also assessed whether *time to first citation* differed significantly by *group*. *Time to first citation* (in days) was calculated by (1) an award's project start date and (2) by the publication date for the article that received the citation. For an award's project start date, *time to first citation* was calculated as the number of days between the publication date of an award's first citation and an award's project start date. In other words, *time to first citation* was considered as the first citation of an award and not as the first citation of the first publication of that award. In most cases, the first publication of an award received the first forward citation but this was not true for all cases. For the article that received the first citation of an award, *time to first citation* was calculated as the number of days between an article's publication date and the publication date of an award's first citation.

Lastly, STPI considered the rate at which citations were accrued (i.e., *time to citation*). *Time to citation* was calculated for each citation that an article received as the number of days between the publication date of the citation and (1) the award's project start date of the article that received the citation, and (2) the publication date of the article that received the citation.

All negative *time to first citation* and *time to citation* values (i.e., a study was cited before it was formally published) were removed from the analysis. For each case, a Cox proportional hazard model was used to assess if the citation rate was significantly affected by *group*. Publications that provided at least the month and year for the publication date were included in this analysis.

Awards with zero publications were removed from all citation analyses. Publications with citation data listed as Not Available (*NA)* were removed on an individual analysis by analysis basis as some citation data would have a numeric value listed (e.g., total number of citations received) but others would not (e.g., RCR).

3. Altmetrics

Altmetrics provides data that are complementary to traditional, citation-based metrics and includes citations on Wikipedia as well as public policy documents; discussions on research blogs; coverage on mainstream media; and mentions on social media such as Twitter and Facebook.[35] Whereas traditional citations provide information on the research impact of an article on the academic community, altmetrics also considers how widely

[35] Altmetric. 2020. "What are Altmetrics? An Introduction." Accessed 21 May 2020. Available at: https://www.altmetric.com/about-altmetrics/what-are-altmetrics/.

disseminated an article is beyond the publishing journal and immediate scientific community and how much attention an article receives from the public sphere.[36] Similarly, because of the lag time between article submission and actual publication, it takes time for articles to accrue citations and therefore, there is also an associated lag time in the ability to measure the immediate impact of an article using traditional, citation-based metrics. Altmetrics, by virtue of being sourced from the world wide web, allows for faster assessment of research impact.

There are, as with any metric, limitations to the use of altmetric data. Altmetrics are a complement to, and not a replacement for, traditional, journal-based citations. It is important to consider altmetrics data in context, for example, understanding where the underlying data come from (e.g., which sources are discussing the article of interest, what the sources are saying about the article of interest). To prevent individuals from artificially inflating the altmetric score for an article, companies that gather such data have algorithms in place to identify and correct for artificial inflation. Lastly, altmetric data are still relatively new, and more research is needed to better understand their use and interpretation.

To gather altmetrics data, STPI queried the Altmetric database using the rAltmetric package in R.[37] Articles were identified using their PubMedID (PMID). For the altmetric analysis, we focused on the Altmetric attention score as the response variable of interest. The Altmetric attention score is an automatically calculated, weighted count of the attention a research output has received and is based on three main factors: the volume of attention or mentions that a research output receives; the source that mentioned the research output; and how often authors of each mention talk about the scholarly articles. Each of these factors is weighted accordingly. For volume, a mention is only counted once from each person per source so that if the same person tweets about the same paper more than once, only the first mention will be counted towards the Altmetric attention score. Different sources contribute differently to the Altmetric attention score where reputable sources—such as a newspaper article—contribute more than a blog post, which contributes more than a tweet.[38] As a last consideration for authors, a mention about an article that is shared by a researcher to other researcher's counts more than a journal account sharing the same article link automatically. More generally, the Altmetric attention score is a metric for the amount of online activity a research output receives and is not necessarily a metric for the quality of the research, or the researcher, as mentions may be both negative and positive.

---

[36] Ibid

[37] Ram, K. 2017. "rAltmetric v 0.7.0: retrieves Altmetrics data for any published paper from Altmetric.com." Available at: https://github.com/ropensci/rAltmetric.

[38] The standard weightings for each mention type used by Altmetric can be found here: https://help.altmetric.com/support/solutions/articles/6000060969-how-is-the-altmetric-score-calculated

STPI used the Altmetric attention score as a metric for broad research impact and to identify articles that received exceptional online coverage that may be of interest to the NIH HRHR program.

A Kruskal-Wallis test was used to assess whether the Altmetric attention score differed significantly between EIA and ESI publications and a quantile-quantile (QQ) plot was used to compare the distribution of Altmetric attention scores between the two groups.

4. Bibliometric Analyses Limited to First and Last Author Publications

To get a more accurate assessment of whether EIA and ESI awardees were acting as independent researchers, and driving the design and implementation of their research awards, the NIH Office of Strategic Coordination asked STPI to re-analyze the publication and citation level metrics, and altmetrics by limiting the bibliometric analyses to cases in which the awardee was listed as the first or last author in a publication. Publications in which the awardee was not listed as either the first or last author of a publication were not included in these analyses (N = 795). A total of 1,339 publications were included in the first-last author bibliometric analyses.

All methodology remained the same. Results for the full bibliometric analyses are presented in B: Results for Bibliometric Analyses and results for the first-last author bibliometric analyses are presented in C: Results for First-Last Author Bibliometric Analyses.

B. Results for Bibliometric Analyses

As a reminder, 39 EIA awards and 117 ESI awards were used in this analysis unless indicated otherwise.

1. Publications

Overall, all EIA and ESI awards reported producing at least one publication. In total, the 39 EIA and 117 ESI awards produced 691 and 1,910 publications, respectively. After limiting publications to those published within 6 years of the award's start date, only 1 ESI award did not produce any publications in the timeframe, resulting in a total of 612 EIA and 1,522 ESI publications that were included in STPI's analyses (Table 3). ESI award publications have been divided by three to normalize against EIA award publications.

Figure 26 shows the distribution of publications over time up to 6 years from project start date, where the number of ESI publications has been divided by three to normalize against EIA publications.

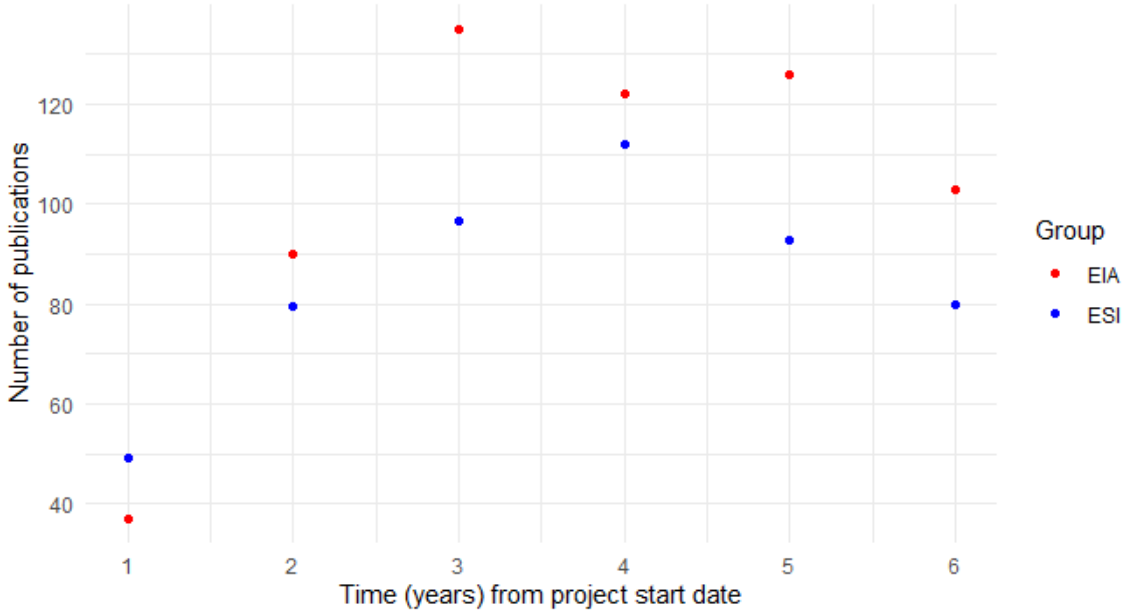


Figure 26. Distribution of Publications over Time for EIA and ESI Awards

Overall, EIA awards on average (± SE), produced a significantly higher number of publications (15.69 ± 2.10) compared to ESI (13.00 ± 0.87) awards ($\chi^2_1 = 14.94, p < 0.001$; Table 2). No significant difference was detected, however, between EIA and ESI awards after STPI normalized the number of publications produced by award duration. The mean rank (± SE) of publications produced per award per year was 2.78 (± 0.36) for EIA awards and 2.35 (± 0.16) for ESI awards ($\chi^2_1 = 0.97, p = 0.33$). Similarly, there was no significant difference in the average (± SE) total direct cost spent to produce a publication

between EIA ($138,630 ± $30,776) and ESI ($168,337 ± $18,417) awards ($\chi_1^2 = 0.84, p = 0.36$).

Table 2. Mean (± SE) Values on Bibliometric Publication Metrics by *Group*

Metric	EIA	ESI	χ_1^2	P-value
Number of publications produced per award	15.69 ± 2.10	13.00 ± 0.87	14.94	< 0.001 ***
Number of publications produced per award per year	2.78 ± 0.36	2.35 ± 0.16	0.97	0.33
Total direct cost spent per publication	$138,630 ± $30,776	$168,337 ± $18,417	0.84	0.36

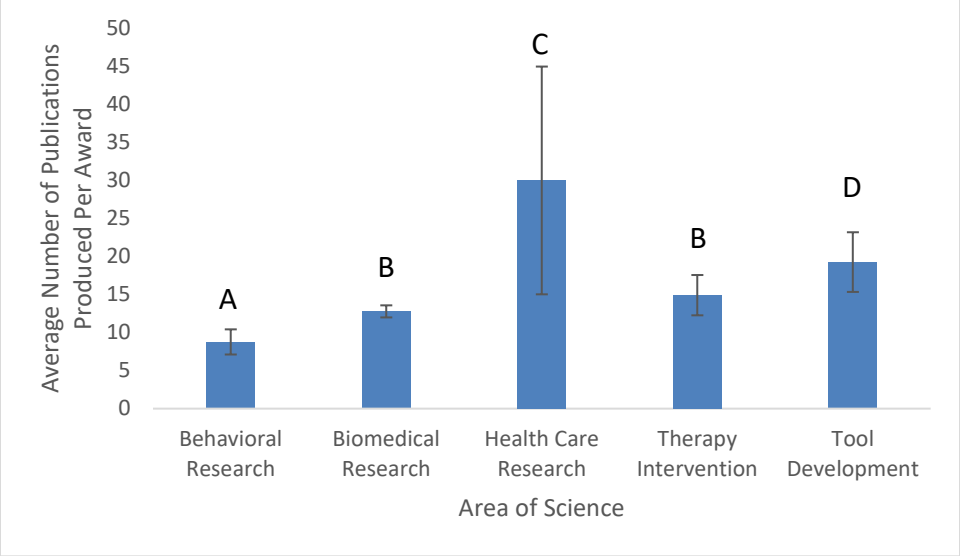
Source: publication data were downloaded from QVR (March 2020)
*** Significant at $p < 0.001$

Results from the multi-variable GLM regression analysis and type-II sum of squares analysis of deviance showed that when all other confounders were held constant, the total number of publications produced by EIA awards was significantly higher than ESI awards ($p = 0.045$). The number of publications produced was also significantly impacted by *award duration*, *total direct cost*, and the research *area of science*. Specifically, when all other factors are held constant, for every year increase in *award duration*, the expected number of publications produced per award increased by 11.7% ($p < 0.001$). While total direct cost was determined to be a significant factor influencing the number of publications produced ($p < 0.001$), the expected increase in the number of publications for every dollar increase in total direct cost is approximately zero—indicating that while it is a statistical difference, it is not true, observable difference. Lastly, when all other factors are held constant, *area of science* was determined to be a significant factor influencing the number of publications produced ($p < 0.001$).

Results from the post-hoc Tukey test on *area of science* showed that the average (± SE) number of publications produced did not differ significantly between awards focused on therapy ($14.9 ± 2.65$) and biomedical research ($12.79 ± 0.79$; $p = 0.42$). Different letters denote significant differences in the number of publications produced between areas of science (Figure 27).

Awards focused on tool development ($19.27 ± 3.92$) had a significantly higher number of publications than those focused on therapy intervention ($p = 0.46$), biomedical research ($p < 0.001$), and behavioral research ($8.77 ± 1.65$; $p < 0.001$); awards focused on therapy intervention produced a significantly higher number of publications than those focused on behavioral research ($p < 0.001$); awards focused on biomedical research had

a significantly higher number of publications than those focused on behavioral research ($p < 0.001$); and awards focused on health care research (30.00 ± 15.0) produced a significantly higher number of publications than those focused on tool development ($p < 0.001$), therapy intervention ($p < 0.001$), biomedical research ($p < 0.001$), and behavioral research ($p < 0.001$). Overall, the total number of publications produced were highest among awards that focused on health care research (denoted as letter C in Figure 25); followed by awards focused on tool development (letter D); awards focused on biomedical research or therapy intervention (letter B); and lastly, awards on biobehavioral research (letter A).



Different letters denote significant differences in the number of publications produced between areas of science.

Figure 27. Average (± 1 SE) Number of Publications Produced per Award by Area of Science

For *time to first publication*, the Cox regression model indicated that there was no significant difference in the rate at which the first article of an award was published between EIA and ESI awards ($p = 0.3$). The hazard ratio (95% confidence interval) for ESI awards compared to EIAs awards was 1.21 (0.84 to 1.74) (Figure 28). Although it is not significantly different, the time to first publication is approximately 21% faster for ESI compared to EIAs.

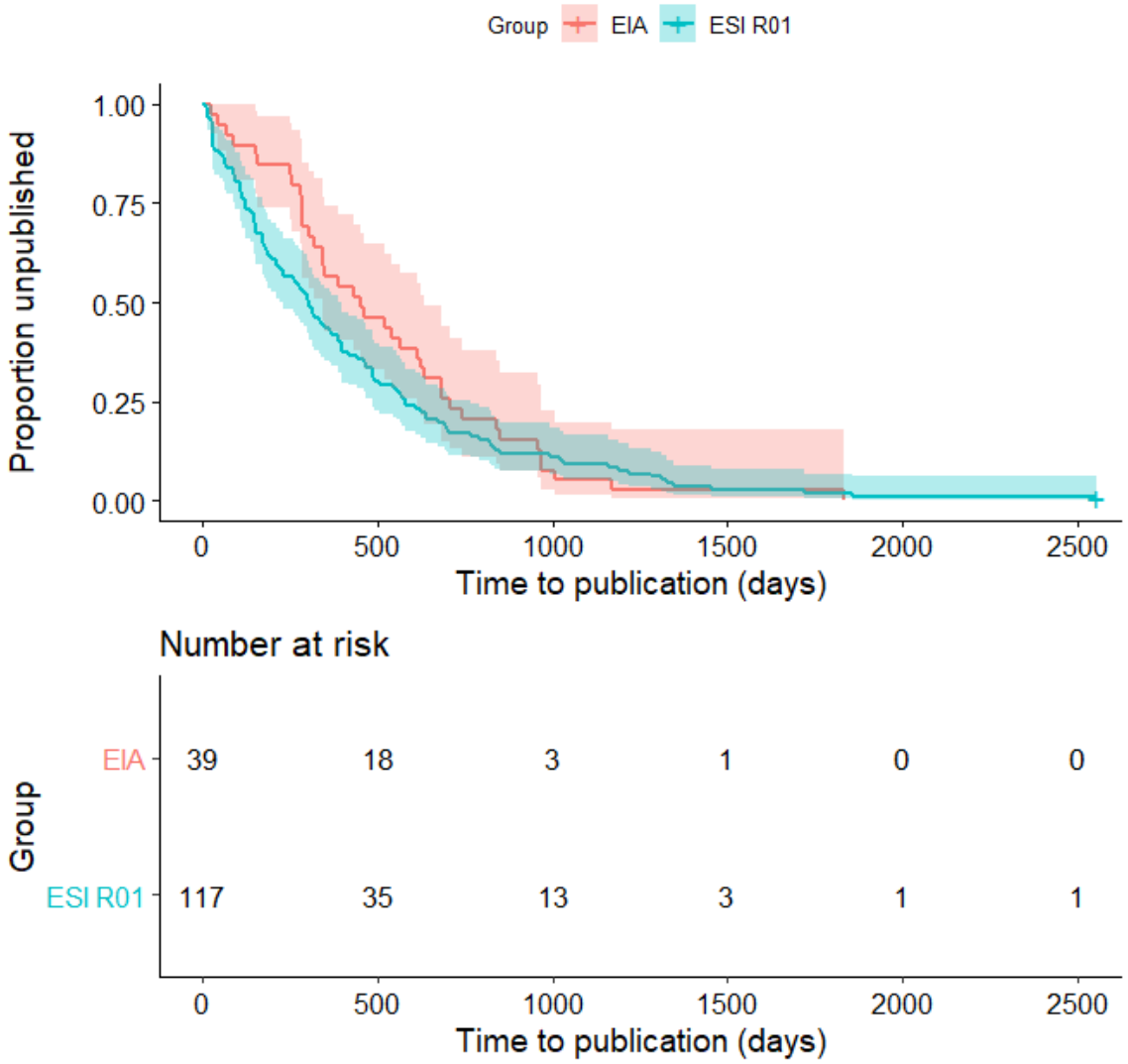


Figure 28. Proportion of Awards That Have Not Published at Least One Article over Time by *Group*

With regard to the publication rate, the Cox regression model for *overall time to publication* indicated that there was no significant difference in the rate at which articles were published between ESI and EIA awards ($p = 0.4$). The hazard ratio (95% confidence interval) for ESI awards compared to EIA awards was 1.04 (0.94 to 1.15) (Figure 29). Although it is not significantly different, the overall time to publication is approximately 4% faster for ESI compared to EIAs.

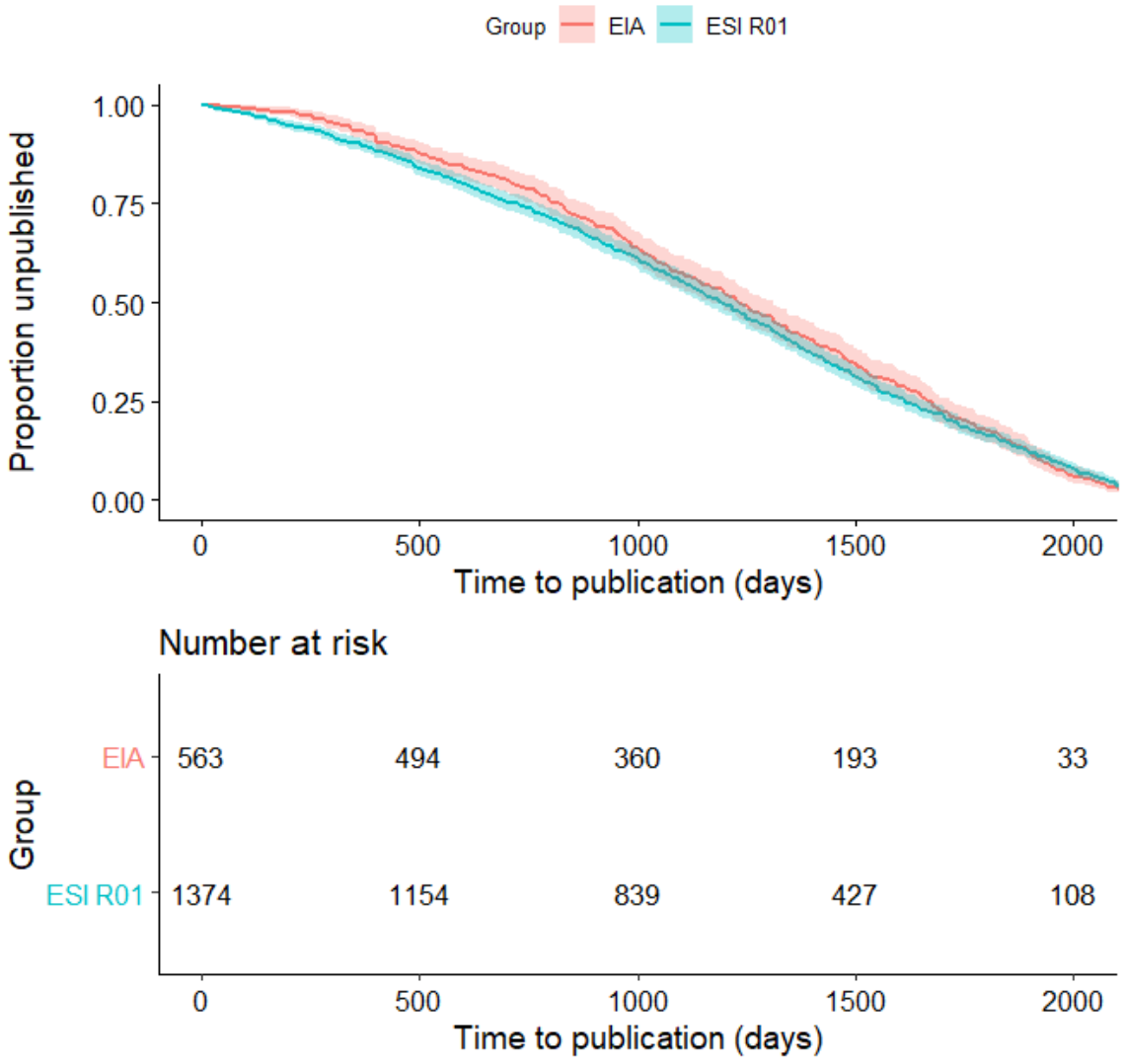


Figure 29. Proportion of Articles Not Published over Time by *Group*.

