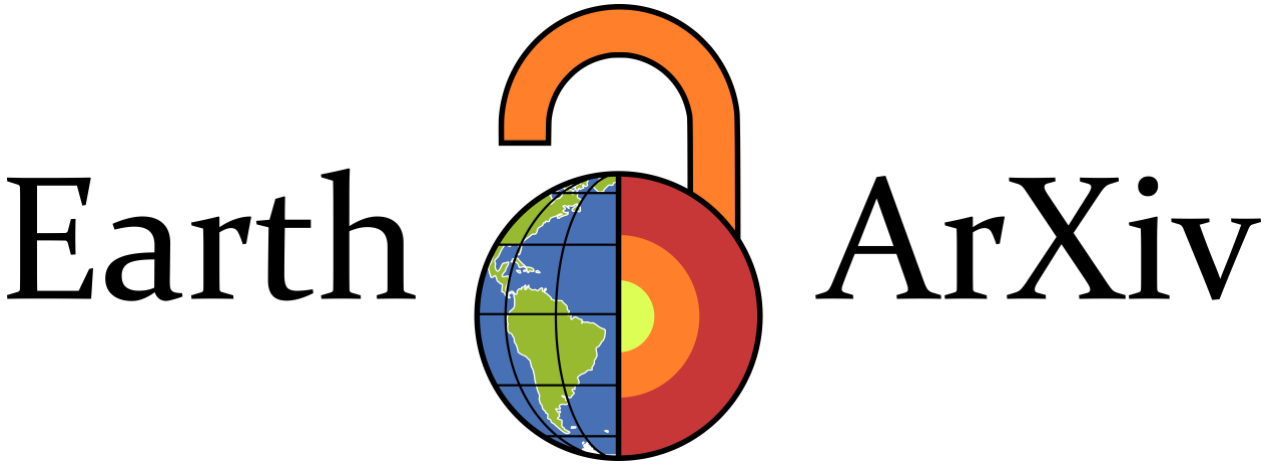

Assessing Challenges for U.S.-Based Polar Early Career Scientists During Science Policy Changes

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ABSTRACT.

Early-career researchers (ECRs) play a critical role in sustaining polar and cryosphere research in the United States. Since January 2025, changes in U.S. science policy and federal research funding have created substantial uncertainty for researchers, particularly those in the early stages of their careers. To assess the impacts of these changes, we conducted a community-driven survey of U.S.-based polar and cryosphere ECRs examining concerns related to science policy, research funding, career trajectories, and workforce reten-

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tion. Survey responses indicate widespread concern regarding recent changes in science policy and funding, with many respondents reporting negative effects on research productivity, motivation, and mental well-being. Respondents also expressed concern regarding future employment opportunities and the long-term health of the scientific enterprise. A substantial proportion reported considering employment opportunities outside the United States, leaving academia, or leaving polar and cryosphere research altogether. At the same time, respondents identified potential pathways for retention, including stable research funding, mentorship, professional support, and reversal of recent funding reductions. These findings provide a timely assessment of workforce sentiment during a period of rapid policy change and highlight factors that may influence the future sustainability of the U.S. polar and cryospheric research community.

INTRODUCTION

Early-career researchers (defined here as undergraduate and graduate students, postdoctoral researchers, research staff, and faculty at pre-tenure or equivalent early-career stages) or ECRs, play a critical role in the production and longevity of scientific research in the United States. ECRs make up the majority of today's scientific workforce and carry out much of its day-to-day research, often developing the methods that define a field's cutting edge (Kent and others, 2022). ECRs form a more diverse cohort than senior scientists, representing a wider range of age, sex, gender identity, sexuality, race, ethnicity, and socioeconomic status (Kent and others, 2022). This diversity along with openness to new ideas, allows ECRs to develop creative, innovative approaches that are generalizable and useful to broader populations (Heggeness and others, 2017; Robel and others, 2024; Kent and others, 2022; Campbell and others, 2019). Investment into the training and education of ECRs is critical because they are the future leaders of the scientific community. Thus, the longevity and sustainability of the American scientific enterprise is critically dependent on the continued training of ECRs.

Since 2025, major changes in United States science policy have introduced substantial uncertainty into the research environment. In 2025, government officials began terminating already-funded grants at the

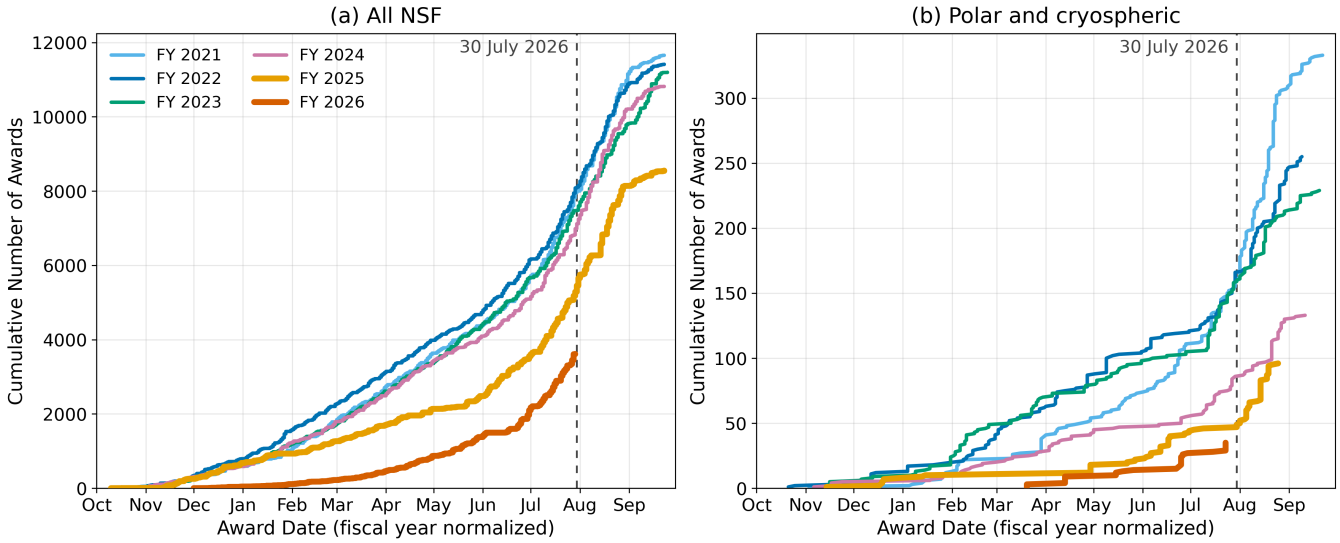


Fig. 1. (a) NSF combined awards, Fiscal Years 2021–2026, on a common Oct–Sep axis, and (b) Polar and cryospheric science awards, Fiscal Years 2021–2026, on a common Oct–Sep axis. Note the distinct decreases in grants awarded in FY 2025 and 2026, with grant awards in FY 2026 only starting in mid-March. Data: National Science Foundation (2026). Plot generated based on work by Berg (2025).

National Institutes of Health (NIH) and the National Science Foundation (NSF) (Kozlov, 2026; Langin, 2026). At the time of this publication, some of these grant suspensions and cancellations have been challenged or overturned in court, but it is unclear how many researchers have actually received their funds (Jones, 2025). In addition, proposed reductions in federal science budgets, grant terminations, workforce reductions, fellowship losses, and restructuring across agencies (including NSF, NASA, NOAA, and NIH) have raised concerns regarding the long-term sustainability of federally supported research (Kozlov, 2026). For example, NSF officials committed funds to approximately 8800 new research project grants in 2025, a 20% decline from the roughly 11,000 made in 2024 (Brainard and Hersher, 2025) (see Figure 1). Notice that cumulative grants awarded always increase through the course of any given fiscal year. Each curve plotted denotes a different fiscal year. Grants awarded in fiscal year 2026 have fallen further behind 2025 numbers.

Over the past two years, funding cuts, workforce reductions, and restructuring across federal scientific agencies have created uncertainty in the U.S. research community, contributing to job losses and hiring freezes across academic and industry science (Crockett, 2025; Garisto and others, 2025). ECRs are especially exposed to these disruptions. Senior scientists are often insulated by institutional or endowed support, whereas ECRs typically hold temporary positions funded directly from grants (so-called “soft

money"). Consistent with this, PhD and postdoctoral hiring has contracted sharply (Brint, 2025; Nuwer, 2025). Fewer openings, greater competition, and salaries tied directly to grant cycles leave ECRs least able to absorb a sustained contraction in federal support.

In the past, federal funding and support has served as a primary enabler of scientific research in the United States. As a result, the United States has long served as a worldwide hub for the education and training of ECRs through domestic and international student programs (Clemens and others, 2025). Government research funds have enabled the development of scientific scholarship and enhanced the retention of talent in American universities and laboratories. The stability and growth in American science funding has allowed for the United States to develop a reputation as the leading attraction for talented scientists worldwide (Doria Arrieta and others, 2017).

United States-based ECRs depend on federal support at every career stage. Beyond relying on research grants, many get their start through federally funded fellowships at the undergraduate, graduate, and postdoctoral levels–a number of which are no longer available (Nelson and Faquin, 2026). As these paths narrow, ECRs who might once have gone on to lead their fields may choose other careers or move to countries offering more opportunity (Witze, 2025). This phenomenon is colloquially known as "brain drain" and may weaken the long-term research workforce by reducing the retention of highly trained scientists and engineers educated in the United States (Clemens and others, 2025). Because training pipelines operate on decade-long timescales, losses at the earliest stages are slow to register and slower to reverse (Moraru and others, 2024; Kennicutt and others, 2014).

These recent federal policy changes have also impacted government agencies focused on monitoring and understanding the weather, climate, and the environment. In 2025, the Environmental Protection Agency (EPA), which enforces federal environmental legislation, reduced its workforce by approximately 23%, reflecting broader reductions in scientific capacity across federal agencies (Fiorino, 2026). The National Oceanic and Atmospheric Administration (NOAA) lost roughly 10% of its staff, including hundreds of National Weather Service forecasters, through terminations and deferred resignations (McKoy, 2025). Furthermore, under a recent proposal by the administration, political appointees would hold final say over every federal grant (Garisto and others, 2025). Such a shift would alter the role of expert peer review in federal grant decision-making by giving political appointees final approval authority.

Polar and cryosphere sciences may be especially vulnerable to cuts in funding because of their dependence on expensive field campaigns, federal logistical infrastructure, international collaborations, and

sustained long-term observations. Polar field observations are annual and weather-limited, ship and station access is scheduled years ahead, and a missed season leaves a permanent gap in records whose values are derived from continuity. Reductions in funding or access to fieldwork opportunities may disproportionately affect graduate students, postdoctoral scholars, and recently appointed researchers, for whom a single lost field season can represent a substantial fraction of a training period or tenure clock. This pressure on ECRs is compounded by the withdrawal of entry-level support such as the decision to not open the Office of Polar Programs post-doctoral fellowship for applications for 2025 (Lin, 2025). Meanwhile, the European Commission's Choose Europe for Science program committed €500 million over 2025-2027, (González, 2025) alongside national schemes in Norway, France, Denmark, and Finland. In response, applications from U.S.-based researchers for the European Research Council early-career grants rose from 60 in 2024 to 169 in 2026 (Joseph, 2025). The cumulative risk is not simply reduced output, but an erosion of the domestic expertise, platforms, and observational continuity on which future U.S. polar research capacity depends.

In this study, we developed and disseminated an online survey to better understand the perspectives, concerns, and future outlook of United States-based polar and cryosphere ECRs during a period of major science policy disruption. Using the responses from survey takers, we assessed perceived impacts on career outlook, funding security, mental well-being, fieldwork access, and intentions to remain in U.S.-based polar science or academia. We applied statistical analysis to survey results and isolated a few principal areas of concern amongst survey respondents. Despite variations in motivations and anxieties among sub-populations of respondents, we find widespread concern regarding employment opportunities and long-term longevity of polar science research in the United States.

SURVEY DESIGN AND METHODS

Survey design and deployment

We designed an anonymous, online survey targeting ECRs in the United States working in polar and cryosphere science. The survey required approximately 15 minutes to complete and included open-response demographic questions, Likert scale statements (see Table 1) rated from 1 ("strongly disagree") to 5 ("strongly agree"), and short-answer prompts. Conditional question modules were presented to specific subgroups, including students, federally funded researchers, and respondents whose work involves fieldwork.

Demographic questions were designed to capture a range of personal and professional characteristics

relevant to the ECR experience, including career stage, age, gender identity, race and ethnicity, disability status, fieldwork involvement, and federal funding status. Questions used a mix of structured categorical response options and open self-report fields. The use of open-response formats for sensitive identity-related questions (rather than fixed category lists) was a deliberate design choice intended to reduce respondent burden, avoid imposing researcher-defined categories on participants, and allow for more inclusive and accurate self-representation.

