



National  
Science  
Foundation

## UNDERSTANDING THE USE AND POTENTIAL EFFECTS OF A NO-DEADLINES APPROACH

**May 2022**

A report from the Evaluation and Assessment  
Capability Section of the National Science Foundation.

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## Preferred citation

Fox, Lindsay, Jesse Chandler, Francesca Venezia, Micah Wood, Emily Rosen, Gina Lewis, Alina Martinez, Samantha Zelenack, and Christina Tuttle. 2022. *Understanding the Use and Potential Effects of a No-Deadlines Approach*. Alexandria, VA: National Science Foundation.

## Data

Data featuring keyword lists and data sources (for searching literature) with access periods to support replication and additional analyses is available upon request. For more information, please contact: [eac@nsf.gov](mailto:eac@nsf.gov).

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## Understanding the Use and Potential Effects of a No-Deadlines Approach

**May 2022**

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## Abstract

This report reviews the theoretical and empirical research on the effect of deadlines across a wide range of domains. It also examines the results of interviews with National Science Foundation (NSF) staff and other contributors to the NSF grant process, along with the results of staff interviews from and website reviews of other relevant organizations. The study's goal is to provide insights into future evaluations of the offer of grant opportunities that do not impose a fixed submission deadline (referred to as a "no-deadlines approach") by understanding how and why no-deadlines approaches are implemented, their theory of change, their possible intended and unintended effects, and their likely effects according to current empirical evidence. NSF staff hypothesized that a no-deadlines approach could make its rigorous merit review process more efficient and now uses a no-deadlines approach in five of its directorates. At least 173 other organizations have offered funding opportunities without deadlines. However, the literature has not examined the implementation and outcomes of no-deadlines approaches in the context of grant solicitations beyond NSF's internal assessments. Theory and empirical evidence generally support the idea that task completion rates are higher in the presence of deadlines than in the absence of deadlines, but there is inconsistent empirical evidence about how deadlines may affect task quality and the characteristics of those completing the task.

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## Executive Summary

The National Science Foundation (NSF) supports basic research in most fields of science and engineering and made awards to 1,900 colleges, universities, and other institutions in FY 2021 (NSF 2021). Proposals submitted to NSF undergo a rigorous peer review process that imposes burden on reviewers, NSF staff members, and principal investigators (PIs). In FY 2021, NSF evaluated more than 43,000 proposals and funded 26 percent of them (a number that has ranged from 22 to 28 percent over the past 10 years) (NSB 2021; NSF 2021). Over 33,000 members of the scientific community participated in the review process as panelists and proposal reviewers and conducted over 211,000 proposal reviews (NSF 2021). Given the demands of the review process, NSF has long explored strategies for improving the efficiency of the funding process for its grants programs while maintaining its commitment to research excellence, quality, and fairness. One approach theorized for improving efficiency is eliminating deadlines for proposal submissions. This approach was piloted by a small program in 2012 and has organically spread to several programs and directorates since then.

This report explores the theory underlying the elimination of deadlines and investigates the potential benefits and drawbacks of the elimination of deadlines as an approach for NSF's funding programs. It draws from a review of NSF documents; a review of theoretical literature and empirical research on deadlines; interviews with NSF staff, NSF PIs and reviewers, and staff at other organizations; and a review of the websites of organizations that have adopted a no-deadlines approach to grant solicitations.

### Key findings indicate that:

- Programs across five NSF directorates and in at least 173 other organizations—including foundations, biotechnology and pharmaceutical companies, universities, and government—use a no-deadlines approach in proposal solicitation. Organizations implement no-deadlines approaches in various ways in terms of the frequency of application review and the timing of proposal decisions. Common challenges include structuring the review process, managing budgets, and managing the constant flow of information.
- Commonly cited motivators for using a no-deadlines approach at NSF and at other organizations include smoothing staff workload and decreasing proposal pressure, expediting decision making and funding, and increasing funding rates. The flexibility that not having deadlines provides to staff and PIs to submit, review, and fund is a driving force. By removing the pressure to submit under a deadline, programs sought to receive more fully-developed proposals that were easier to review and more likely to be funded.
- The most common outcome of no-deadlines approaches reported in NSF's tracking of related outcomes is a reduction in proposal volume. The reduction did not appear to be concentrated among specific types of institutions or investigators, but NSF staff voiced interest in further examining outcomes related to the diversity of the portfolio.
- The theoretical literature suggests that deadlines may produce benefits for task prioritization and task completion. However, predictions about the quality of work produced are not straightforward. On one hand, people are more likely to focus on tasks with deadlines, focus more on the concrete details of the task at hand, and work harder to complete it. Groups may find it easier to coordinate their activities when constrained by a shared external deadline. On the other hand, stress associated with deadlines can undermine performance on complex tasks.

- The empirical literature on no-deadlines approaches to grant solicitations is limited. Existing studies address NSF’s implementation of no-deadlines approaches and compare outcomes before and after adopting such approaches.
- Studies of how deadlines impact task volume in other contexts such as work, school, and home, generally report results that are consistent with the decrease in proposal submissions observed by NSF. Several rigorous studies demonstrated that task completion was lower in the absence of deadlines, but for tasks that are much simpler than writing a grant proposal.
- There are fewer studies of how deadlines impact task quality, and they produce mixed or weak evidence that deadlines impact quality. The studies we identified mostly used correlational designs with obvious potential confounds.

## 1. Introduction

NSF achieves its mission of advancing the progress of science by funding research and education in most fields of science and engineering. It is a major source of funding for academic research in the United States and is the second largest source of federal funding for basic research after the Department of Health and Human Services (CRS 2021). In FY 2021, NSF received \$9.1 billion in discretionary appropriations, made awards to 1,900 colleges, universities, and other institutions, and directly supported an estimated 318,000 people (NSF 2021). To identify meritorious projects for funding that have the potential to advance knowledge and benefit society, the vast majority of proposals submitted to NSF undergo a rigorous review process. In FY 2021, NSF evaluated more than 43,000 proposals (NSF 2021).

NSF's merit review process places a large burden on reviewers, NSF staff members, and principal investigators (PIs). After a proposal is received, it is assigned to a program for review where it first undergoes an initial assessment for compliance with NSF requirements.<sup>1</sup> For the vast majority of the remaining proposals, program directors (PDs) are responsible for organizing external peer review, including determining the method for review, selecting subject matter experts to conduct reviews, synthesizing reviewer comments, and recommending an action.<sup>2</sup> The peer review process is typically conducted through either an "ad-hoc only" review method, a "panel-only" review method, or a combination of ad-hoc review and panel review.<sup>3</sup> For ad-hoc reviews, selected reviewers are sent links to proposals and asked to submit reviews electronically; for panels, reviewers convene to discuss their reviews and advise the PD as a group; when ad-hoc reviews and panels are used, they can happen in either order. In FY 2020, approximately 30,122 members of the scientific community participated in the peer review process, and on average, reviewers provided 4 reviews per proposal (NSB 2021).

After external reviews are completed, PDs must consider several factors including reviewer comments and portfolio balance to make final recommendations. Those recommendations are then sent to division directors who make the final decision on whether a proposal will be funded. On average, between FY 2017 and FY 2021, about 26 percent of proposals were funded (NSF 2021). For programs with yearly or twice-a-year deadlines, large spikes in proposal submissions before a deadline mean a surge in effort by NSF staff and reviewers to complete the merit review process and provide PIs with timely funding decisions.

Given the demands of its merit review process, NSF has long explored strategies to increase the efficiency of its funding process while maintaining its commitment to research excellence and the diversity of its research portfolio. One approach theorized to increase the efficiency of the merit review process is the elimination of proposal submission deadlines. Under a no-deadlines approach, NSF programs accept proposals anytime rather than tying submissions to fixed due dates. This approach was piloted by the Instrumentation and Facilities (IF) program within the Division of Earth Sciences (EAR) in the Directorate for Geosciences (GEO) in 2012 and achieved a decrease in the number of submitted proposals. The expansion of the no-deadlines approach to four more programs in EAR demonstrated similar declines in proposal numbers and those proposals were submitted more evenly throughout the

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<sup>1</sup> In FY 2020, 1.8% of proposals were returned without review (NSB 2021).

<sup>2</sup> A small number of proposals can be exempted from external review. In FY 2020, 6 percent of proposals were internally reviewed (NSB 2021).

<sup>3</sup> NSF PDs may also choose to use site visits as a review method, and these are commonly used to review proposals requesting funding for facilities or centers (NSB 2021).

year, suggesting that the approach might reduce and smooth the burden on those involved in the merit review process (Patino and Garcia 2020).

The approach expanded organically over the following decade to additional programs within GEO and then to programs in several other directorates. Programs and directorates varied in their motivations and goals for implementing the no-deadlines approach, including reducing NSF staff and reviewer workload, increasing funding rates, distributing workload throughout the year, providing greater flexibility to PIs to think creatively, build interdisciplinary teams, and submit better proposals, and increasing communication between PIs and NSF PDs (Patino and Garcia 2020; Yuan et al. 2020; Lane 2021). After programs adopted the approach, they conducted retrospective analyses to investigate how key metrics had changed following the adoption and shared these within the agency.

To understand more fully the potential impact of a no-deadlines approach on the scientific community and on NSF staff, NSF commissioned a preliminary study both to explore the theory underlying the elimination of deadlines and to investigate the potential benefits and drawbacks of the elimination of deadlines as an approach in its funding programs. Specifically, we conduct a systematic review of the literature across relevant disciplines to answer the following research questions:

1. What motivates the use of a deadline-free approach to grant solicitations (or similar situations)?
2. What theories or hypotheses undergird the removal, or adoption of no deadlines in different contexts, particularly with regards to grant solicitations?
3. How are these deadline-free or no deadlines approaches implemented? By which types of organizations and in what situations?
4. What methodologies have been used to study no deadline approaches? What has been the focus of these studies—outcomes, impacts, implementation benefits, and so on? How rigorous have these approaches been, quantitatively and qualitatively?
5. What outcomes are associated with no deadlines? What are the impacts of no deadlines?

Exhibit 1 summarizes our data sources and analytic approach for answering each research question. The data sources we use include the following:

- Literature on no-deadlines approaches and the effects of deadlines in the context of grant solicitations and other related areas
- NSF documentation related to no-deadlines approaches
- Interviews with NSF staff and other relevant individuals<sup>4</sup>
- Web pages of organizations using no-deadlines approaches

The literature scan requires identifying, screening, and reviewing theoretical and empirical findings of the no-deadlines approach and the effects of deadlines from relevant, high-quality sources. Reviewing NSF documentation and internal analyses provides an understanding of the outcomes of interest and recent findings. Conducting a small set of interviews allow us to develop a nuanced understanding of the implementation of the no-deadlines approach across NSF and in other organizations, particularly with respect to differences in motivation, approach, and outcomes between and among directorates and

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<sup>4</sup> We obtained approval to conduct the interviews under NSF's "Generic Clearance for the Collection of Qualitative Feedback on Agency Service Delivery" (OMB control number 3145-0215).

programs. Examining organizations beyond NSF allows us to understand how and in which situations no-deadlines approaches are implemented.