Table 3. Summary Statistics of Publication Level Bibliometric Data by *Group*

Group	Total number of awards	Number (percent) of awards with at least one publication	Total number of publications ǂ	Mean (± SE) number of publications/award *
EIA	39	39 (100%)	612	15.69 (± 2.10)
ESI	117	116 (99.1%)	1,522	13.00 (± 0.87)

Source: publications were downloaded from QVR (March 2020)

ǂ Only publications that had publication dates after a year of an award's project start date and within a year of an award's project end date are included in STPI's analyses

* Includes awards with 0 publications

2. Citations

Overall, 602 of the 612 (98.6%) EIA publications and 1,477 of the 1,522 (97.1%) ESI publications have received at least one citation. In total, EIA publications have accumulated 36,172 citations as of May 2020, and ESI publications have accumulated 54,602 citations during the same time. On average (± SE), EIA publications received significantly more citations (59.30 ± 8.04) than ESI award publications (35.92 ± 2.42; $\chi^2_1 = 5{,}235,\ p < 0.001$; Table 4). This was true even after the data were normalized to number of citations received per publication per year. EIA publications, on average (± SE), received 12.34 ± (1.53) citations per year, which was significantly higher than ESI publications (6.80 ± 0.43; $\chi^2_1 = 58.70,\ p < 0.001$). There was also a significant difference between EIA and ESI awards for total direct cost spent for each citation received ($\chi^2_1 = 11.69, p < 0.001$). Each citation, on average (± SE), cost $5,660 (± $1,769) for EIA awards and $21,223 (± $8,742) for ESI awards.

EIA publications also had significantly higher RCRs (4.16 ± 0.51) than ESI award publications (2.37 ± 0.13; $\chi^2_1 = 49.38, p < 0.001$). As a reminder, iCite only has RCR data for articles published between 1980 and 2018; consequently, it did not have data for 17 EIA publications and 23 ESI publications. Those publications were removed from the RCR analysis.

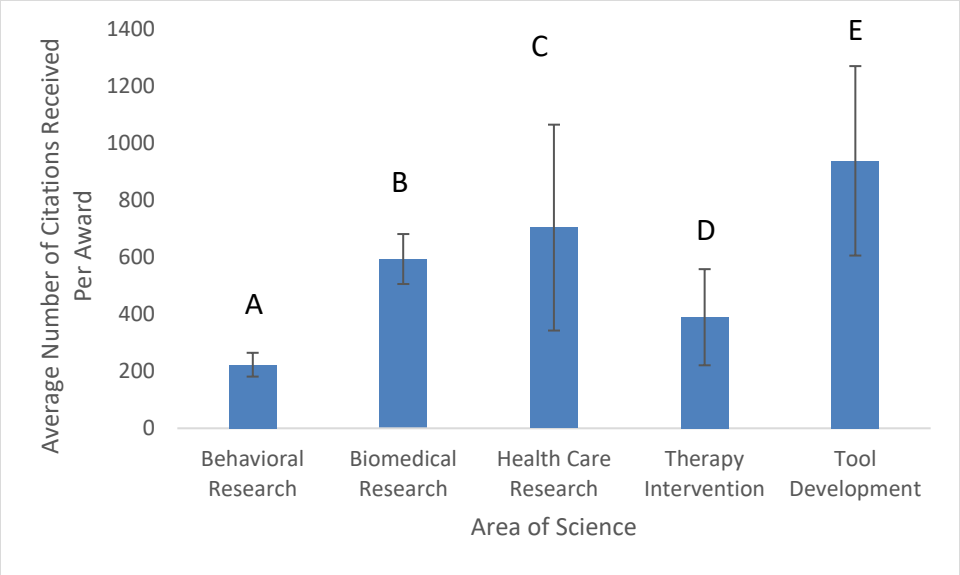
Table 4. Mean (± SE) Values on Bibliometric Citation Metrics by *Group*

Metric	EIA	ESI	χ_1^2	P-value
Number of citations received per publication	59.30 ± 8.04	35.92 ± 2.42	5,235	< 0.001 ***
Number of citations received per publication per year	12.34 ± 1.53	6.80 ± 0.43	58.70	< 0.001 ***
Total direct cost spent per citation received	$5,660 ± $1,769	$21,223 ± $8,742	11.69	< 0.001 ***
Relative Citation Ratio	4.16 ± 0.51	2.37 ± 0.13	49.24	< 0.001 ***

Source: publication data were downloaded from iCite (May 2020)
*** Significant at $p < .001$

At the award level, results from the multi-variable GLM regression analysis and type-II sum of squares analysis of deviance showed that *group*, *award duration*, *total direct cost*, and *area of science* all significantly affected the total number of citations received ($p < 0.001$ for group, award duration, and area of science, $p = 0.03$ for total direct cost). Specifically, when all other confounders are held constant, the expected number of citations decreased by 44% for ESI awards relative to EIA awards; and the expected number of citations increased by 7.7% for every year increase in award duration. Again, while total direct cost was determined to be a significant factor influencing the number of citations received, the expected increase in the number of citations for every dollar increase in total direct cost is approximately zero indicating that while it is a statistical difference, it is not a true, observable difference.

Results from the post-hoc Tukey test on *area of science* showed that the average (± SE) number of citations received differed significantly across all areas of science ($p < 0.001$ for each pair-wise comparison (Figure 30). Specifically, awards focused on tool development received, on average (± SE), the highest number of citations per award (939 ± 332), followed by awards focused on health care research (704 ± 361), biomedical research (593 ± 88), therapy intervention (390 ± 169), and then behavioral research (223 ± 42).



Different letters denote significant differences in the number of citations received among different areas of science.

Figure 30. Mean Number of Citations Received Per Award by Area of Science

At the publication level, results from the multi-variable GLM regression analysis and type-II sum of squares analysis of deviance showed that *group*, *year of publication*, and the total *number of authors* on a publication all significantly affected the number of citations received per publication ($p < 0.001$ for each). Specifically, the expected number of citations received per ESI award publication was 54% lower than those received per EIA award publication; for every year increase in year of publication, the expected number of citations received per publication decreased by 27%; and for every additional author listed on a publication, the expected number of citations received per publication increased by 1.7%.

In total, EIA publications were cited by 45,283 unique publications and ESI publications were cited by 33,619 unique publications. The Cox regression model for *time to first citation* by an award's project start date showed that there was no significant difference in rate at which first citations were received between EIA and ESI awards ($p = 0.77$). The hazard ratio (95% confidence interval) for ESI awards compared to EIA awards was 1.06 (0.73 to 1.52) Although it is not significantly different, the time to first citation is approximately 6% faster for ESI compared to EIAs (Figure 31).

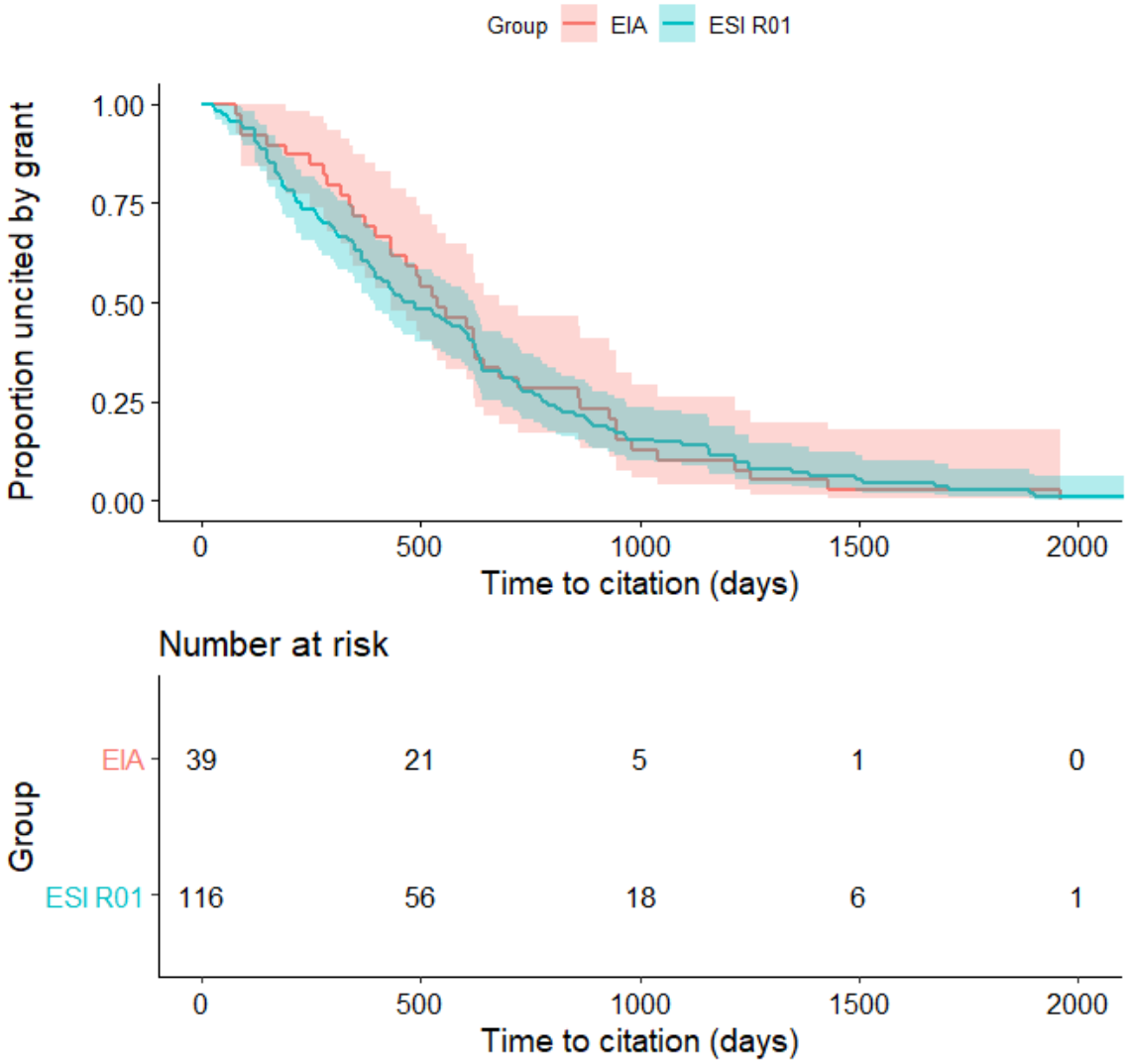


Figure 31. Proportion of Awards with Publications That Are Uncited over Time by *Group* Where Time to First Citation Is Calculated from an Award's Project Start Date

The Cox regression model for *time to first citation* by the publication date of the article that received the first citation of an award showed that there was a significant difference in rate at which first citations were received between EIA and ESI awards ($p = 0.01$). The hazard ratio (95% confidence interval) for ESI awards compared to EIA awards was 0.62 (0.43 to 0.90) meaning that ESI awards, on average, received their first citation 38% slower than EIA awards (Figure 32).

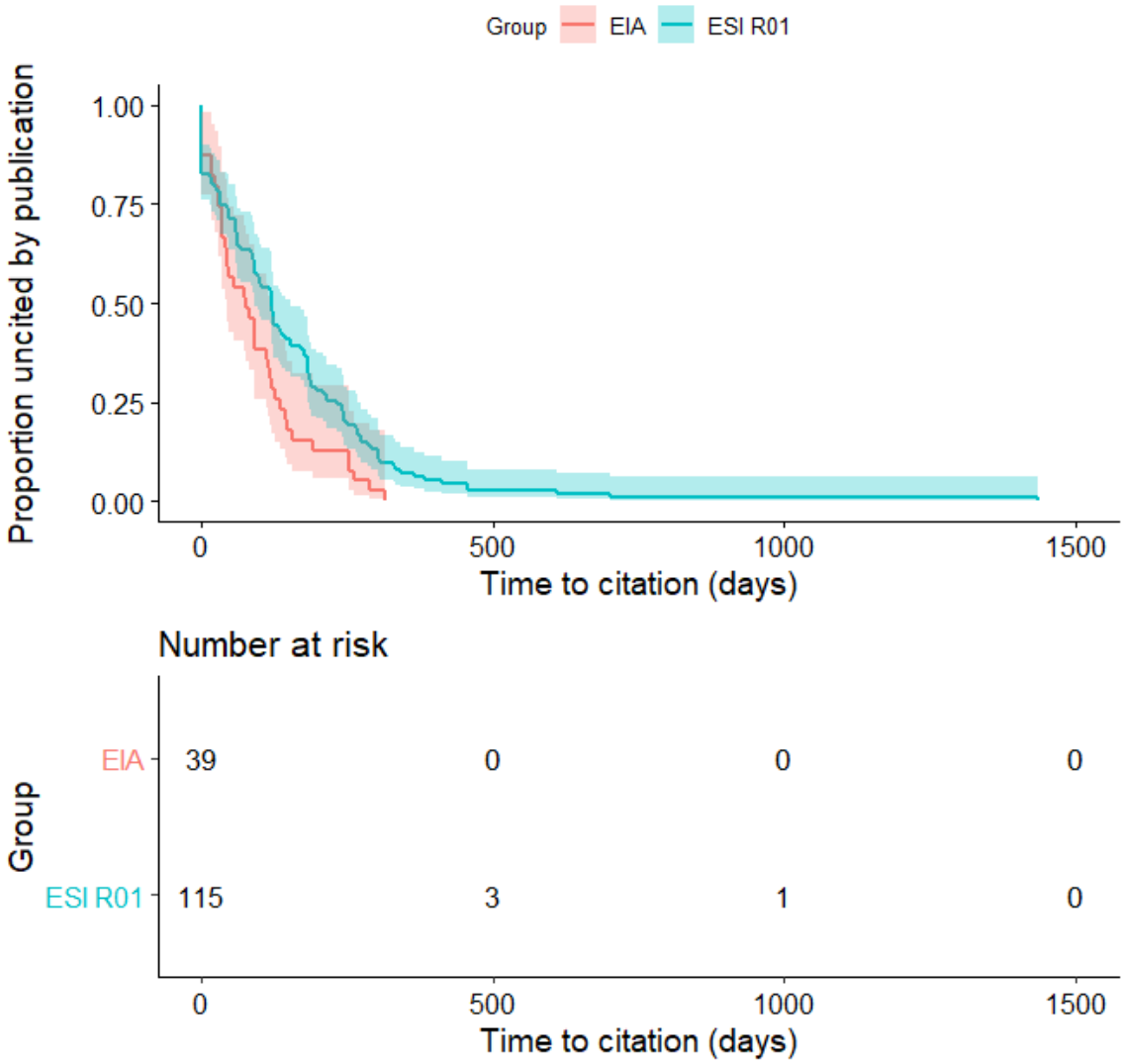


Figure 32. Proportion of Awards with Publications That Are Uncited over Time by *Group* Where Time to First Citation Is Calculated from the Publication Date of the Article That Received the Citation

With regard to the citation rate, the Cox regression model for *overall time to citation* by an award's project start date indicated that there is a significant difference in the rate at which articles were cited between ESI and EIA awards ($p < 0.001$). The hazard ratio (95%

confidence interval) for ESI awards compared to EIA awards was 0.79 (0.78 to 0.80), indicating that ESI awards receive their citations 21% slower than EIA awards (Figure 33).

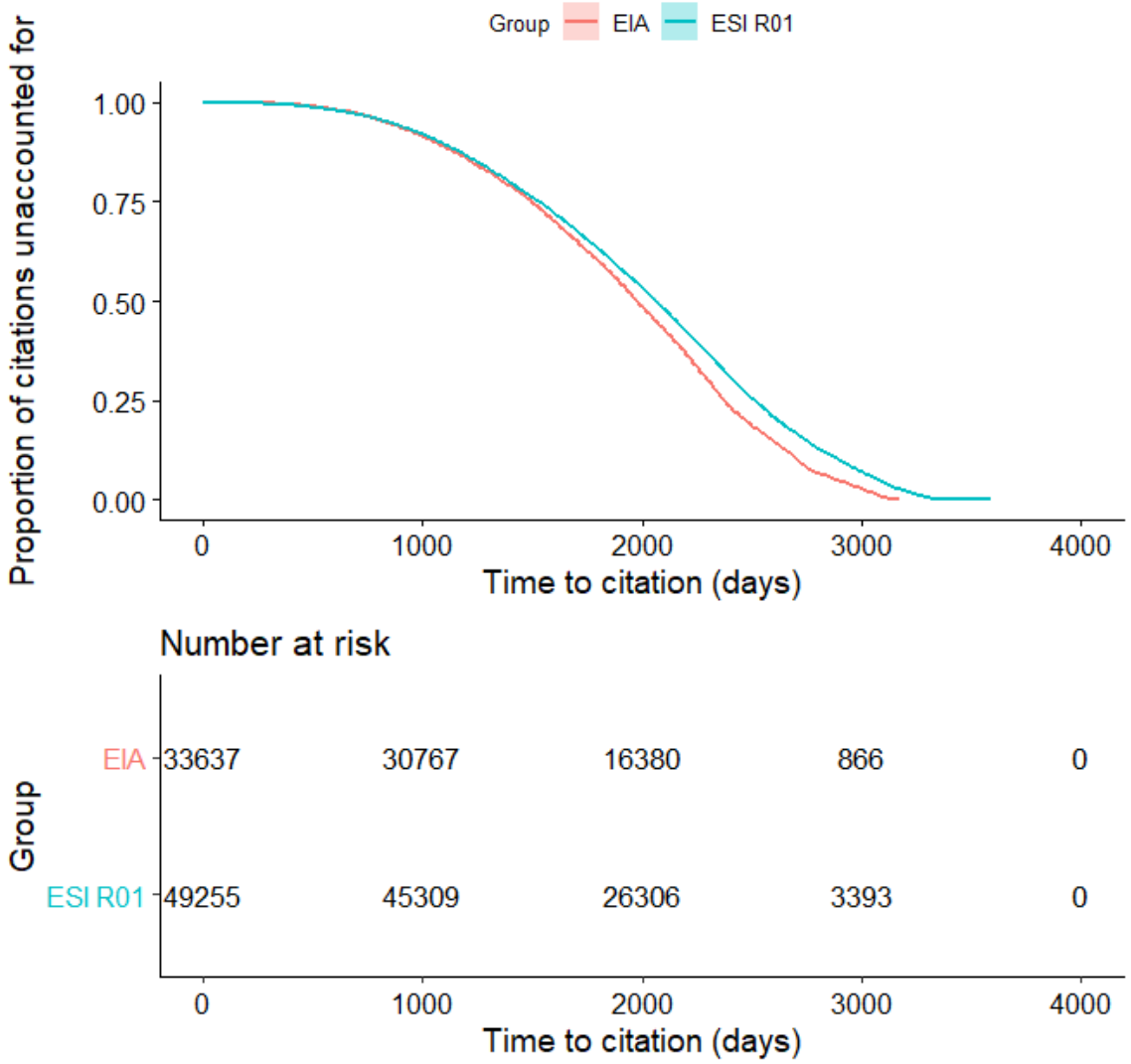


Figure 33. Proportion of Citations That Are Unaccounted for by Group Where Time to Citation Is Calculated from an Award's Project Start Date

The Cox regression model for *overall time to citation* by the publication date of the article that received the first citation of an award showed that there was a significant difference in rate at which citations were received between EIA and ESI awards ($p < 0.001$). The hazard ratio (95% confidence interval) for ESI awards compared to EIA awards was 0.83 (0.82 to 0.84) meaning that ESI awards, on average, received their first citation 17% slower than EIA awards (Figure 34).

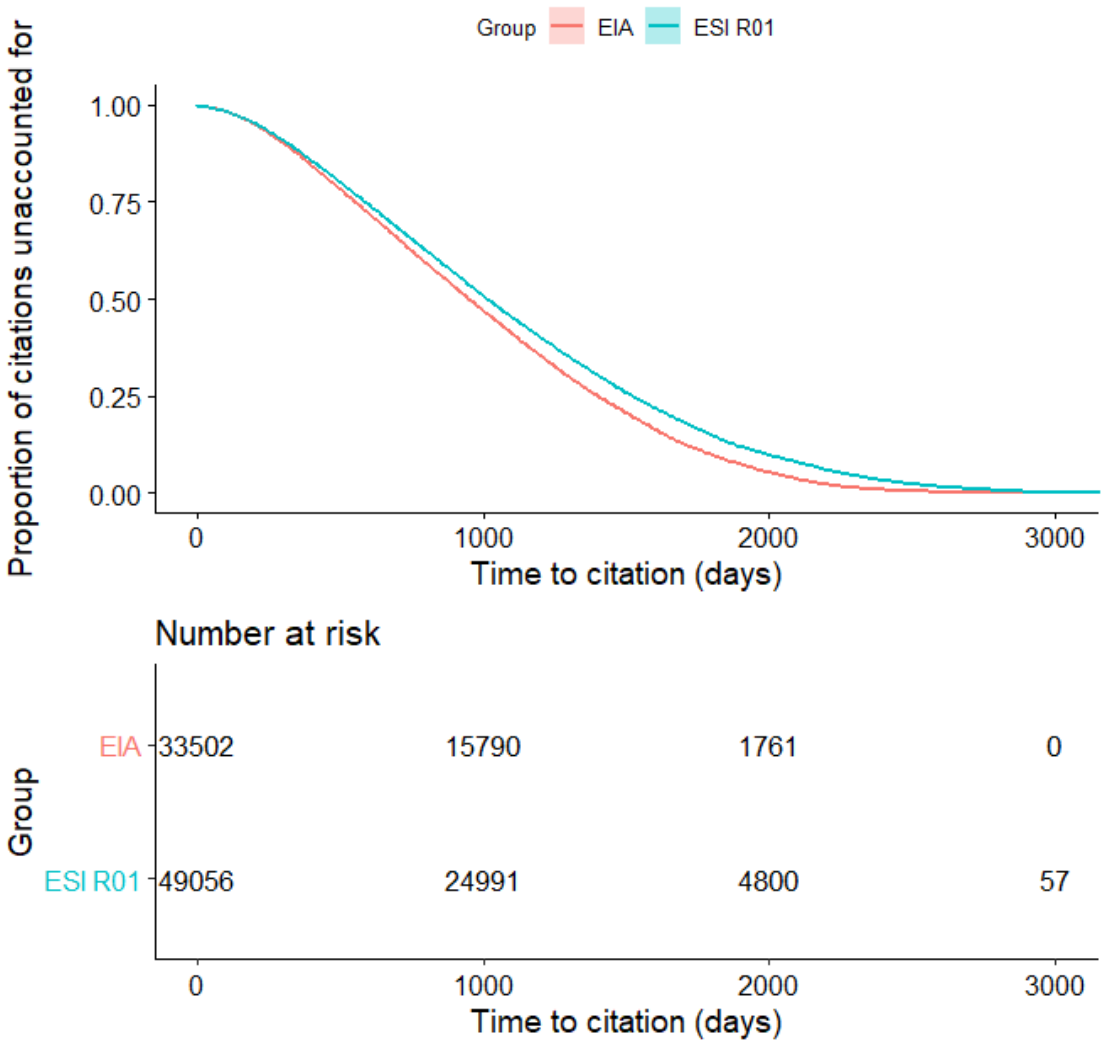


Figure 34. Proportion of Citations That Are Unaccounted for by Group Where Time to Citation Is Calculated from the Publication Date of the Article That Received the Citation

3. Altmetrics

The mean (± SE) Altmetric attention score was 104.5 (± 16.33) among 540 EIA publications and 23.0 (± 2.60) among 1,132 ESI publications. Results from the Kruskal-Wallis test indicate that EIA publications, on average, have significantly higher Altmetric attention scores than ESI publications ($\chi_1^2 = 172.29, p < 0.001$). This is corroborated by the QQ plot of Altmetric attention scores for EIA and ESI publications, which shows that EIA publications had higher Altmetric attention scores compared to ESI publications (Figure 35).