We defined ECRs broadly to include undergraduate and graduate students, postdoctoral researchers, research staff, and faculty at pre-tenure or equivalent early-career stages, as well as ECRs working outside traditional academic settings in the private sector. Through this survey, we assessed experiences related to recent U.S. science policy and funding changes, focusing on perceived impacts on career outlook, funding security, mental well-being, job mobility, fieldwork access, and the ability to communicate science publicly.

The survey was developed and administered through the Qualtrics XM platform and distributed between November 2025 and March 2026 through professional networks, discipline-specific mailing lists, and social media channels associated with polar and cryosphere research communities. Respondents were offered entry into a gift-card raffle using anonymous completion tokens to preserve confidentiality. Survey procedures were approved by the Princeton University Institutional Review Board (Protocol #18449), and all participants provided informed consent.

Data analysis

Demographic and Likert-scale responses were summarized using descriptive statistics, while open-ended responses were examined descriptively using word-frequency visualization to identify recurring topics. Full details of variable construction, coding, and model diagnostics are given in Supplementary Section S2.

Demographic Analysis

Career stage, disability status, fieldwork involvement, and federal funding status were collected as categorical items; gender identity, race and ethnicity, and age were collected as open text and coded post hoc into standardized analytical categories following conventions used in recent STEM workforce and inclusion surveys (Rasmussen and others, 2023; Sarraju and others, 2023). Respondents reporting more than one racial or ethnic identity were coded as multiracial or multiethnic. Categorical variables are reported as counts and percentages and age as median and interquartile range. “Prefer Not to Answer” responses

were excluded from the relevant subgroup analyses but retained elsewhere, and rates of non-disclosure are reported. To protect respondent confidentiality and avoid underpowered comparisons, subgroups with fewer than 15 respondents were not analyzed independently; where necessary, categories were collapsed into broader groupings (Supplementary Section S2.1).

Likert-scale Response Analysis

Likert responses are ordinal, and distributions to strongly valenced items are typically skewed, so we did not summarize them using means or standard deviations. Instead, each item is reported as the median, interquartile range, and full distribution across the five ordered categories, visualized as diverging stacked bar charts in which disagreement and agreement extend in opposite directions from a central neutral point. Subgroups were defined by career stage (pre-PhD, including doctoral students, vs. post-PhD/industry), binarized gender (man vs. woman), fieldwork involvement, funding status, and binarized race (white vs. non-white). "Does not apply" responses were excluded from distributions and rank summaries.

These descriptive patterns are intended to convey the shape and direction of subgroup differences independently of statistical significance. Coherent directional patterns across related items are interpreted as suggestive; claims of a reliable difference are reserved for effects supported by the regression models below.

Ordinal Regression Analysis of Subgroup Differences in Likert Scale Responses

Because respondent characteristics such as career stage and age are related, the descriptive summaries cannot attribute a difference to any one of them. We therefore fit a cumulative-link (proportional-odds) ordinal logistic regression to each item, which models the ordered five-point response directly without assuming equal spacing between categories. All characteristics were entered together, so each estimate reflects one characteristic with the others held constant: career stage (pre-PhD vs. post-PhD or industry), binarized gender (men vs. women), fieldwork involvement (participants vs. non-fieldwork), funding status (federally funded vs. not), binarized race (white vs non-white), and age (per additional 10 years).

Results are reported as adjusted odds ratios with 95% confidence intervals. Each odds ratio compares the first group listed above to the second, or one decade of age to the next: a value above one means the first group had higher odds of giving a more-agreeing response, a value below one means lower odds, and an interval spanning one means the direction is not well determined by these data. Because every

characteristic was tested against every item, p-values were corrected across items within each predictor using the Benjamini-Hochberg false-discovery-rate procedure; only associations surviving correction are treated as confirmatory, and the remainder are described as exploratory. Fitting details and model diagnostics are given in Supplementary Section S2.2.

Principal component analysis

To examine major patterns of covariance among attitudinal items, we conducted principal component analysis on the Likert-scale questions, treated as approximately continuous and standardized to zero mean and unit variance. Sampling adequacy and correlation structure were sufficient for dimension reduction (Kaiser–Meyer–Olkin test value = 0.706; Bartlett's test $\chi^2 = 1069.46$, $p < 0.001$; see Supplementary Section S2.3 for more information). Component retention was guided by the scree plot (Supplementary Figure S1), cumulative explained variance, and interpretability of loadings, and the first three components were retained. Because the sign of a principal component is arbitrary, interpretation focuses on the relative clustering of and contrasts among variables rather than the direction of loadings. The retained components were interpreted as reflecting (1) institutional confidence versus perceived instability, (2) career vulnerability versus professional support and resilience, and (3) professional belonging and career reflection.

Analysis of survey comments

Survey responders were given the option to provide comments to Likert-scale questions (Table 1) and open-response questions, for a total of 8 optional comments. We use the python package wordcloud (Mueller, 2018), in which word size is scaled according to the frequency of occurrence. Non-descriptive and neutral words were removed before the final word cloud was generated (see Supplementary Material Table S1).

RESULTS

In this section, we first discuss the word cloud from the text responses, then present the raw survey results and finally present the principal component analysis.

Descriptive review of open-ended responses

A word cloud summarizing the open-ended survey responses is shown in Figure 2. After removing common neutral words, the most frequently occurring terms included *funding*, *opportunities*, *support*, *fieldwork*, *job*,

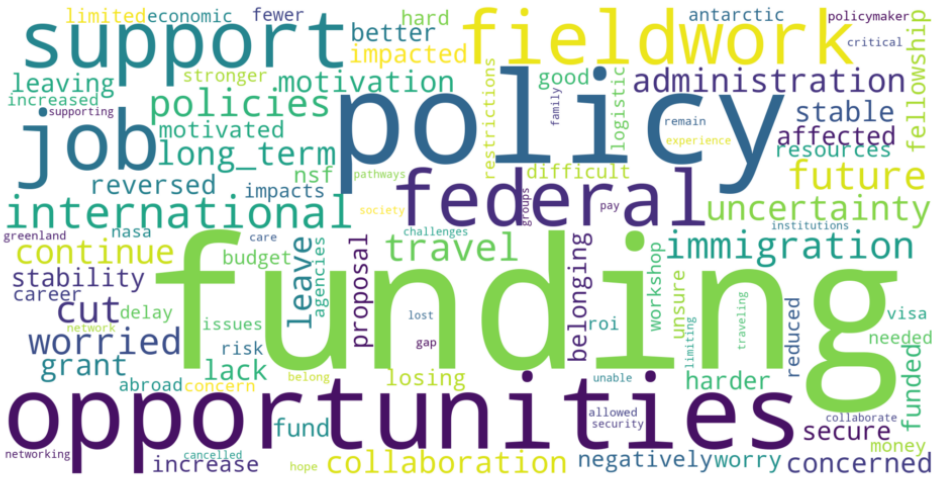


Fig. 2. Word cloud of open-ended survey responses. Words are sized by frequency, with more frequent words appearing larger.

international, and *worried*, with *funding* appearing over 300 times. These recurring words are broadly consistent with the themes identified throughout the structured survey responses, particularly concerns regarding research funding, career opportunities, and professional support.

Terms such as *funding*, *federal*, and *policies* appeared prominently, indicating that respondents frequently discussed changes to the research funding landscape. Words including *job*, *opportunities*, *future*, *international*, and *immigration* suggest that respondents were also concerned about career prospects, international mobility, and scientific collaboration. Frequent occurrences of words such as *support*, *fieldwork*, and *collaboration* further highlight the importance of maintaining research opportunities, professional networks, and access to field-based research.

Because word frequency alone does not convey the context or sentiment in which terms are used, the word cloud is presented as a descriptive overview of recurring topics rather than a formal qualitative analysis. Nevertheless, the dominant terms closely mirror the principal themes observed in the quantitative survey results presented below, including concerns regarding funding stability, career trajectories, research productivity, and long-term workforce retention within the U.S. polar and cryosphere research community.

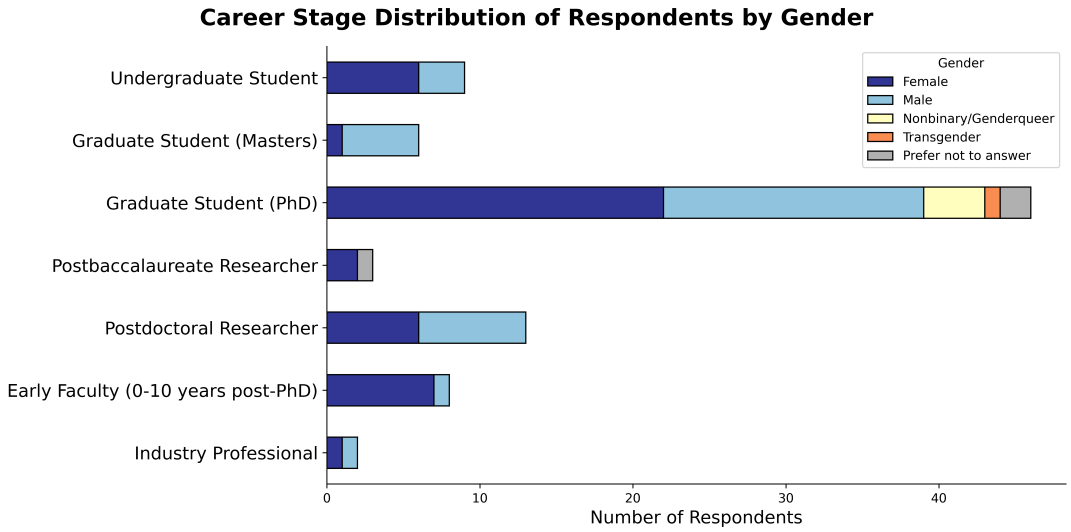


Fig. 3. Distribution of respondents across career stages.

Raw survey results

Respondent Characteristics

A total of 100 respondents completed the survey. The distribution of respondents across career stages (Figure 3) was dominated by graduate students, particularly PhD students, who represented the largest proportion of the sample. Postdoctoral researchers constituted the second largest group, followed by early-career faculty members. Undergraduate students, master's students, post-baccalaureate researchers, and respondents employed outside academia collectively represented a smaller fraction of respondents. The age distribution of respondents (Figure 4*a*) was concentrated among younger researchers. More than half of respondents were between 20 and 29 years old, with the 25-29 year age category representing the largest group. Respondents aged 30-34 years constituted the next largest age category, while comparatively few respondents were older than 40 years. These patterns indicate that the survey primarily captured perspectives from researchers in the early stages of their careers. Gender composition of the survey population (Figure 4*b*) was predominantly female, followed by male respondents. Smaller proportions of respondents identified as non-binary or queer, transgender, or preferred not to disclose their gender identity. The racial and ethnic composition of respondents (Figure 4*c*) was primarily White, followed by Asian respondents, while Hispanic or Latino, African American, Indigenous, and multiracial respondents collectively represented a smaller proportion of the sample. Disability status of respondents (Figure 4*d*) indicated that most respondents reported no disability, while 15% reported having a disability.