### Exhibit 1. Research questions, data sources, and analytic approaches

| Research question  | Data sources  | Analytic approach <sup>a</sup>  |
|--|---|---|
| 1. What motivates the use of a deadline-free approach to grant solicitations (or similar situations)?  | <ul style="list-style-type: none"> <li>• Interviews</li> <li>• NSF documents</li> </ul>                       | <ul style="list-style-type: none"> <li>• Review and summarize findings</li> </ul>   |
| 2. What theories or hypotheses undergird the removal, or adoption of no deadlines in different contexts, particularly with regards to grant solicitations?   | <ul style="list-style-type: none"> <li>• Interviews</li> <li>• Literature</li> <li>• NSF documents</li> </ul> | <ul style="list-style-type: none"> <li>• Review and summarize findings</li> <li>• Propose logic model</li> </ul>  |
| 3. How are these deadline-free or no deadlines approaches implemented? By which types of organizations and in what situations?   | <ul style="list-style-type: none"> <li>• Interviews</li> <li>• NSF documents</li> <li>• Web pages</li> </ul>  | <ul style="list-style-type: none"> <li>• Review and summarize findings</li> <li>• Summarize and categorize information on implementation, including challenges and solutions</li> </ul> |
| 4. What methodologies have been used to study no deadline approaches? What has been the focus of these studies—outcomes, impacts, implementation benefits, and so on? How rigorous have these approaches been, quantitatively and qualitatively? | <ul style="list-style-type: none"> <li>• Literature</li> <li>• NSF documents</li> </ul>                       | <ul style="list-style-type: none"> <li>• Review studies using standardized template</li> <li>• Conduct quantitative and qualitative descriptive analyses</li> </ul>                     |
| 5. What outcomes are associated with no deadlines? What are the impacts of no deadlines?   | <ul style="list-style-type: none"> <li>• Literature</li> <li>• NSF documents</li> </ul>                       | <ul style="list-style-type: none"> <li>• Review studies using standardized template</li> <li>• Conduct quantitative and qualitative descriptive analyses</li> </ul>                     |

Note: This exhibit lists each research question and the data sources and analytical approaches that will be used to answer each.

<sup>a</sup>NSF's (2020) Evaluation Policy (Section A1 in Appendix A) also guided our analytic approach.

The remainder of this report is organized as follows. Below, we describe each of these data sources and analytical approaches further followed by the main limitations of our approach. Afterwards, we document the implementation of no-deadlines approaches at NSF and at other organizations. We then provide an examination of the literature and insights from interviews. Next, we discuss our views on the answer to each research question and the implications for an evaluation of no-deadlines approaches at NSF. Lastly, we provide further details in appendices. Specifically, Appendix A provides details on strategies used to adhere to NSF's Evaluation Policy; methodological details on how we conducted the interviews; and a list of organizations that have used a no-deadlines approach. Appendix B contains the proposed logic model for a no-deadlines approach at NSF. Appendix C documents the quality assurance procedures we used, and Appendix D provides a key to the acronyms that appear in this report.

## 2. Data and analytical approach

### Literature review

We conducted a review of literature, both theoretical and empirical, with a focus on both the core literature (publications directly related to the use of no-deadlines approaches in the context of grant solicitations) and adjacent literature (works that cover disciplines and contexts other than grant solicitations that could provide insights into the effects of deadlines).

We relied on the following sources: (1) NSF documents; (2) results of keyword searches in academic databases (Academic Search Premier and Scopus), conducted separately for core and adjacent literature; (3) results of Google Scholar searches (the primary source for grey literature), conducted separately for core and adjacent literature; (4) searches within a predefined set of high-impact journals; (5) articles identified as relevant by the study team's subject matter experts; and (6) custom Google searches of private sector website domains.

Across these sources, the core literature search identified 573 records representing 397 unique records, and the adjacent literature search identified 1,519 records representing 1,302 unique records. We removed duplicate records across the sources and screened the remaining records using four criteria: 1) it must be in English, 2) it must discuss deadlines or time pressure of a day or longer, 3) it must address the potential effects of deadlines or time pressure on people or organizations, and 4) it must analyze an outcome that is a decision, behavior, or material consequence for an individual or organization. Ultimately, 13 studies in the core literature and 82 studies in the adjacent literature were included in our review and summarized in this report.<sup>5</sup>

### NSF documentation

NSF provided us with 15 internal documents related to the motivation, implementation, and results of no-deadlines approaches consisting of Office of Integrative Activities (OIA) reports, directorate- or division-level presentations, and Merit Review Digests. The documents furthered our understanding of the implementation of no-deadlines approaches across several directorates and programs, particularly the timing of transitions and the key players involved in monitoring the outcomes. NSF documents presented the results of internal analyses of no-deadlines approaches, advancing our knowledge of the outcomes of interest.

We conducted a preliminary review of all NSF documents to deepen our understanding of the motivation and initial implementation of no-deadlines approaches and to develop familiarity with NSF terminology. We then conducted in-depth reviews of the 10 OIA reports or presentations and directorate- or division-level presentations in accordance with the literature review process described in section 6.<sup>6</sup>

### Interviews

Between November 7, 2021, and January 6, 2022, we conducted a total of 34 interviews with 37 respondents who are NSF staff, others involved in the NSF grant process, and staff at other

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<sup>5</sup> In section 6, we provide details on how the literature was identified, screened, classified, and reviewed.

<sup>6</sup> We did not review the 5 Merit Review Digests as part of the literature review because they did not focus on no-deadlines approaches.

organizations.<sup>7</sup> The aim of the interviews was to understand the motivation, theory, and implementation of no-deadlines approaches and to explore the expected and observed outcomes of these approaches. We interviewed three groups of respondents:

- NSF staff—including individuals working with programs that have and have not implemented a no-deadlines approach and individuals with different roles within the organization (n = 25)
- Staff at other organizations (government agencies and foundations) that have implemented a no-deadlines approach (n = 5)
- PIs who submitted grant proposals, all of whom also served as reviewers (n = 7)

We identified and selected NSF staff respondents across all directorates using the NSF online directory and individual recommendations from NSF staff. Through searches for other organizations using a no-deadlines approach (described next), we identified respondents from organizations similar to NSF and spoke with contacts who agreed to be interviewed. To identify NSF PIs, we asked PDs for recommendations and reached out to a sample balanced on demographic characteristics and scientific disciplines.<sup>8</sup> We reviewed, coded, and summarized notes from all interviews.

### Organizational websites

To understand how and in which situations no-deadlines approaches are implemented, we identified organizations outside NSF that use a no-deadlines approach and collected information from their websites. We conducted a search for organizations that use a no-deadlines approach in their grant programs and then compiled a list from the following sources:

1. A curated list of programs using a no-deadlines approach from the Icahn School of Medicine at Mount Sinai (2020) identified while searching Google for background materials during the project's proposal phase
2. An additional curated list from Boston University's School of Medicine (2021) identified through an ad hoc Google search
3. A review of the organizations and universities returned from searching the top 10 universities by NSF funding, the top 10 foundations by endowment size, and the top 10 universities by endowment size

In total, we identified 173 unique organizations and recorded each organization's type and program type from organizations' websites.<sup>9</sup> A subject matter expert on the study team then selected 20 organizations that are similar to NSF in that they focus on research and development (R&D) but vary by type (foundations, government, and industry). We then reviewed the organizations' websites and recorded information about use of the no-deadlines approach, including program names, review process, timing,

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<sup>7</sup> We obtained approval to conduct the interviews under NSF's "Generic Clearance for the Collection of Qualitative Feedback on Agency Service Delivery" (OMB control number 3145-0215).

<sup>8</sup> In section 7, we provide a summary of our approach to identifying respondents and the interview topics. Additional technical details are in Section A2 of Appendix A.

<sup>9</sup> We classified 10 of the organizations as government agencies: Argonne National Laboratory, Biomedical Advanced Research and Development Authority, Centers for Disease Control and Prevention, Defense Advanced Research Projects Agency, Department of Energy, Department of the Army, Federal Communications Commission, National Aeronautics and Space Administration, National Institutes of Health, and the U.S. Agency for International Development.

and decision-making process.<sup>10</sup> We provide a complete list of identified organizations and their websites in Section A3 of Appendix A.<sup>11</sup>

### 3. Limitations

Our approach to this study has several limitations. First, we purposefully selected samples of interviewees with important knowledge of the no-deadlines approach. As such, the respondents do not comprise representative samples, but they provided a diversity of perspectives and offered deep insights into particular topics. Notably, we interviewed NSF staff from all directorates and balanced, to the extent possible, PIs and reviewers across gender, location, type of university, and directorates; staff at other organizations came from various organization types. However, it is possible that our approach does not capture all perspectives.

Similarly, other organizations that we identified as using no-deadlines approaches do not constitute the universe of all organizations using no-deadlines approaches. We identified the other organizations from curated lists and conducted additional systematic searches, likely developing a good sense of the types of organizations and programs using no-deadlines approaches. However, it was not within scope to conduct an exhaustive search of all funding opportunities that do not rely on deadlines.<sup>12</sup>

Another limitation is that the interview respondent groups provide limited insight into how institutions and PIs responded to the no-deadlines approaches. For example, we did not interview administrative staff or grant-related support staff at colleges/universities and therefore cannot report on their perspectives on the intended and unintended effects of a no-deadlines approach (though we did ask PIs for their perspective on how no-deadlines approaches affect support staff). Other perspectives may also be missing, such as those of PIs with varying tenure status and degrees of experience in seeking NSF funds. In addition, interviewees from other organizations did not represent the types of organizations using no-deadlines approaches and only included interviews with government agencies and foundations.

We also found that detailed information on the implementation and outcomes of no-deadlines approaches at other organizations is not readily available online. We searched the websites of other organizations identified as using no-deadlines approaches and found that information about their review processes was targeted to those interested in submitting proposals. We did not find detailed contextual and implementation information such as the number of proposals received, average grant size or grant-making budget, percentage of proposals funded, or whether the organization has always used a no-deadlines approach (except in the case of NASA for which some of this information was available). We also did not find (or learn of through interviews) any studies conducted by the organizations themselves on the use of no-deadlines approaches.

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<sup>10</sup> We found a presentation that contained additional information on the no-deadlines approach used by NASA, including core principles, selection timing, innovations, advantages, and risks/concerns (Rinehart 2021).

<sup>11</sup> Because funding opportunities are continuously opening and closing, it is possible that some organizations may no longer offer the program for which they used a no-deadlines approach as listed in the original source; for example, several organizations offered expedited grants related to COVID-19 research and did not impose deadlines.