As a reminder, a QQ plot is a visual tool to help assess whether two different data sets have the same distribution by plotting the quantiles (i.e., the fraction, or percent, of

points below a given value) of each group against one another. In Figure 33, the estimated quantiles from the EIA and ESI Altmetric attention scores are represented by the x- and y-axes, respectively.[39] The 45-degree diagonal line represents the theoretical quantiles, if both the EIA and ESI Altmetric attention scores came from a population with the same distribution, the points should fall approximately along the diagonal line. The greater the departure from this diagonal line, the greater the evidence that the EIA and ESI Altmetric attention scores come from populations with different distributions.

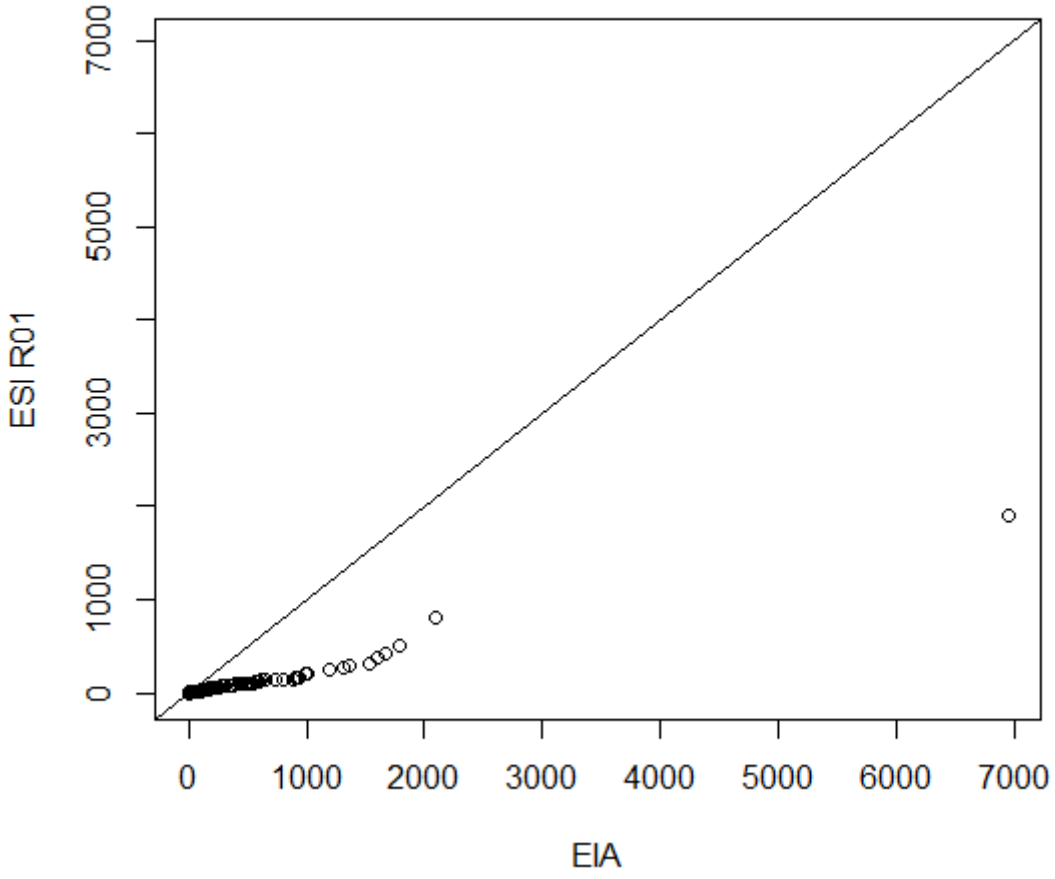


Figure 35. QQ plot of Altmetric attention scores for EIA and ESI publications.

The QQ plot also shows that one EIA publication received much more online and media attention than all other EIA and ESI publications. The publication of interest (PMID

[39] For more information about QQ plots, please visit the Engineering Statistics Handbook at https://www.itl.nist.gov/div898/handbook/eda/section3/qqplot.htm#:~:text=A%20q%2Dq%20plot%20is%20a,70%25%20fall%20above%20that%20value.

27992617) is from grant number DP5OD017897 (Physician Determinants of Health Care Spending, Quality, and Patient Outcomes) and titled "Comparison of Hospital Mortality and Readmission Rates for Medicare Patients Treated by Male vs. Female Physicians." This article had an Altmetric attention score of 6,944 and has received coverage in 453 news stories in 303 news outlets from around the world as of July 2020 including Time, Scientific American, NPR, Forbes, Vice, Washington Post, and the New York Magazine. Comparatively, it has received 120 total academic citations since its publication date in 2017 and has an RCR of 30.91. As a reminder, the median RCR value for NIH publications is benchmarked at 1.0. This means that a paper with an RCR of 30 has received 30-times as many cites per year as the median NIH-funded paper in the same field.

Although the total number of citations and the RCR value indicate that the article made a substantial impact on the scientific community, there are 128 other publications that had a higher total number of citations, and 12 publications that had higher RCRs. In fact, one EIA publication (PMID 26432245: A global reference for human genetic variation) had the highest total number of citations (2,766) as well as the highest RCR (237) among all EIA and ESI publications. Conversely, this article has an Altmetric attention score of 620 and has, thus far, received coverage from 29 news outlets since its publication in 2015.

Furthermore, it is important to note that of the top ten articles with the highest Altmetric attention scores from both EIA and ESI awards, seven of them were from one EIA award (DP5OD017897). All seven publications had Altmetric attention scores over 1,000. The area of science for this award is health care research. To assess the impact of this one award on overall EIA results, STPI removed this grant from the data set and repeated the analysis. EIA publications still receive higher Altmetric attention scores (52.10 ± 6.44) compared to ESI publications (23.00 ± 2.60), a difference that is statistically significant ($p < 0.001$). This finding indicates that the results for the full analysis are not driven by a single, high visibility grant.

In comparison, the highest Altmetric attention score received by an ESI publication was 1,898. The publication of interest (PMID 26840489) is from grant number R01HL111121 and titled "Naturally occurring p16Ink4a-positive cells shorten healthy lifespan." The area of science for this award was biomedical. This ESI publication received much more attention compared to other ESI publications with global coverage in 229 news stories across 199 news outlets. Its total number of academic citations was 589 and it has an RCR of 51. Again, both the total number of citations and RCR values for this ESI article are higher than the EIA article about the differences between male and female physicians, but its Altmetric attention score is much lower.

This finding highlights the importance of considering altmetric data when assessing research impact. From a traditional, citation-based viewpoint, the publication on human genome represents the highest levels of scientific findings and research impact. The

publication on the differences between male and female physicians, while also notable, would have paled in comparison when only considering traditional metrics such as total citations received and RCRs. However, its broader impact on the general public could have only been brought to the forefront using altmetric data.

We also found that the area of science of an award, irrespective of group, influences Altmetric attention scores, as publications from different areas of science significantly differ from each other ($p < 0.001$). The average altmetric attention score is 36.4 (± 11.3) for behavioral research, 29.2 (± 3.2) for biomedical research, 320.9 (± 70.8) for healthcare research, 21.6 (± 5.2) for therapy interventions, and 31.8 (± 4.3) for tool development (Figure 36).

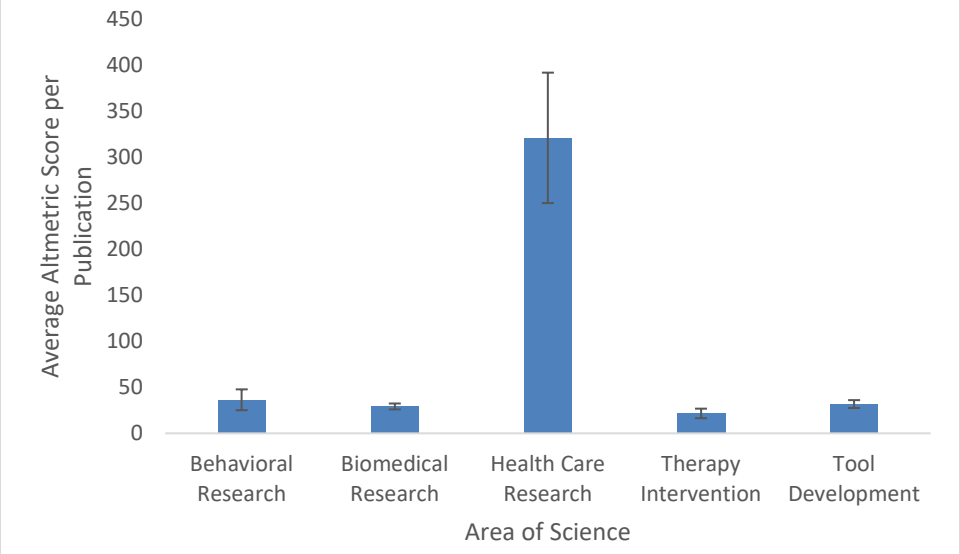
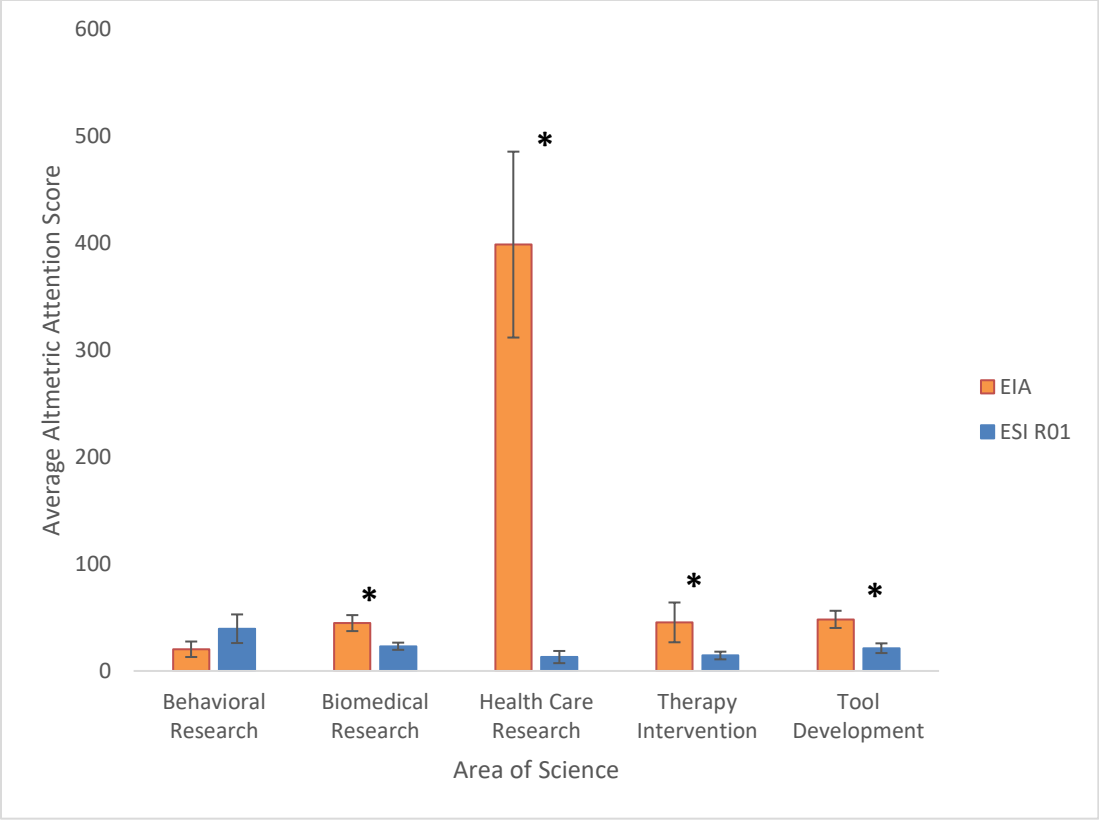


Figure 36. Average Altmetric Attention Scores per Publication by Area of Science

EIA publications received significantly higher Altmetric attention scores (44.75 ± 7.48) compared to ESI publications for biomedical research (23.12 ± 3.36; $p < 0.001$; Figure 37). For health care research, EIA publications also received significantly higher Altmetric attention scores (398.70 ± 86.92) compared to ESI publications (13.00 ± 5.70; $p < 0.001$). For therapy intervention research, EIA publications received significantly higher Altmetric attention scores (45.42 ± 18.60) compared to ESI publications (14.45 ± 3.59; $p < 0.001$). The same is true for tool development research, EIA publications received significantly higher altmetric attention scores (48.24 ± 9.04) compared to ESI publications (21.27 ± 4.54; $p < 0.001$). The only exception is in behavioral research, where there was no significant difference between EIA publications (20.28 ± 7.24) and ESI publications (39.49 ± 13.38; $p = 0.33$).



Asterisks denote statistical significance between EIA And ESI publications within an area of science.

Figure 37. Mean Altmetric Attention Score for EIA and ESI Publications by Area of Science

C. Results for First-Last Author Bibliometric Analyses

The findings for the bibliometric analysis of all publications citing the award,

1. Publications

Overall, all 39 EIA and 110 of the 117 ESI awards produced publications in which the awardee was listed as either the first or last author on publications associated with the award. In total, 382 of the 612 EIA publications (62%) and 957 of the 1,522 ESI publications (63%) are included in the first-last author bibliometric analyses (Table 5).

Table 5. Summary Statistics for First-Last Author Bibliometric Data by *Group*

Group	Total number of awards	Number (percent) of awards with at least one publication	Total number of publications ǂ	Mean (± SE) number of publications/award *
EIA	39	39 (100%)	382	9.79 (± 1.66)
ESI	117	110 (94%)	957	8.18 (± 0.58)

Source: publications were downloaded from QVR (March 2020)

ǂ Only publications that had publication dates after a year of an award's project start date and within a year of an award's project end date are included in STPI's analyses

* Includes awards with 0 publications

Overall, EIA awards on average (± SE), produced a significantly higher number of publications (9.79 ± 1.66) compared to ESI (8.18 ± 0.58) awards ($\chi^2_1 = 8.63, p < 0.01$; Table 6). No significant difference was detected, however, between EIA and ESI awards after STPI normalized the number of publications produced by award duration. The mean rank (± SE) of publications produced per award per year was 1.73 (± 0.28) for EIA awards and 1.55 (± 0.10) for ESI awards ($\chi^2_1 < 0.01, p = 0.96$). Similarly, there was no significant difference in the average (± SE) total direct cost spent to produce a publication between EIA ($241,946 ± $36,681) and ESI ($268,376 ± $28,282) awards ($\chi^2_1 = 0.04, p = 0.83$).

Table 6. Mean (± SE) Values on Bibliometric Publication Metrics by *Group*

Metric	EIA	ESI	χ^2_1	P-value
Number of publications produced per award	9.79 ± 1.66	8.18 ± 0.58	8.63	< 0.01 **

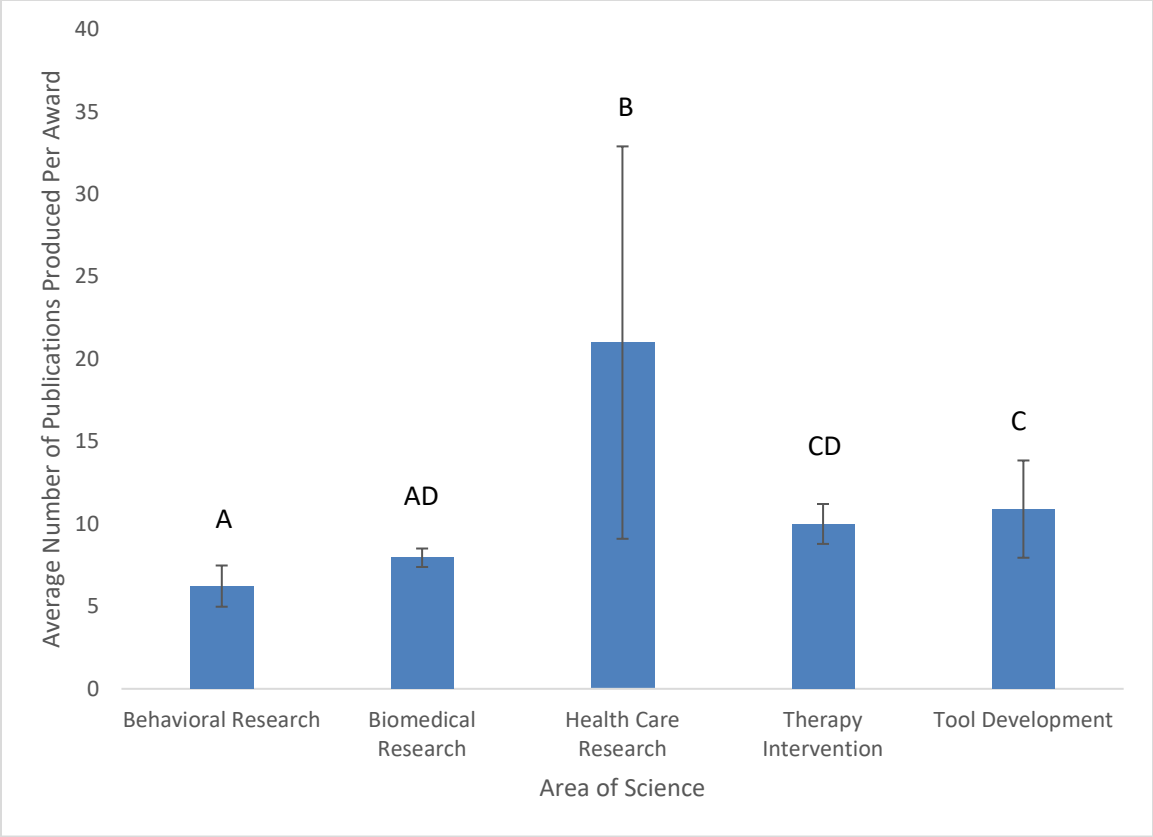
Metric	EIA	ESI	χ_1^2	P-value
Number of publications produced per award per year	1.73 ± 0.28	1.55 ± 0.10	<0.01	0.96
Total direct cost spent per publication	$241,946 ± $36,681	$268,376 ± $28,282	0.04	0.83

Source: publication data were downloaded from QVR (March 2020)
** Significant at $p < 0.01$

Results from the multi-variable GLM regression analysis and type-II sum of squares analysis of deviance showed that when all other confounders were held constant, the total number of publications produced by EIA awards did not differ significantly from ESI awards ($p = 0.14$). Total direct cost was also not a significant factor in determining the number of publications produced ($p = 0.19$). The number of publications produced was significantly impacted by *award duration* ($p < 0.001$), and the research *area of science* ($p < 0.001$). Specifically, when all other factors are held constant, for every year increase in *award duration*, the expected number of publications produced per award increased by 14.9% ($p < 0.001$).

Results from the post-hoc Tukey test on *area of science* showed that the average (± SE) number of publications produced did not differ significantly between awards focused on behavioral research (6.23 ± 1.25) and biomedical research (7.96 ± 0.56; $p = 0.14$); biomedical research and therapy (10.0 ± 1.21; $p = 0.15$); and tool development (10.9 ± 2.95) and therapy intervention ($p = 0.93$; Figure 36). Awards that focused on behavioral research produced significantly lower number of publications than those focused on health care (21.0 ± 11.9; $p < 0.001$), therapy intervention ($p < 0.01$), and tool development ($p < 0.001$). Awards that focused on biomedical research produced significantly lower number of publications than those focused on health care ($p < 0.001$) and tool development ($p < 0.01$). Awards that focused on health care produced significantly higher number of publications than those focused on therapy intervention ($p < 0.001$) and tool development ($p < 0.001$).

Overall, the total number of publications produced were highest among awards that focused on health care research (denoted as letter B in Figure 38); followed by awards focused on tool development (letter C), therapy (letters CD), biomedical research (letters AD), and behavioral research (letter A).



Different letters denote significant differences in the number of publications produced between areas of science.

Figure 38. Average (± 1 SE) Number of Publications Produced per Award by Area of Science

For *time to first publication*, the Cox regression model indicated that there was no significant difference in the rate at which the first article of an award was published between EIA and ESI awards ($p = 0.06$). The hazard ratio (95% confidence interval) for ESI awards compared to EIAs awards was 1.43 (0.98 to 2.09; Figure 39). Although it is not significantly different at the $\alpha = 0.05$ level, the time of first publication is approximately 43% faster for ESI compared to EIAs.