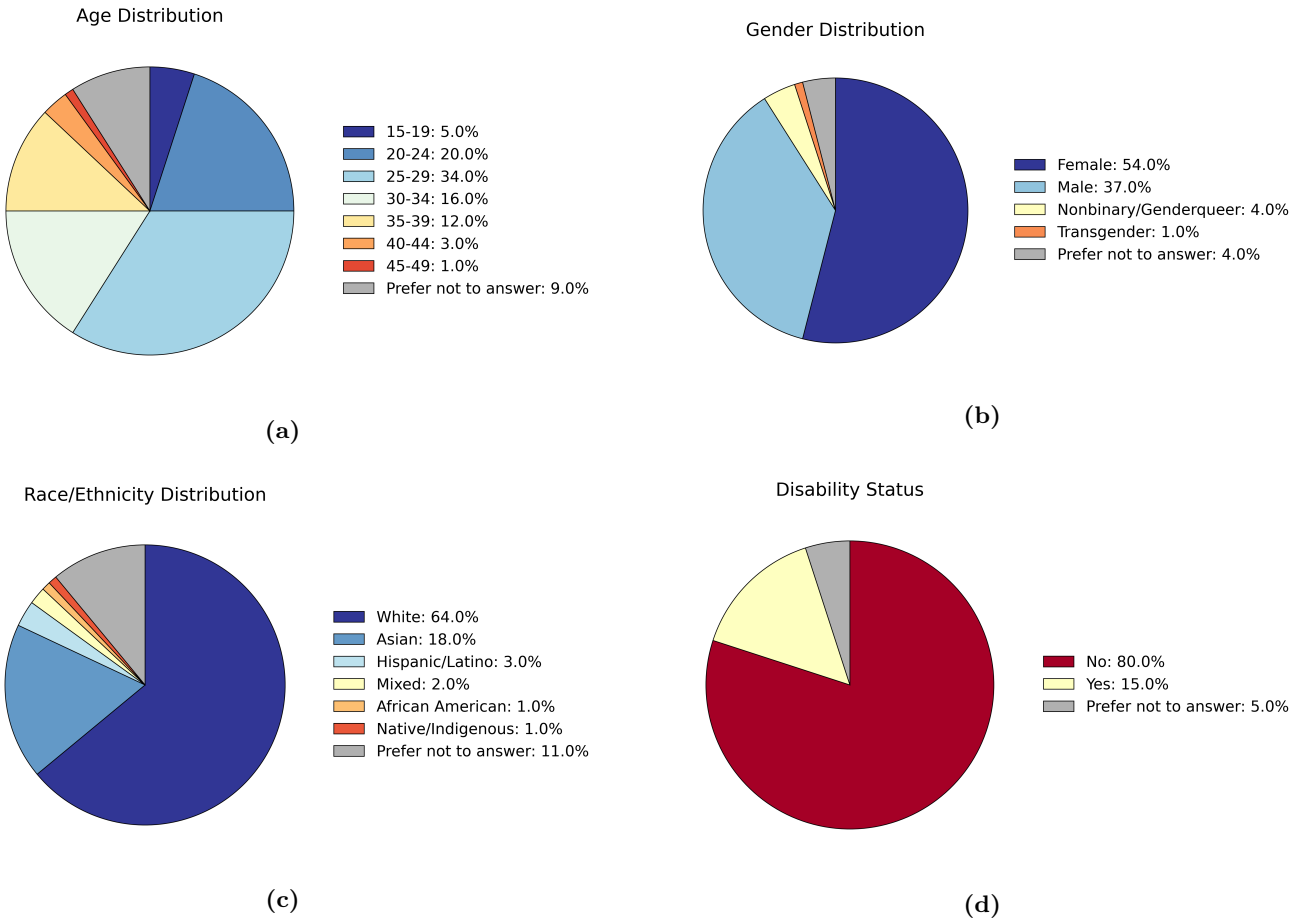
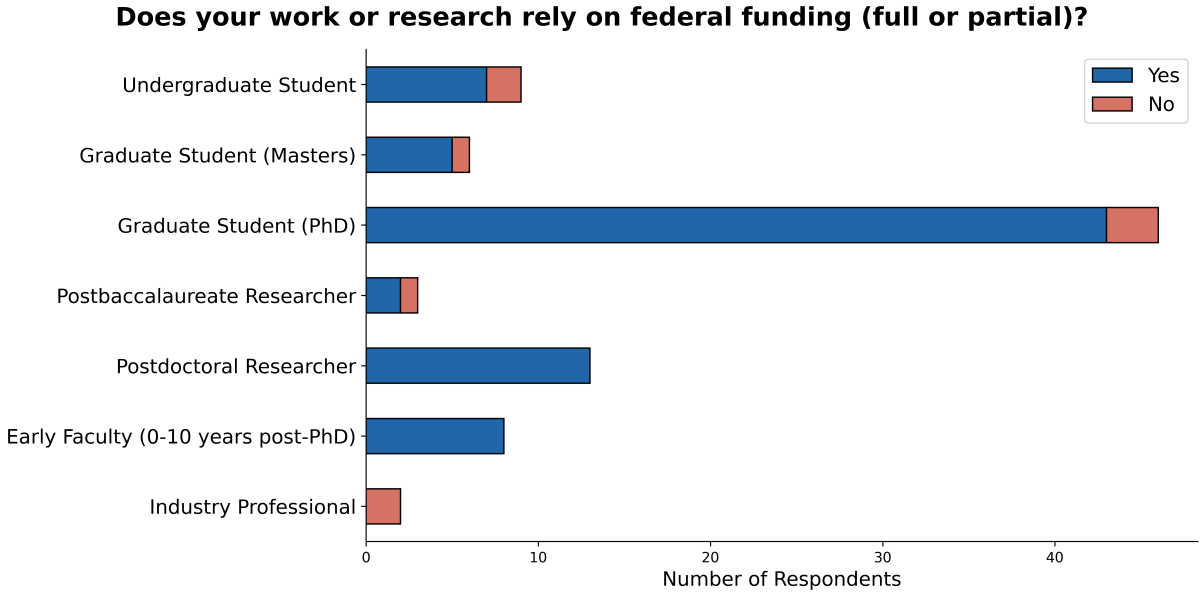


Fig. 4. Demographic characteristics of survey respondents: (a) age distribution, (b) gender distribution, (c) race and ethnicity, and (d) disability status.

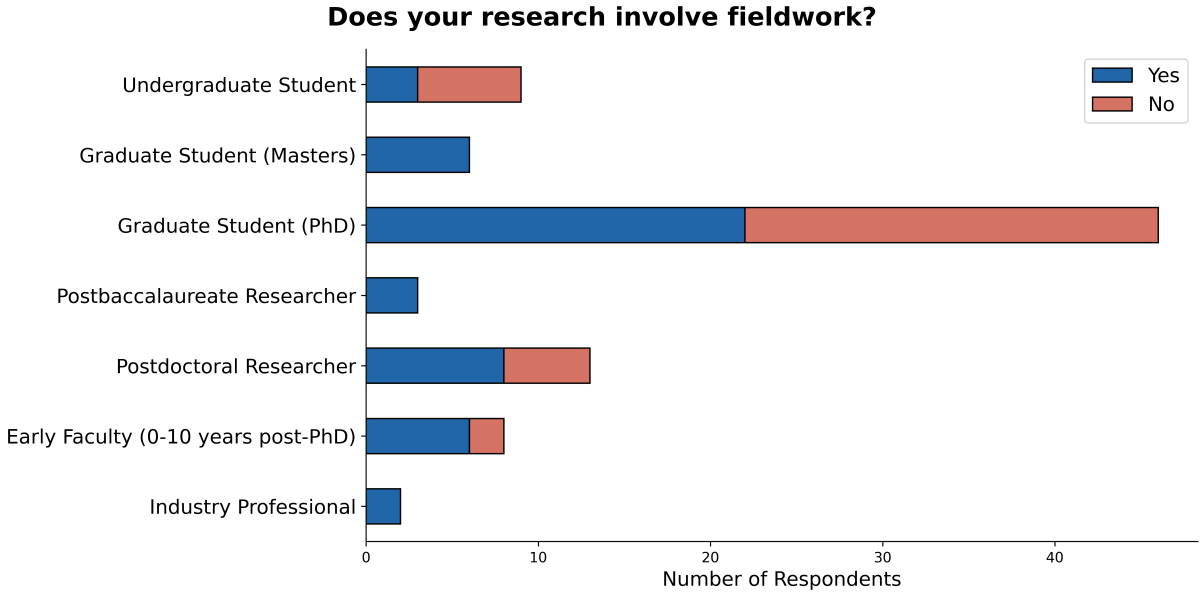
Dependence on Federal Funding and Field-Based Research

Federal funding dependence across career stages (Figure 5*a*) was widespread. The majority of PhD students, postdoctoral researchers, and faculty members reported that their work relied either fully or partially on federal funding. Reliance on federal funding was particularly pronounced among postdoctoral researchers and faculty members, where few respondents reported no dependence on federal support. Respondents employed outside academia generally reported lower dependence on federal funding than respondents in academic positions.

Fieldwork participation across career stages (Figure 5*b*) was also common. Participation in field-based research was most prevalent among PhD students, postdoctoral researchers, and faculty members. Undergraduate and master's students exhibited more mixed responses, while respondents outside academia reported comparatively lower levels of fieldwork participation. Together, these results demonstrate that



(a)



(b)

Fig. 5. Dependence on (a) federal funding and (b) participation in field-based research across career stages.

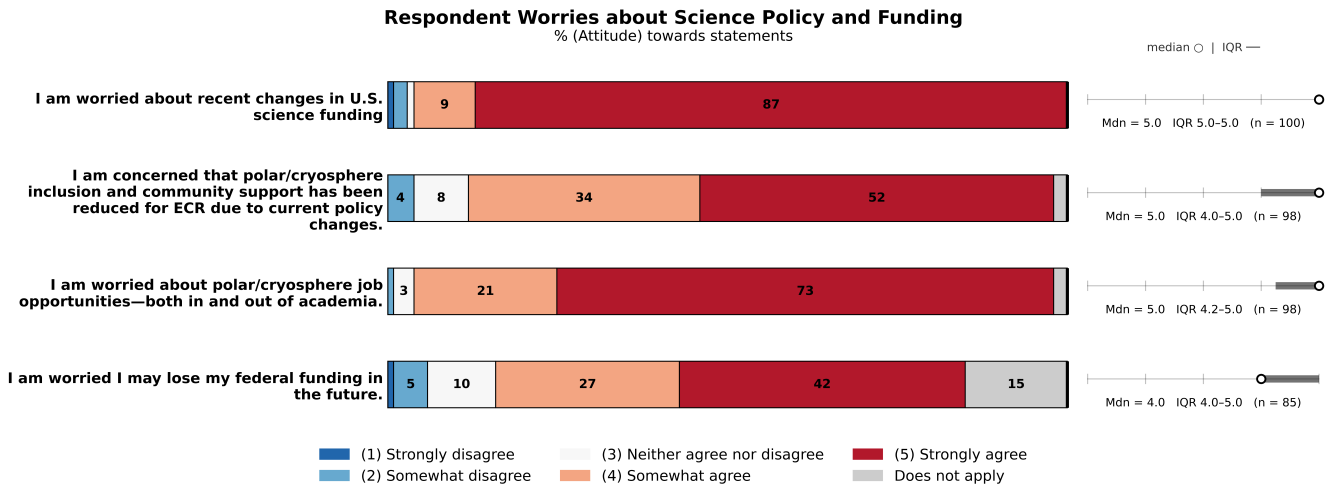


Fig. 6. Respondent attitudes towards a selection of four statements concerning science policy, funding, and career opportunities. Bars show the percentage of respondents selecting each point on the five-point Likert scale, from strongly disagree to strongly agree, ordered from disagreement (left) through agreement (right); respondents selecting "does not apply" are shown as a separate grey segment at the right of each bar. Segments narrower than approximately 3% are left unlabelled. The panel at right summarises each item's central tendency and spread, showing the median (open circle) and interquartile range (horizontal bar) of numeric responses, with "does not apply" treated as missing; n is the number of respondents contributing to that summary and varies across items because respondents could skip individual statements. A complete list of questions along this theme and respondent attitudes are provided in the Table 1.

many respondents occupy positions that depend heavily on both federal funding and field-based research activities.

Concerns Regarding Science Policy and Funding

Respondent concerns regarding science policy, funding, and career opportunities are summarized in Figure 6. Concern regarding recent changes in U.S. science funding received the strongest level of agreement among all survey questions. Nearly all respondents reported that they were either concerned or highly concerned about changes in federal science funding. Similarly, concern regarding recent changes in U.S. science policy was widespread, with only a small fraction of respondents expressing disagreement. The survey also revealed substantial concern regarding future career opportunities (Figure 6). Most respondents reported concern regarding future job opportunities in polar and cryosphere science, both within and outside traditional academic pathways. Concerns regarding declining support and inclusion for early-career researchers

Table 1. Full wording of all general survey statements, grouped by thematic type: ICO = institutional confidence and community; CIN = concern and perceived instability; CTJ = career trajectory and intentions; AAC = adaptation and action. Shaded rows indicate statements whose response distributions are shown in the main-text Likert figures, as given in the legend below.