<sup>12</sup> Furthermore, the curated lists of funding opportunities were those available at a given time, and those organizations may or may not still offer funding opportunities without deadlines.



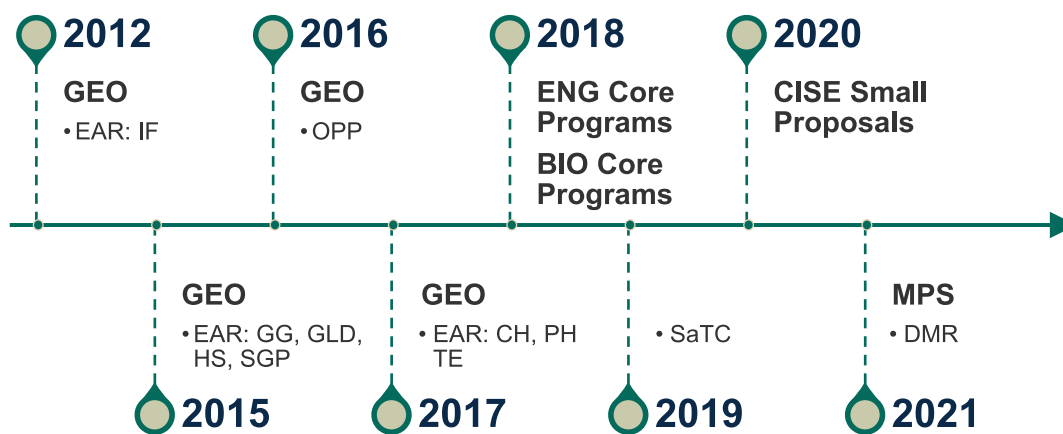
Further, the search for literature may have missed relevant articles. The adjacent literature search posed calibration challenges related to the many plain-language uses of terms that commonly describe research on deadlines (such as “time,” “grant,” and “deadline”). When a common set of specific terms or concepts does not unify a topic, the proportion of returned search records relevant to a study of that topic is low.

Another challenge in calibrating the search arose from researchers’ use of deadlines to operationalize phenomena (such as time pressure or scarcity) in order to study general processes (such as motivation and goal pursuit). With these phenomena described in abstract terms, reliance on deadline-related keyword searches can overlook relevant studies. To mitigate this limitation, we also included articles based on Google and Google Scholar searches that rely on an algorithm to identify and rank likely relevant results, a scan of high-impact journals containing expert literature reviews, and recommendations from subject matter experts.

#### 4. Implementation of a no-deadlines approach at NSF

Interest in implementing a no-deadlines approach has been developing and slowly spreading at NSF for the past 10 years (Exhibit 2).<sup>13</sup> Experimentation with the approach began in GEO, with other areas of the organization eventually adopting the approach. In 2012, NSF ran a series of pilot programs to test the efficacy of several policy changes aimed at addressing challenges such as “rising submission rates, increased reviewer workloads, and declining program success rates (the percentage of submitted proposals a program funds per year)” (Hare, Trucano, and Duque 2017). Among them was the no-deadlines approach which was piloted by the GEO/EAR/IF program and was associated with a steep decline in proposal volume (Hare et al. 2017). Other programs within GEO implemented the no-deadlines approach for their own funding solicitations between 2015 and 2017.

**Exhibit 2. Timeline of implementation of no-deadlines approaches at NSF**



Source: NSF documentation (Hare et al. 2017; Pankow 2020; Patino and Garcia 2020; Yuan et al. 2020; Miller 2020; Rissi et al. 2020; Ray and Virella 2020; Iacono and Rissi 2020; Tornow and Blevins 2021; Lane 2021).

<sup>13</sup> The Division of Atmospheric and Geospace Sciences within the GEO directorate is not included in Exhibit 2 because it had traditionally not used deadlines for its core programs so there was no equivalent adoption of the no-deadlines approach as there is for the other directorates in the exhibit.

## Exhibit 2 (continued)

Note: This exhibit shows the timing of adoption of no-deadlines approaches within NSF directorates, divisions, and programs. GEO = Geosciences; EAR = Division of Earth Sciences; IF = Instrumentation & Facilities; GG = Geobiology and Low-Temperature Geochemistry; GLD = Geomorphology and Land Use Dynamics; HS = Hydrologic Sciences; SGP = Sedimentary Geology and Paleobiology; OPP = Office of Polar Programs; CH = Petrology and Geochemistry; PH = Geophysics; TE = Tectonics; ENG = Engineering; BIO = Biological Sciences; SaTC = Secure and Trustworthy Cyberspace; CISE = Computer and Information Science and Engineering; MPS = Mathematical and Physical Sciences; DMR = Division of Materials Research.

No-deadlines approaches spread from GEO to Engineering (ENG) and Biological Sciences (BIO), both of which adopted the no-deadlines approach for their core programs in 2018 (Tornow and Blevins 2021). In both cases, ENG and BIO retained a deadlines-based approach for specific non-core funding opportunities, including training and education grants (such as the Faculty Early Career Development Program (CAREER)) and time-sensitive research topics.

In recent years, Computer and Information Science and Engineering (CISE) and Mathematical and Physical Sciences (MPS) have adopted a no-deadlines approach in more limited ways. CISE has adopted a no-deadlines approach only for “small” funding opportunities since 2020. MPS has adopted a no-deadlines approach only for a single division (Division of Materials Research) since 2021. This pilot-based tactic offered more opportunities for experimentation and internal comparison with programs that had not adopted a no-deadlines approach.

Interest in adopting a no-deadlines approach across NSF unfolded gradually and naturally. In formal presentations and in more informal “water cooler” conversations, PDs from divisions that had implemented the approach described their experiences to colleagues in other divisions and directorates. In some cases, directorate leaders encouraged the adoption of a no-deadlines approach by convening and participating in cross-directorate conversations.

As units implemented the approach, their staff also tracked changes in key metrics, and those analyses (discussed in detail in Section 6) were shared within and across divisions and directorates. The availability of this information, how it was interpreted, and its applicability to other divisions and directorates likely influenced each unit’s goals for and decision to use the no-deadlines approach.

Overall, there was not a single goal that unified each adoption of the no-deadlines approach. Various goals were cited in NSF documents including reducing workload by reducing the number of proposals, increasing funding rates, providing greater flexibility to PIs to think creatively and submit better proposals, reducing reviewer burden, distributing workload, and reducing pressure on PIs (Hare et al. 2017; Patino and Garcia 2020; Yuan et al. 2020; Lane 2021).

## 5. Implementation of a no-deadlines approach at other organizations

We investigated the use of no-deadlines approaches outside NSF and found wide variation in the types of organizations and programs that use such approaches and the means of implementation. Of the 173 organizations using no-deadlines approaches we identified, 75 are foundations, 34 are industry (particularly biotechnology or pharmaceutical companies), and 21 are universities (particularly medical centers). The remainder are professional societies, government agencies, and other types of organizations such as research institutes, health systems, consortiums, and cultural organizations (Exhibit 3). The

programs using no-deadlines approaches within these organizations generally focus on R&D, health care, and career development.

### Exhibit 3. Types of organizations with no-deadlines approaches



Source: List compiled through our organizational website searches.

Note: This exhibit shows the number of each organization type we identified as having used a no-deadlines approach. We list the organizations in Section A3 of Appendix A.

To understand the range of how no-deadlines approaches are implemented outside NSF, we conducted a website review of 20 organizations that focused on R&D and might be similar to NSF and that spanned multiple organization types. Of those organizations, 7 use no-deadlines approaches for all their programs, and the remainder use no-deadlines approaches for only some of their programs. None of the websites provided a rationale for using no-deadlines approaches with specific types of programs.

Most organizations' websites mention the involvement of internal review committees and/or external review committees as part of their review processes. Some organizations also rely on a board of directors, an executive director, or a program mentor to make final award decisions. Organizations review applications and provide proposal decisions in various ways that may depend on organization size, budget, and other resources. Although the organizations' websites do not list a deadline by which applications must be submitted, they may still disclose some logistics about how and when the review process takes place. For example, they may:

- Review applications two to three times annually
- Review applications monthly
- Review applications greater than \$250,000 quarterly
- Review applications greater than \$250,000 three times a year
- Review applications under \$250,000 on a rolling basis
- Review applications once a certain number is accumulated (for example, three to six)
- Provide decisions 60 days before the program start date
- Provide decisions within 26 weeks of submission

- Provide decisions within 7 to 10 days of submission
- Provide decisions in 150 days or fewer; maximum time is 225 days or fewer
- Provide decisions three to four weeks after initial conversation
- Award grant to first applicant who submits an application with compelling evidence
- Award grants until all current funds are committed

Information beyond the above was available only for NASA. NASA specified that there should be no real, implied, or inferred due dates and that reviews would be carried out on a rolling basis, using rolling evaluation panels and triage. Rolling evaluation panels include people who agree to review for a set time; reviewers may not submit a proposal to the program for four months after their service. Reviewers may join the rolling evaluation panel as soon as any proposal they may have submitted is no longer under consideration. NASA uses triage whereby a small number of proposals receives a summary of individual reviews but does not undergo a panel review (Rinehart 2021).

In addition to variation in the review process, no-deadlines approaches can vary with regard to which parts of the process do not involve deadlines. For example, one organization accepts letters of intent at any time but assigns deadlines for proposals in order to fit them into the cycle for board meetings and the review process. Another organization relies on a “quasi-deadline” that PIs must meet for proposals to be reviewed at a particular meeting, although it is a soft deadline that is usually determined largely by when a proposal needs funding.

## 6. Examining the literature on no-deadlines approaches

### Conducting the literature review

The literature review sought to identify research directly tied to the elimination (or use) of deadlines in grant programs as well as related theory and literature that might guide NSF’s use of no-deadlines approaches. We deemed literature that dealt directly with the use of no-deadlines approaches in the proposal submission process as core. We deemed literature from other contexts that might provide insights into the effects of deadlines as adjacent. Our examination proceeded by identifying, screening, classifying, and reviewing the evidence standards of the literature.

### Identifying literature

To identify literature for the study, we considered the following sources: literature that NSF provided; that resulted from database, Google Scholar, and Google searches; that resulted from searches within a set of high-impact journals; and that subject matter experts on the study team had identified.

NSF provided ten documents about the removal of deadlines from NSF programs. These included two written reports and the slide decks from two presentations prepared for or by OIA that provided an overview of the no-deadline approach (Hare et al. 2017; Iacono and Rissi 2020; Pankow 2020; Rissi, Pankow, and Lev 2020). NSF also provided six internal presentations from directorates or divisions in the process of implementing a no-deadlines approach, representing programs within GEO, BIO, ENG, MPS,

and SaTC (Tornow and Blevins 2021; Lane 2021; Miller 2020; Patino and Garcia 2020; Ray and Virella 2020; Yuan et al. 2020).<sup>14</sup>

We also conducted two sets of literature searches targeting the core and adjacent literatures. For both sets, the team conducted keyword searches in academic databases (Scopus and Academic Search Premier) and searches of gray literature through Google Scholar. The core literature search included keywords designed to identify studies of no-deadlines approaches in grant programs but placed no restrictions on publication date. The search strategy used to search the core literature is documented in Exhibit 4.