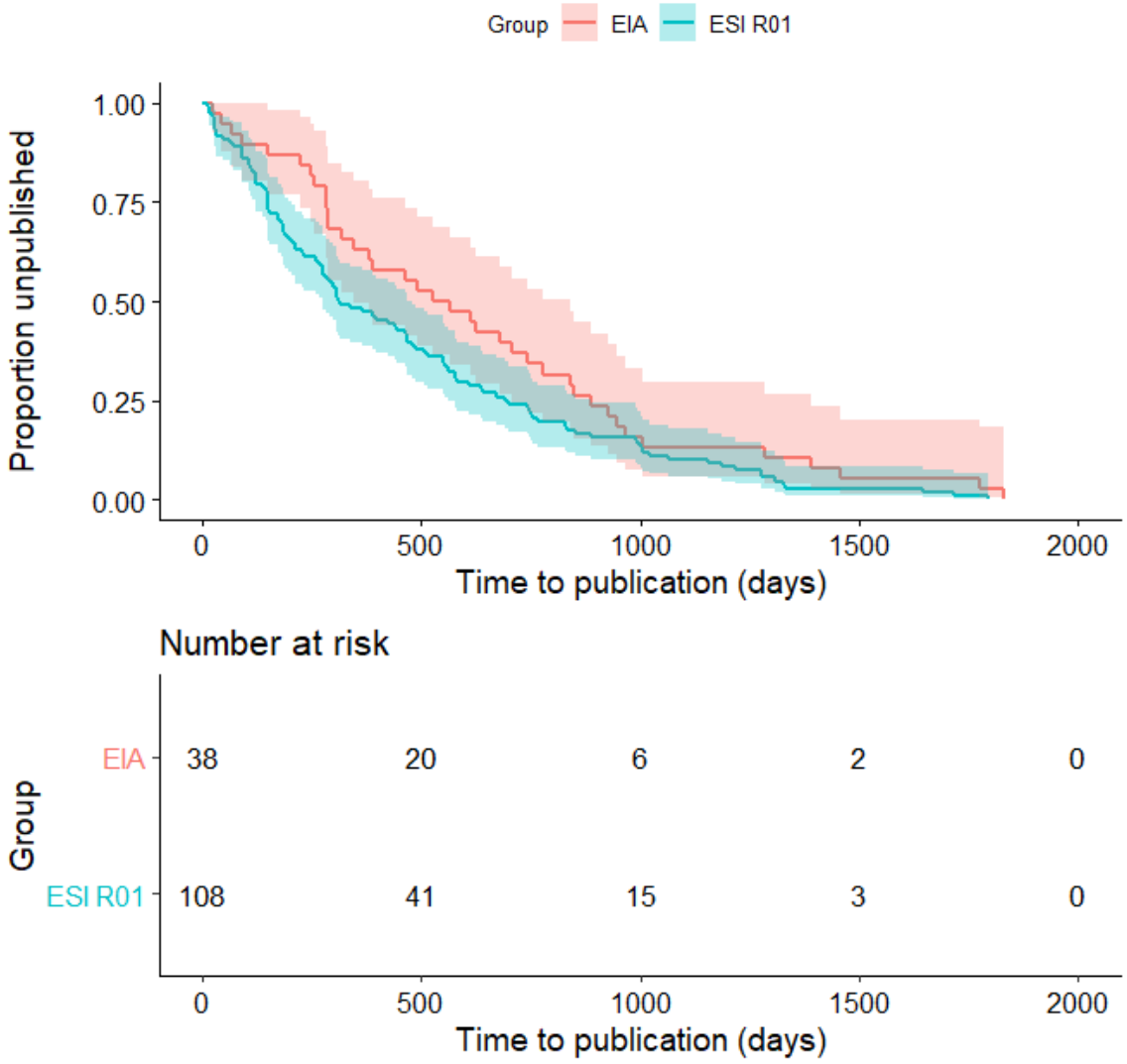


Figure 39. Proportion of Awards That Have Not Published at Least One Article over Time by *Group*

With regard to the publication rate, the Cox regression model for *overall time to publication* indicated that there was no significant difference in the rate at which articles were published between ESI and EIA awards ($p = 0.4$). The hazard ratio (95% confidence interval) for ESI awards compared to EIA awards was 1.06 (0.93 to 1.20; Figure 40). Although it is not significantly different, the overall time to publication is approximately 6% faster for ESI compared to EIAs.

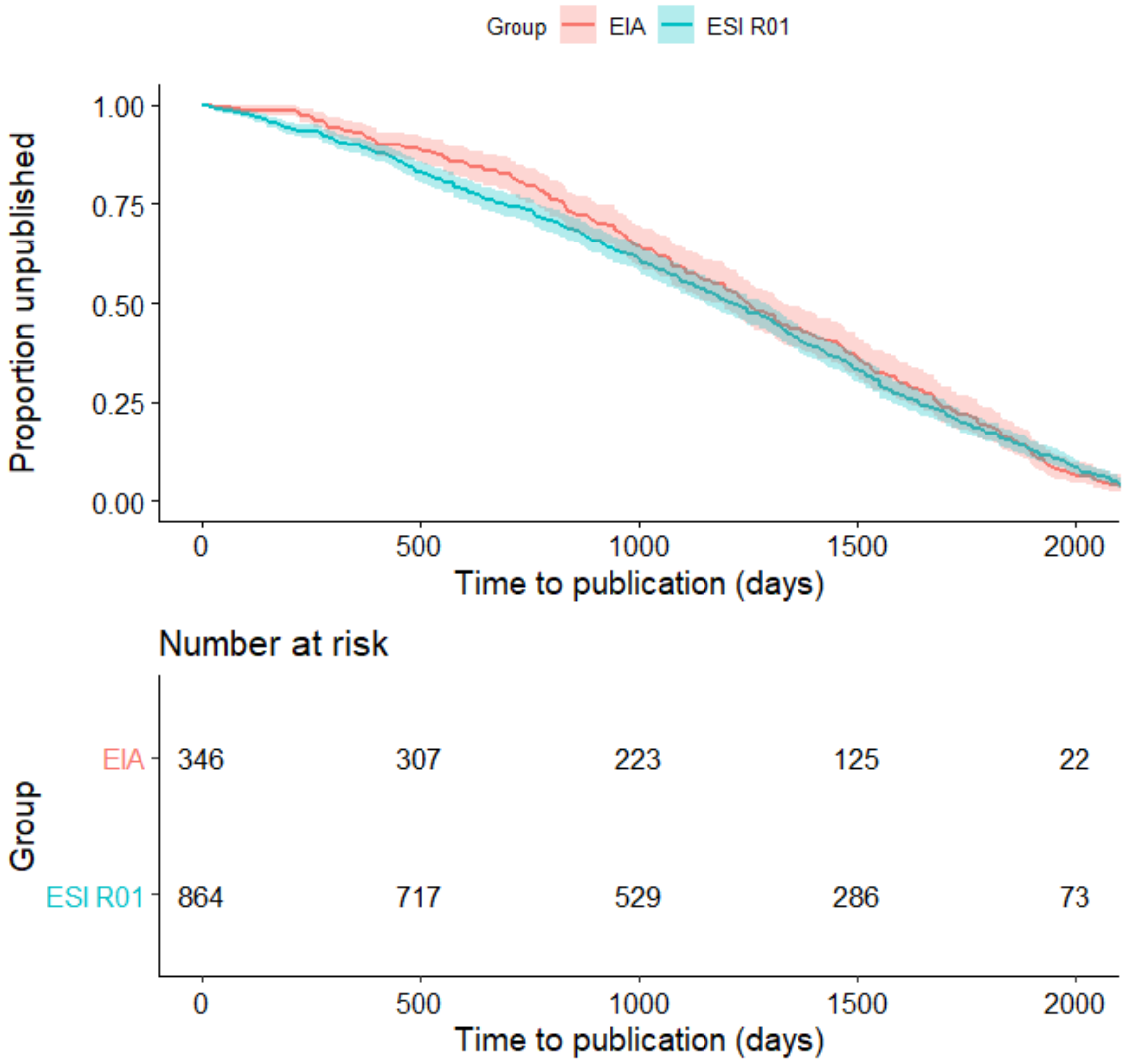


Figure 40. Proportion of Articles Not Published over Time by *Group*.

2. Citations

Overall, 381 of the 382 (99.7%) EIA publications and 955 of the 957 (99.8%) ESI publications have received at least one citation. In total, EIA publications have accumulated 16,395 citations as of May 2020, and ESI publications have accumulated 31,593 citations during the same time. On average (± SE), EIA publications received significantly more citations (43.0 ± 3.96) than ESI award publications (33.1 ± 2.61; $\chi^2_1 = 724, p < 0.001$; Table 7). This was true even after the data were normalized to number of citations received per publication per year. EIA publications, on average (± SE), received 9.33 (± 0.74) citations per year, which was significantly higher than ESI publications (6.18 ± 0.42; $\chi^2_1 = 20.8, p < 0.001$). There was no significant difference between EIA and ESI awards for total direct cost spent for each citation received ($\chi^2_1 = 3.73, p = 0.05$). Each citation, on average (± SE), cost $15,512 (± $3,812) for EIA awards and $29,301 (± $5,878) for ESI awards.

EIA publications also had significantly higher RCRs (3.34 ± 0.26) than ESI award publications (2.20 ± 0.14; $\chi^2_1 = 19.7, p < 0.001$). As a reminder, iCite only has RCR data for articles published between 1980 and 2018; consequently, it did not have data for 13 EIA publications and 19 ESI publications. Those publications were removed from the RCR analysis.

Table 7. Mean (± SE) Values on Bibliometric Citation Metrics by *Group*

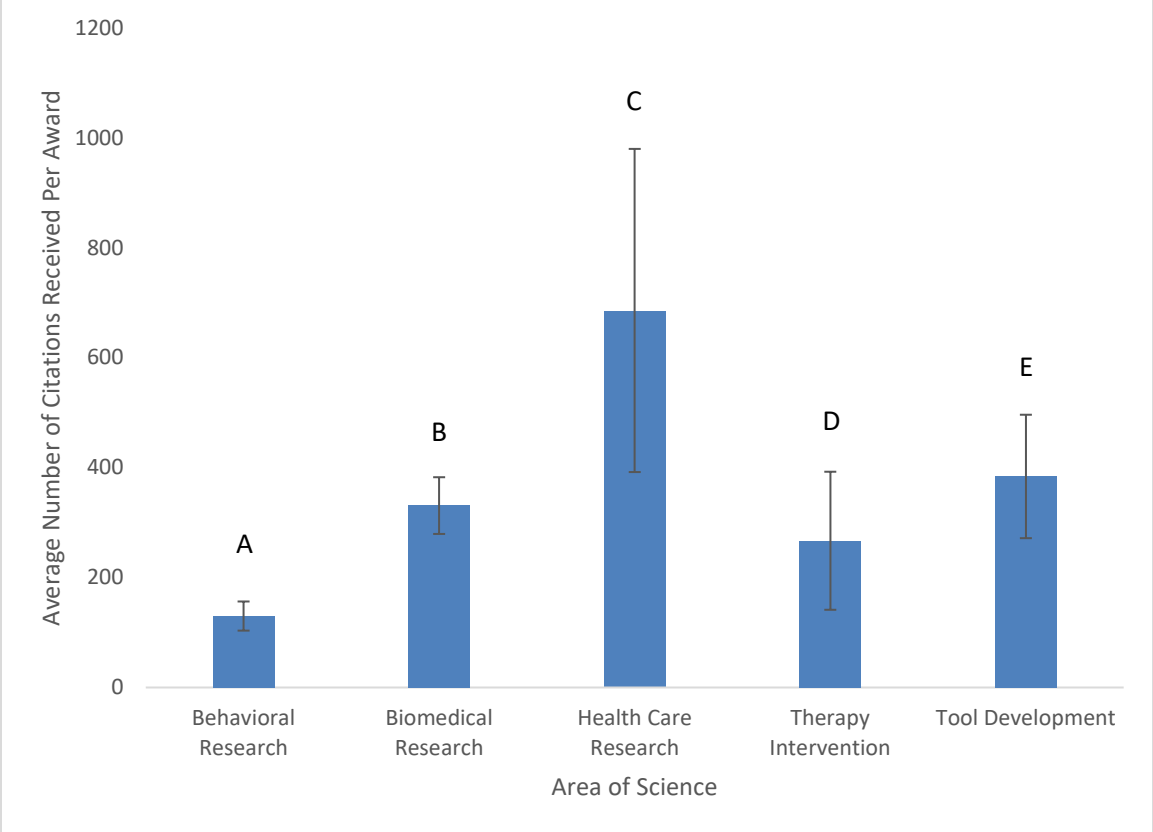
Metric	EIA	ESI	χ^2_1	P-value
Number of citations received per publication	43.0 ± 3.96	33.1 ± 2.61	724	< 0.001 ***
Number of citations received per publication per year	9.33 ± 0.74	6.18 ± 0.42	20.8	< 0.001 ***
Total direct cost spent per citation received	$15,512 ± $3,812	$29,301 ± $5,878	3.73	0.05
Relative Citation Ratio	3.34 ± 0.26	2.20 ± 0.14	19.7	< 0.001 ***

Source: publication data were downloaded from iCite (May 2020)
*** Significant at $p < .001$

At the award level, results from the multi-variable GLM regression analysis and type-II sum of squares analysis of deviance showed that *group*, *award duration*, *total direct cost*, and *area of science* all significantly affected the total number of citations received ($p < 0.001$ for group, award duration, and area of science, $p = 0.03$ for total direct cost). Specifically, when all other confounders are held constant, the expected number of

citations decreased by 44% for ESI awards relative to EIA awards; and the expected number of citations increased by 7.7% for every year increase in award duration. Again, while total direct cost was determined to be a significant factor influencing the number of citations received, the expected increase in the number of citations for every dollar increase in total direct cost is approximately zero indicating that while it is a statistical difference, it is not a true, observable difference.

Results from the post-hoc Tukey test on *area of science* showed that the average (± SE) number of citations received differed significantly across all areas of science ($p < 0.001$ for each pair-wise comparison; Figure 41). Specifically, awards focused on health care received, on average (± SE), the highest number of citations per award (686 ± 294), followed by awards focused on tool development (384 ± 112), biomedical research (331 ± 52), therapy intervention (267 ± 126), and then behavioral research (130 ± 26).



Different letters denote significant differences in the number of citations received among different areas of science.

Figure 41. Mean Number of Citations Received Per Award by Area of Science

At the publication level, results from the multi-variable GLM regression analysis and type-II sum of squares analysis of deviance showed that *group*, *year of publication*, and

the total *number of authors* on a publication all significantly affected the number of citations received per publication ($p < 0.001$ for each). Specifically, the expected number of citations received per ESI award publication was 40% lower than those received per EIA award publication; for every year increase in year of publication, the expected number of citations received per publication decreased by 29%; and for every additional author listed on a publication, the expected number of citations received per publication increased by 5.6%.

In total, EIA publications were cited by 14,975 unique publications and ESI publications were cited by 28,161 unique publications. The Cox regression model for *time to first citation* by an award's project start date showed that there was no significant difference in rate at which first citations were received between EIA and ESI awards ($p = 0.65$). The hazard ratio (95% confidence interval) for ESI awards compared to EIA awards was 1.09 (0.75 to 1.58) Although it is not significantly different, the time to first citation is approximately 9% faster for ESI compared to EIAs (Figure 42).

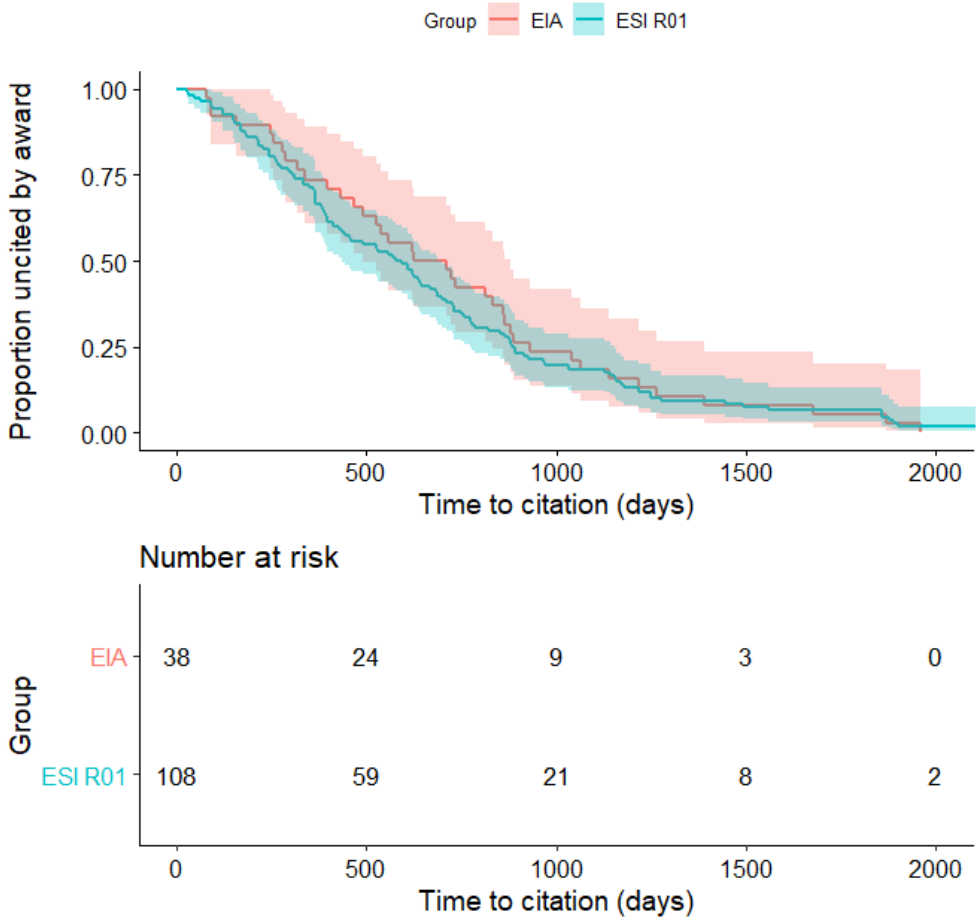


Figure 42. Proportion of Awards with Publications That Are Uncited over Time by *Group* Where Time to First Citation Is Calculated from an Award's Project Start Date

The Cox regression model for *time to first citation* by the publication date of the article that received the first citation of an award showed that there was a significant difference in rate at which first citations were received between EIA and ESI awards ($p = 0.03$). The hazard ratio (95% confidence interval) for ESI awards compared to EIA awards was 0.66 (0.46 to 0.97) meaning that ESI awards, on average, received their first citation 34% slower than EIA awards (Figure 43).

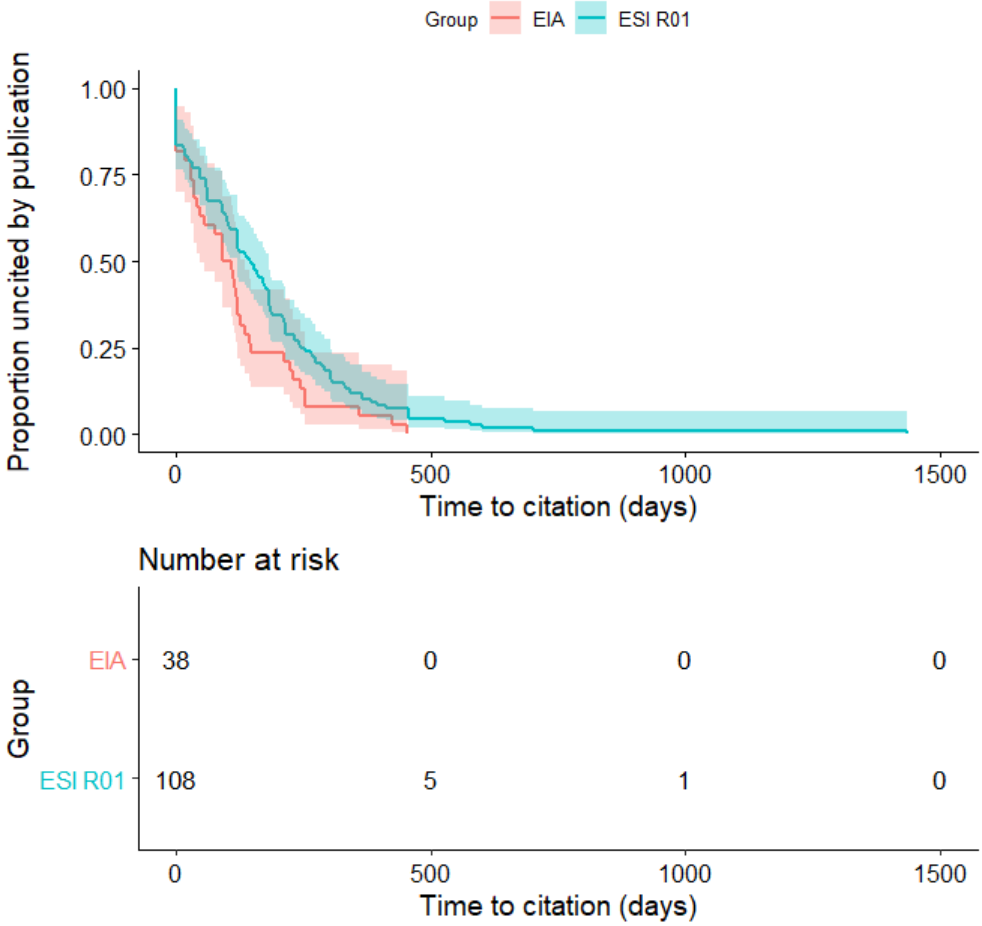


Figure 43. Proportion of Awards with Publications That Are Uncited over Time by *Group* Where Time to First Citation Is Calculated from the Publication Date of the Article That Received the Citation

With regard to the citation rate, the Cox regression model for *overall time to citation* by an award's project start date indicated that there is a significant difference in the rate at which articles were cited between ESI and EIA awards ($p < 0.001$). The hazard ratio (95% confidence interval) for ESI awards compared to EIA awards was 0.62 (0.61 to 0.63), indicating that ESI awards receive their citations 38% slower than EIA awards (Figure 44).