Shown in Figure 6 Shown in Figure 7 Shown in Figure 8

Question #	Type	Survey Question
8	ICO	I understand how current U.S. science policy decisions are made and who influences them.
9	ICO	I trust that U.S. government agencies prioritize long-term scientific research.
10	CIN	I feel that polar/cryosphere science is underrepresented in federal policy discussions.
11	CIN	I am worried about recent changes in U.S. science policy.
12	CIN	I am worried about recent changes in U.S. science funding.
13	CIN	Recent policy and funding changes have impacted my mental well-being and research/work productivity.
14	CIN	I am concerned about science skepticism in the U.S.
15	CIN	I am concerned that the general audience within the U.S. will be less informed about polar/cryosphere research in the future.
16	CIN	I am concerned that polar/cryosphere inclusion and community support (outside of research funding) has been reduced for ECR like me due to current policy changes.
17	CIN	I feel worried about polar/cryosphere job opportunities—both in and out of academia.
18	CTJ	Compared to 2024, I am just as likely to continue my research/work in polar/cryosphere science.
19	CTJ	I plan to pursue job opportunities outside of the U.S. due to polar/cryosphere science research funding instability.
20	CTJ	I plan on leaving academia to work in industry jobs/research.
21	CTJ	I am considering leaving polar/cryosphere research entirely due to funding instability.
22	CTJ	I am more likely to stay within U.S. polar/cryosphere research if recent science policy and funding reduction decisions are reversed.
23	CIN	I am worried about losing career opportunities such as speaking at international conferences and participating in workshops due to recent shifts in U.S. immigration policies.
24	CIN	My department/program/company is being adversely affected by recent science policy and funding changes.
25	CIN	My peers and colleagues have been negatively impacted and/or stressed by recent science policy and funding changes.
26	CIN	My motivation to do my research has been negatively affected by recent science policy and funding changes.
27	AAC	Compared to 2024, I have made changes to how I talk to other people about science research.
28	AAC	Compared to 2024, I am just as likely to talk to other people about the importance of science funding.
29	AAC	I have faced challenges in pursuing federal funding for my research due to recent constraints on allowable research topics.
30	CIN	I think recent science policy and funding changes are negatively impacting U.S. polar/cryosphere science research.
31	ICO	I feel supported by my professional community despite current funding challenges.
32	ICO	I feel my voice as an early career researcher is heard in discussions about science policy.
33	ICO	Mentorship in my institution has helped me navigate funding uncertainty.
34	ICO	I feel optimistic about the future of polar/cryosphere research in the U.S.
35	ICO	I believe international collaborations are essential for maintaining progress in polar science.

Table 2. Wording of the additional statements shown only to respondents who indicated that their research was fully or partially federally funded (thematic type: FED). These items were presented on the same five-point scale as the statements in Table 1, from strongly disagree to strongly agree, with a "does not apply" option; some items invited a free-text elaboration. Because the branch was shown to a subset of respondents, sample sizes for these items are smaller than for the statements in Table 1. Shaded rows indicate statements whose response distributions are shown in the main-text Likert figures, as given in the legend below. QF3 duplicated QF2 in the deployed survey and was excluded from analysis.

Shown in Figure 6 Shown in Figure 7 Shown in Figure 8

Question #	Type	Survey Question
QF1	FED	I have faced administrative or logistical delays in accessing federal research funds.
QF2	FED	I have sought out external sources of funding in the recent months beyond my federal grant funding.
QF4	FED	I am worried I may lose my federal funding in the future.
QF5	FED	I have made changes to how I phrase my science when writing funding proposals in response to recent science policy and funding changes.
QF6	FED	I have considered changing my research focus to increase funding competitiveness.
QF7	FED	I am spending more time on grant-writing or applying for scholarships/fellowship funding than research.

were also highly prevalent. A similarly large proportion of respondents expressed concern regarding increasing science skepticism in the United States. Broader societal concerns were evident throughout the responses. Most respondents agreed that the public may become less informed about polar and cryosphere science in the future. Concerns regarding future access to federal funding opportunities were also common. Additionally, many respondents reported concern regarding the potential loss of international networking, conference participation, and collaborative opportunities. Across nearly all survey items shown in Figure 6, responses were concentrated in the "agree" and "strongly agree" categories, indicating consistently high levels of concern regarding recent policy and funding changes.

Impacts on Research Activities and Well-Being

Perceived impacts of recent science-policy and funding changes are summarized in Figure 7. The strongest agreement was observed for the statement: "recent policy and funding changes are negatively affecting U.S. polar and cryosphere science". The majority of respondents agreed or strongly agreed with this statement, while only a small minority expressed disagreement. Respondents also reported substantial impacts on their own research activities and professional well-being. Negative effects on research motivation were commonly reported, with many respondents indicating that policy and funding uncertainty had reduced

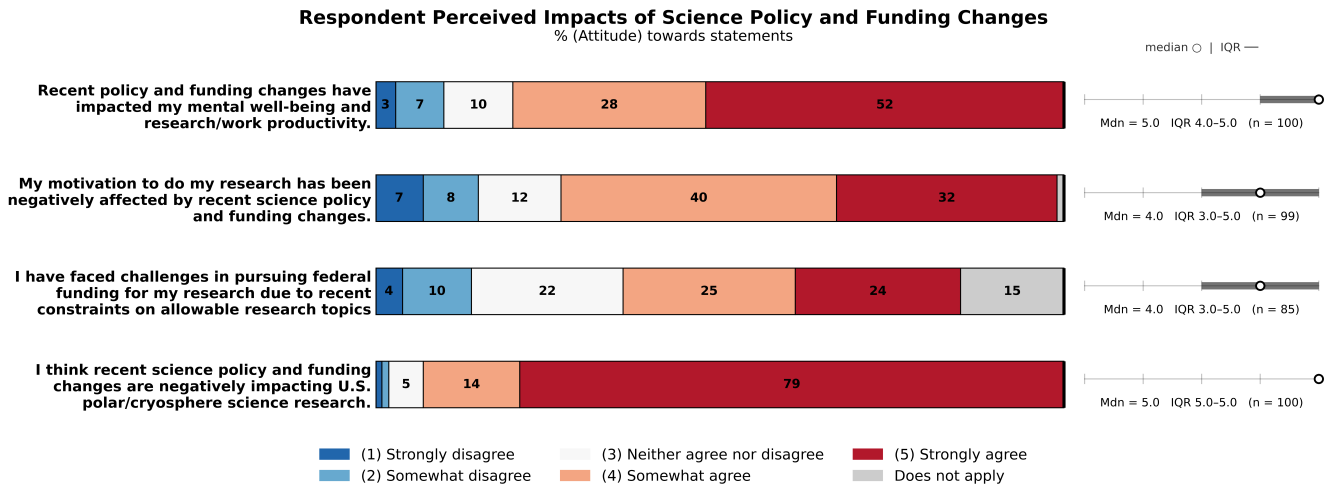


Fig. 7. Perceived impacts of policy and funding changes on research and well-being.

their enthusiasm for conducting research. Similar patterns were observed for mental well-being and research productivity, where a large proportion of respondents reported adverse effects. The impacts extended beyond personal well-being. Respondents also reported challenges associated with pursuing federal funding opportunities. A substantial proportion agreed that restrictions on research topics or changing funding priorities had complicated efforts to obtain funding, although responses to this question were more distributed than for other survey questions. Overall, Figure 7 demonstrates that respondents perceived recent policy and funding changes as affecting both individual researchers and the broader research community.

Future Career Intentions

Future career intentions of respondents (Figure 8) shows that substantial proportion of respondents reported considering employment opportunities outside the United States because of instability in research funding. Similarly, many respondents indicated that they were considering leaving polar and cryosphere research entirely. Respondents also reported uncertainty regarding their future participation in research. While some indicated that they were likely to continue pursuing careers in polar and cryosphere science, others reported reduced likelihood of remaining in the field relative to previous years. Responses were distributed across multiple categories, indicating variation in anticipated career trajectories. One of the strongest areas of agreement was with the potential effect of policy reversal. Most respondents agreed that they would be more likely to remain in U.S. polar and cryosphere research if recent science-policy and funding reductions were reversed. This pattern was evident across multiple career stages and was among the most strongly

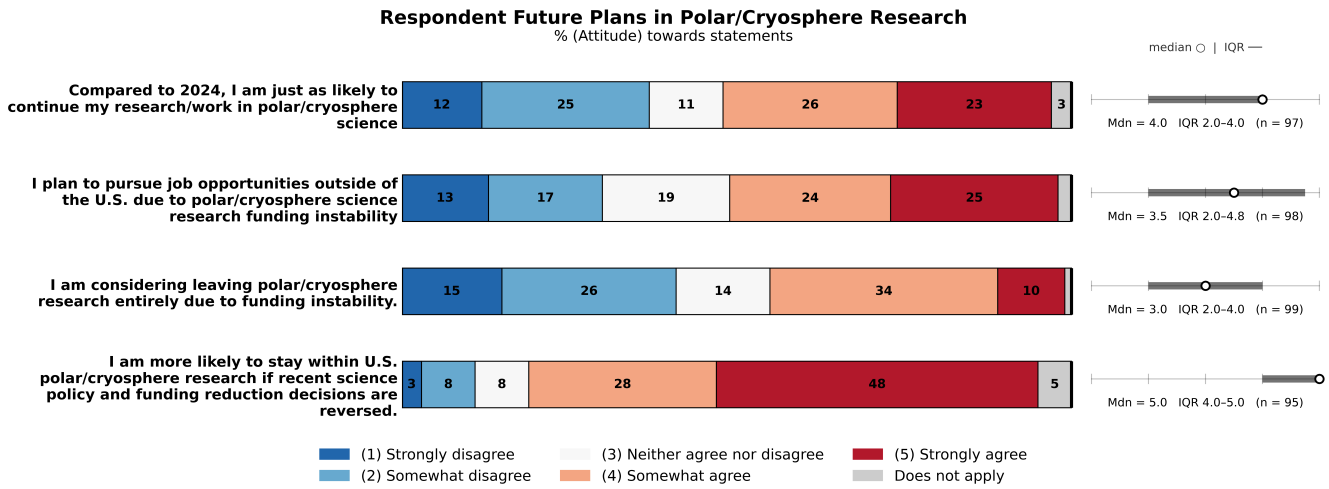


Fig. 8. Future career intentions and retention within polar science.

supported statements in the survey.

Variation in Survey Responses within the Community

Responses to most statements were tightly concentrated, with the community leaning consistently in one direction. On a subset of items, the spread was substantially wider, suggesting that views diverged within the population (note the inter-quartile ranges in Figures 6, 7, and 8). To test whether that divergence was structured by who the respondents were, we fitted ordinal regression models, which ask whether respondents sharing a given characteristic tended to sit higher or lower on the agree-disagree scale. Each model included all seven characteristics at once, so every result describes one characteristic while holding the other six constant — important here because they overlap (e.g. pre-PhD researchers being younger on average).

Results are reported as odds ratios: 1 means no difference between groups, above 1 means the first-named group agreed more, below 1 the comparison group. Each comes with a 95% confidence interval, the range of values consistent with the data. Because many statements were tested, we applied a false discovery rate correction, which raises the bar for significance in proportion to the number of tests. Results surviving it are called confirmatory; those significant only beforehand are suggestive, worth following up but not established. Full estimates are in Table S3 and visualized in Figures S2-S8.

Federal funding status showed the most consistent pattern. Federally funded respondents reported greater worry and more negative impact on six statements, with no reversal in direction i.e. on every statement where funding status mattered, it was the federally funded group agreeing more, rather than

the pattern flipping from one statement to the next. Two were confirmatory and large: agreement that policy changes had affected well-being and productivity, and worry about science funding changes. Four were suggestive and similar in size: reduced motivation, considering leaving research, worry about policy changes, and willingness to stay if funding were reversed. Confidence intervals here are very wide, as few respondents were not federally funded, so these indicate direction rather than precise magnitude.

Gender was the only characteristic on which every association was confirmatory. Compared with women, men were more likely to report considering leaving research, planning to leave academia, and concern about losing international opportunities — all pointing toward greater disengagement from their current career path.

Age was associated with three statements, per additional decade. Older respondents were substantially more likely to report considering leaving research, the only age effect surviving correction; younger respondents expressed greater worry about policy changes and stronger agreement that international collaboration is essential.

Three characteristics showed suggestive associations only. Pre-PhD researchers more often reported plans to leave academia and considering leaving research, while post-PhD and industry respondents more often reported changing how they communicate their science and concern about losing international opportunities. Respondents reporting a disability were more likely to report considering leaving research and planning to leave academia, and less likely to expect to continue in the field — three statements describing one pattern of reduced intended persistence. Non-white respondents agreed more strongly than white respondents about losing international opportunities, advocating for funding, and optimism about the future, though the last reaches 1 and is consistent with no difference. Fieldwork produced the least coherent pattern: participants valued international collaboration more and were more optimistic, while non-fieldwork researchers worried more about job opportunities.

Considering leaving research divided respondents along five of the seven characteristics (federal funding, gender, age, career stage, and disability status), more than any other statement; concern about losing international opportunities divided them along three. With 58–70 respondents per model, these results identify which characteristics structure disagreement rather than estimating precisely how much.