**Exhibit 4. Core literature: Databases searched, search terms, access dates, and number of results**

| Source                  | Date accessed | Search string  | Number of results |
|-------------------------|---------------|--|-------------------|
| Academic Search Premier | 11/10/2021    | ("grant deadline*" OR "no deadline*" OR "submission deadline*" OR "funding deadline*" OR "program deadline*" OR "soft deadline*" OR "hard deadline*") AND (grant* OR submission* OR award* OR funding OR solicitation* OR announcement*)                 | 334               |
| Scopus                  | 11/10/2021    | TITLE-ABS-KEY (("grant deadline*" OR "no deadline*" OR "submission deadline*" OR "funding deadline*" OR "program deadline*" OR "soft deadline*" OR "hard deadline*") AND (grant* OR submission* OR award* OR funding OR solicitation* OR announcement*)) | 144               |
| Google Scholar          | 11/30/2021    | (deadlines OR deadline OR "no deadline" OR "no deadlines") AND ((grant OR funding OR solicitation OR award OR announcement)  | 80                |
| <b>Total</b>            |               |  | <b>558</b>        |

Note: This exhibit shows the method and results of the core literature search including the databases searched, the search terms and access dates, and the number of results returned. The asterisk (\*) is a Boolean operator and allows the truncation of the term so that the search returns any word that begins with the specified letters. Our search returned records based on keywords appearing in titles, abstracts, subject headings, and author-supplied keywords. These searches did not impose a time constraint.

Unlike the database searches that returned records based on keywords appearing in titles, abstracts, subject headings, and author-supplied keywords, Google Scholar searches the full text of documents and returns many more records. It uses an algorithm that returns records ranked in order of their likely relevance. This approach returns many records, most of which are unlikely to be relevant. To determine which records to screen, we used a stopping rule whereby screeners read the descriptions provided by the search and included the page of results until they reached a page in which all records were clearly irrelevant.

The adjacent literature search removed keywords that constrained results to grantmaking activities. To help manage the volume of results, we restricted results to only those published during or after the year 2000 for the Academic Search Premier and Scopus searches. We did not restrict the Google Scholar search by date because restricting by date did not seem to have a meaningful effect on search volume after

<sup>14</sup> NSF also pointed us to Merit Review Digests representing fiscal years 2015 through 2019 (NSB 2016, 2017, 2019, 2020a, 2020b). The documents provided detailed descriptions of the merit review process as carried out during years in which some units used no-deadlines approaches. The documents included standardized reports of key outcome data reported for NSF overall and, in some cases, disaggregated by directorate. The outcomes included the number of proposals submitted to NSF, funding rates, award sizes, geographic distribution of awards, and PI demographic data. We ultimately excluded the Merit Review Digests because although they provided valuable contextual information, they added little to our understanding of no-deadlines approaches.

applying the stopping rule described earlier.<sup>15</sup> We further augmented this search with a scan of what might be available and relevant within the private sector through custom searches in Google focused on the websites of six major consulting firms. We did not restrict the private sector Google searches by date and used the same stopping rule as described earlier. The search in adjacent areas also involved broad keywords within a small set of high-impact journals that mostly focus on broad, integrative reviews of their respective fields. Finally, we included literature with which subject matter experts were familiar. The search strategy used to search the adjacent literature is documented in Exhibit 5.

**Exhibit 5. Adjacent literature: Databases searched, search terms, access dates, and number of results**

| Source                  | Date accessed | Search string  | Number of results |
|-------------------------|---------------|--|-------------------|
| Academic Search Premier | 11/10/2021    | ("time pressure" OR "time urgency" OR "externally imposed deadline" OR "deadline perception" OR "deadline oriented behavior" OR "fixed deadline" OR "deadline length" OR "cancellation deadline" OR "shorter deadline" OR "deadline pressure" OR "deadline effect" OR "deadline flexibility" OR "manipulated deadline" OR "explicit deadline") AND ("decision making" OR "consumer behavior" OR "capacity for thought" OR "risk choice" OR "self-selection" OR prioritization OR "now OR never effect" OR "deal seeking behavior" OR "behavioral insight" OR "prosocial behavior" OR "cooperative strategies" OR negotiation OR "organization behavior" OR procrastination OR "task completion" OR creativity OR "completion rate" OR innovation OR forgetfulness OR flexibility OR "task reinforcement" OR "task prompting" OR "nudge" OR productivity OR creativ*)   | 578               |
| Scopus                  | 11/10/2021    | TITLE-ABS-KEY(("time pressure" OR "time urgency" OR "externally imposed deadline" OR "deadline perception" OR "deadline oriented behavior" OR "fixed deadline" OR "deadline length" OR "cancellation deadline" OR "shorter deadline" OR "deadline pressure" OR "deadline effect" OR "deadline flexibility" OR "manipulated deadline" OR "explicit deadline") AND ("decision making" OR "consumer behavior" OR "capacity for thought" OR "risk choice" OR "self-selection" OR prioritization OR "now OR never effect" OR "deal seeking behavior" OR "behavioral insight" OR "prosocial behavior" OR "cooperative strategies" OR negotiation OR "organization behavior" OR procrastination OR "task completion" OR creativity OR "completion rate" OR innovation OR forgetfulness OR flexibility OR "task reinforcement" OR "task prompting" OR "nudge" OR productivity OR creativ*) AND (LIMIT-TO ( EXACTKEYWORD,"Human") OR LIMIT-TO ( EXACTKEYWORD,"Humans")) | 566 <sup>a</sup>  |
| Google Scholar          | 11/23/2021    | deadline AND "task completion" OR productivity OR collaboration OR creativity OR "decision making"   | 190               |
| Google Private Sector   | 12/1/2021     | deadline AND "task completion" OR productivity OR collaboration OR creativity OR "decision making" AND [domain]<br>Where [domain] = the website domain of the corresponding private sector consulting firm: <ul style="list-style-type: none"> <li>• Deloitte: <a href="https://www2.deloitte.com">https://www2.deloitte.com</a></li> <li>• Accenture: <a href="https://www.accenture.com">https://www.accenture.com</a></li> <li>• Price Waterhouse Cooper: <a href="https://www.pwc.com">https://www.pwc.com</a></li> <li>• McKinsey &amp; Company: <a href="https://www.mckinsey.com">https://www.mckinsey.com</a></li> <li>• Boston Consulting Group: <a href="https://www.bcg.com">https://www.bcg.com</a></li> <li>• Bain &amp; Company: <a href="https://www.bain.com">https://www.bain.com</a></li> </ul>  | 140               |

<sup>15</sup> Consequently, published results before 2000 are possible when identified via Google Scholar.

**Exhibit 5 (continued)**

| Source               | Date accessed | Search string  | Number of results |
|----------------------|---------------|--|-------------------|
| High-impact journals | 11/10/2021    | Search the websites of 15 pre-identified journals <sup>b</sup> to identify articles that contain the terms “deadlin*”, “schedul*”, or “time” in the abstract | 19                |
| <b>Total</b>         |               |  | <b>1,493</b>      |

Note: This exhibit shows the method and results of the adjacent literature search including the databases searched, the search terms and access dates, and the number of results returned. The asterisk (\*) is a Boolean operator and allows the truncation of the term so that the search returns any word that begins with the specified letters. The Academic Search Premier, Scopus, and high-impact journal searches are limited to research from 2000 onward. We did not impose a time constraint on Google searches.

<sup>a</sup> Scopus is a highly interdisciplinary database that includes a high volume of irrelevant findings related to processes in the physical world and computer science. We restricted our search to articles indexed by authors or publishers as pertaining to humans.

<sup>b</sup> Publications searched in the following journals: *Annual Review of Psychology*, *Annual Review of Organizational Psychology and Organizational Behavior*, *Educational Psychology Review*, *Trends in Cognitive Sciences*, *Psychological Science in the Public Interest*, *Personality and Social Psychology Review*, *Academy of Management Annals*, *Academy of Management Review*, *Journal of Public Administration Research and Theory or Public Management Review*, *Annual Review of Anthropology*, *Review of Educational Research*, *Human Relations*, *Social Issues and Policy Review*, *American Sociological Review*, *Annual Review of Organizational Psychology and Organizational Behavior*.

**Screening literature**

In screening the literature, we eliminated duplicative search results and reviewed abstracts (or full text when needed) to screen records for possible inclusion in the literature review. For records with more than one primary data collection, we treated each data collection as a separate study.<sup>16</sup> All other records were treated as a single study. We excluded any study that did not meet the following four criteria:

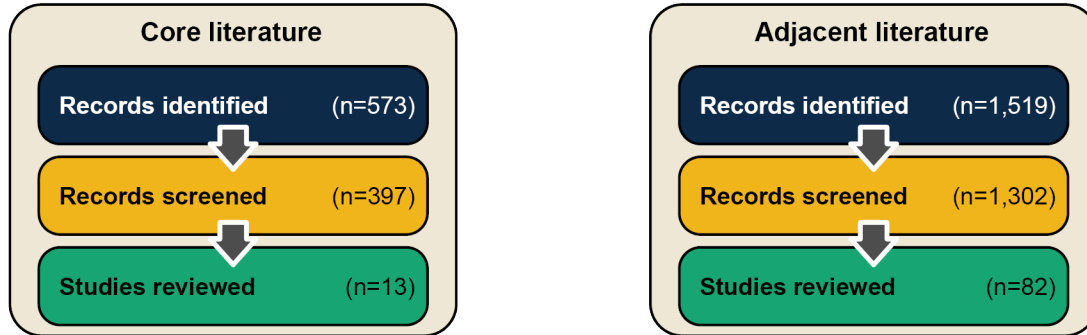
- The study must be available in English.
- Deadlines or time pressure discussed in the articles must be measured in days, weeks, or months. We excluded studies that only measured the effect of extremely short deadlines (less than a day).
- The study must address the potential effects of deadlines (or phenomena or processes operationalized through deadlines such as time pressure) on people or organizations.
- The study must analyze an outcome that is a decision, behavior, or material consequence for an individual or organization. We included studies that operationalized these outcomes through self-report but excluded studies that only measured how deadlines impacted people’s mental or physiological states (such as affect or emotions) through self-report. Examples of such outcomes include whether the participant liked the task and the extent to which they felt hurried.

During the screening process, screeners confirmed whether a publication should be classified as core or adjacent literature. The screeners recategorized two articles: one from the core database search was reclassified as adjacent, and one from the adjacent database search was reclassified as core. Trained reviewers screened the articles, and a senior team member checked all screening decisions (items screened in and out). The number of studies identified, screened, and reviewed for the core and adjacent

<sup>16</sup> Because the studies are presented within the same publication, we distinguish them by referring to the study number that appears in the manuscript.

literature is in Exhibit 6. Ultimately, a total of 13 studies were reviewed for the core literature, and a total of 82 studies were reviewed for the adjacent literature.