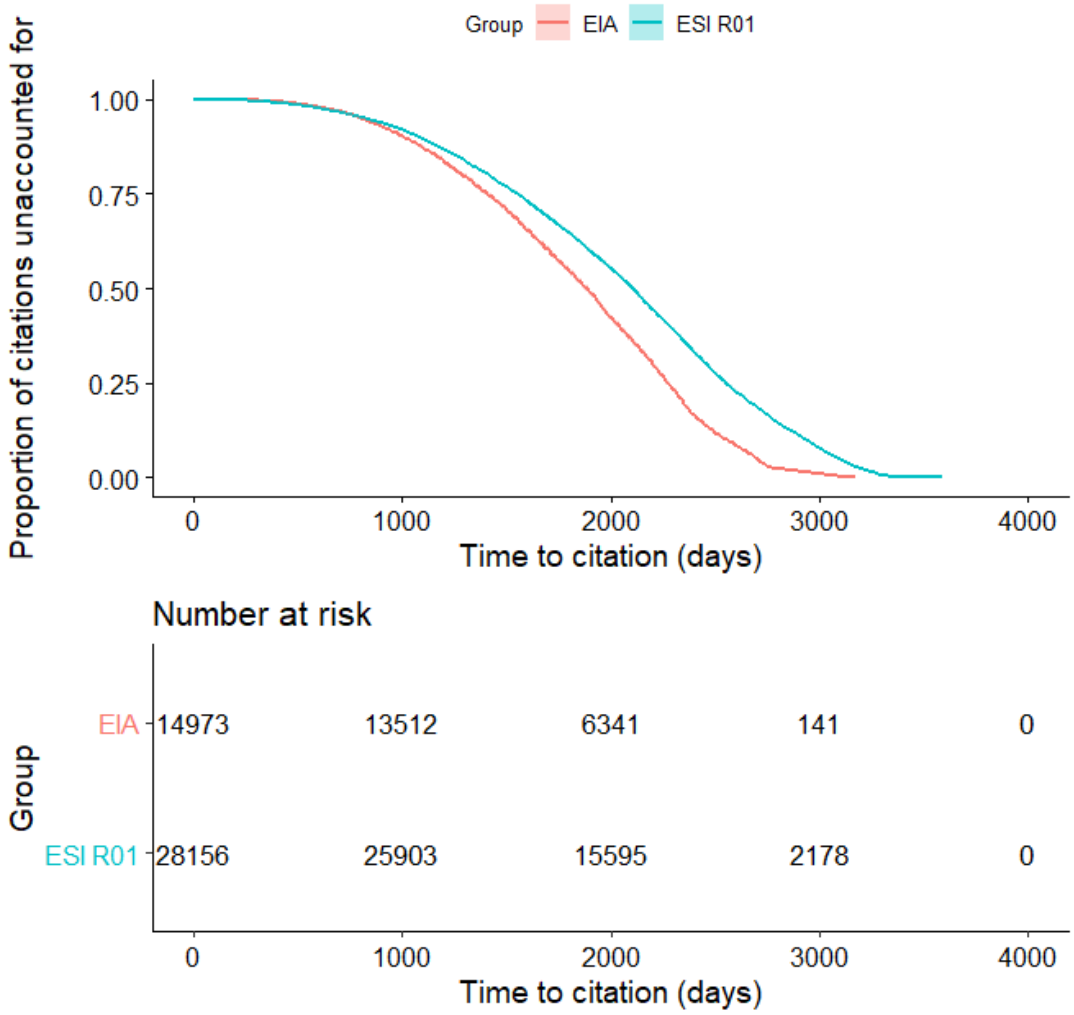


Figure 44. Proportion of Citations That Are Unaccounted for by Group Where Time to Citation Is Calculated from an Award's Project Start Date

The Cox regression model for *overall time to citation* by the publication date of the article that received the first citation of an award showed that there was a significant difference in rate at which citations were received between EIA and ESI awards ($p < 0.001$). The hazard ratio (95% confidence interval) for ESI awards compared to EIA awards was 0.75 (0.73 to 0.76) meaning that ESI awards, on average, received their first citation 25% slower than EIA awards (Figure 45).

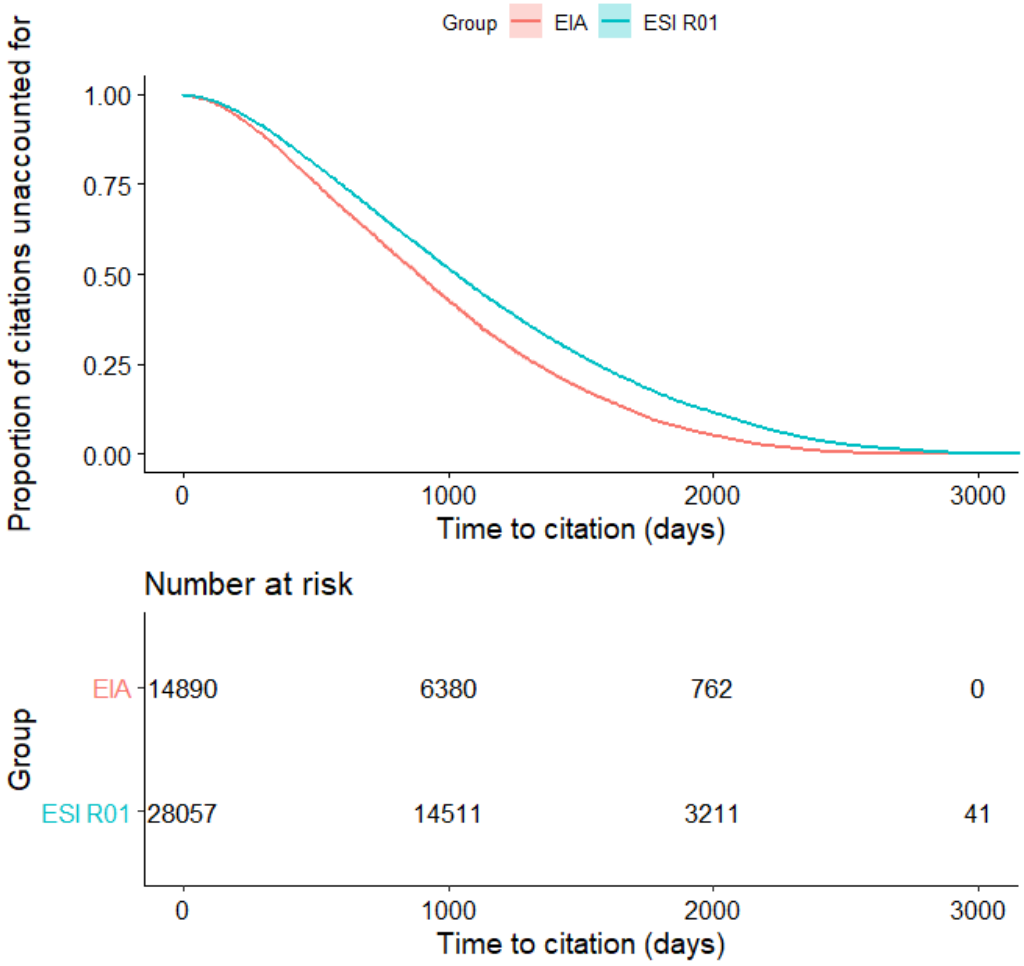


Figure 45. Proportion of Citations That Are Unaccounted for by Group Where Time to Citation Is Calculated from the Publication Date of the Article That Received the Citation

3. Altmetrics

The mean (± SE) Altmetric attention score was 108.9 (± 15.1) among 331 EIA publications and 15.5 (± 1.66) among 698 ESI publications. Results from the Kruskal-Wallis test indicate that EIA publications, on average, have significantly higher Altmetric attention scores than ESI publications ($\chi_1^2 = 132, p < 0.001$). This is corroborated by the QQ plot of Altmetric attention scores for EIA and ESI publications, which shows that EIA publications had higher Altmetric attention scores compared to ESI publications (Figure 46).

As a reminder, a QQ plot is a visual tool to help assess whether two different data sets have the same distribution by plotting the quantiles (i.e., the fraction, or percent, of points below a given value) of each group against one another. In Figure 44, the estimated quantiles from the EIA and ESI Altmetric attention scores are represented by the x- and y-

axes, respectively.[40] The 45-degree diagonal line represents the theoretical quantiles, if both the EIA and ESI Altmetric attention scores came from a population with the same distribution, the points should fall approximately along the diagonal line. The greater the departure from this diagonal line, the greater the evidence that the EIA and ESI Altmetric attention scores come from populations with different distributions.

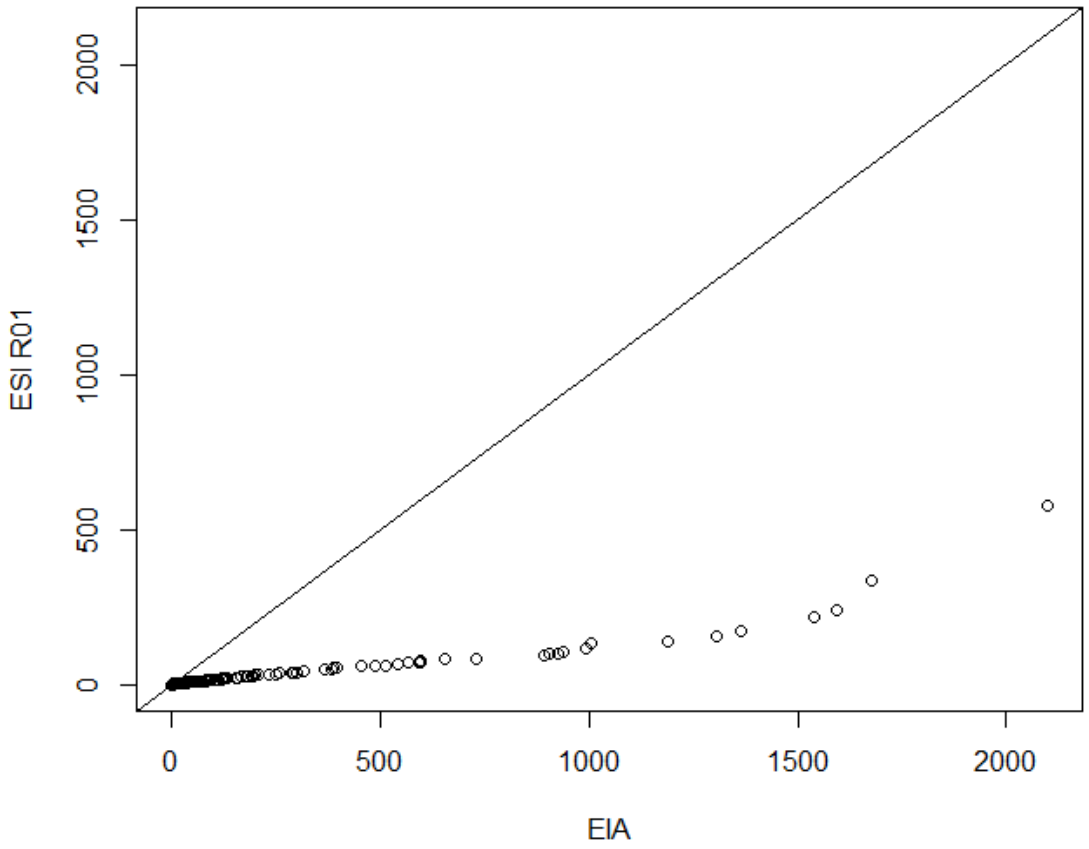


Figure 46. QQ plot of Altmetric attention scores for EIA and ESI publications.

We also found that the area of science of an award, irrespective of group, influences Altmetric attention scores, as publications from different areas of science significantly differ from each other ($p < 0.001$). The average altmetric attention score is 28.5 (± 7.51) for behavioral research, 22.1 (± 3.31) for biomedical research, 312 (± 50.2) for health care

[40] For more information about QQ plots, please visit the Engineering Statistics Handbook at https://www.itl.nist.gov/div898/handbook/eda/section3/qqplot.htm#:~:text=A%20q%2Dq%20plot%20is%20a,70%25%20fall%20above%20that%20value.

research, 21.4 (± 4.78) for therapy interventions, and 24.9 (± 4.90) for tool development (Figure 47).

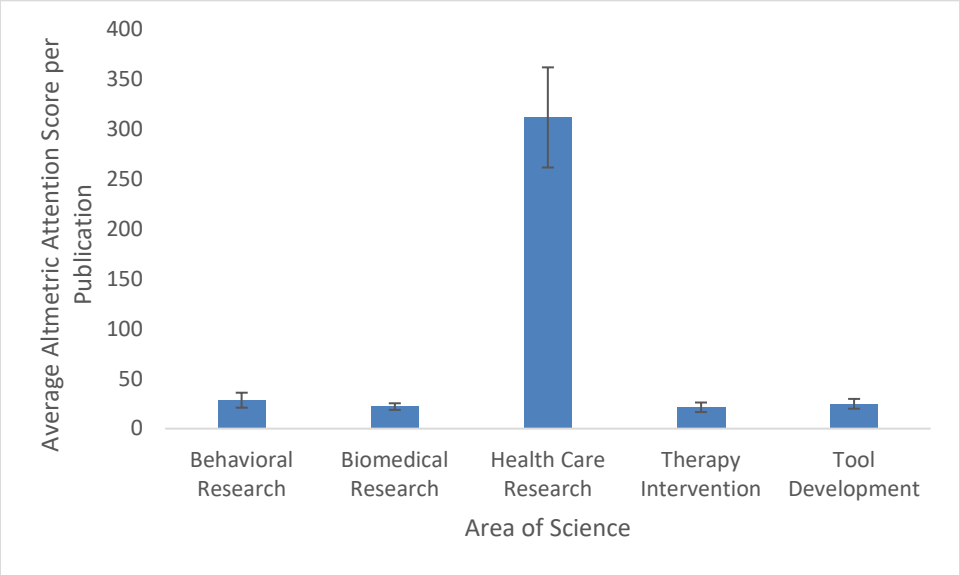
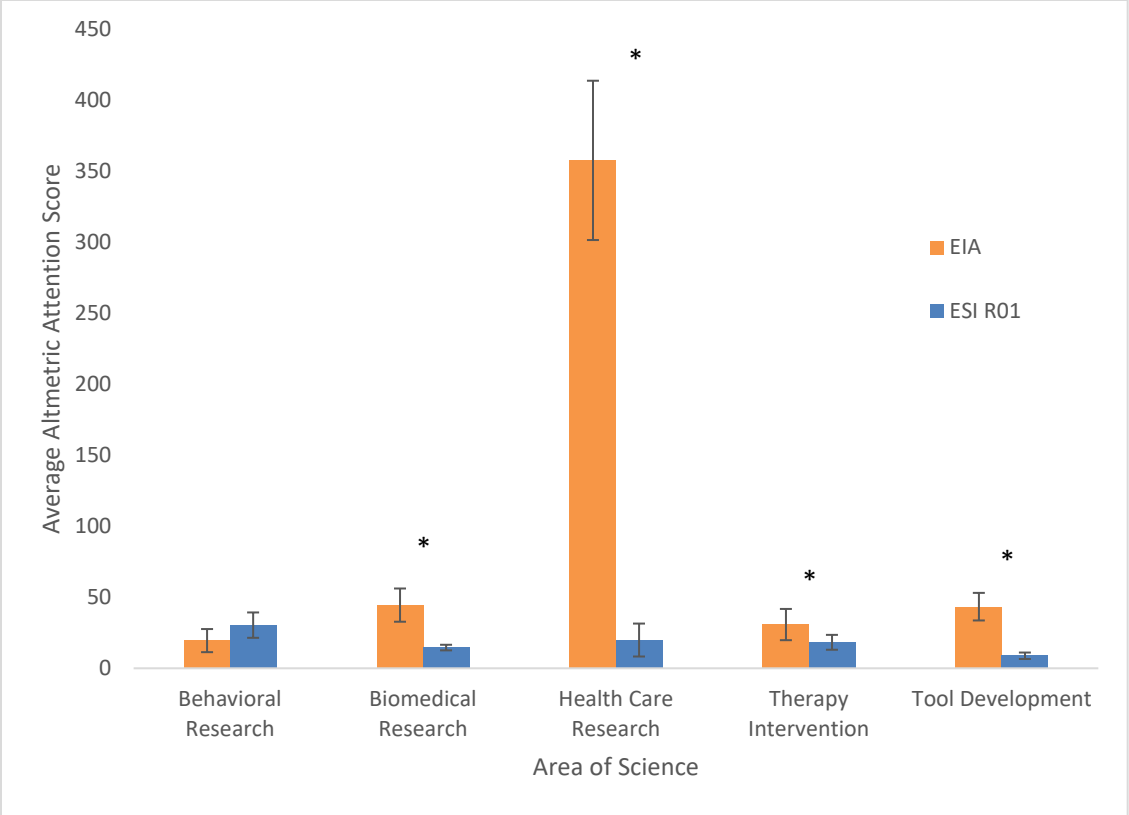


Figure 47. Average Altmetric Attention Scores per Publication by Area of Science

EIA publications received significantly higher Altmetric attention scores (44.5 ± 11.7) compared to ESI publications for biomedical research (14.6 ± 1.97; $p < 0.001$; Figure 48). For health care research, EIA publications also received significantly higher Altmetric attention scores (358 ± 56.1) compared to ESI publications (19.9 ± 11.6; $p < 0.001$). For therapy intervention research, EIA publications received significantly higher Altmetric attention scores (30.8 ± 11.0) compared to ESI publications (18.3 ± 5.24; $p = 0.02$). The same is true for tool development research, EIA publications received significantly higher altmetric attention scores (43.4 ± 9.71) compared to ESI publications (8.82 ± 2.27; $p < 0.001$). The only exception is in behavioral research, where there was no significant difference between EIA publications (19.5 ± 8.14) and ESI publications (30.4 ± 8.93; $p = 0.23$).



Asterisks denote statistical significance between EIA And ESI publications within an area of science.

Figure 48. Mean Altmetric Attention Score for EIA and ESI Publications by Area of Science

D. Limitations to the Bibliometric Study

As a reminder, two EIA awards are currently active with project end dates of August 2020. We note that it is possible that these awards may receive additional no-cost extensions, thereby increasing their award durations. In addition, they may also publish additional articles or receive citations, which may change or alter the findings presented in this study.

4. Biosketch Analysis

A. Methodology

A post-doctoral experience not to exceed 12 months was a 2011-2013 FOA criterion for the EIA award; however, 31% of ESI respondents reported post-doctoral training of 0–2 years (Figure 6). Because this could influence our understanding of the EIA experience compared to that of ESI survey respondents, STPI examined the biosketch provided in the award application to understand this finding in more detail. STPI notes that a post-doctoral fellowship is not the only path for junior investigators to gain research experience—and for this analysis expanded the concept of *post-doctoral fellowships* to include other research experience post-terminal degree, including industrial experience.

STPI conducted an analysis of the EIA and ESI survey respondents' post-terminal degree and post-clinical fellowship or residency experience using the biosketches found in NIH's QVR database. STPI noted the year in which individuals completed their terminal degree or clinical experience and all positions held between that date and the receipt of their EIA or ESI award. *Years of experience* was calculated by summing the number of years individuals held professional positions between these dates. The number of years of experience determined by the biosketch analysis was compared to the number of years of post-doctoral experience reported by the EIA and ESI survey respondents.

STPI also noted the position titles of EIA and ESI survey respondents in the specified *years of experience*. Professional positions included post-doctoral and faculty positions at universities, medical centers, and industry positions, such as staff scientist and research scientist. Because many ESI survey respondents held positions other than postdoctoral fellowships, STPI analyzed and categorized the types of positions they held before the receipt of their ESI award. This analysis was not performed on EIA survey respondents, because none of them held positions other than postdoctoral fellowships before receipt of their EIA.

B. Results

Based on this analysis, all EIA survey respondents reported less than 2 years of experience on their biosketches (Figure 49). The average and median number of years of experience was less than 1 for EIA survey respondents.

ESI respondents reported 3–12 years of experience on their biosketches, and the average number of years of experience was 7.75 (Figure 49). The median number was 8 years of experience, and the minimum number of years of experience was 3.

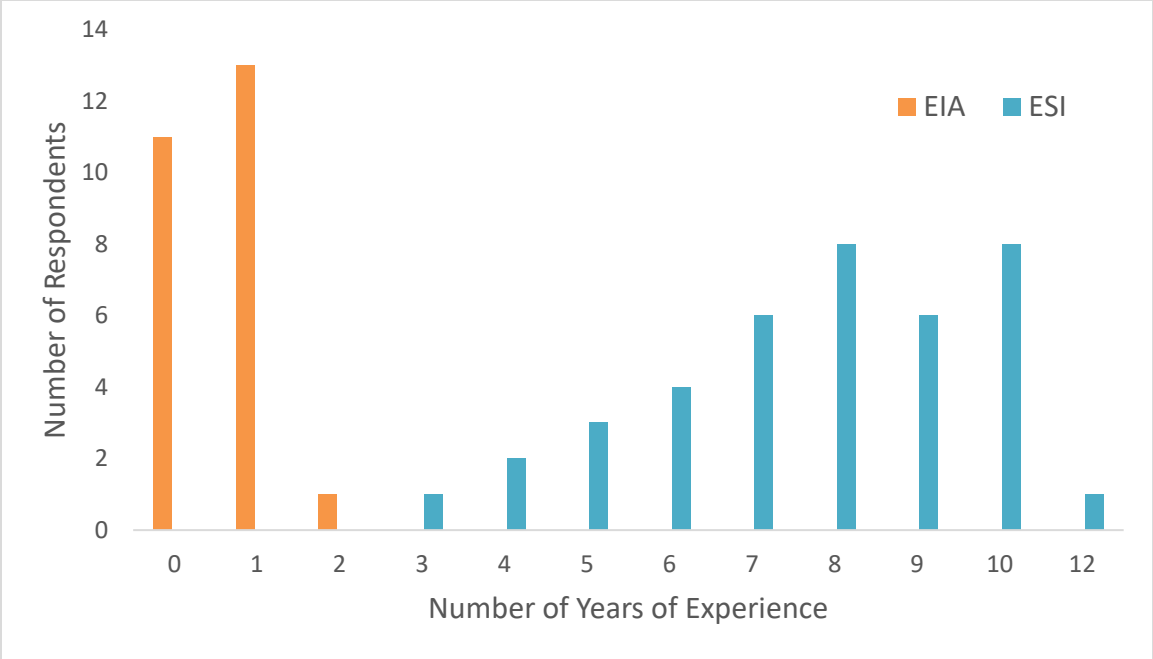


Figure 49. Number of Years of Experience between Finishing Their Terminal Degree and Receiving Their Award for All EIA and ESI Survey Respondents

For EIA survey respondents, comparison of the survey-reported years of post-doctoral fellowship with the years of experience derived from the biosketch analysis demonstrates minimal divergence (Figure 48). Only one EIA survey respondent misreported the number of post-doctoral fellowship years, number that remained within the EIA FOA criterion.

For ESI survey respondents, the length of formal post-doctoral training reported in Figure 6 was correct; however, it did not provide a clear measure of research experience prior to receiving their award. The individuals reporting 0 years of post-doctoral training did not have formal post-doctoral fellowship positions, but had other research positions that provided equivalent experience in maturing scientific thinking and running a laboratory (Figure 50). Based on this analysis, ESI survey respondents had 2 to 8 or more years of research experience prior to receiving their award, with the majority having 5 or more years of experience. This finding is not discordant with the 3–12 years reported in Figure 49 as the survey question reported in Figure 48 grouped the response as 2–5 years post-doctoral experience.

Using *years of experience since terminal degree/residency*, STPI confirmed that the ESI group is distinct from the EIA awardees for this measure.