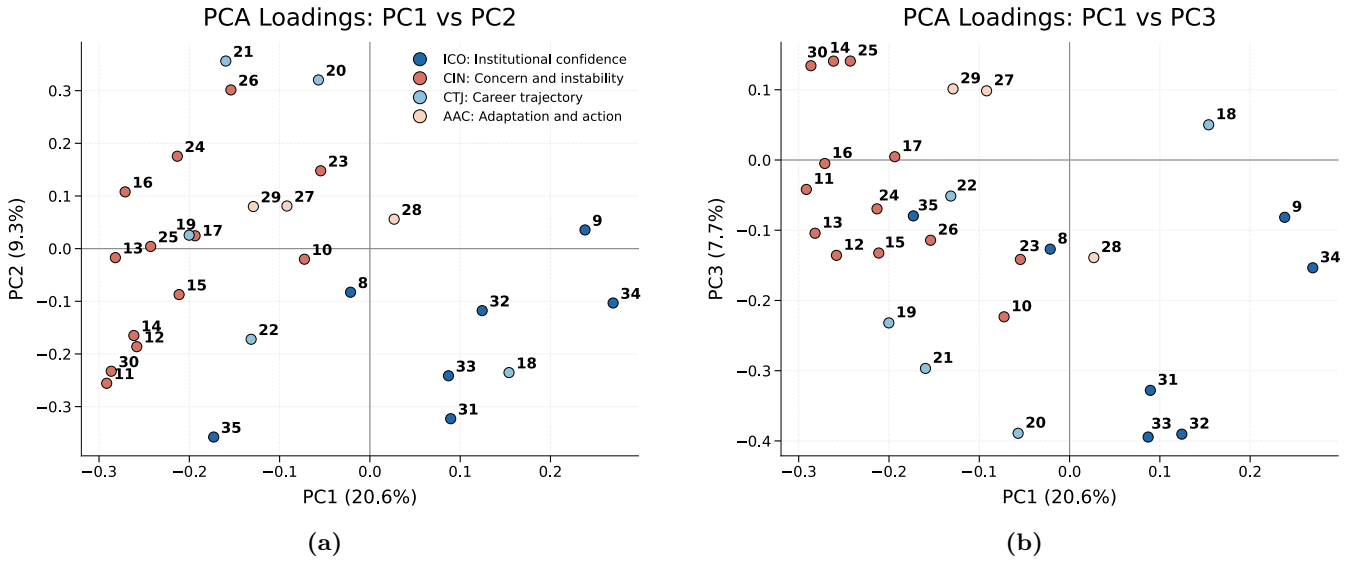
Principal Component Analysis of Survey Responses

Principal component analysis identified major patterns of covariance among survey responses and was used as an exploratory tool to summarize dominant response structures. The scree plot (Supplementary Figure S1) indicates that the first principal component (PC1) explained 20.6% of variance, followed by PC2 (9.3%) and PC3 (7.7%). Together, the first three components accounted for 37.6% of total variance.

PC1 represents the primary axis of variation and reflects a gradient from institutional confidence to perceived instability (Figures 9*a*,*b*; see Supplementary Table S2 for PCA loadings). Positive loadings are associated with trust in government prioritization of science, optimism about the future of polar research, and perceptions of professional support. Negative loadings correspond to concerns about science funding, policy changes, misinformation, and declining support for early-career researchers. This component captures a broad contrast between confidence in the scientific system and concern about its current trajectory.

PC2 was interpreted as reflecting a gradient between career vulnerability and professional support and resilience (Figure 9*a*). Positive loadings were associated with intentions to leave academia or research, reduced motivation, concerns regarding career opportunities, and perceived impacts on departments and colleagues. Negative loadings were associated with mentorship, professional community support, continued engagement in research, and the importance of international collaboration. This component suggests that respondents experiencing greater career uncertainty clustered separately from those reporting stronger support networks and professional resilience.

PC3 reflects a dimension linking perceptions of professional support, community inclusion, and mentorship with future career decision-making (Figure 9*b*). Because indicators of professional support and career withdrawal loaded in the same direction, this component does not represent a simple support-versus-withdrawal gradient. Instead, it suggests that considerations of professional belonging and future career decisions are closely intertwined within the respondent population. Strong loadings were observed for perceptions of community support, mentorship, having one's voice heard in science-policy discussions, and career decisions related to remaining in or leaving academia and research. Together, these variables suggest a dimension associated with how respondents perceive their place within the scientific community while evaluating future career pathways. Unlike PC2, which primarily contrasts career vulnerability with professional support and retention, PC3 appears to capture how respondents situate themselves within the broader scientific community while evaluating future career pathways. This component therefore reflects a dimension of professional support, community belonging, and career reflection rather than a simple



(a) **(b)**

Fig. 9. Principal component analysis (PCA) of Likert-scale survey responses. (a) PCA loadings of survey items in the PC1-PC2 loading space (loadings in Supplementary Table S2). (b) PCA loadings of survey items in the PC1-PC3 loading space. The first three principal components explain 20.6%, 9.3%, and 7.7% of total variance, respectively (Supplementary Figure S1). The numbers correspond to question numbers as given in Tables 1 in the Appendix. Colors denote thematic survey categories assigned a priori (Institutional Confidence, Concern and Instability, Career Trajectory, and Adaptation and Action) and are shown for visual reference only; principal component interpretations were based on loading patterns rather than category membership. PC1 primarily separates institutional confidence from perceived instability, whereas PC2 differentiates career vulnerability from professional support and resilience. PC3 captures variation in professional belonging and career reflection, linking mentorship, community support, perceptions of being heard, and future career decision-making.

support-versus-withdrawal gradient.

DISCUSSION

The survey results indicate that recent changes in U.S. science policy and funding are associated with widespread concern among early-career researchers in polar and cryosphere science. Across multiple survey questions, respondents expressed concern regarding funding stability, future career opportunities, public trust in science, and the long-term trajectory of the research enterprise. Concern regarding science funding and science policy represented some of the strongest responses observed in the survey, with the vast majority of respondents reporting concern about both issues. Respondents also overwhelmingly agreed that recent policy and funding changes are negatively affecting U.S. polar and cryosphere science.

The findings further suggest that these concerns extend beyond research funding itself. More than half of respondents reported negative impacts on mental well-being and research productivity, while many also reported declines in motivation. Similar relationships between funding uncertainty, job insecurity, and reduced researcher well-being have been documented across academic STEM disciplines, particularly among early-career researchers occupying temporary or grant-dependent positions (Levecque and others, 2017; Woolston, 2019; Johnson and Lester, 2022). These results indicate that uncertainty surrounding funding and policy environments may influence both professional activities and personal well-being. Such effects are particularly important within the early-career research community, where many researchers occupy temporary positions and depend heavily on external funding for salary support, fieldwork, and career advancement.

Career intentions emerged as another important theme. A substantial fraction of respondents reported considering leaving polar or cryosphere research entirely, pursuing employment opportunities outside the United States, or seeking alternative career paths. Although stated intentions do not necessarily translate into future actions, these responses suggest that funding instability may influence workforce retention. Previous studies have shown that perceived career instability, limited funding opportunities, and uncertain employment prospects can influence decisions to leave academic research careers (Sauermann and Roach, 2012; Christian and others, 2021). Because polar science depends heavily on long-term observational programs, specialized technical expertise, and sustained institutional knowledge, the loss of early-career researchers could have consequences extending beyond individual careers. Reductions in workforce retention may affect the continuity of scientific programs, future leadership development, and the long-term capacity of the discipline.

At the same time, respondents expressed strong support for conditions that would encourage continued participation in the field. A large majority reported that they would be more likely to remain in U.S. polar and cryosphere research if recent science-policy and funding reductions were reversed. This finding suggests that many respondents have not permanently disengaged from the field and that workforce retention may remain responsive to changes in funding conditions and institutional support. Changes in immigration policies may also influence participation in conferences, workshops, summer schools, international collaborations, and field-based research activities. These issues were not explored in detail in the present survey and warrant further investigation in future studies.

Altogether, survey results highlight population-specific variations within the general consensus amongst

the survey participants. While descriptive responses showed broad convergence on many statements, the adjusted models identified systematic differences by federal funding status, gender, and age, with further suggestive variation by career stage, disability status, race, and fieldwork participation. Notably, these differences clustered around the items with the most direct bearing on individual futures, as intentions to leave research or academia appeared as a point of divergence across five of the seven characteristics examined. This pattern suggests that shared concern about the direction of U.S. science policy coexists with unevenly distributed exposure to its consequences: respondents holding federal funding, for example, reported substantially greater impact on their well-being, motivation, and career plans than those without. We emphasize that most of these differences are suggestive rather than confirmatory, and that the modest sample size limits the precision of individual estimates; the appropriate inference is not that any specific subgroup contrast is firmly established, but that meaningful heterogeneity exists and warrants explicit attention in how community-wide findings are interpreted and generalized.

The principal component analysis provides additional insight into the structure of these responses. The PCA diagnostics support the appropriateness of the analysis (see Supplementary Section S2.3). The first principal component was interpreted as a gradient between institutional confidence and perceived instability. Respondents reporting greater trust in government support for science, optimism regarding the future of polar research, and stronger perceptions of professional support tended to cluster separately from respondents expressing concerns regarding funding, policy changes, and the future of the scientific enterprise. This pattern suggests that perceptions of current challenges are not isolated issues but form part of a broader evaluation of system stability.

The second principal component was interpreted as reflecting career vulnerability and withdrawal-oriented attitudes versus professional support and resilience. Intentions to leave academia or research, reduced motivation, and funding-related challenges loaded together and opposed variables associated with mentorship, community support, and collaboration. This pattern suggests that professional support networks may play an important role in shaping how researchers respond to periods of uncertainty.

The third principal component highlighted a distinct dimension related to professional belonging and career reflection. Variables associated with mentorship, community support, and feeling heard in science-policy discussions clustered together with questions concerning future career decisions, including intentions to leave academia or leave polar and cryosphere research. Unlike PC2, which primarily reflected career vulnerability and retention, PC3 appears to capture how respondents evaluate their place within the

scientific community while considering future career pathways. This finding suggests that professional belonging, mentorship, and community engagement are closely intertwined with long-term career decision-making among early-career researchers.

Several limitations should be considered when interpreting these findings. Based on the demographics survey information from American Geophysical Union between 2013-2025, the approximate number of people who identify as early careers with affiliation to the cryosphere section are $1,156 \pm 246$ (mean $\pm$ SD) with 795 members in 2025, the year in which our survey was sampling. Thus, we conservatively estimate that the survey captures about 7-11% of the population represented. Participation was voluntary and respondents experiencing stronger concerns may have been more likely to participate, potentially introducing response bias. Additionally, because recruitment occurred through professional networks, mailing lists, and social media, the sample may not fully represent the diversity of perspectives across the broader U.S. polar and cryosphere early-career research community. The survey represents perceptions at a particular point in time and may not capture future changes in attitudes as policy conditions evolve. We used ordinal logistic regression to identify differences between subgroups within the surveyed population. Because each model was fitted on only 58 to 70 people while considering seven characteristics at once, the estimates are imprecise: the larger values indicate a substantial difference between groups rather than a precise multiple, and only six of the differences remained statistically significant once we accounted for the number of comparisons made. In addition, the principal component analysis was intended as an exploratory tool for identifying major patterns of covariance among survey responses rather than defining latent psychological constructs. Finally, the first three principal components explained 37.6% of total variance. While this proportion is typical for exploratory analyses of attitudinal survey data, it indicates that additional factors beyond the three retained components also contribute to variation in respondent responses.

Overall, the results suggest that concerns regarding science policy and funding extend beyond immediate research impacts and influence broader perceptions of career stability, professional support, and the future of the discipline. Continued monitoring of the polar and cryosphere research workforce may therefore be important for understanding how evolving policy environments affect both scientific productivity and long-term workforce sustainability.

CONCLUSIONS

This study provides insight into how recent changes in U.S. science policy and funding are perceived by early-career researchers in polar and cryosphere science. Respondents reported widespread concern regarding science funding, science policy, future employment opportunities, and the long-term health of the research enterprise. These concerns were accompanied by reported declines in motivation, productivity, and mental well-being, suggesting that the effects of policy uncertainty extend beyond research funding alone. The survey results also indicate that funding instability may influence future workforce retention. Many respondents reported considering employment opportunities outside the United States, leaving academia, or leaving polar and cryosphere research altogether. At the same time, a large majority indicated that they would be more likely to remain in U.S. polar and cryosphere research if recent science-policy and funding reductions were reversed. These findings suggest that career decisions remain strongly influenced by perceptions of future funding stability and institutional support.

Ordinal regression analysis revealed variance in participant responses in key questions around present concerns and future plans. Such variance provides further context and nuance to the U.S. polar early career community, letting us infer community attitude while acknowledging diversity in perspectives present.

Principal component analysis identified three broad response dimensions that help summarize variation among survey responses. The first component reflected a gradient between institutional confidence and perceived instability, the second captured career vulnerability and withdrawal-oriented attitudes relative to professional support and resilience, and the third reflected a dimension linking professional support, community belonging, and career reflection, linking perceptions of mentorship, community support, and engagement with future career decisions. Together, these patterns suggest that concerns regarding funding, policy, professional support, and career intentions are closely interconnected rather than independent issues. Because polar and cryosphere science relies heavily on specialized expertise, long-term observations, and sustained workforce development, continued monitoring of the early-career research community may be important for understanding the long-term consequences of changing policy and funding environments. Efforts that strengthen funding stability, mentorship, professional support, and opportunities for career development may help maintain a resilient and productive scientific workforce capable of addressing emerging challenges in the polar regions.