**Exhibit 6. Number of records identified and screened for the core literature and adjacent literature**



Note: This exhibit shows the number of core and adjacent records identified and screened into the study, and the number of studies reviewed. For the adjacent literature, we identified 1,493 documents through searches and an additional 26 through subject matter expertise, for a total of 1,519 records. The number of records screened is a de-duplicated count.

### Classifying literature

In classifying the literature, studies screened in for review were classified into one of three categories according to the type of research it contained:

- Studies that review existing literature and describe concepts and theories but that do not report original data are classified as theory/literature review.<sup>17</sup>
- Studies that report primary data and examine relationships between variables, including causal and correlational studies, are classified as inferential.
- Studies that present quantitative and/or qualitative descriptive statistics such as patterns or trends but neither make causal claims nor attempt to describe a correlation or impact, are classified as descriptive.

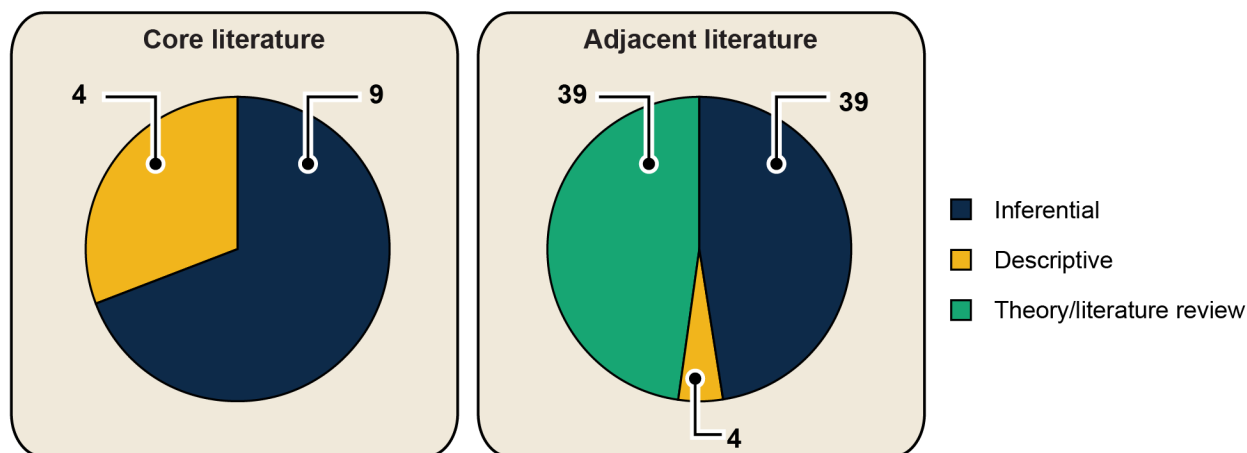
Exhibit 7 provides the number of studies in each category for the core and adjacent literature. Of the 13 reviewed studies within the core literature, 9 studies were inferential and 4 were descriptive. Of the 82 reviewed studies within the adjacent literature, 39 were inferential, 4 were descriptive, and 39 were either theoretical or literature reviews.

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<sup>17</sup> We explored classifying theory and literature reviews separately, but in the articles we reviewed, these distinctions are quite arbitrary. Most theory papers seek to explain findings observed in the existing literature, and most literature reviews are organized around evidence for particular theories.



## Exhibit 7. Classification of studies in core literature and adjacent literature



Note: This exhibit shows the classification of studies included in the core and adjacent reviews. Inferential studies examine associations between variables. Descriptive studies provide counts, trends, or other estimates but do not describe correlations or impacts. Theory/literature review papers synthesize existing bodies of work but do not report original data.

### Reviewing studies

In reviewing studies, we used a standardized template for collecting information. We recorded features of the intervention (such as a description of the intervention and when it occurred), study design (such as research questions, study design, contrast, data, outcomes, sample, and methods), findings, limitations of the study, and considerations for interpreting study results. As with screening, multiple trained team members conducted the reviews that a senior team member then checked.

### Evidence standards

We assessed the strength of causal evidence for studies classified as inferential by using CLEAR standards 2.1 (U.S. Department of Labor 2019) and the design-specific tabs of the study review guide template (U.S. Department of Labor 2021). The standards provide criteria by type of research design that must be satisfied to achieve one of three ratings: high, moderate, or low. For simplicity, we collapsed the moderate and low ratings into a single “low-quality” category. Research with a high rating means that the estimated impacts of the intervention can confidently be attributed solely to the intervention. Randomized controlled trials (RCTs) and interrupted time series (ITS) are the only two research designs that can receive a high rating, providing that the results were not attributable to other confounding factors. Each outcome received its own rating; as a result, ratings could vary within a study.

### Review and findings from the core literature on grants

We identified 13 studies within the core literature. Twelve of the thirteen reviewed studies were about NSF grant applications. Ten of those studies were provided to us by NSF and contained analyses of key metrics following the implementation of a no-deadlines approach (Hare et al. 2017; Pankow 2020; Patino and Garcia 2020; Yuan et al. 2020; Miller 2020; Rissi et al. 2020; Ray and Virella 2020; Iacono and Rissi 2020; Tornow and Blevins 2021; Lane 2021); one was a news item that reported on NSF’s reduction in proposal volume following the implementation of a no-deadlines approach (Hand 2016); and one was written by an NSF program director who proposed a model of grant submissions as a function of time

using NSF administrative data (Durakiewicz 2016). The only study that was not related to NSF was about applicant perceptions of grant deadlines for programs funded by the National Health and Medical Research Council (NHMRC) of Australia (Herbert et al. 2014).

We classified 9 of the 13 studies as inferential. These 9 inferential studies (all of which were NSF reports and presentations) and their designs are listed in Exhibit 8. We classified the remaining 4 studies (Durakiewicz 2016; Hand 2016; Herbert et al. 2014; Lane 2021) as descriptive.<sup>18</sup>

Each of the 9 inferential studies used ITS designs (which includes pre/post designs for the purpose of assessing the strength of causal evidence) to examine the potential effect of removing grant deadlines. They varied in the number of programs they examined, the number of years of data before and after implementation of the no-deadlines approach, and how the data were aggregated across years. Seven of the studies (Hare et al. 2017; Pankow 2020; Patino and Garcia 2020; Yuan et al. 2020; Miller 2020; Ray and Virella 2020; Tornow and Blevins 2021) included times series data for more than two years with at least one data point before and one data point after the implementation of a no-deadlines approach, and two studies used only a pre/post design that showed data from two years (Rissi et al. 2020; Iacono and Rissi 2020). Of the seven studies that showed more than two years of data, three of them (Patino and Garcia 2020; Yuan et al. 2020; Tornow and Blevins 2021) also contained analyses that calculated averages for sets of years before and after the implementation of a no-deadlines approach (for example, comparing the average of FY15-18 to FY19 as in Yuan et al. 2020). None of the studies used regression analyses to model outcomes or statistically control for other observable characteristics.

We assigned all of these studies a low rating for the strength of causal evidence. One study (Hare et al. 2017) used an ITS with nonequivalent comparison groups but did not demonstrate parallel trends before the implementation of the no-deadlines approach nor include statistical controls. As such, and in line with the authors' stated limitations, we assigned this study a low rating for the strength of causal evidence because the changes in outcomes could not be confidently attributed to the no-deadlines approach (for example, they could have been due to differences between divisions or programs). Of the 8 studies that used an ITS design without a comparison group, none specified three or more independent demonstrations of the intervention implemented at three time points and three or more observations of the outcomes of interest before and after the intervention which is necessary to achieve a high rating for an ITS design (U.S. Department of Labor 2019). Consequently, we assigned these studies a low rating for the strength of causal evidence because the observed changes in outcomes could not be confidently attributed to the no-deadlines approach.

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<sup>18</sup> We classified Lane (2021) as descriptive because it presented trends in proposal submissions in the period after implementation of the no-deadlines approach without a comparison to trends before implementation nor to another program.

### Exhibit 8. Methodological design of the 9 inferential studies in the core literature

| Study                     | Directorate reporting | Programs studied                  | No-deadlines implementation year | Study design                             | Supplemental data           |
|---------------------------|-----------------------|-----------------------------------|----------------------------------|--|-----------------------------|
| Hare et al. (2017)        | OIA                   | GEO: IF                           | 2012                             | ITS with nonequivalent comparison groups | Survey of PIs and reviewers |
| Pankow (2020)             | OIA                   | GEO: GG, GLD, HS, SGP             | 2015                             | ITS                                      |                             |
| Patino and Garcia (2020)  | GEO                   | GEO: GG, GLD, HS, SGP, CH, PH, TE | 2015 and 2017                    | ITS                                      |                             |
| Yuan et al. (2020)        | ENG                   | ENG: CBET, CMMI, ECCS, EEC        | 2018                             | ITS                                      |                             |
| Miller (2020)             | BIO                   | BIO: All core programs            | 2018                             | ITS                                      |                             |
| Rissi et al. (2020)       | OIA                   | BIO, ENG, and GEO                 | 2015–2018                        | ITS (pre/post only)                      | Survey of PIs and reviewers |
| Ray and Virella (2020)    | CISE                  | SaTC                              | 2020                             | ITS                                      | Survey of SaTC team members |
| Iacono and Rissi (2020)   | OIA                   | All directorates                  | 2015–2019                        | ITS (pre/post only)                      | Survey of PIs and reviewers |
| Tornow and Blevins (2021) | BIO and ENG           | BIO and ENG: All core programs    | 2018                             | ITS                                      |                             |

Note: This exhibit summarizes the study designs used for the ten studies of removing grant deadlines provided to us by NSF. OIA = Office of Integrative Activities; GEO = Geosciences; ENG = Engineering; BIO = Biological Sciences; CISE = Computer and Information Science and Engineering; IF = Instrumentation & Facilities; GG = Geobiology and Low-Temperature Geochemistry; GLD = Geomorphology and Land Use Dynamics; HS = Hydrologic Sciences; SGP = Sedimentary Geology and Paleobiology; CH = Petrology and Geochemistry; PH = Geophysics; TE = Tectonics; CBET = Chemical, Bioengineering, Environmental and Transport Systems; CMMI = Civil, Mechanical, and Manufacturing Innovation; ECCS = Electrical, Communications and Cyber Systems; EEC = Engineering Education and Centers; SaTC = Secure and Trustworthy Cyberspace; EPMD = Electronics, Photonics, and Magnetic Devices; ITS = interrupted time series.

The 9 inferential studies in Exhibit 8 examined a set of outcomes of interest related to proposal submissions, proposal quality, the merit review process, and diversity and representation among PIs and institutions. None of the studies applied tests of statistical significance to their findings; therefore, we report only on the directionality of the findings in Exhibit 9.