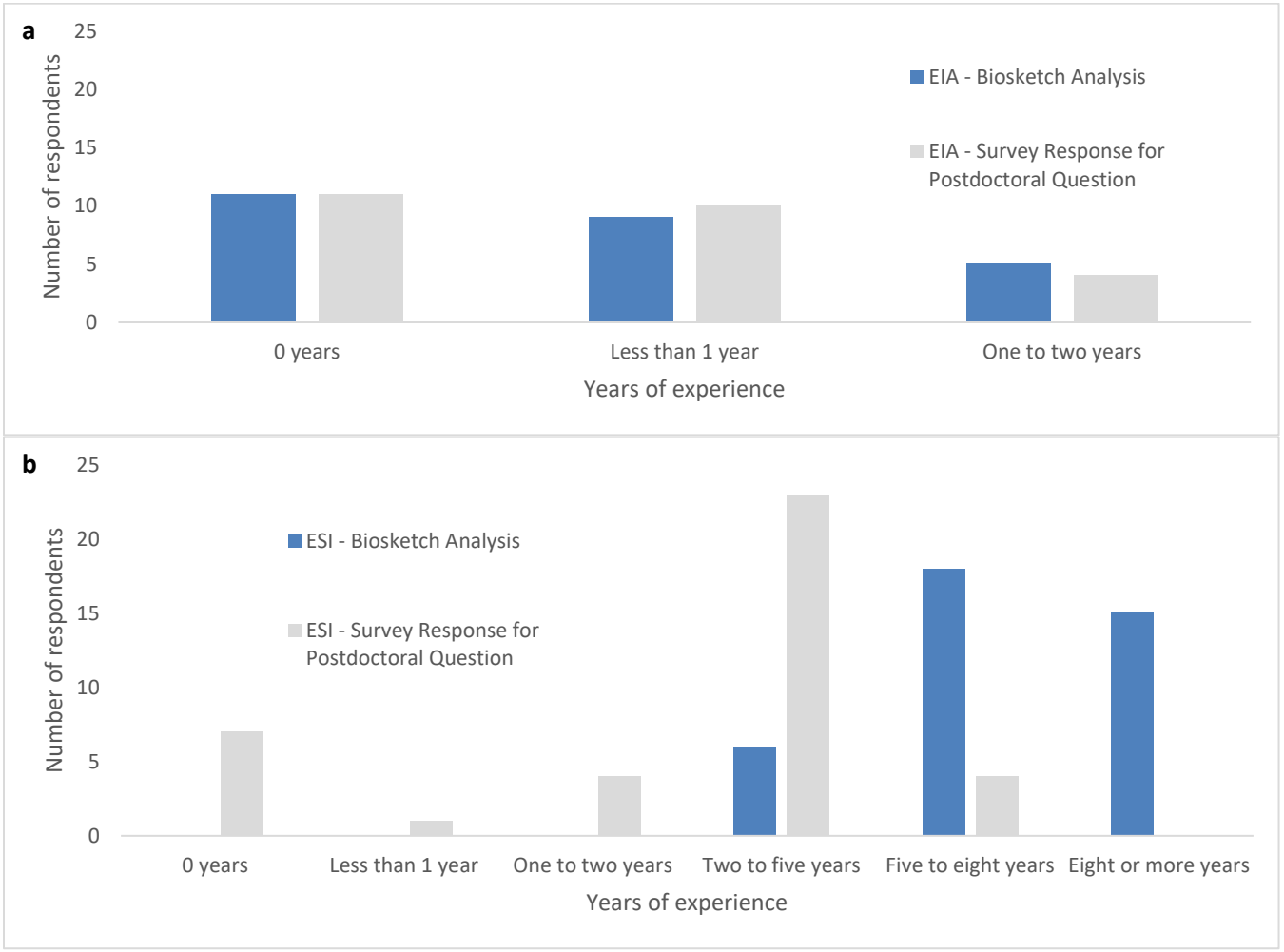


Figure 50. Comparison of the Number of Years in a Post-Doctoral Fellowship Based on Survey Response with the Number of Years of Experience Based on the Biosketch Analysis for All (a) EIA and (b) ESI Survey Respondents

ESI survey respondents indicated many position titles outside of their postdoctoral experience. Figure 51 provides the distribution of position titles held by ESIs during the relevant years of experience. The academic faculty category includes all professorship positions as well as instructor and lecturer titles. The fellowship category includes all postdoctoral positions as well as clinical fellowships and research fellowship titles. The research category includes all scientist position titles as well as other titles indicating bench research. The other category includes all other titles such as directorships and physicians.

There were 32 unique titles amongst the ESI survey respondents in the relevant years of experience for this study, and the 39 ESI survey respondents held 108 different titles. EIA survey respondents only held postdoctoral position titles before receipt of their EIA and thus are not included this analysis.

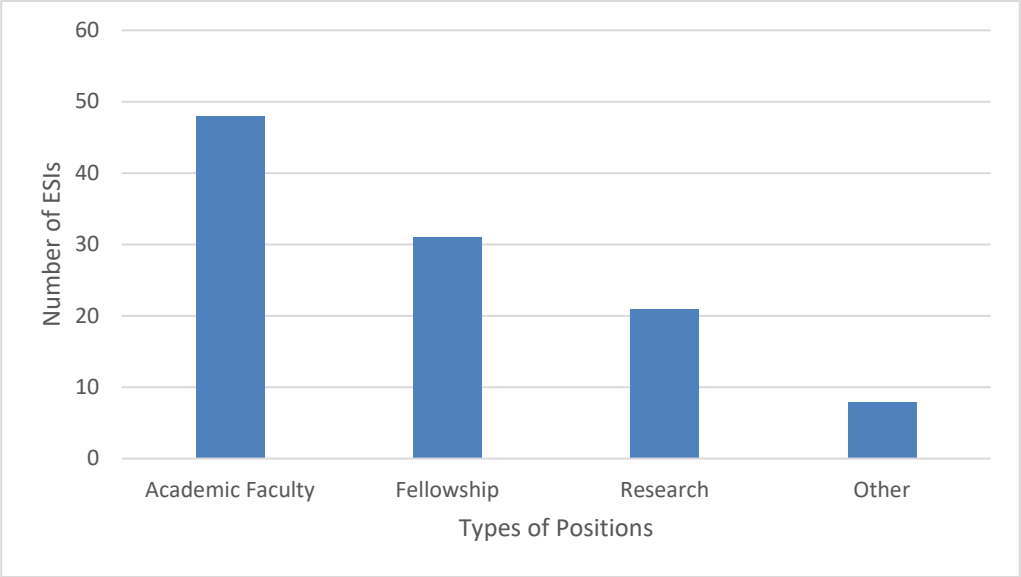


Figure 51. Distribution of types of position titles held by ESIs before receipt of their ESI

5. Post-award Funding Analysis

A. Methodology

NIH funding history was downloaded for each EIA and R01 contact PI through the Person Project Participation and Funding History (PERSONFUND) standard report in QVR. STPI limited the post-award funding analysis to new (Type 1) and renewal (Type 2) applications that were awarded and had a project start date after the awardee's respective EIA or ESI award project start date. If an individual received both a Type 1 and Type 2 award for the same grant, this was counted as two separate follow-on awards. STPI excluded awards that do not directly reflect the individual's ability to compete successfully for NIH research or research scientist development funding. Awards that were excluded from the analysis are: cooperative agreements (U awards, N = 11), specialized centers or research program projects (P awards, N = 4), training programs (T awards, N = 2), and loan repayment programs (L30 or L40 activity codes, N = 7).

A two-sample proportion test was used to assess whether the percent of EIA and ESI awardees who received follow-on awards differed from one another. A GLM with a Poisson distribution was used to assess whether the number of follow-on awards received differed between EIA and ESI awardees. Similarly, STPI used a two-sample proportion test and a GLM with a Poisson distribution to assess whether the percent of EIA awardees who received an R01 follow-on award differed from that of ESI awardees, and whether the number of R01 follow-on awards received differed between EIA and ESI awardees, respectively.

To determine if it takes EIA or ESI awardees longer to obtain their first research or research scientist development award, STPI used the first follow-on award for each awardee and calculated the time to each follow-on award as the number of years in between an awardee's EIA or ESI project start date and the project start date for the follow-on award.

Analysis of the time to first R01 award is influenced by the fact that the ESI award is an R01, whereas the EIA award is a DP5. To determine time to first R01 follow-on award, only the first Type 1 R01 follow-on award for each awardee is included in the analysis. A non-parametric Kruskal-Wallis test was used to assess whether time to first follow-on award (in years), as well as time to first R01 follow-on award, differed by *group*.

Lastly, STPI assessed the rate at which EIA and ESI awardees received post-award funding. A Cox proportional hazard model was used to examine whether *group* was predictive of *time to all post-award funding* and *time to R01 post-award funding*. Awardees with zero post-award funding were removed from all post-award funding analyses.

B. Results

Overall, 20 of the 39 EIA awardees (51%) and 66 of the 117 ESI awardees (56%) received a total of 49 and 149 NIH follow-on awards, respectively. Of the 49 follow-on awards received by EIA awardees, one was the NIH Director's Pioneer Award (NDPA); one was for a specialized center; one was for a research project cooperative agreement; and the remaining 46 were R awards. Of the 149 follow-on awards received by ESI awardees, one was a research scientist development award; one was a research program project; two were specialized centers; two were institutional National Research Service Awards; four were research project cooperative agreements; two were specialized center cooperative agreements; two were phase I, exploratory or developmental cooperative agreements; and the remaining 134 were R awards. Of these, the 47 EIA and 135 R01 follow-on awards related to research (R and DP awards) or research scientist development (K award) were used for additional post-award funding analysis.

1. Follow-on Awards

Of the 47 EIA follow-on awards received by 20 EIA awardees, one was a Type 2 and the remaining 46 were Type 1 awards. Of the 135 R01 follow-on awards received by the 62 ESI awardees, 4 were Type 2 awards and the remaining 131 were Type 1. The percentage of EIA and ESI awardees who received research or research scientist development follow-on awards (51% and 53%, respectively) were not significantly different from one another ($\chi^2 = 0.0, p = 1.0$; Table 8). On average (± SE), the number of follow-on awards received per EIA (2.30 ± 0.33) awardee was not significantly different from those received by ESI (2.18 ± 0.17) awardees ($\chi_1^2 = 0.10, p = 0.75$).

2. R01 Follow-on Awards

The percentage of EIA awardees (44%) who obtained an R01 follow-on award was not significantly different from that of ESI awardees (43%; $\chi_1^2 = 0.0, p = 1.0$; Table 8). Similarly, the average (± SE) number of R01 follow-on awards received did not differ significantly between EIA (1.65 ± 0.23) and ESI (1.64 ± 0.13) awardees ($\chi_1^2 < 0.001, p = 0.98$).

3. Time to First Follow-on Award

For all research or research scientist development follow-on awards, the average (± SE) time to first follow-on award for EIA awardees was 3.84 (±0.48) years and 3.68 (± 0.30) years for ESI awardees (Table 8). Results from the Kruskal-Wallis test indicated that the amount of time it takes for an awardee to obtain his/her first follow-on award does not differ between EIA and ESI awardees ($\chi_1^2 = 0.05,$ $= 0.83$).

Similarly, the average (± SE) time to first R01 follow-on award did not differ significantly between EIA (4.53 ± 0.69 years) and ESI (3.89 ± 0.42 years) awardees ($\chi_1^2 = 0.67, p = 0.41$; Table 8).

Table 8. Summary Statistics of Post-award Funding Data by *Group*

Group	Percent of awardees who received a research or research scientist development follow-on award	Average (± SE) number of research or research scientist development follow-on awards received	Percent of awardees who received an R01 follow-on award	Average (± SE) number of R01 follow-on awards received	Average (± SE) time to first research or research scientist development follow-on award	Average (± SE) time to first R01 follow-on award
EIA	51%	2.30 ± 0.33	44%	1.65 ± 0.23	3.84 ± 0.48 years	4.53 ± 0.69 years
ESI	53%	2.18 ± 0.17	43%	1.64 ± 0.13	3.68 ± 0.30 years	3.89 ± 0.42 years

4. Time to All Post-award Funding

For *time to all post-award funding*, the Cox regression model indicated that there was no significant difference in the rate at which post-award funding is received between EIA and ESI awardees ($p = 0.93$). The hazard ratio (95% confidence interval) for ESI awardees compared to EIA awardees was 1.02 (0.72 to 1.42; Figure 52). Although it is not significantly different, the rate at which ESI awardees obtain post-award funding is approximately 2% faster than that of EIA awardees.

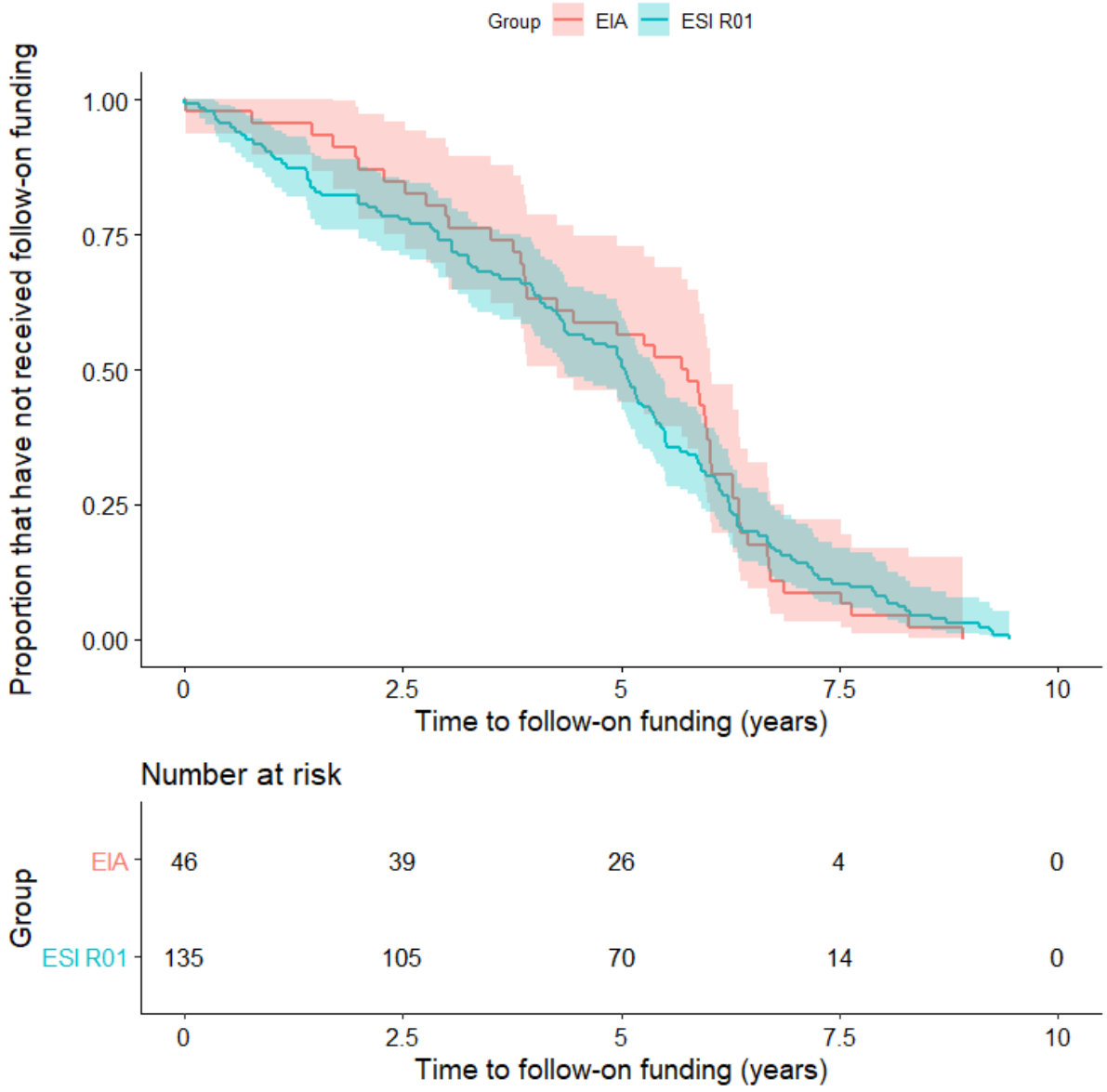


Figure 52. Proportion That Have Not Received Post-award Funding Over Time by *Group*.

5. Time to R01 Post-award Funding

For *time to R01 post-award funding*, the Cox regression model indicated that there was no significant difference in the rate at which post-award funding is received between EIA and ESI awardees ($p = 0.90$). The hazard ratio (95% confidence interval) for ESI awardees compared to EIA awardees was 0.97 (0.63 to 1.50; Figure 53). Although it is not significantly different, the rate at which ESI awardees obtain post-award funding is approximately 3% slower than that of EIA awardees.

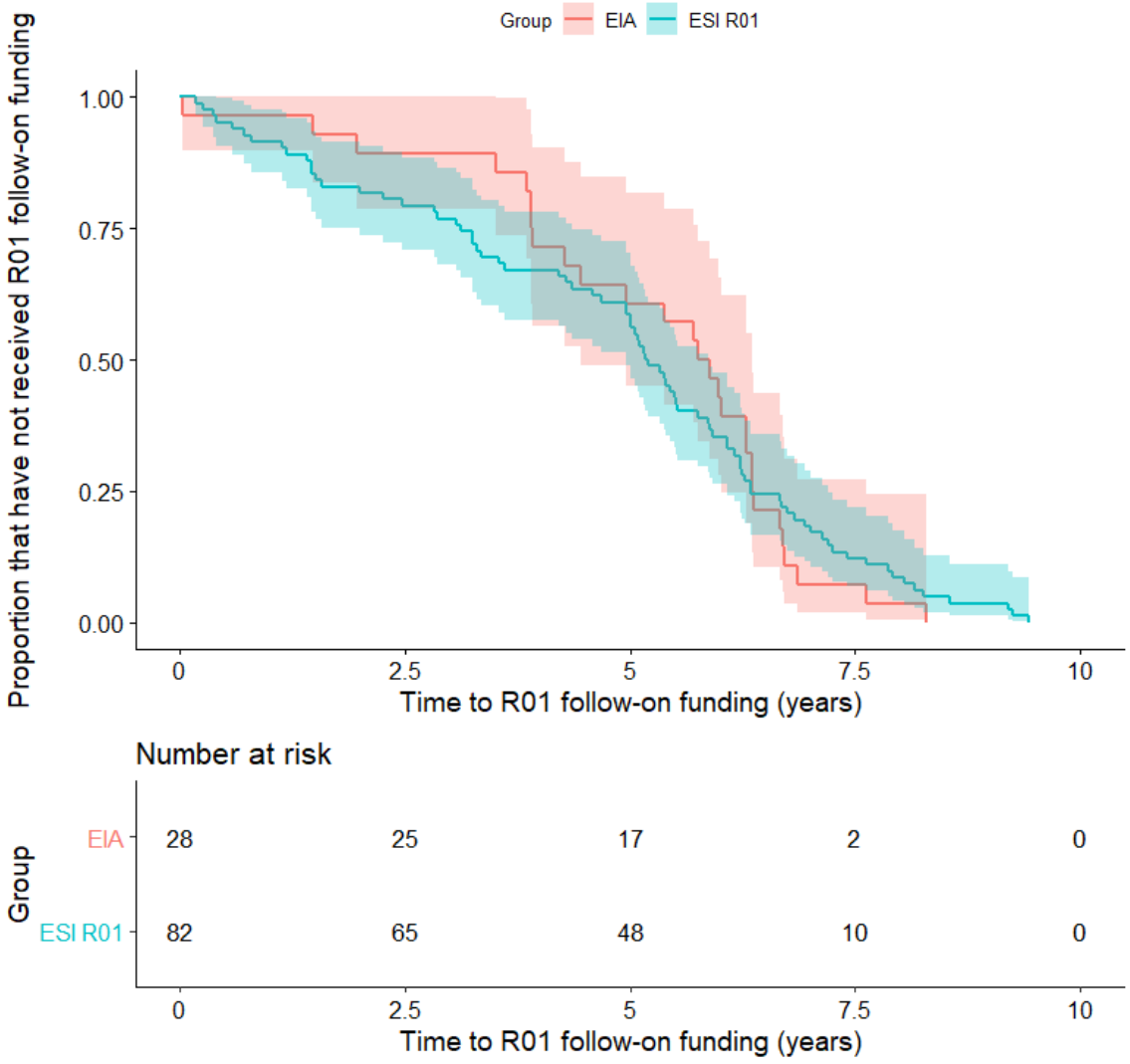


Figure 53. Proportion That Have Not Received R01 Post-award Funding Over Time by *Group*

6. Integration and Context for Findings

Multi-modal study design, as employed in this evaluation, assesses complex, multi-faceted questions using different approaches, and it is the integration of these disparate results that provides the most complete understanding of EIA awardees' research and career outcomes. In this section, STPI integrated the data from the survey and bibliometric analyses to address key study questions regarding EIA awardees' *research outputs and career impacts* relative to the ESI comparison group, and the secondary questions that examine the impact of the shortened mentoring period on the scientific and administrative skills needed by EIA awardees to establish an independent laboratory and research program.

Following integration of the survey and bibliometric data into one framework, STPI parsed the results according to the readiness, research, and career categories (Figure 54). *Readiness* to launch an independent career was evaluated through survey data assessing readiness to develop a research proposal, manage a laboratory and other job-related duties, from the bibliometric analysis of time to first publication by project start date, and through the biosketch analysis.

Questions related to *research*, productivity, and impact were evaluated through survey items assessing the ability to conduct research and to develop and expand a scientific program, laboratory, and collaborations. Citation level metrics and publication and citation cost metrics completed the data set in the research category.

The *career* development questions are informed by survey data related to promotion; the publication and research recognition of invited presentations, honors and awards; and work-life balance. Altmetrics derived from social media and online postings contribute a novel element to the understanding of public recognition.