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CONFLICT OF INTEREST

The authors are early-career researchers working in the polar and cryosphere science community and therefore belong to the population represented in this study. To minimize potential bias, survey responses were anonymized and were not accessible to the co-authors until the analysis was conducted.

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Supplementary Material for "Assessing Challenges for U.S.-Based Polar Early Career Scientists During Science Policy Changes"

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S1 OVERVIEW OF SUPPLEMENTARY MATERIAL

This Supplementary Material provides additional methodological details, tables, figures, and supporting analyses referred to throughout the main manuscript. Section S2 describes the construction and coding of demographic variables, the specification of the adjusted proportional-odds ordinal regression models, and the pre-processing, adequacy testing, the interpretation procedures used for principal component analysis

[*] These authors contributed equally to this work and are listed in alphabetical order.

(PCA), and words removed from the word cloud generated from optional comment responses.

Section S3 presents the supplementary results. The PCA results are documented through the scree plot (Figure S1) and the loadings of individual survey items on the first three principal components (Table S2). Figures S2-S8 then show adjusted odds ratios and 95% confidence intervals separately for federal funding status, gender, age, career stage, disability status, race, and fieldwork participation. All supplementary sections, tables, and figures included here are referred to at the relevant locations in the main text.

S2 METHODS

S2.1 Demographic variable construction and coding

Career stage was collected using a predefined list of ten options encompassing the full range of early-career positions in academic and non-academic research settings: undergraduate students, post-baccalaureate researchers, master's students, PhD students, postdoctoral researchers, research scientists, lab managers, industry-based cryosphere and polar research specialists, early-stage faculty, and researchers within ten years of completing a PhD or equivalent terminal degree. For descriptive summaries and subgroup analyses, categories were retained as defined or, where cell sizes were small, collapsed into broader groupings (e.g., combining undergraduate, post-baccalaureate, and master's students into a single pre-doctoral category) to ensure sufficient power for between-group comparisons.

Disability status, fieldwork involvement, and federal funding status were each collected as binary or ternary categorical variables (Yes / No / Prefer Not to Answer) and summarized as proportions of the total respondent sample. Respondents selecting "Prefer Not to Answer" for disability status were excluded from subgroup analyses involving that variable but retained in all others.

Gender identity, age, and race and ethnicity were collected via open text fields with a "Prefer Not to Answer" option, yielding a diverse range of responses reflecting the varied ways individuals describe their own identities. Entries were reviewed and manually coded into standardized analytical categories by the research team through iterative review of raw responses, development of a coding scheme grounded in the response data, and reconciliation of ambiguous or non-standard entries through team discussion. Gender responses were coded as man, woman, nonbinary or genderqueer, and other or prefer not to answer (Rasmussen and others, 2023). Race and ethnicity were coded using a framework drawn from established practice in STEM workforce and higher education research, which prioritizes respondent-centered language and explicitly accommodates multiracial and multiethnic identities (Sarraju and others, 2023). Age was

recorded as continuous where a numeric value was provided; non-numeric or ambiguous responses were treated as missing.

S2.2 Ordinal regression model specification

Each of the five ordered response categories was modeled as an ordinal outcome under a cumulative-link (proportional-odds) specification with a logit link, fit by maximum likelihood. Unlike one-variable rank tests, this model accommodates multiple predictors simultaneously, so the association of each characteristic with a given item is estimated while adjusting for the others.

Predictors were entered as main effects only. No interaction terms were included: with the subgroup sizes available here, interaction estimates would rest on very few respondents per cell and would not be interpretable. For the same reason, each categorical characteristic was reduced to a single binary contrast against a stated reference category, with the reference chosen as the larger or more conventionally reported group (pre-PhD for career stage, man for gender, affirmative fieldwork involvement, affirmative federally funded, and white for race/ethnicity). Age was the only continuous predictor and was rescaled so that each unit corresponds to 10 years, making the reported odds ratio the shift associated with one additional decade rather than one additional year.

Models were estimated on complete cases across all predictors, with "Does not apply" responses treated as missing on the outcome; the analytic sample size therefore varies by item and is reported alongside each model. Model fits were inspected for convergence and for sparsely populated predictor-response cells capable of producing unstable estimates or implausibly wide confidence intervals. All models converged; estimates with wide confidence intervals were interpreted cautiously.

The Benjamini-Hochberg correction was applied within predictor across items, treating the set of items tested for a single characteristic as one family. This reflects the structure of the research question, which asks whether a given characteristic is associated with responses across the survey, rather than whether any association exists anywhere in the full predictor-by-item grid. Both unadjusted and FDR-corrected p-values are reported for every estimate. Given the sample size, interpretation emphasizes the magnitude and direction of effects rather than significance thresholds alone, and exploratory associations are read alongside their effect sizes and the descriptive patterns in the main text.

S2.3 PCA preprocessing and adequacy testing

To examine major patterns of covariance among attitudinal survey responses, we conducted principal component analysis on Likert-scale survey questions. Survey responses were originally collected on a five point Likert scale ranging from 1 to 5 where the responses marked "does not apply" were treated as missing values. Likert responses were converted to numeric value. Missing values were imputed using variable medians prior to analysis. Because the survey items were measured on a common ordinal scale but could differ in variance, variables were standardized to zero mean and unit variance before PCA. Despite their ordinal nature, Likert responses were treated as approximately continuous for PCA, consistent with common practice in exploratory multivariate analyses.

Sampling adequacy and suitability of the correlation structure were evaluated using the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity. The overall KMO statistic was 0.706, indicating acceptable sampling adequacy for PCA. Bartlett's test was highly significant ($\chi^2 = 1069.46$, $p < 0.001$), demonstrating that correlations among survey items were sufficient to justify dimension reduction. These diagnostics indicate that the identified principal components capture meaningful covariance structures within the survey responses and provide a useful summary of the dominant response patterns. Rather than representing independent concerns, many survey items clustered into broader patterns of perception.

Principal components were extracted from the standardized correlation matrix. Component retention was guided by inspection of scree plots, cumulative explained variance, and interpretability of loading patterns. The first three components formed the dominant variance structure visible in the scree plot and provided interpretable loading patterns; therefore, they were retained for discussion. Component loadings were examined to identify clusters of related survey items and to characterize dominant response dimensions. The sign of a principal component is mathematically arbitrary; therefore, interpretations focus on the relative clustering and contrasts among variables rather than the direction of positive or negative loadings themselves.

Based on the loading structure, the leading components were interpreted as reflecting broad constructs such as (1) institutional confidence versus perceived instability, (2) career vulnerability versus professional support and resilience, and (3) professional belonging and career reflection. PCA loading plots and scree plots were generated to visualize variable contributions and component structure. These outputs are presented in Section S3.1.

S2.4 Comment words removed from word cloud

Table S1. Non-descriptive and neutral words removed before generating the word cloud, sorted respectively by frequency.

to	the	and	i	in	of	a	for	that	my	research	us	is	not	have
are	more	be	science	this	as	am	it	on	but	will	with	if	career	polar
has	about	work	or	field	would	feel	so	na	researchers	we	our	they	can	me
there	changes	do	like	because	by	recent	from	at	their	stay	no	cryosphere	less	being
an	climate	think	been	people	scientists	dont	need	also	which	other	change	due	just	these
citizen	ecrs	im	community	current	early-career	early	who	scientific	how	those	still	was	now	even
polarcryosphere	likely	see	out	were	much	make	many	all	academia	when	year	public	very	made
available	than	decisions	phd	students	get	government	time	had	country	important	lot	them	ability	programs
conferences	any	able	may	colleagues	shifts	should	what	doing	know	really	help	involved	its	however
into	since	some	long	sense	within	already	go	find	could	new	general	projects	you	impact
most	then	way	student	want	such	one	getting	sure	working	sciences	apply	here	only	well
years	others	ive	back	having	graduate	outside	seems	data	while	things	directly	through	-	looking
making	next	where	myself	position	ensure	positions	cannot	participate	environment	direct	left	countries	finding	during
importance	personally	become	yes	etc	focus	project	grad	makes	essential	researcher	longer	going	example	after
right	say	issue	might	merit	topics	cant	currently	believe	plan	feels	attend	yet	clear	place
related	before	impacting	justify	intellectual	immediate	tangible	application	market	trying	term	reducing	though	reduction	feeling
create	particularly	communication	shift	result	without	doesnt	everything	communicate	first	between	over	does	scientist	equipment
always	voice	rather	considering	national	around	group	forward	share	down	deeply	consistent	ecr	status	return
point	organizations	needs	seem	building	often	events	global	life	peers	up	definitely	significantly	both	pis
especially	affects	try	everyone	either	top	another	far	high	look	take	recently	question	move	affect
white	overall	staying	postdoctoral	private	sometimes	under	talk	too	never	pursuing	participation	beyond	contribute	priority
wont	away	industry	require	role	advisor	thank	ever	planned	last	landscape	mentorship	regions	access	ways
conference	program	least	strong	states	maintain	value	own	professional	development	clearer	conduct	therefore	entire	ideas
otherwise	generally	postdoc	means	participating	path	seen	big	particular	applying	generation	actually	understand	used	whether
ill	areas	once	felt	based	order	chosen	helpful	keep	previous	non-us	allows	retention	system	shaping
off	lab	write	leadership	senior	survey	id	havent	theres	why	every	greater	past	department	stage
chance	this	conduct	participate	already	though	should	merit	options	conversations	united	face	together	did	your
relevant	similar	effect	power	consider	possible	real	marine	collection	delayed	behind	heard	vital	elsewhere	valued
come	lose	further	cause	increases	engaging	same	citizens	different	effects	presence	level	interested	among	towards
university	done	sources	maybe	best	two	meetings	true	greatly	words	including	open	arent	enough	places
increasing	speak	experienced	strongly	world	members	use	american	start	affecting	space	home	across	somewhat	anything
quite	instead	later	faculty	entirely	short	include	specifically	valuable	training	advocacy	makers	study	put	seasons
quality	end	meeting	seeing	prior	months	whole	thus	communities	built	media	advisory	imagine	faith	rely
perspectives	mentors	reasons	weve	anymore	campaign	effort	progress							

S3 SUPPLEMENTARY RESULTS

S3.1 Principal component analysis

Figure S1 shows the proportion of variance explained by each principal component. Table S2 gives the loadings of all survey items on the first three retained components.

Table S2. Loadings of survey items on the first three principal components. Question wording corresponding to each item identifier is provided in Table 1. Loadings with absolute values $\geqslant 0.25$ are shown in bold to highlight the strongest contributors to each component.

Question #	**Interpretation**	**PC1**	**PC2**	**PC3**
8	Understand policy decisions	-0.021	-0.083	-0.127
9	Trust government priorities	0.238	0.035	-0.082
10	Science underrepresented	-0.073	-0.020	-0.223
11	Worried about policy changes	**-0.292**	**-0.256**	-0.042
12	Worried about funding	**-0.258**	-0.186	-0.136
13	Policy affects wellbeing	**-0.282**	-0.017	-0.104
14	Concern about skepticism	**-0.261**	-0.165	0.141
15	Public less informed	-0.211	-0.087	-0.132
16	ECR support reduced	**-0.271**	0.108	-0.005
17	Job insecurity	-0.194	0.024	0.005
18	Continue research	0.154	-0.235	0.050
19	Jobs outside U.S.	-0.200	0.026	-0.232
20	Leave academia	-0.057	**0.320**	**-0.389**
21	Leave research	-0.160	**0.356**	**-0.297**
22	Stay if funding returns	-0.132	-0.172	-0.051
23	Lose opportunities	-0.054	0.148	-0.142
24	Department impacted	-0.213	0.175	-0.070
25	Peers impacted	-0.243	0.004	0.141
26	Motivation reduced	-0.154	**0.301**	-0.114
27	Changed communication	-0.092	0.081	0.098
28	Advocate for funding	0.027	0.056	-0.139
29	Funding challenges	-0.129	0.080	0.101
30	Policy harming science	**-0.286**	-0.233	0.134
31	Community support	0.089	**-0.323**	**-0.328**
32	Voice heard	0.124	-0.118	**-0.390**
33	Mentorship helps	0.087	-0.241	**-0.394**
34	Optimistic future	**0.269**	-0.103	-0.154
35	International collaboration	-0.173	**-0.358**	-0.080

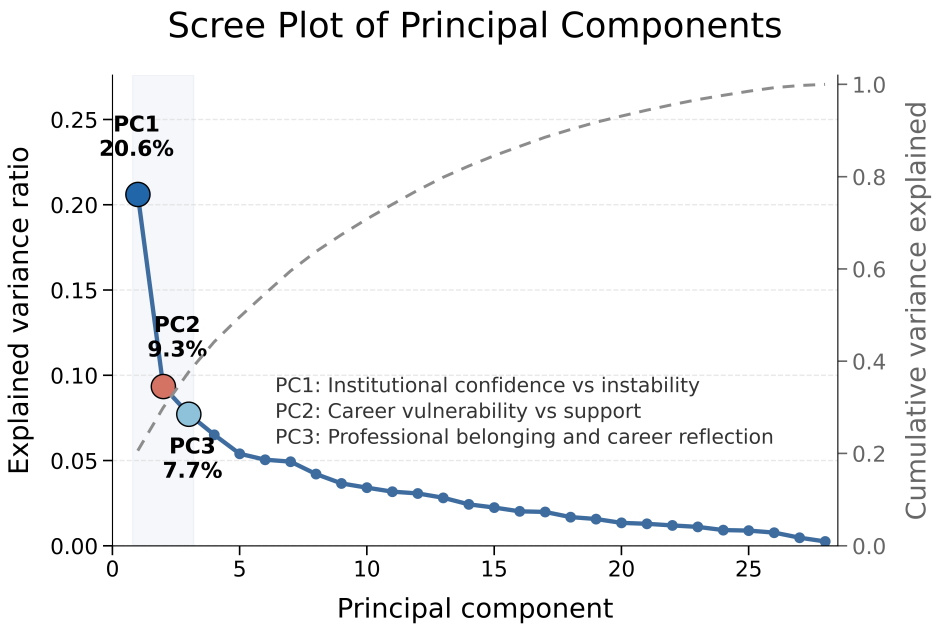

Fig. S1. Principal component analysis (PCA) of Likert-scale survey responses. Scree plot showing the proportion of variance explained by each principal component (PC).