### Exhibit 9. Outcomes measured in the 9 inferential studies in the core literature

| Outcome category                     | Outcome   | GEO | BIO | ENG | SaTC |
|--------------------------------------|---|-----|-----|-----|------|
| Proposal submissions                 | Distribution of proposal submission                             | ⊖   | ⊖   |     | ⊖    |
|                                      | Number of proposals submitted                                   | ⊖   | ⊖   | ⊖   | ⊖    |
|                                      | Number of proposals withdrawn                                   | +   |     |     |      |
|                                      | Number of proposals returned without review                     | ⊖   |     |     |      |
|                                      | Number of resubmissions   | ⊖   |     |     |      |
|                                      | Funding rate  | +   | +   | +   | +    |
| Proposal quality                     | Average review score  | +   |     |     | +    |
|                                      | Proportion of proposals in highest category of quality analyzed |     | ⊖   | +   | +    |
|                                      | Proportion of proposals in lowest category of quality analyzed  |     | +   | ⊖   | +    |
| Merit review process                 | Dwell time  | ⊖   | ⊖   | ⊖   | ⊖    |
|                                      | Award size  | ⊖   | +   |     |      |
|                                      | Reviewer workload   | ⊖   | ⊖   |     | ⊖    |
| Primary investigator characteristics | PI gender   | ⊘   | ⊘   | ⊘   |      |
|                                      | PI race and ethnicity   | ⊘   | ⊘   |     |      |
|                                      | PI career stage   |     | ⊘   | ⊘   |      |
|                                      | PI institution type   | ⊘   | ⊘   |     |      |
|                                      | Number of unique PI institutions                                |     | ⊖   | ⊖   |      |

Source. Hare et al. 2017; Pankow 2020; Patino and Garcia 2020; Yuan et al. 2020; Miller 2020; Rissi et al. 2020; Ray and Virella 2020; Iacono and Rissi 2020; Tornow and Blevins 2021.

Note. This exhibit summarizes outcomes measured in NSF studies of the effect of removing grant deadlines. The results of studies are reported, aggregated by directorate, except for SaTC, which is a cross-directorate program. There were no cases in which divisions within a directorate or programs within a directorate reported different directionality for a given outcome. Outcomes are reported if at least one division or program within a directorate reported on a particular outcome; it does not mean that all divisions or programs within that directorate reported on the outcome. Blank cells indicate that the outcome was not reported in NSF documents; + indicates an increase in magnitude after no-deadlines implementation; ⊖ indicates a decrease in magnitude; ⊖ indicates that the directorates reported the monthly or quarterly rate of proposal submission was distributed roughly evenly across the calendar year; and ⊘ indicates no change. There were no cases in which divisions within a directorate or programs within a directorate reported different directionality for a given outcome.

Below, we discuss the findings of the 9 inferential studies and 4 descriptive studies. We begin by discussing findings related to when applicants make progress on their proposals and ultimately submit them. Next, we discuss findings related to proposal completion and proposal quality. Finally, we discuss other outcome changes from a no-deadlines approach, such as those related to the merit review process and PIs characteristics.

## Findings on proposal progress and timing of submissions

Durakiewicz (2016) used NSF data and found that submission rates could be accurately modeled by assuming that effort to complete proposals increases hyperbolically as the deadline approaches. This finding suggests that the time remaining to complete a task plays a critical role in PIs making progress toward completing their proposals.

Herbert et al. (2014) surveyed 215 researchers who submitted funding proposals to the NHMRC of Australia in the previous year. The NHMRC relies on a single annual deadline for all grant submissions (March) that requires that faculty complete grant applications by early February during the Australian summer holidays. Despite the predictability of the application deadline and a full academic year in which to prepare application materials, most researchers agreed that work on their grant proposals always eclipsed personal commitments (87 percent) and that they restricted their holidays during the grant-writing season (88 percent). This research suggests that applicants tend to delay making progress on applications until just before the deadline, even if this produces undesirable outcomes.

Three studies that focused on GEO, BIO, and SaTC reported that after the implementation of a no-deadlines approach, PIs submitted their proposals more evenly throughout the year compared to the spikes they saw previously, though there were still small spikes around August in GEO and SaTC and in mid-December for BIO (Patino and Garcia 2020; Ray and Virella 2020; Tornow and Blevins 2021). Using only data from after implementation of the no-deadlines approach, Lane (2021) observed spikes in counts of weekly proposal submissions for MPS/DMR/Topic Materials Research Programs (TMRP) in early November and mid-December and a drop in submissions between mid-January to mid-February. These findings suggest that without a deadline, PIs are working on proposals throughout the year, though there may be some seasonality for some programs.

## Findings on proposal completion

The most consistently documented finding in the core literature is that the volume of proposals declines when deadlines are removed. The magnitude of the change varied from a 35 percent decrease<sup>19</sup> in the number of proposals, as observed in the SaTC program (for transition to practice proposals) (Ray and Virella 2020), to a 63 percent decrease<sup>20</sup>, as observed in the GEO/EAR/Hydrologic Sciences (HS) program (Pankow 2020). Decreased submission rates persist for at least nine years after the implementation of a no-deadlines approach (Patino and Garcia 2020). These findings were echoed in a brief news item published in *Science*, which reported on the immediate and dramatic decrease in the number of proposals received after removing deadlines (Hand 2016).

Pankow (2020) also looked at the number of proposals that were withdrawn, the number of proposals returned without review (those that were not compliant), and the number of resubmissions by the same PI within a 2-year time frame. The author found that the number of proposals withdrawn increased substantially following the implementation of a no-deadlines approach, and the number of proposals returned without review fell substantially. There was also a decrease in the number of resubmissions.

Funding rate is another outcome examined in the core literature that is directly related to proposal volume. Funding rates consistently increased with the implementation of a no-deadlines approach which is expected if there is decreased proposal volume but a program's budget—and thus the number of

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<sup>19</sup> Transition to practice proposals dropped from 31 in FY18 to 20 in FY20 (Ray and Virella 2020).

<sup>20</sup> From a bar graph, we estimate that proposal submissions went from an average of 240 in FY13 and FY14 to an average of 87.5 in FY16 and FY17 (Pankow 2020).

proposals the program can fund—has remained constant. The magnitude of the change in funding rate varied from a 1 percentage-point increase in BIO/Biological Infrastructure (DBI)<sup>21</sup> (Miller 2020) to a 17 percentage-point increase in GEO/EAR and BIO/Molecular and Cellular Biosciences (MCB)<sup>22</sup> (Patino and Garcia 2020; Miller 2020).

### Findings on proposal quality

Several studies assessed changes in proposal quality that may result from implementation of a no-deadlines approach and many different measures were used. Hare et al. (2017) examined average review scores on a 1 to 5 scale<sup>23</sup>, and Miller (2020) examined the proportion of proposals in 4 categories of average review scores.<sup>24</sup> Ray and Virella (2020) used a “RoboRA scoring method” on a scale of 1 to 9.<sup>25</sup> The authors examined the average reviewer scores on this scale as well as in 5 collapsed categories of scores.<sup>26</sup> Lastly, Yuan et al. (2020) defined 3 categories based on the maximum and average review scores<sup>27</sup> and examined the percentage of proposals in each.

Observed changes in proposal quality following the implementation of a no-deadlines approach were inconsistent. Two programs reported small increases (9 percent in GEO/EAR/IF and 2 percent in SaTC) in the average score proposals received from reviewers (Hare et al. 2017; Ray and Virella 2020). In ENG, there was a 2-percentage point increase in the proportion of proposals rated “Exceptional”<sup>28</sup> and a 5-percentage point decrease in the proportion of proposals rated “Underperformed”<sup>29</sup> (Yuan et al. 2020). However, BIO reported about a 7-percentage point decrease over 2 years<sup>30</sup> in the proportion of proposals rated “Very good to excellent” (Miller 2020), and SaTC reported an 8-percentage point increase over 2 years<sup>31</sup> in the proportion of proposals rated “Fair/poor” or “Poor” (Ray and Virella 2020). Ray and Virella (2020) also reported a 2-percentage point increase in the proportion of proposals with panel ratings of “highly competitive” and a 4-percentage point increase in the proportion of proposals with panel ratings of “competitive”.

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<sup>21</sup> From a bar graph, we estimate the change in funding rate for DBI to have gone from about 26.5 percent in FY18 to 27.4% in FY 20 (Miller 2020).

<sup>22</sup> From a bar graph, we estimate the change in funding rate for MCB to have gone from about 16 percent in FY18 to 33.1% in FY20 (Miller 2020).

<sup>23</sup> As noted by Hare et al. (2017), proposal quality is subjective and should be interpreted with care.

<sup>24</sup> The four categories included: “Poor to fair” which is a score between 1 and 2, “Fair to Good” which is a score between 2 and 3, “Good to very good” which is a score between 3 and 4, and “Very good to excellent” which is a score between 4 and 5 (Miller 2020).

<sup>25</sup> The scale corresponds to the categories “fair”, “fair/poor”, “fair”, “good/fair”, “good”, “very good/good”, “very good”, “excellent/very good”, and “excellent” (Ray and Virella 2020).

<sup>26</sup> The five categories included: “Excellent” or “Excellent/very good”, “Very good” or “Very good/good”, “Good”, “Good/fair” or “Fair”, and “Fair/poor” or “Fair” (Ray and Virella 2020).

<sup>27</sup> The three categories included: “Exceptional”, “Fair”, and “Underperformed”. “Exceptional” proposals are ones with a maximum review score greater than or equal to 4 and an average review score greater than or equal to 4. “Underperformed” proposals are ones with a maximum review score less than 3 and an average review score less than 3. “Fair” proposals are ones that are not in the other two categories.

<sup>28</sup> The percentage of proposals rated “Exceptional” was 13 percent in FY15-18 and 15 percent in FY19 (Yuan et al. 2020).

<sup>29</sup> The percentage of proposals rated “Underperformed” was 35 percent in FY15-18 and 30 percent in FY19 (Yuan et al. 2020).

<sup>30</sup> From a bar graph, we estimated the percentage of proposals rated “Very good to excellent” went from about 29 percent in FY18 to 21.9 percent in FY20 and was about 25 percent in FY19 (Miller 2020).

<sup>31</sup> The percentage of proposals rated “Fair/poor” or “Poor” went from 6.1 percent in FY18 to 14.1 percent in FY20, and was 4.3 percent in FY19 (Ray and Virella 2020).