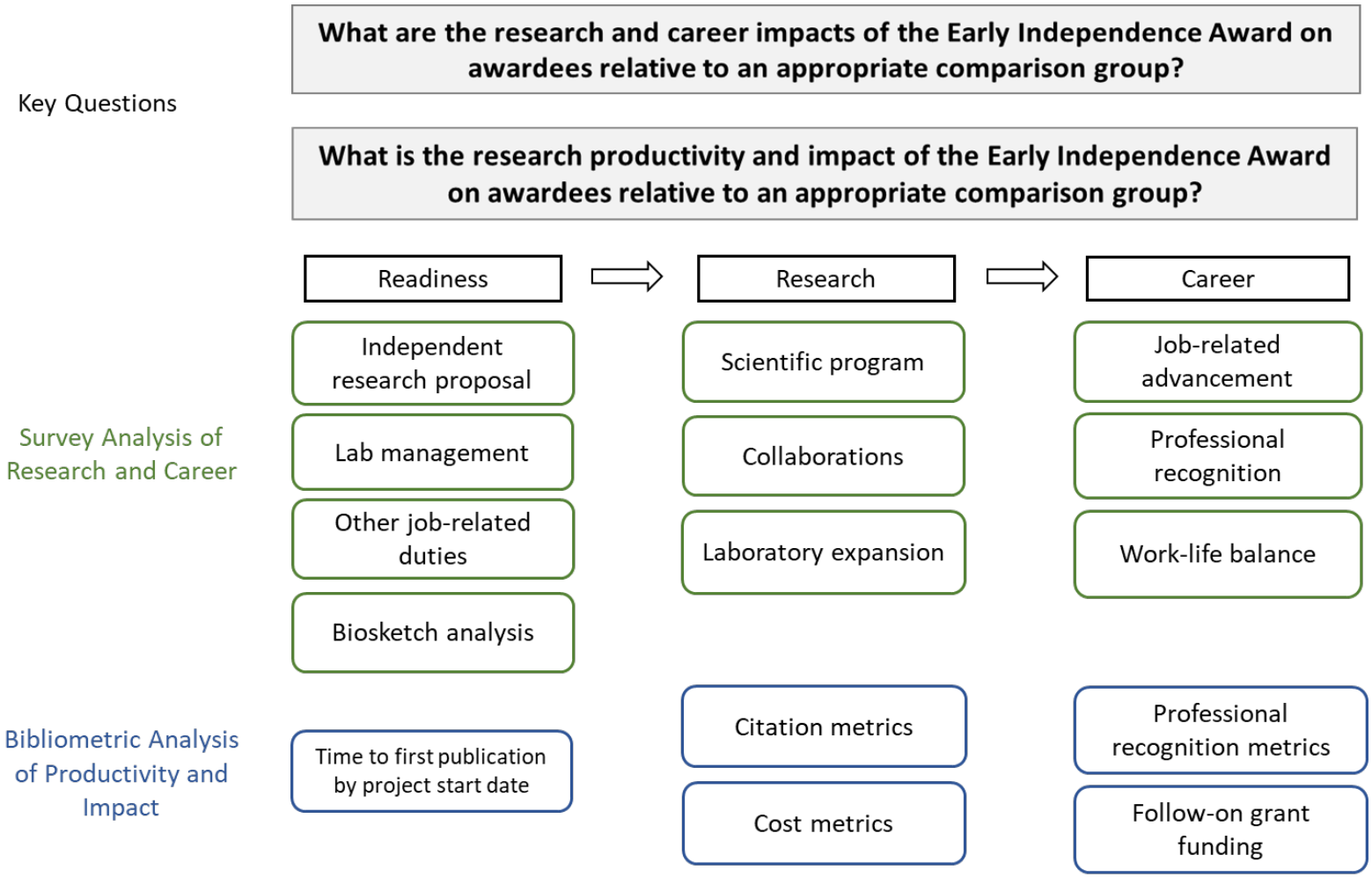


Figure 54. Data Integration Framework

The EIA and ESI data sets were then considered in the context of the four study questions and the logic model, including the rationale and assumptions (Figure 52).

A. Readiness

As background for understanding the EIA awardees' research products and impacts, STPI examined the shortened mentored training period on the awardees' ability to launch a productive research program. When queried about their post-doctoral training through the survey, 100% of the EIA respondents reported 0–2 years of post-doctoral fellowship, whereas 31% of the ESI respondents disclosed 0–2 years post-doctoral training and 69% reported 2–8 years. Further examination of ESI respondents led to the determination that all had 3–12 years of post-terminal degree or clinical fellowship research experience, indicating that the levels of research experience between the two groups is better approximated by 0–2 years for EIA respondents and 3–12 years for ESI respondents. As noted in the biosketch analysis, STPI captured the breadth of ESI research experience prior to their R01 award as *years of equivalent research experience*.

Through the factors examined in the survey, EIA and ESI respondents reported similar patterns of response for scientific readiness (e.g., understanding the complexities of establishing their own research lab, able to initiate and build new collaborations, having matured scientific thinking to be able to shape a research program) *at the time of application*. Furthermore, a similar percentage of EIA and ESI respondents indicated that they had received offers for independent research positions at the time of application. The finding that two-fifths of EIA survey respondents indicated they had an independent research position at the time of application could be explained by misinterpretation of the term and the possibility that individuals in non-academic positions would consider themselves to be in an independent research position.

EIA survey respondents, however, were more likely to report challenges with the complexities of establishing their laboratory and a statistically significant difference in preparation to manage technical staff. It is possible that the longer duration ESI post-doctoral fellowship included laboratory management and technical staff supervision, experience which could account for their responses demonstrating that ESI respondents felt more confident managing staff.

During the *transition to independence*, EIA and ESI survey respondents had similar response patterns that indicated a transition that had unforeseen issues and took longer than anticipated. Interestingly, EIA respondents were more likely to indicate transition to independence without significant difficulty, suggesting they were able to manage the unforeseen difficulties. The overall similarity in readiness factors selected by the respondents is underscored by data demonstrating no significant difference in time to first research publication from project start for bibliometric analyses of all publications or first-

last author publications attributed to the award. As a reminder, bibliometric data are derived for all awardees in the group, not just the survey respondents.

In summary, these data indicate differences in years of mentored training but similar levels of readiness at the time of application and first two years of the EIA or ESI award. The EIA initiative was designed for exceptional junior investigators, and the data provided here suggest that NIH identified individuals who were able to successfully launch an independent research program with fewer years of post-doctoral or mentored training. This conclusion is reinforced by the STPI efforts to develop a comparison group composed of exceptional junior investigators funded by private foundations. STPI found that 82% (14 of 17) of the private foundation award recipients considered in comparison group development (Section 2.A of this report) had also received an EIA award. These 14 constituted 36% (14 of 39) of the EIA cohort from 2011-2013.

Several additional explanations for readiness should be considered. Factors that might explain EIA readiness include EIA awardees who might have had exceptional training environments and/or more access to scientific mentoring and personal support, thus allowing them to better develop their independent research skills during their graduate training. STPI recognizes that EIA awardees may be able to capitalize on this enriched environment more fully than other trainees; however, it is possible that a larger population of graduate students and clinicians would, given comparable training, be capable of an early transition to independence, a question not addressed in this evaluation.

It is also possible that the pool of EIA applicants could be biased by graduate student advisors who are better at promoting their students and universities that preselect which students may apply for an EIA award. Additionally, the university internal selection processes may have different goals when determining who may apply for the EIA award—efforts that could keep other candidates with the potential for successful early independence from applying for reasons unrelated to the EIA initiative goals. There is also a possibility of award selection bias due to mentor or university prestige—biases unrelated to junior investigator exceptionalism.

B. Research

A key component of this analysis is the examination of EIA research outputs using measures of productivity and impact. This is generally performed through well-established bibliometric analysis of publications; however, the experiences of exceptional junior investigators in launching an independent scientific program and establishing a functional laboratory and a professional reputation at their host institution are germane to their ability to perform research. STPI assessed professional experience during the *first two years* of the award through the survey, and productivity and impact through a bibliometric analysis. It is important to note that multiple publication and citation metrics are assessed, and conclusions can only be drawn when the set of measures shows a consistent result. For the

bibliometric analysis reported in Section 3.B, the citation metrics consistently demonstrate that EIA awardees are cited more often; however, the publication metrics are inconsistent, varying between EIA awardees having significantly higher results, and EIA and ESI awardees not being statistically different. Because the selective reporting of publication data in this section could misconstrue the conclusions, STPI chose not to include these data in the integration of research findings. They are fully reported in Section 3.B.1, and the metrics included in this section are represented graphically in Figure 55.

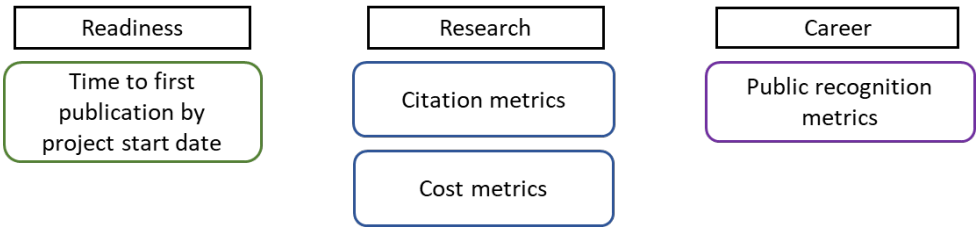


Figure 55. Bibliometric Asnalyses Integrated into Report Context

Through the survey, EIA and ESI respondents were similar in reporting that they published research findings independent of their previous advisors, expanded their research into new topic areas, and were professionally recognized by their departments in the first two years after their award. They were also similar in securing the personnel, equipment, and space needed to set up their laboratories, although significantly more EIA respondents reported laboratory expansion and wider scientific recognition outside of their departments but within their institutions. Additionally, there is no significant difference in time to publication for EIA and ESI first research paper attributed to the award.

Several factors could influence these response patterns. The results showing that EIA respondents were similar to ESI respondents suggest that EIA respondents were able to manage a complex research environment despite fewer years of training. One might also consider that the well-established activities associated with developing a research program and operationalizing a laboratory might override years of experience. The institutional hiring and ordering processes, access to shared equipment, and personnel hiring practices challenge all investigators, regardless of years of experience.

EIA survey responses indicate a significantly higher level of institutional recognition (university-wide invited talks and expanded laboratory space) that could confirm exceptional scientific abilities and/or the prestige of winning an NIH Director's award. Breadth of the EIA respondents' collaborative networks, personal speaking skills, and areas of science may also contribute to this recognition. Bibliometric analysis of citations for publications attributed to the award confirms EIA awardees' scientific recognition as they had a significantly higher number of citations per publication, citations per publication per year, and Relative Citation Ratio; and citations were received at a significantly faster rate.

Cost is another metric of interest to NIH as it compares the 2011–2013 research investment made through the DP5 program. While there is no significant difference in the total direct cost per publication for the two comparison groups, EIA awardees have a significantly lower direct cost per citation. This finding is consistent with the similar number of EIA and ESI publications per award but the significantly higher number of EIA citations.

Investigators maintain their research programs primarily through competitive grant awards. EIA and ESI awardees were not statistically different in the overall number of awards they were able to obtain following their EIA and ESI awards, the number of R01 awards, or the time to first award. This analysis of post-award funding suggests that EIA awardees were not disadvantaged by their shorter training period and that the EIA award did not confer a funding advantage.

C. Career

Through the promotion of early independence, NIH aspires to increase the likelihood exceptional junior investigators will experience research success, professional recognition, and work-life balance, elements that could support their retention in biomedical research. The ESI policy was established to provide similar benefit to new investigators transitioning to their first major award and an independent research position.[41] The assessment of career status was informed by survey data related to job promotion; professional recognition provided through invited presentations, honors and awards; general public recognition; and work-life balance.

Tenure is considered a major career milestone and an indicator of professional success. Requirements vary among institutions that offer tenure; however, the ability to generate external research funding is common. EIA and ESI awardees demonstrated no significant differences in the receipt of competitive NIH grants following their EIA or ESI award (total number of NIH awards or R01 awards; time to first award for all awards or R01 awards). EIA and ESI respondents were similar in their response patterns regarding tenure (hired into a tenured position, tenure-track offer at award institution), and ESI respondents were significantly more likely to report promotion within the award institution. In contrast, EIA survey respondents were significantly more likely to report that they received a tenure-track offer from an institution other than the one they were located at when they received their EIA award, suggesting broader recognition of the junior investigators' accomplishments. In sum, the respondents indicate that the EIA and ESI awards have similar positive impact on their ability to achieve a tenured academic position,

---

[41] Walsh, R., Moore, R.F., Doyle, J.M. 2018. "An evaluation of the National Institutes of Health Early Stage Investigatory policy: using existing data to evaluate federal policy." *Research Evaluation* 27(4): 380-387.

perhaps differing in the breadth of the EIA awardees scientific reputation (external job offer) and the EIA awardees' more established research experience (internal promotion).

The assessment of career recognition has two components: survey responses regarding academic responsibilities, awards, and honors; and online, general public recognition of research outputs. EIA respondents were significantly more likely to report that their research was featured in the popular press, and this finding is supported by the significantly higher EIA awardees' Altmetric attention scores. The career response patterns for EIA and ESI survey respondents suggests that they are experiencing comparable career milestones, such as invitations to present research findings or serve as a grant or journal reviewer, recognition both groups attribute to their respective awards.

As a final element of the career survey assessment, STPI queried awardees about elements that create work-life balance. EIA survey respondents were significantly more likely to report that their institutions supported their early independence and their research and that their compensation was *adequate*. They were similar to ESI awardees in their responses on employment benefits, mentoring, and the balance of their research and other responsibilities, although EIA responses were overall more positive than ESI responses (Figure 15).

In summary, the data indicate that EIA respondents report results similar to ESI respondents for tenure, career milestones, and work-life balance. The data suggest that EIA junior investigators are not disadvantaged by early independence and benefit from receiving the award.

D. Additional factors influencing data interpretation

It is beyond the scope of this analysis to estimate the influence of job openings and research funding on the need for and length of post-doctoral fellowships; however, the influence of these factors cannot be discounted.[42] Two factors with ramifications for the current assessment are the Matthew effect and the impact of gender on traditional metrics of research accomplishment.

In science and academia, there is often an assumption that we are operating under a meritocratic system where individuals are recognized and rewarded based on their abilities and merits that are assessed through objective evaluation. However, studies have shown that a small percentage of researchers receive the majority of research funding.[43] A 2018 study found that whether an individual received funding did not necessarily mean that the

---

[42] Ibid.

[43] Bol, T., de Vaan, M., de Rijt, A. 2018. "The Matthew effect in science funding." *PNAS* 115(19): 4887-4890.

proposal was of superior quality nor that the researcher had greater scientific ability. [44] The idea of *cumulative advantage* in science, that success begets success, was first introduced in 1968 and is referred to as the Matthew effect.[45] This effect describes a positive feedback loop that applies to early career funding, post-award funding, awards, prestigious academic appointments, and other accolades. The converse of cumulative advantage suggests that researchers not experiencing the early funding advantages are actually disadvantaged in spite of their similar scientific abilities. In the context of the EIA assessment, the Matthew effect suggests that early funding of exceptional junior investigators would have long-term career impact, and that the number of junior researchers with similar scientific abilities who could benefit from early funding could be much larger than the current number of eligible EIA applicants.

The EIA FOAs contain language describing the NIH commitment to research workforce diversity (EIA FOA hyperlink footnotes, page 2), and studies have shown that men tend to publish more than women at all academic rankings, accrue more citations, and more frequently cite their own papers. [46,47,48] although gender distribution was not an element of this assessment, it could have implications for the interpretation of the higher productivity, impact, and professional recognition results.

---

[44] Ibid.

[45] Merton, R. 1968. "The Matthew effect in science: the reward and communication systems of science are considered." *Science* 159(3810): 56-63.

[46] Holliday, E.B., Jagsi, R., Wilson, L.D., Choi, M., Thomas, C.R., Fuller, C.D. 2015. "Gender differences in publication productivity, academic position, career duration and funding among U.S. academic radiation oncology faculty." *Academic Medicine* 89(5): 767-773.

[47] Lerchenmueller, M., Sorenson, O., Jena, A.B. 2019. "Gender differences in how scientists present the importance of their research: observational study." *BMJ* 367.

[48] Chawla, D.S. 2016. "Men cite themselves more than women do." *Nature* 535(7611): 212.

7. Final Considerations

The data derived in this assessment indicate that 2011-2013 EIA awardees are able to transition to early independence and establish a research program and laboratory without the additional years of training the ESI awardees received. EIA awardees are able to produce research papers that garner significantly more citations than their ESI counterparts, and they have higher RCR and altmetric scores, suggesting greater scientific impact. EIA and ESI awardees report similar career milestones and work-life balance. Although challenges arose during the transition to independence, EIA survey respondents reported that they were able to manage the difficulties. These results indicate that NIH identified junior investigators who were able to transition to early independence and establish productive, impactful research careers.

This assessment examines awardee status from the time of application to the end of the award. STPI recommends that NIH consider additional questions that were identified during the course of the assessment, including an assessment of longer-term impacts of the award, perhaps 10–12 years after close of the award. Are the gains associated with early independence maintained? Do the exceptional junior investigators become exceptional mid-career biomedical researchers?

There are additional aspects of the EIA initiative that NIH might wish to consider. The criteria for demonstrating readiness for scientific independence are, for the most part, the traditional metrics of an independent scientific proposal, number of publications, and letters of reference. Unconventional and innovative thinking are not always recognized and rewarded through these traditional mechanisms, factors that might keep this pool of applicants from being recognized and applying.

NIH might also choose to explore the training environments for EIA awardees. Are there elements that could translate to a wider cohort of graduate students and produce more junior investigators ready for independence earlier in their career? What would be the impact of early independence on creative and innovative scientific thinking? Would it produce more creative and innovative biomedical research?

Appendix A. Methodology on ESI Comparison Group Matching

Award data[49] were downloaded for the 39 EIA awards and all type 1, competing, R01 projects awarded between FY 2011–FY 2013 (10,588 awards) using NIH's QVR system. The number of R01 awards eligible to be used as a comparison group was limited by *total direct cost* and *award duration*. The *total direct cost*[50] of an award was calculated by summing the direct costs from each fiscal year the grant was active. After limiting R01 awards to those that fell within the range of EIA *total direct cost* ($962,144 to $1,367,632),[51] 4,477 awards remained. *Award duration* was calculated as the number of years between an award's project start and end date (including no cost extensions), rounding to the nearest tenth. After limiting R01 awards to those that were within the award duration range of EIAs (3.9 to 7.0 years),[52] 4,022 R01 awards remained. The pool of eligible R01 awards to be included as a comparison group was further limited to awards with principal investigators who had ESI[53] eligibility at the time of their application. This further narrowed the pool of eligible R01 awards to 1,108.

Because the comparison between EIA and ESI awards is a non-experimental, observational study, it is necessary to account for the different baseline characteristics between the *treated* (i.e., EIA) and the *untreated* (i.e., ESI) group. Propensity score matching (PSM) is a statistical method that can reduce or eliminate the effects of

---

49 Award data included *award type, project number, fiscal year (FY), award title, project start* and *end dates, award direct costs, principal investigator (PI) name* and *institution, abstract text,* and whether the award received a *no cost extension*.

50 Supplements were not included in the calculations for *total direct cost* because they are typically used for equipment costs and changes in overhead budgets at the institution and do not fund actual research efforts.

51 The median and average total direct costs of the 39 EIA awards were $1,242,500 and $1,185,060, respectively.

52 Even though the original FOA stated that EIAs were 5-year awards, most lasted longer than 5 years. Many of the EIAs received no cost extensions. The minimum and maximum award durations were 3.9 and 7.0 years, respectively. The median and average award durations were 5.6 and 5.9 years, respectively.

53 NIH defines ESIs as a program director or principal investigator who completed their terminal research degree or end of post-graduate clinical training within the past 10 years and has not yet received a substantial NIH independent research award.

confounding variables (e.g., total direct cost, award duration) in observational studies.[54] One of the benefits of PSM is that it allows observational studies to mimic some of the characteristics of a randomized controlled trial.[55] STPI used PSM, without replacement, to perform a 1-to-3 matching using *total direct cost* and *award duration* to identify which ESI awards have similar propensity scores to EIA awards. A 1-to-3 matching was deemed necessary to procure a similar sample size of survey respondents from both the EIA and ESI awardee surveys. Using PSM, 117 ESI awards were identified as the comparison group to the EIA awards.

STPI established area of science through a subject matter expert review. STPI identified the topic of each abstract (e.g., molecular pathway, cell or organ system, disease, health-related behavior, technology) and examined the hypothesis and anticipated outcomes for each abstract (e.g., understand fundamental biology, behavior, or disease; identify a drug target; develop a drug, influence health behavior, produce a tool). Acknowledging the complexity of the research being proposed and the potential for overlap between categories, STPI assessed the results and identified four general categories: biomedical research, behavior, therapy, and tool development. Each abstract was assigned to the category best aligned to the topic, intent, and outcomes for the research. A chi-squared test of independence was performed to assess whether EIA and ESI awards were proportional by area of science.

---

[54] Austin, P.C. 2011. "An introduction to propensity score methods for reducing the effects of confounding in observational studies." *Multivariate Behavioral Research* 46(3): 399-424.

[55] Ibid.

Appendix B. EIA/ESI Survey

Thank you for taking part in this study conducted by the IDA Science and Technology Policy Institute (STPI) on behalf of the National Institutes of Health Office of the Director (NIH/OD). STPI is a federally funded research and development center that provides rigorous, independent research and analysis to the Federal government.

Purpose of the Survey

This survey solicits your perspectives on the Early Independence Award (EIA) you received/ the first R01 you received as an Early Stage Investigator (ESI), specifically the activities, outcomes, and elements of the award which influenced your career path. The aggregated results will assist NIH in continuing to offer programs that support early career researchers.

Confidentiality Statement

STPI is independent of NIH and has been contracted to collect these data. All responses will be kept confidential and protected to the extent possible by law. Only aggregate data will be provided to NIH and your survey responses will not be linked to your institution. Your decision to participate is voluntary and will have no effect on your current or future relationship with the agency.

Instructions for the Survey

Please have a current version of your CV available for reference.

The survey will ask for information about your career progression as it relates to your EIA/first R01.

The survey will take an average of 20 minutes to complete. Until you select the survey submit button, your survey responses are automatically saved and you will be able to move backward through the survey to review or edit your responses. Once you submit the survey, you will not be able to edit your responses.

While completing this survey, you will be asked several questions about your NIH application. You should only consider your EIA/ first R01 when answering these questions.

If you would like to review the EIA Funding Opportunity Announcement to which you applied, please see the following links:

2011 EIA FOA: https://grants.nih.gov/grants/guide/rfa-files/RFA-RM-10-019.html

2012 EIA FOA: https://grants.nih.gov/grants/guide/rfa-files/RFA-RM-11-007.html

2013 EIA FOA: https://grants.nih.gov/grants/guide/rfa-files/RFA-RM-12-018.html

Follow-Up Interview

After submission of your survey, STPI staff may call you for a short (~30 minute or less) phone call to clarify or expand on your survey responses.