S3.2 Adjusted ordinal regression: full results

Figures S2-S8 present the complete set of adjusted odds ratios from the proportional-odds ordinal regressions reported in the main text. One figure is given per respondent characteristic. Each model contained all seven respondent characteristics simultaneously (federal funding status, gender, age, career stage, disability status, race, and fieldwork participation), so every estimate is adjusted for the remaining six. Models were fitted separately for each Likert-scale item, and each figure displays only those items for which the characteristic in question reached $p < .05$ before correction; items with no association are omitted rather than shown as null estimates.

Estimates for federal funding status were the most affected by sparse cells: few respondents reported not being federally funded, and the resulting confidence intervals are correspondingly wide, spanning 17- to 37-fold (ratio of upper CI limit and lower CI limit) on the odds ratio scale compared with 7- to 8-fold for gender. These estimates are reported because their direction is consistent across all six items, but their magnitudes should not be interpreted as precise. No model was excluded on diagnostic grounds.

Odds ratios are plotted on a log scale with 95% confidence intervals. The contrast and its direction are stated beneath each panel: values to the right of 1 indicate that the group named on the right-hand side of the contrast gave more-agreeing responses. Filled markers denote effects that survived false discovery rate (FDR) adjustment and are treated as confirmatory in the main text; open markers denote effects significant at $p < .05$ before adjustment only, and are reported as suggestive. Asterisks give unadjusted significance levels ($^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$). The sample size shown beside each item is the number of complete cases contributing to that model; it varies across items because respondents could skip individual statements, and is lowest ($n = 58$) for the item on losing international opportunities. Age is modelled as a continuous predictor and its odds ratios are expressed per 10-year increase.

Table S3. Adjusted odds ratios from ordinal regression models, for all characteristics and statements reaching significance before correction. Odds ratios above 1 indicate that the first-named group in each contrast gave more-agreeing responses; values below 1 indicate the comparison group did. "Confirmatory" effects survived false discovery rate correction; "suggestive" effects were significant at $p < .05$ before correction only. Asterisks give significance before correction ($^*p < .05$, $^{**}p < .01$, $^{***}p < .001$). n is the number of respondents contributing to each model.

Statement	n	OR [95% CI]	Status
Federal funding (federally funded vs. not)			
Policy changes affect wellbeing/productivity	70	23.57 [4.97-111.63]***	Confirmatory
Worried about science funding changes	70	14.88 [2.46-89.91]**	Confirmatory
Motivation negatively affected	69	6.63 [1.57-28.05]*	Suggestive
Consider leaving research	70	5.94 [1.46-24.27]*	Suggestive
Worried about science policy changes	70	5.81 [1.02-33.06]*	Suggestive
More likely to stay if funding reversed	67	5.71 [1.33-24.50]*	Suggestive
Gender (men vs. women)			
Consider leaving research	70	9.05 [3.25-25.20]***	Confirmatory
Plan to leave academia	69	5.75 [2.20-15.00]***	Confirmatory
Concern losing international opportunities	58	4.59 [1.60-13.14]**	Confirmatory
Age (per additional 10 years)			
Consider leaving research	70	5.94 [2.07-17.03]***	Confirmatory
Worried about science policy changes	70	0.19 [0.04-0.96]*	Suggestive
International collaboration essential	70	0.17 [0.03-0.84]*	Suggestive
Career stage (pre-PhD vs. post-PhD/industry)			
Plan to leave academia	69	6.18 [1.73-22.00]**	Suggestive
Consider leaving research	70	5.98 [1.65-21.69]**	Suggestive
Changed science communication	69	0.24 [0.06-0.91]*	Suggestive
Concern losing international opportunities	58	0.15 [0.03-0.69]*	Suggestive
Disability status (with disability vs. without)			
Consider leaving research	70	4.78 [1.30-17.53]*	Suggestive
Plan to leave academia	69	3.75 [1.06-13.33]*	Suggestive
Likely to continue in field	68	0.20 [0.06-0.69]*	Suggestive
Race (white vs. non-white respondents)			
Optimistic about future	70	0.37 [0.13-1.00]*	Suggestive
Likely to advocate for funding	69	0.26 [0.09-0.73]*	Suggestive
Concern losing international opportunities	58	0.17 [0.05-0.55]**	Suggestive
Fieldwork (participants vs. non-fieldwork)			
International collaboration essential	70	5.07 [1.11-23.25]*	Suggestive
Optimistic about future	70	2.69 [1.05-6.86]*	Suggestive
Worried about job opportunities	69	0.24 [0.06-0.96]*	Suggestive

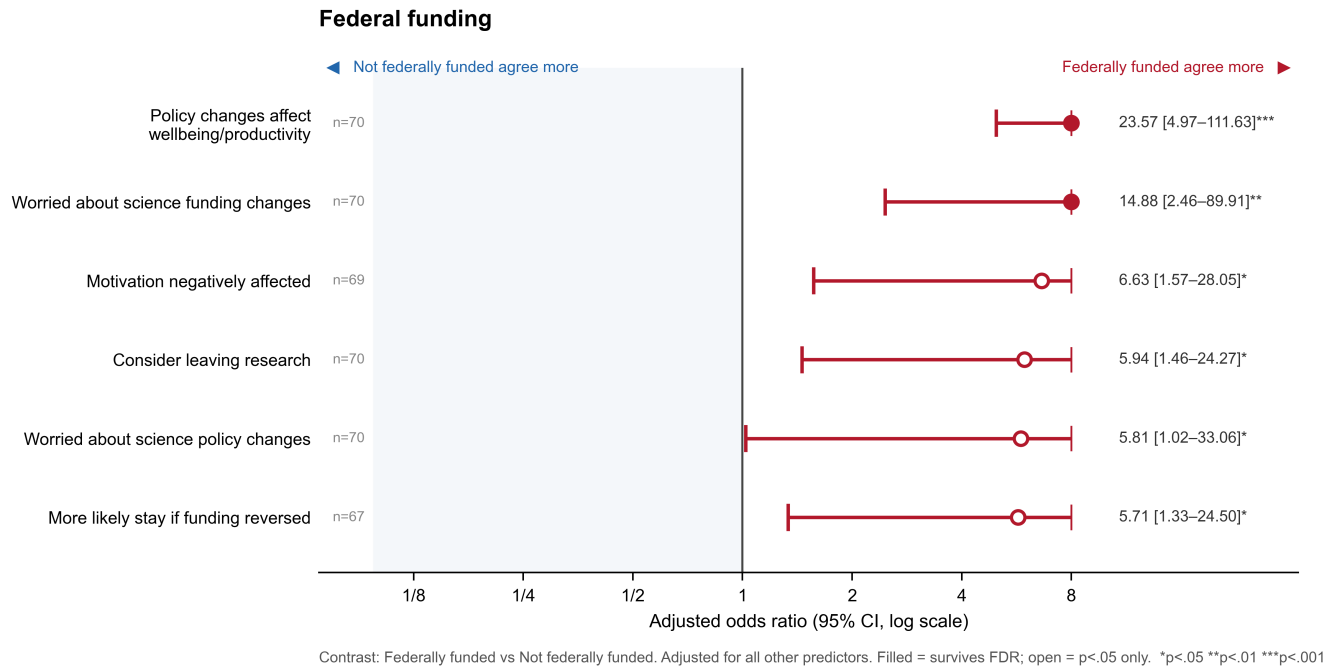

Fig. S2. Adjusted odds ratios (95% CI) for federal funding status. Contrast: federally funded versus not federally funded; values above 1 indicate that federally funded respondents gave more-agreeing responses. Filled markers are confirmatory (survived FDR adjustment), open markers suggestive ($p < .05$ unadjusted); n = complete cases per item.

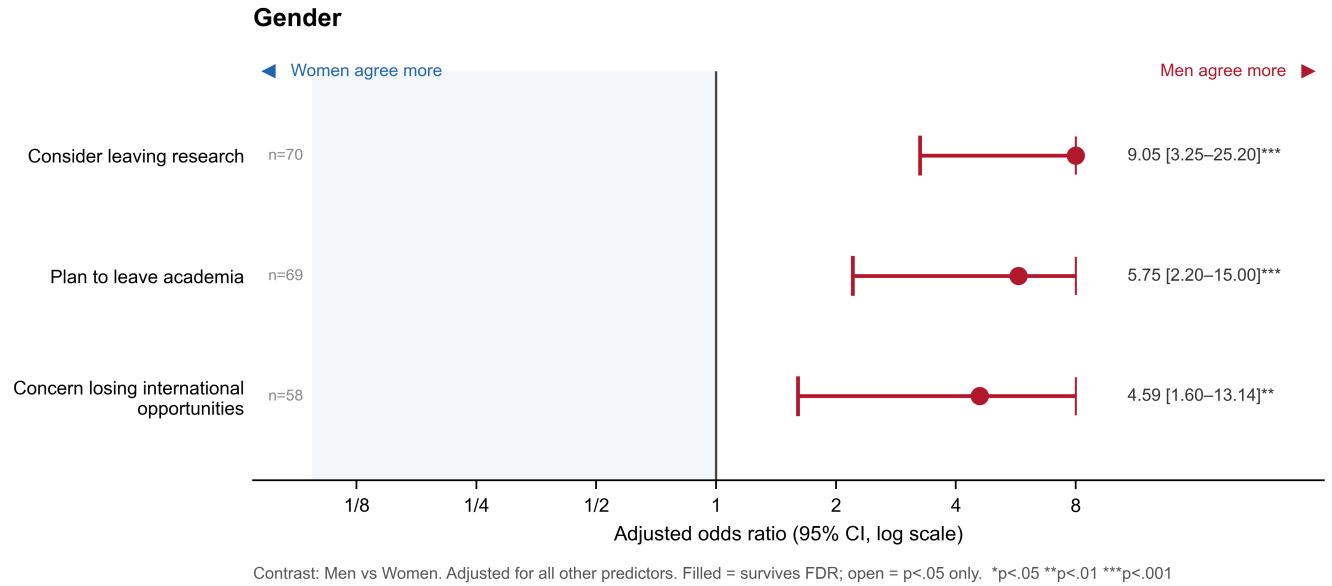

Fig. S3. Adjusted odds ratios (95% CI) for gender. Contrast: men versus women; values above 1 indicate that men gave more-agreeing responses. Filled markers are confirmatory (survived FDR adjustment), open markers suggestive ($p < .05$ unadjusted); n = complete cases per item.