### **Findings on dwell time**

Several studies explored other outcomes of removing grant deadlines. The most common of these was the downstream impact of removing deadlines on dwell time. All studies that examined dwell time reported a downward trend. The magnitude ranged from a 2 percent decrease in GEO/EAR/IF (Hare et al. 2017) to a 24 percent decrease in SaTC (Ray and Virella 2020). It should be noted that the GEO/EAR/IF program is small (167 proposals annually before no-deadlines implementation) and was the first pilot program in 2012, while SaTC received over 800 proposals annually before the 2019 implementation of the no-deadlines approach. Because dwell time is related to efficiency at scale, it is appropriate to consider the initial sizes of these programs. In addition, to the extent that NSF staff have benefitted from the practice and knowledge others developed during previous implementations, later adopters of the no-deadlines approach, such as SaTC, may operate more efficiently.

### **Findings on award size**

Two studies looked at how award size changed with the implementation of the no-deadlines approach. Pankow (2020) showed an initial drop in award size to below \$300,000 for 4 GEO programs that returns to levels observed prior to the no-deadlines approach that were around \$350,000. Miller (2020) reports an increase in the median award amount in BIO from \$500,000 in FY18 to \$600,000 in FY20.

### **Findings on reviewer workload**

Another outcome examined was reviewer workload which decreased in both GEO and BIO. Hare et al. (2017) observed that the average number of proposals per unique reviewer went from an annual average of 0.29 in the 3 years before the no-deadlines approach was implemented in GEO/EAR/IF to 0.21 in the 3 years afterwards. In BIO, where the switch to a no-deadlines approach occurred in 2018, Tornow and Blevins (2021) reported a decrease in the number of projects per panelist (3.9 in FY16 compared to 1.7 in FY21) as well as a decrease in the number of projects per panel (60 in FY16 compared to 24 in FY21). The authors concluded that reviewer workload was reduced under the no-deadlines approach and also noted that the transition to virtual panels in FY20 and FY21 contributed to a further reduction.

### **Findings on PI characteristics**

Some studies also considered how the demographic and career-level characteristics of the PIs submitting proposals changed under the no-deadlines approach. None of the studies found that the proportional representation of PI communities of interest (women, historically underrepresented racial and ethnic communities, and early-career researchers) changed substantially after implementation of the no-deadlines approach (Pankow 2020; Patino and Garcia 2020; Miller 2020; Rissi et al. 2020; Iacono and Rissi 2020). Similarly, none of the studies found substantial changes in the institution type of the PIs submitting proposals (Patino and Garcia 2020; Miller 2020). However, two studies reported that the number of unique institutions of the PIs submitting proposals decreased following implementation of the no-deadlines approach (Yuan et al. 2020; Miller 2020).

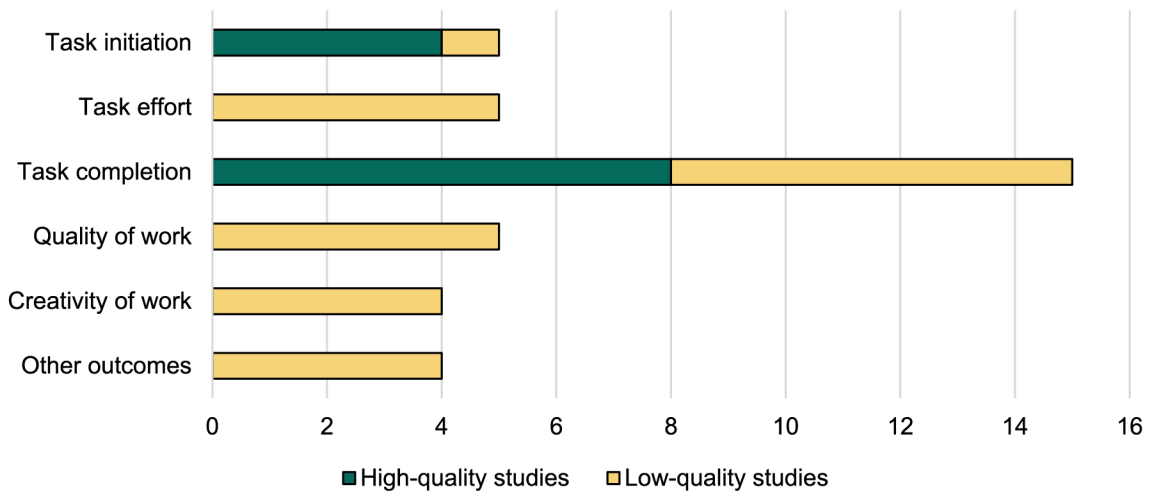
### **Review and findings from the literature beyond grants**

When looking beyond grantmaking activities, research that directly examines how introducing or eliminating deadlines might affect behavior is sparse. We did identify 82 studies of potential relevance. We classified the potential outcomes of deadlines discussed in these studies into six categories, some that map closely onto proposal progress and proposal completion (task initiation and progress, task effort, and

task completion), some that map onto proposal quality (work quality and work creativity), and other outcomes that do not fall into these categories. Below, we present the adjacent literature for each outcome category separately, first reporting the findings and strength of evidence for the inferential studies that directly test the effects of deadline presence or length and then summarizing other inferential findings, descriptive findings, and theoretical claims that are relevant to the outcome category.

From the 82 studies of potential relevance, we identified 39 inferential empirical studies but note that some focus on areas that are quite different from grant writing (consumer behavior and survey response rates, for example). Of these inferential empirical studies, 29 (measuring 38 reported outcomes) and one meta-analysis examined the effect of deadline pressure, either by varying the presence or length of deadlines or by asking people to self-report about the deadline pressure they faced. The outcomes discussed in these studies are summarized in Exhibit 10. As shown, most of these studies focused on task-related issues (task initiation, effort, and completion), while some focus on quality and creativity of work.

**Exhibit 10. Number of study outcomes related to deadline pressure, by outcome type and study quality**



Note: This exhibit summarizes the strength of evidence from 29 studies (measuring 38 outcomes) that examine whether changes in deadline pressure (such as the length or presence of deadlines) influence different kinds of outcomes. A high rating means that the estimated impacts of the intervention can confidently be attributed solely to the intervention. All other studies are rated as of low quality.

The remaining 9 inferential empirical studies varied other characteristics of deadlines such as their sequencing but may be indirectly relevant to NSF’s research questions about a no-deadlines approach to grantmaking. We report these studies separately because although they measure similar outcomes, they study qualitatively different treatment variables.

The theory papers and literature reviews that we identified were rarely focused on deadlines. Social scientists are usually more interested in general processes (for example, goal pursuit), but predictions about the effects of deadlines sometimes follow from these theoretical frameworks. The preponderance of theory and research comes from literature reviews within cognitive psychology, decision science, social psychology, and organizational behavior. Most of this literature addressed the role of deadlines in task



completion, with less attention devoted to the role of deadlines in task performance.<sup>32</sup> We report the key insights from these studies separately within the relevant outcome categories and note that most of these sources represent entry points into large literatures that are beyond the scope of this review.

## Findings on task initiation and progress

### *Studies that manipulate the presence of deadlines or deadline length*

Five studies measured the effect of a deadline ( $n = 3$ ) or the length of a deadline ( $n = 2$ ) on how quickly people begin work on a task. Four of these studies were rated as providing high-quality evidence. Exhibit 11 presents summary information for each study, including study quality, methods, outcomes of interest, sample size, and effect size. The methods used include RCTs in which outcomes are compared for groups formed through a random process, quasi-experimental designs (QEDs) in which outcomes are compared for groups formed without random assignment, and correlational studies in which associations between continuous variables are examined.

**Exhibit 11. Studies that examine the impact of deadline pressure on task initiation and progress**

| Study                        | Contrast   | Method           | Outcome   | Sample size | Effect size ( $d$ ) |
|------------------------------|--|------------------|---|-------------|---------------------|
| <b>High-quality studies</b>  |  |                  |   |             |                     |
| Berens and Funke (2020)      | 1 day deadline vs. 1–2 month deadline (depending on decision complexity) | RCT              | Decision deferral when making weekend plans or choosing apartments, university seminars, or internships | 312         | 0.55                |
| Knowles et al. (2021)        | 1 week <sup>a</sup> deadline vs. no deadline                             | RCT              | Response rate in first 3 days   | 2,133       | -0.1                |
| Zamir et al. (2017), Study 1 | 1 month deadline vs. no deadline   | RCT              | Intention to complete pension form  | 471         | 0.28                |
| Zamir et al. (2017), Study 2 | 1 month deadline vs. no deadline   | RCT              | Intention to appeal court judgments   | 124         | 0.38                |
| <b>Low-quality studies</b>   |  |                  |   |             |                     |
| Whitworth and Wright (2015)  | 2 week deadline vs. 4 week deadline                                      | QED <sup>b</sup> | When students ask questions about the assignment  | 628         | na                  |

Note: This exhibit summarizes studies that examine the impact of deadline pressure on task initiation and progress including the study design, outcomes measured, sample size, and observed impact of more deadline pressure. na is not available. All sample sizes are individual respondents, unless noted otherwise. Effect sizes are expressed in Cohen's  $d$ , which is the difference between the mean outcomes for two groups divided by the pooled standard deviation for the data.

<sup>a</sup>The study also included a one-month deadline condition.

<sup>b</sup>The study compared two courses with different deadline policies.

Two studies suggested that people planned when to begin tasks based on their deadlines, consistent with the hyperbolic increase in NSF grant applications discussed earlier (Durakiewicz 2016). Whitworth and

<sup>32</sup> A notable exception is studies that measure the deterioration of various cognitive processes in response to very short deadlines to gain insight into underlying psychological processes. These studies fall outside the scope of this review because of the short time periods they use.

Wright (2015) observed that students tend to ask questions about academic assignments about a week before assignments are due, regardless of whether they are given two weeks or four weeks to complete them. Knowles et al. (2021) found that imposing a one-week deadline on a request decreases completion rates in the three days following the request relative to the absence of deadlines.

One study examined the role of procrastination. Knowles and colleagues (2021) speculated that people procrastinate, beginning tasks based on when they are due rather than when they become aware that they need to be completed. However, when people lack an externally imposed deadline upon which they can base their planning, they must use other strategies to decide when to act. One such strategy for simple requests is to complete them immediately so they will not require further attention.

Contrary to these findings reported by Knowles and colleagues (2021), another series of studies found that people report more willingness to begin tasks with deadlines versus without deadlines. Zamir, Lewinsohn-Zamir, and Ritov (2017, Study 1)<sup>33</sup> presented people with a hypothetical pension plan that either did or did not have a contribution deadline. They found that people reported more interest in contributing to the plan when faced with a deadline. Zamir and colleagues replicated this finding with a different scenario, finding that people reported greater willingness to appeal a court judgment when faced with a deadline for the appeal (Zamir et al. 2017, Study 2). Similarly, people are less likely to defer life decisions (such as whether to rent a specific apartment) when the decision has a shorter versus longer deadline (Berens and Funke 2020).