Inquiries and Concerns

If you have questions or concerns about completing this survey, please contact us at NIHgrantstudy@ida.org. Inquiries and concerns are also held confidential.

Your responses are invaluable to the study.

Thank you for your participation.

1. **Please select the extent to which you agree/disagree with the following statements. *When I applied for my EIA/ESI R01,* my training had already provided me with the following:**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N/A
My scientific thinking had matured to the point where I could shape a research program.	( )	( )	( )	( )	( )	( )
I understood the complexities of	( )	( )	( )	( )	( )	( )

establishing my own research lab.						
I was able to initiate and build new collaborations.	( )	( )	( )	( )	( )	( )
I was prepared to manage technical staff.	( )	( )	( )	( )	( )	( )

2. **Think back to the *first two years* of your EIA/ESI R01. Considering the institution at which you were employed at the time, please select whether the following occurred/did not occur.**

	This occurred	**This did not occur**
My institution gave me adequate research lab space.	( )	( )
My institution expanded my research lab space.	( )	( )
My institution gave me, or gave me access to, the equipment I needed to conduct my research.	( )	( )
I was able to acquire equipment for my research lab.	( )	( )
I expanded my lab personnel.	( )	( )

3. **Below is a list of changes that may have occurred *since receiving your EIA/ESI R01*. Please select whether the following occurred or did not occur.**

	This occurred	This did not occur
I received and accepted a tenure-track offer at the institution where I received my EIA/ESI R01 award.	( )	( )
I received and accepted a tenure-track offer at an institution other than the one at which I received my EIA/ESI R01 award.	( )	( )
I received a promotion within the institution where I received my EIA/ESI R01 award.	( )	( )
The EIA/ESI R01 grant allowed me to apply for tenure.	( )	( )
I was hired into a tenured position.	( )	( )
I have the option to stay at my current institution for the next several years.	( )	( )
I was asked to present my EIA/ESI R01 research findings to research groups in my institution but outside of my department.	( )	( )
I was asked to collaborate by other researchers at my institution.	( )	( )
I was asked to participate in an institution or department committee, for example the hiring or curriculum committee.	( )	( )
I formed new research partnerships/collaborations.	( )	( )
I published research findings independent of my graduate or post doc advisor.	( )	( )
My EIA/ESI R01 findings launched me into new topic areas.	( )	( )

	This occurred	This did not occur
I have expanded my research aims/goals while remaining within my EIA/ESI R01 topic area.	( )	( )

Logic: Show/hide trigger exists.

4. **Please indicate whether or not the following took place for you *once your EIA/ESI R01 research was published*. Please select all that apply.**

[ ] My research has been featured on the cover of an academic journal.

[ ] My research has been featured in the popular press/media.

[ ] I have been invited to serve as a regular reviewer for a journal.

[ ] I have been invited to present my research outside of my current institution.

[ ] I have been invited to serve as a grant reviewer for NIH.

[ ] I served as a grant reviewer for an institution other than NIH.

[ ] I have been invited to serve as a journal reviewer.

[ ] I have been invited to contribute to a technical book.

[ ] I received an unsolicited inquiry about interest in moving to another institution.

[ ] Other: _____

[ ] None of the above

Logic: Hidden unless: #4 Question "Please indicate whether or not the following took place for you *once your EIA/ESI R01 research was published*. Please select all that apply. " is not one of the following answers ("None of the above")

Piping: Piped Values From Question 4. (Please indicate whether or not the following took place for you ***once your EIA/ESI R01 research was published***. Please select all that apply.)

5. **Which of the following do you think could be attributed to your EIA/ESI R01? Please select all that apply.**

6. **Describe any other recognition that may have resulted from your EIA/ESI R01 that has had impact on your career path.**

_____

_____

_____

_____

7. Please select how strongly you agree or disagree with the following aspects *of your current position.*

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**	**N/A**
My institution supports and values my research.	( )	( )	( )	( )	( )	( )
I have a good balance between research and other responsibilities.	( )	( )	( )	( )	( )	( )
My institution colleagues are supportive of my early independence.	( )	( )	( )	( )	( )	( )
The mentoring structure at my institution is supportive of my early independence.	( )	( )	( )	( )	( )	( )
My salary provides adequate compensation for my position.	( )	( )	( )	( )	( )	( )
The health and other employee benefits I am receiving	( )	( )	( )	( )	( )	( )

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	N/A
through my institution provide job security that benefits my research.						

Page exit logic: Skip / Disqualify Logic**IF:** (Question "Do you have another grant award to report? " is one of the following answers ("No") OR Question "Do you have another grant award to report? ") **THEN:** Jump to page 13 - Job title

8. **Please provide the following information for each grant award you have received since your EIA/ESI R01.**

Grant Title: _____

Grant Number: _____

Estimated Award Amount: _____

Award Length: _____

Award Date: _____

Funding Agency/Organization: _____

Please select if this award was a continuation of your EIA/ESI R01 research topic area.

( ) This award IS a continuation of my EIA/ESI R01/ESI R01 research topic area

( ) This award IS NOT a continuation of my EIA/ESI R01/ESI R01 research topic area

Do you have another grant award to report?

( ) Yes

( ) No

Page exit logic: Skip / Disqualify Logic**IF:** (Question "Do you have another grant award to report? " is one of the following answers ("No") AND Question "Do you have another grant award to report? ") **THEN:** Jump to page 13 - Job title

9. **Please provide the following information for each grant award you have received since your EIA/ESI R01.**

Grant Title: _____

Grant Number: _____

Estimated Award Amount: _____

Award Length: _____

Award Date: _____

Funding Agency/Organization: _____

Please select if this award was a continuation of your EIA/ESI R01 research topic area.

( ) This award IS a continuation of my EIA/ESI R01 research topic area

( ) This award IS NOT a continuation of my EIA/ESI R01 research topic area

Do you have another grant award to report?

( ) Yes

( ) No

Page exit logic: Skip / Disqualify Logic**IF:** (Question "Do you have another grant award to report? " is one of the following answers ("No") AND Question "Do you have another grant award to report? ") **THEN:** Jump to page 13 - Job title

10. **Please provide the following information for each grant award you have received since your EIA/ESI R01.**

Grant Title: _____

Grant Number: _____

Estimated Award Amount: _____

Award Length: _____

Award Date: _____

Funding Agency/Organization: _____

Please select if this award was a continuation of your EIA/ESI R01 research topic area.

( ) This award IS a continuation of my EIA/ESI R01 research topic area

( ) This award IS NOT a continuation of my EIA/ESI R01 research topic area

Do you have another grant award to report?

( ) Yes

( ) No

11. Please provide the following information for each grant award you have received since your EIA/ESI R01.

Grant Title: _____

Grant Number: _____

Estimated Award Amount: _____

Award Length: _____

Award Date: _____

Funding Agency/Organization: _____

Please select if this award was a continuation of your EIA/ESI R01 research topic area.

( ) This award IS a continuation of my EIA/ESI R01 research topic area

( ) This award IS NOT a continuation of my EIA/ESI R01 research topic area

Do you have another grant award to report?

( ) Yes

( ) No

12. What is your current job title? Please include academic rank, if applicable.

_____

_____

_____

_____

13. Please indicate how long you were a post-doctoral fellow.

( ) 0 years

( ) Less than 1 year

( ) One to two years

( ) Two to five years

( ) Five to eight years

( ) More than eight years

14. Please select whether or not the following had occurred *when you applied to your EIA/ESI R01.*

	This occurred	**This did not occur**
I had already received an offer for an independent research position.	( )	( )
I was already in an independent research position.	( )	( )

15. When considering *your transition to independent research*, please select how strongly you agree or disagree with the following statements.

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**	**N/A**
I was able to transition to independent research	( )	( )	( )	( )	( )	( )

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	N/A
without significant difficulty.						
The transition to independence took longer than I expected and impacted my ability to generate research results.	( )	( )	( )	( )	( )	( )
There were unforeseen issues in transitioning to independent research.	( )	( )	( )	( )	( )	( )

Logic: Hidden unless: ((Question "I was able to transition to independent research without significant difficulty." is one of the following answers ("Strongly disagree","Disagree") OR Question "The transition to independence took longer than I expected and impacted my ability to generate research results." is one of the following answers ("Agree","Strongly agree")) OR Question "There were unforeseen issues in transitioning to independent research." is one of the following answers ("Agree","Strongly agree"))

16. You indicated that you experienced difficulty in transitioning to independent research. Please describe what difficulties you encountered.

_____

_____

_____

_____

Logic: Show/hide trigger exists.

17. Have you ever experienced any unintended consequences that negatively impacted your career from receiving your EIA/ESI R01?

( ) Yes, I have experienced unintended consequences from receiving the EIA/ESI R01 that have negatively impacted my career

( ) No, I have not experienced unintended consequences from receiving the EIA/ESI R01 that have negatively impacted my career

Logic: Hidden unless: #17 Question "Have you ever experienced any unintended consequences that negatively impacted your career from receiving your EIA/ESI R01? " is one of the following answers ("Yes, I have experienced unintended consequences from receiving the EIA/ESI R01 that have negatively impacted my career")

18. Please describe briefly what those consequences have been.

_____

_____

_____

_____

19. Please share any additional information with regard to the impact that your EIA/ESI R01 has had on your career.

_____

_____

_____

_____

Thank You!

Appendix C. EIA/ESI Survey Data

Table 1. Please select the extent to which you agree/disagree to the following statements. When I applied for my EIA/ESI, my training had already provided me with the following:

Item of interest	Group of interest (total number of respondents)	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I was able to initiate and build new collaborations.	EIA (N = 25)	NA	1 (4.0%)	NA	11 (44.0%)	13 (52.0%)
	ESI (N = 39)	NA	1 (2.6%)	4 (10.3%)	16 (41.0%)	18 (46.2%)
I understood the complexities of establishing my own research lab.	EIA (N = 25)	1 (4.0%)	3 (12.0%)	5 (20.0%)	8 (32.0%)	8 (32.0%)
	ESI (N = 39)	NA	3 (7.7%)	5 (12.8%)	15 (38.5%)	16 (41.0%)
My scientific thinking had matured to the point where I could shape a research program.	EIA (N = 25)	NA	NA	3 (12.0%)	7 (28.0%)	15 (60.0%)
	ESI (N = 39)	NA	2 (5.1%)	3 (7.7%)	16 (41.0%)	18 (46.2%)
I was prepared to manage technical staff.	EIA (N = 25)	1 (4.0%)	6 (24.0%)	6 (24.0%)	6 (24.0%)	6 (24.0%)
	ESI (N = 39)	NA	4 (10.3%)	5 (12.8%)	18 (46.2%)	12 (30.8%)

Table 2. Think back to the first two years of your EIA/ESI. Considering the institution at which you were employed at the time, please select whether the following occurred/did not occur.

Item of interest	Group of interest (total number of respondents)	This occurred	This did not occur	Chisq (df)	p
I was able to acquire equipment for my research lab.	EIA (N = 25)	22 (88.0%)	3 (12.0%)	0.27 (df = 1)	0.6
	ESI (N = 39)	37 (94.9%)	2 (5.1%)		
I expanded my lab personnel.	EIA (N = 25)	12 (48.0%)	13 (52.0%)	0 (df = 1)	1
	ESI (N = 39)	19 (48.7%)	20 (51.3%)		
My institution gave me adequate research lab space.	EIA (N = 25)	23 (92.0%)	2 (8.0%)	0 (df = 1)	1
	ESI (N = 39)	35 (89.7%)	4 (10.3%)		
My institution expanded my research lab space.	EIA (N = 25)	25 (100.0%)	NA	4.94 (df = 1)	0.03
	ESI (N = 39)	30 (76.9%)	9 (23.1%)		
My institution gave me, or gave me access to, the equipment I needed to conduct my research.	EIA (N = 25)	23 (92.0%)	2 (8.0%)	0.04 (df = 1)	0.85
	ESI (N = 39)	34 (87.2%)	5 (12.8%)		

Table 3. Below is a list of changes that may have occurred since receiving your EIA/ESI. Please select whether the following occurred or did not occur.

Item of interest	Group of interest (total number of respondents)	This occurred	This did not occur	Chisq (df)	p
I received and accepted a tenure-track offer at the institution where I received my EIA/ESI award.	EIA (N = 25)	11 (44.0%)	14 (56.0%)	0.51 (df = 1)	0.48
	ESI (N = 39)	22 (56.4%)	17 (43.6%)		
I received and accepted a tenure-track offer at an institution other than the one at which I received my EIA/ESI award.	EIA (N = 25)	16 (64.0%)	9 (36.0%)	15.85 (df = 1)	0
	ESI (N = 39)	5 (12.8%)	34 (87.2%)		
I received a promotion within the institution where I received my EIA/ESI award.	EIA (N = 25)	14 (56.0%)	11 (44.0%)	7.88 (df = 1)	0.01
	ESI (N = 39)	35 (89.7%)	4 (10.3%)		
The EIA/ESI grant allowed me to apply for tenure.	EIA (N = 25)	12 (48.0%)	13 (52.0%)	0.65 (df = 1)	0.42
	ESI (N = 39)	24 (61.5%)	15 (38.5%)		
I was hired into a tenured position.	EIA (N = 25)	10 (40.0%)	15 (60.0%)	0.5 (df = 1)	0.48
	ESI (N = 39)	11 (28.2%)	28 (71.8%)		
I have the option to stay at my current institution for the next several years.	EIA (N = 25)	23 (92.0%)	2 (8.0%)	0.23 (df = 1)	0.63
	ESI (N = 39)	33 (84.6%)	6 (15.4%)		
I was asked to present my EIA/ESI research findings to research groups in my institution but outside of my department.	EIA (N = 25)	23 (92.0%)	2 (8.0%)	6.67 (df = 1)	0.01
	ESI (N = 39)	23 (59.0%)	16 (41.0%)		

Item of interest	Group of interest (total number of respondents)	This occurred	This did not occur	Chisq (df)	p
I was asked to collaborate by other researchers at my institution.	EIA (N = 25)	24 (96.0%)	1 (4.0%)	2.88 (df = 1)	0.09
	ESI (N = 39)	30 (76.9%)	9 (23.1%)		
I was asked to participate in an institution or department committee, for example the hiring or curriculum committee.	EIA (N = 25)	22 (88.0%)	3 (12.0%)	0.08 (df = 1)	0.77
	ESI (N = 39)	32 (82.1%)	7 (17.9%)		
I formed new research partnerships/collaborations.	EIA (N = 25)	25 (100.0%)	NA	0.66 (df = 1)	0.42
	ESI (N = 39)	36 (92.3%)	3 (7.7%)		
I published research findings independent of my graduate or post doc advisor.	EIA (N = 25)	25 (100.0%)	NA	0 (df = 1)	1
	ESI (N = 39)	38 (97.4%)	1 (2.6%)		
My EIA/ESI findings launched me into new topic areas.	EIA (N = 25)	25 (100.0%)	NA	0.66 (df = 1)	0.42
	ESI (N = 39)	36 (92.3%)	3 (7.7%)		
I have expanded my research aims/goals while remaining within my EIA/ESI topic area.	EIA (N = 25)	23 (92.0%)	2 (8.0%)	1.12 (df = 1)	0.29
	ESI (N = 39)	39 (100.0%)	NA		

Table 4. Please indicate whether or not the following took place for you once your EIA/ESI research was published. Please select all that apply.

Item of interest	EIA (N = 25)	ESI (N = 39)	Chi-square (df = 1)	p
My research has been featured on the cover of an academic journal.	8 (32.0%)	10 (25.6%)	0.07	0.79
My research has been featured in the popular press/media.	20 (80.0%)	20 (51.3%)	4.21	0.04
I have been invited to serve as a regular reviewer for a journal.	20 (80.0%)	30 (76.9%)	0	1
I have been invited to present my research outside of my current institution.	25 (100.0%)	35 (89.7%)	1.26	0.26
I have been invited to serve as a grant reviewer for NIH.	22 (88.0%)	33 (84.6%)	< 0.001	0.99
I served as a grant reviewer for an institution other than NIH.	22 (88.0%)	31 (79.5%)	0.29	0.59
I have been invited to serve as a journal reviewer.	25 (100.0%)	39 (100.0%)	NA	NA
I have been invited to contribute to a technical book.	15 (60.0%)	21 (53.8%)	0.05	0.82
I have received an unsolicited inquiry about interest in moving to another institution.	18 (72.0%)	21 (53.8%)	1.42	0.23
Other	1 (4.0%)	3 (7.7%)	0.004	0.95
NA	1 (4.0%)	3 (7.7%)	0.004	0.95

Table 5. Which of the following do you think could be attributed to your EIA/ESI? Please select all that apply.

Item of interest	EIA	ESI	Chi-square (df = 1)	p
My research has been featured on the cover of an academic journal.	5 (62.5%)	6 (60.0%)	< 0.001	1
My research has been featured in the popular press/media.	14 (70.0%)	9 (45.0%)	1.64	0.20
I have been invited to serve as a regular reviewer for a journal.	10 (50.0%)	11 (36.7%)	0.41	0.52
I have been invited to present my research outside of my current institution.	17 (68.0%)	24 (68.6%)	< 0.001	1
I have been invited to serve as a grant reviewer for NIH.	17 (77.3%)	26 (78.8%)	< 0.001	1
I served as a grant reviewer for an institution other than NIH.	12 (54.5%)	21 (67.7%)	0.47	0.49
I have been invited to serve as a journal reviewer.	14 (56.0%)	21 (53.8%)	< 0.001	1
I have been invited to contribute to a technical book.	6 (40.0%)	6 (28.6%)	0.13	0.72
I have received an unsolicited inquiry about interest in moving to another institution.	13 (72.2%)	12 (57.1%)	0.41	0.52
Other	1 (100.0%)	2 (66.7%)	< 0.001	1

Table 6. Please select how strongly you agree or disagree with the following aspects of your current position.

Item of interest	Group of interest (total number of respondents)	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	N/A
My institution colleagues are supportive of my early independence.	EIA (N = 25)	NA	NA	NA	8 (32.0%)	17 (68.0%)	NA
	ESI (N = 39)	3 (7.7%)	2 (5.1%)	4 (10.3%)	19 (48.7%)	11 (28.2%)	NA
My institution supports and values my research.	EIA (N = 25)	NA	1 (4.0%)	1 (4.0%)	10 (40.0%)	13 (52.0%)	NA
	ESI (N = 39)	4 (10.3%)	5 (12.8%)	5 (12.8%)	16 (41.0%)	8 (20.5%)	1 (2.6%)
The mentoring structure at my institution was supportive of my early independence.	EIA (N = 25)	NA	NA	NA	4 (16.0%)	20 (80.0%)	1 (4.0%)
	ESI (N = 39)	1 (2.6%)	1 (2.6%)	6 (15.4%)	12 (30.8%)	19 (48.7%)	NA
The health and other employee benefits I am receiving through my institution provide job security that benefits my research.	EIA (N = 25)	NA	NA	2 (8.0%)	7 (28.0%)	15 (60.0%)	1 (4.0%)
	ESI (N = 39)	3 (7.7%)	5 (12.8%)	5 (12.8%)	15 (38.5%)	11 (28.2%)	NA
My salary provides adequate compensation for my position.	EIA (N = 25)	NA	NA	2 (8.0%)	6 (24.0%)	17 (68.0%)	NA
	ESI (N = 39)	4 (10.3%)	8 (20.5%)	7 (17.9%)	9 (23.1%)	11 (28.2%)	NA
I have a good balance between research and other responsibilities.	EIA (N = 25)	NA	NA	1 (4.0%)	5 (20.0%)	19 (76.0%)	NA

Item of interest	Group of interest (total number of respondents)	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	N/A
	ESI (N = 39)	1 (2.6%)	3 (7.7%)	6 (15.4%)	15 (38.5%)	14 (35.9%)	NA

Table 7. Please indicate how long you were a post-doctoral fellow.

Group of interest (total number of respondents)	0 years	< 1 year	1 to 2 years	2 to 5 years	5 to 8 years
EIA (N = 25)	11 (44.0%)	10 (40.0%)	4 (16.0%)	NA	NA
ESI (N = 39)	7 (17.9%)	1 (2.6%)	4 (10.3%)	23 (59.0%)	4 (10.3%)

Table 8. Please select whether or not the following had occurred when you applied to your EIA/ESI.

Item of interest	Group of interest (total number of respondents)	This occurred	This did not occur	Chisq (df)	p
I had already received an offer for an independent research position.	EIA (N = 25)	13 (52.0%)	12 (48.0%)	0.17 (df = 1)	0.68
	ESI (N = 38)	23 (60.5%)	15 (39.5%)		
I was already in an independent research position.	EIA (N = 25)	11 (44.0%)	14 (56.0%)	7.97 (df = 1)	<0.001
	ESI (N = 38)	31 (81.6%)	7 (18.4%)		

Table 9. When considering your transition to independent research, please select how strongly you agree or disagree with the following statements.

Item of interest	Group of interest (total number of respondents)	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	N/A
I was able to transition to independent research without significant difficulty.	EIA (N = 25)	NA	NA	6 (24.0%)	11 (44.0%)	7 (28.0%)	1 (4.0%)
	ESI (N = 39)	1 (2.6%)	8 (20.5%)	8 (20.5%)	14 (35.9%)	8 (20.5%)	NA
The transition to independence took longer than I expected and impacted my ability to generate research results.	EIA (N = 25)	6 (24.0%)	8 (32.0%)	7 (28.0%)	3 (12.0%)	NA	1 (4.0%)
	ESI (N = 39)	4 (10.3%)	13 (33.3%)	10 (25.6%)	9 (23.1%)	2 (5.1%)	1 (2.6%)
There were unforeseen issues in transitioning to independent research.	EIA (N = 25)	3 (12.0%)	4 (16.0%)	7 (28.0%)	8 (32.0%)	2 (8.0%)	1 (4.0%)
	ESI (N = 39)	3 (7.7%)	9 (23.1%)	10 (25.6%)	11 (28.2%)	5 (12.8%)	1 (2.6%)

Table 10. Have you ever experienced any unintended consequences that negatively impacted your career from receiving your EIA/ESI?

Group of interest (total number of respondents)	No, I have not experienced unintended consequences	Yes, I have experienced unintended consequences
EIA (N = 25)	20 (80.0%)	5 (20.0%)
ESI (N = 39)	35 (89.7%)	4 (10.3%)