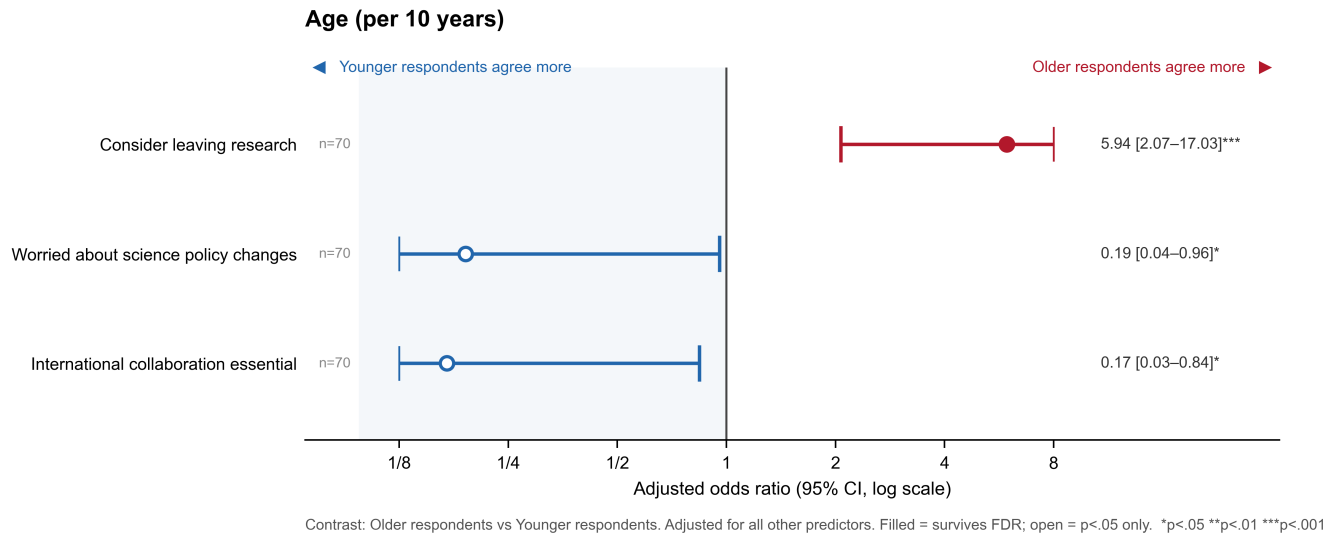

Fig. S4. Adjusted odds ratios (95% CI) for age, per 10-year increase. Values above 1 indicate that older respondents gave more-agreeing responses. Filled markers are confirmatory (survived FDR adjustment), open markers suggestive ($p < .05$ unadjusted); n = complete cases per item.

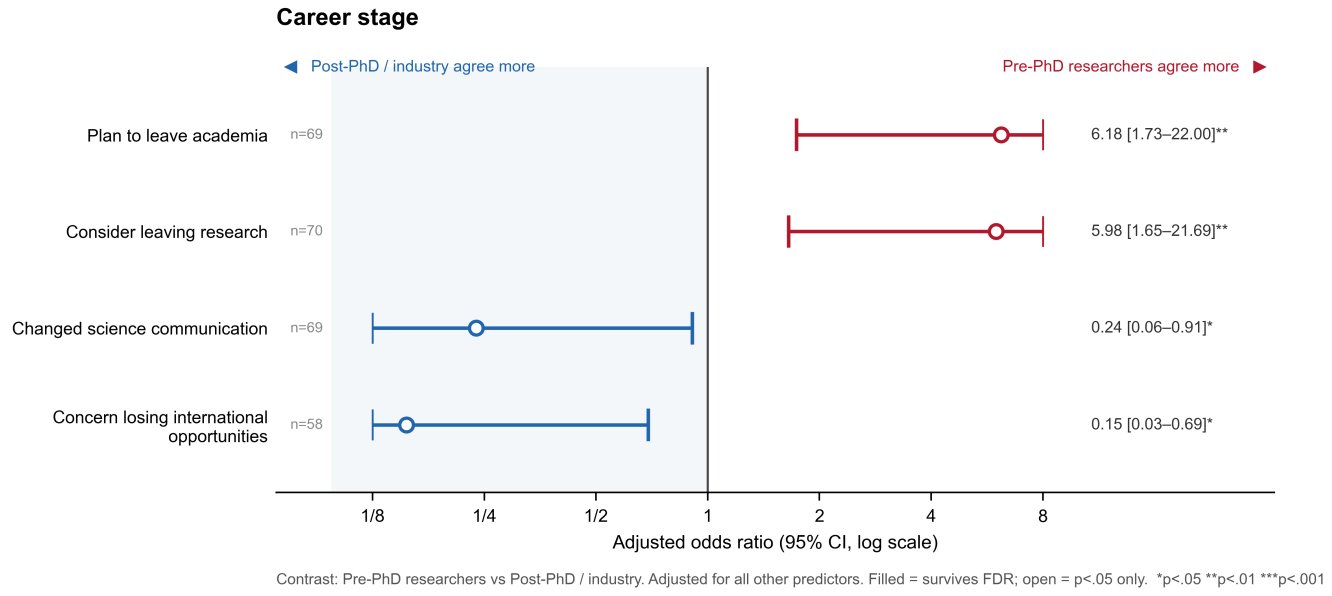

Fig. S5. Adjusted odds ratios (95% CI) for career stage. Contrast: pre-PhD researchers versus post-PhD and industry respondents; values above 1 indicate that pre-PhD researchers gave more-agreeing responses. All effects shown are suggestive ($p < .05$ unadjusted, none surviving FDR adjustment); n = complete cases per item.

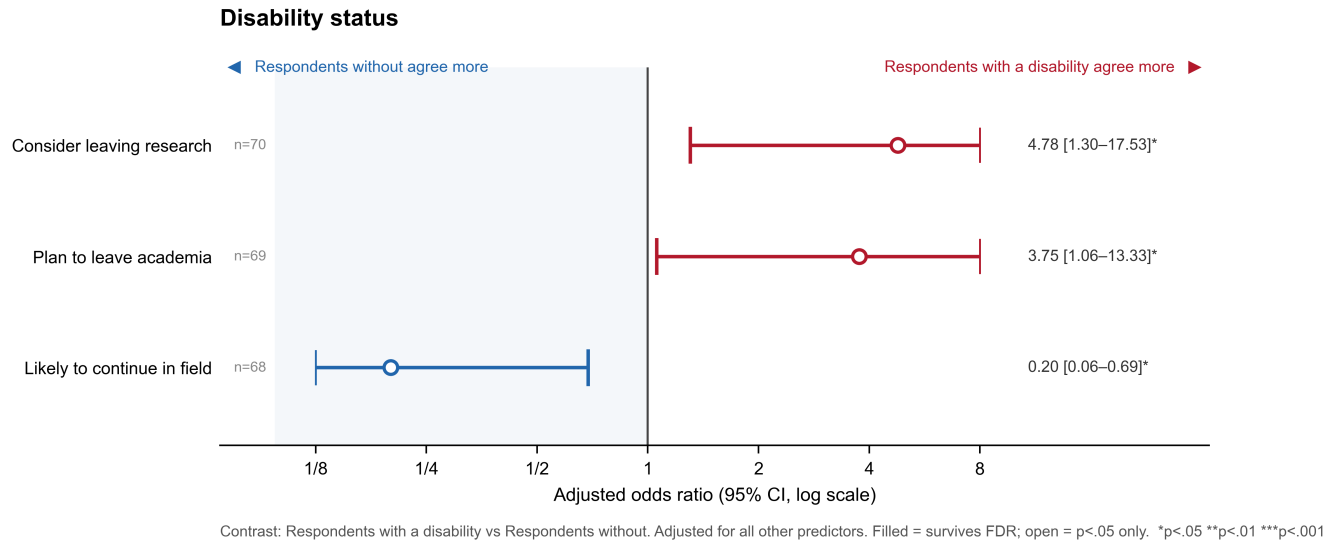

Fig. S6. Adjusted odds ratios (95% CI) for disability status. Contrast: respondents reporting a disability versus respondents without; values above 1 indicate that respondents with a disability gave more-agreeing responses. All effects shown are suggestive ($p < .05$ unadjusted, none surviving FDR adjustment); n = complete cases per item.

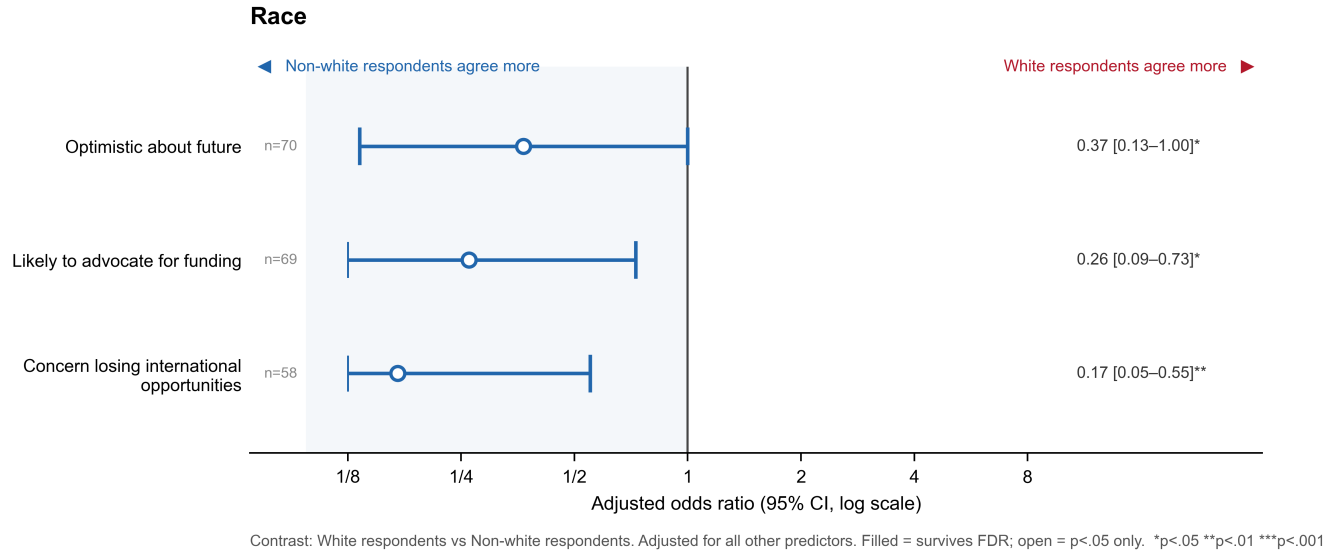

Fig. S7. Adjusted odds ratios (95% CI) for race. Contrast: white versus non-white respondents; values below 1 indicate that non-white respondents gave more-agreeing responses. All effects shown are suggestive ($p < .05$ unadjusted, none surviving FDR adjustment); n = complete cases per item.

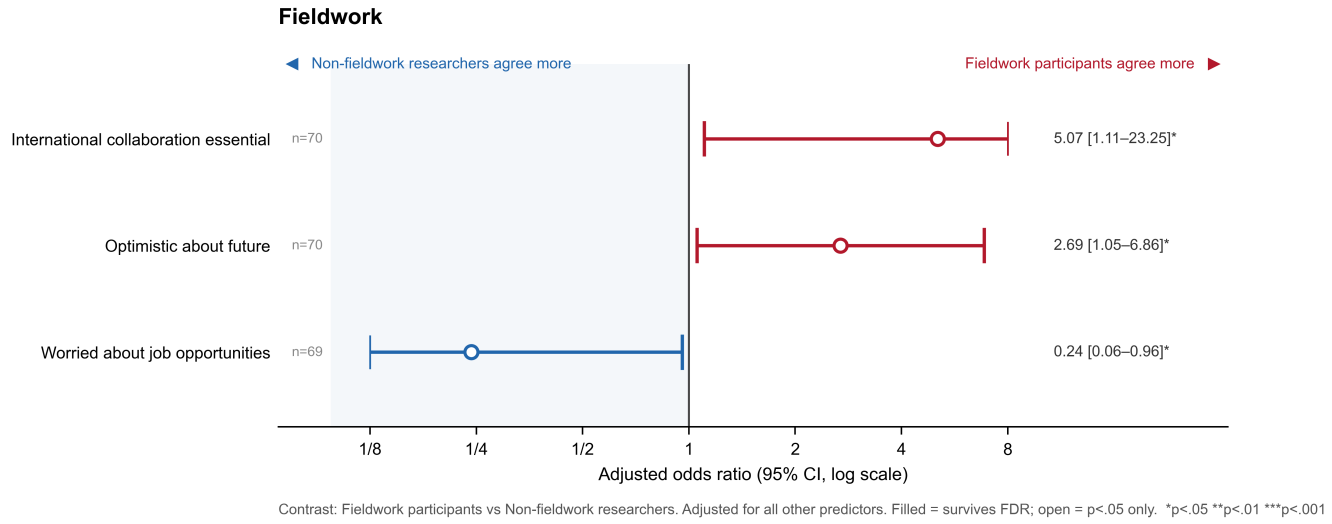

Fig. S8. Adjusted odds ratios (95% CI) for fieldwork participation. Contrast: fieldwork participants versus non-fieldwork researchers; values above 1 indicate that fieldwork participants gave more-agreeing responses. All effects shown are suggestive ($p < .05$ unadjusted, none surviving FDR adjustment); n = complete cases per item.

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