#### *Studies that examine other characteristics of deadlines*

Studies that hold deadlines constant but vary whether the deadline feels close or distant provide consistent evidence that people prioritize tasks that feel imminent. Tu and Soman (2014, Study 1) challenged Indian farmers who attended a financial literacy class to achieve a specific savings goal. The author's offered a financial incentive to participants who could save at least Rs 5,000 within the next six months. For one group, the six-month deadline fell in December of the current year and for the other group, the six-month deadline fell in January of the following year. Farmers challenged to meet a deadline that fell within the present year were four times more likely to open a bank account than farmers challenged to meet a deadline that fell within the following year. The authors reasoned that people are more likely to initiate a task when a deadline falls in a time period represented as "like now" than when it falls in a time period represented as "unlike now." The authors conceptually replicated their finding in two follow-up studies. In their second study, Tu and Soman (2014) found that people were more willing to start planning a birthday party described as occurring in seven days if they first sorted numbers into categories representing days of the week (highlighting the similarity between dates that shared days of the week) than if they first sorted numbers by their remainders when they were divided by 2. In their third study, Tu and Soman found that when holding the temporal distance of a deadline constant, people were more willing to begin a data entry task if the deadline fell in the current month than if it fell in the following month (Tu & Soman 2014, Study 3).

#### *Insights from theory and literature reviews*

In a review of research on goal pursuit, Gollwitzer and Sheeran (2006) note that many goals are not achieved because people tend to focus on whatever task they are preoccupied with, forgetting, or failing to notice opportunities to pursue other important goals. Several theories of goal pursuit represent the

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<sup>33</sup> When a record reports the results of more than one study, we refer to each separately by the study numbers used by the authors.

urgency and the expected value of completing goals as separate dimensions. All of the articles we reviewed that adopt this dimensional approach note that although normative<sup>34</sup> models of time management usually recommend allocating time to those tasks that are most important, in practice, people over-allocate time to those that are most urgent (Costello 1984; Mitchell et al. 2008; Neal, Ballard, and Vancouver 2017; Perlow 1999).<sup>35</sup>

The effects of task importance and task urgency on task choice are difficult to study in everyday behavior because tasks are interdependent, and task urgency is correlated with supply and demand of associated resources. However, this observation is consistent with several lines of evidence:

- Reminders have been shown to increase completion rates, even for important tasks like benefits take-up and adherence to medical treatments (for example, Bhargava and Manoli 2015; Vervloet et al. 2012). The necessity of meeting deadlines for tasks that have them may lead people to discuss them more as deadlines approach, increasing their salience. As one indication of the importance of deadlines, upcoming dates and deadlines are the primary message of almost a quarter of Twitter posts by nonprofits (Waters and Jamal 2011).
- Temporally close goals are more salient than distant goals, and people report spending more time thinking about them (Lord et al. 2010).
- People underestimate task completion times (the “planning fallacy”) (Buehler, Griffin, and Ross 1994), leaving them with more work than they anticipate. Even if people triage less important tasks before trying to complete the remaining tasks in the order of urgency, they are still likely to leave important but less urgent tasks uncompleted.
- People discount the value of future outcomes, making distant goals seem less attractive (Ballard, Vancouver, and Neal 2018; Lord et al. 2010; Steel and König 2006). For this reason, if people select goals based on subjective importance, more urgent goals will be preferred over less urgent goals. Goals without firm deadlines exist in an indefinite future and remain consistently undervalued.
- Urgency is a salient cue that draws attention away from other aspects of the task. People are less likely to weigh the costs and benefits of replying to urgent emails than to less urgent emails (Cox et al. 2021). Similarly, workers in an online labor market will select urgent but lower-paying work over less urgent but higher-paying work even when completing one of these tasks precluded working on the other (Zhu, Yang, and Hsee 2018).

The importance of deadlines may be further magnified in groups or organizations, which plan their behavior around constraints imposed by external deadlines (Ancona, Okhuysen, and Perlow 2021; Blount and Janicik 2001). In an organizational context, people must share information about deadlines and coordinate action (Ancona, Okhuysen, and Perlow 2021; Gevers, Rutte, and Van Eerde 2006). In this context, urgent tasks may take on even greater importance as other people’s work often depends on their timely completion.

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<sup>34</sup> We use normative in its evaluative sense of “how people ought to behave” rather than in its descriptive sense. In decision making, the norm is usually a rational actor.

<sup>35</sup> A popular time management decision aide called the “Eisenhower decision matrix” that helps users classify tasks along the dimensions of urgency and importance is based on a similar model.

## Findings on task effort

### *Studies that manipulate the presence of deadlines or deadline length*

Five studies measured the effect of a deadline ( $n = 1$ ), length of a deadline ( $n = 2$ ), or perceived deadline pressure ( $n = 2$ ) on task effort. None of these studies were rated as providing high-quality evidence. Exhibit 12 presents summary information for each study, including study quality, methods, outcomes of interest, sample size, and effect size.

**Exhibit 12. Studies that examine the impact of deadline pressure on task effort**

| Study                          | Contrast                                      | Method        | Outcome                             | Sample size                | Effect Size ( $d$ ) |
|--------------------------------|---|---------------|-------------------------------------|----------------------------|---------------------|
| <b>Low-quality studies</b>     |   |               |                                     |                            |                     |
| Amabile, Mueller et al. (2002) | Continuous (self-reported deadline pressure)  | Correlational | Hours worked                        | 177 (> 8,000 observations) | 0.54                |
| Chetty et al. (2014)           | 4 week deadline vs. 6 week deadline           | RCT           | Review submission time              | 1,265                      | 0.57                |
| Hartonen and Alava (2013)      | 3 week deadline vs. 4 week deadline           | QED           | Review submission time              | 10,466 reviews             | na                  |
| Pinfari (2010)                 | Continuous (deadline pressure)                | Correlational | Agreement comprehensiveness         | 61                         | 0.31                |
| White and Locke (1981)         | Deadline mentioned vs. deadline not mentioned | QED           | High- or low-productivity situation | 152                        | 1.01                |

Note: This exhibit summarizes studies that examine the impact of deadline pressure on task effort including the study design, outcomes measured, sample size, and observed impact of more deadline pressure. na is not available. All sample sizes are individual respondents, unless noted otherwise. Effect sizes are expressed in Cohen's  $d$ , which is the difference between the mean outcomes for two groups divided by the pooled standard deviation for the data. Outcomes from studies with continuous predictor variables are converted to Cohen's  $d$  and represent the difference between the mean outcomes of individuals with predictor variable scores that are one standard deviation above and one standard deviation below the mean.

<sup>a</sup>The study compared review assignments made by two different academic journals

<sup>b</sup>The study asked participants to recall a high productivity situation or a low productivity situation.

When faced with deadlines, people seem to complete more work in a shorter time. Pinfari (2010, also reported in Pinfari 2011) measure effort by examining how much progress is made within a set amount of time, claiming that negotiators working under a deadline may be able to produce more comprehensive peace agreements, providing those talks do not collapse (Pinfari 2010, 2011).<sup>36</sup> Similarly, when faced with a tighter deadline people can complete a fixed task in less time. Chetty and colleagues (2014) and Hartonen and Alava (2013) both found that reviewers given less time to complete a review also take less time to complete it. To the extent that people begin tasks with deadlines sooner, they will naturally have more time to invest in completion of a task. However, people may also devote a greater proportion of available time to a task and work with greater intensity when faced with a deadline (Amabile, Mueller et

<sup>36</sup> This is the authors' claim based on their analysis of dichotomized data. A supplementary analysis treating deadline pressure as continuous rejected the hypotheses that deadline pressure predicted the breadth of the agreement produced,  $r(59) = .18, p = .16$ .

al. 2002). In support of such a possibility, people are also more likely to mention deadlines when describing high-productivity versus low-productivity work events (White and Locke 1981).<sup>37, 38</sup>

### *Insights from theory and literature reviews*

The influence of deadlines on task effort logically follows from the observation that people initiate tasks with short deadlines sooner than tasks with long deadlines. However, in a review of the broader literature on goal pursuit, Markman and Brendl (2000) note that goals have a motivational pull that increases as people approach them, and that pull cannot be fully explained by temporal discounting and may even result from other (likely interrelated) factors (Markman and Brendl 2000). This pull is likely because close goals (including imminent deadlines) increase the intensity of emotional experience for one of two reasons: (1) a lack of closure feels aversive (Mitchell et al. 2008) or generates a subjective feeling of finality (Ariely and Zackay 2001), or (2) near-success feels worse than clear failure (Roese 1997).

Cognitive psychologists have noted that people adopt different mindsets when thinking about near-term and long-term goals, and these mindsets may impact task initiation and performance. In a review of the literature on concrete and abstract levels of construal (known as construal level theory), Trope and Liberman (2010) observed that people tend to think about psychologically distant tasks in abstract terms and proximal tasks in more concrete terms. Thinking about a task in abstract terms tends to emphasize the desirability of the goal (Trope and Liberman 2010), which can amount to daydreaming but can also place such a high bar on expectations for success that abstraction discourages action (Wood, Bakker, and Fisher 2021). Thinking about a task in concrete terms emphasizes a goal's feasibility and leads to the formation of concrete plans about the actions to be taken to achieve the goal (Trope and Liberman 2010). This mindset makes it easier to initiate action (Wood et al. 2021) and forces people to revise goals downward to reflect what is feasible (Richard and Diefendorf 2011).

A similar pattern is observed in collaborative work groups. Gersick (1988) observed that about halfway through a task (regardless of how much time is allocated), groups shift from discussing what could be done to actually completing the work. This finding is also broadly consistent with the observation that deadlines determine when people submit work, regardless of how much time they have to complete it.

## **Findings on task completion**

### *Studies that manipulate the presence of deadlines or deadline length*

Fifteen studies measured the effect of a deadline ( $n = 6$ ) or the length of a deadline ( $n = 9$ ) on task completion. Eight of these studies were rated as providing high-quality evidence. Exhibit 13 presents summary information for each study, including study quality, methods, outcomes of interest, sample size, and effect size.

Unfortunately, most of the high-quality studies differ substantially from grant applications in two ways: they focus on relatively simple tasks (that is, the costs of acting are low), but people are not particularly motivated to complete the tasks (that is, the benefits of acting are also low). The cost/benefit ratio of action is a potentially critical determinant of how deadlines affect behavior. At least one set of studies

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<sup>37</sup>Although participants are randomly assigned to recall either a high or low productivity event in this study, we treat it as a QED because the experience of time pressure and level of productivity are not randomly assigned.

<sup>38</sup>Informants in smaller descriptive studies echo the same findings (Ishaque et al. 2014; Moriarty and Vandenberg 1984).

found that deadlines tend to motivate action when costs are low relative to benefits and discourage action when costs are high relative to benefits (Janakiraman and Ordóñez 2012).

Of the fifteen studies that measured the effect of deadlines on task completion, four (all of which compare deadlines to no deadlines; two studies are each described in two papers) are especially noteworthy because they examined the impact of deadlines on complex real-world outcomes and highly-motivated samples:

- In a retrospective study of federal rule making, proposed agency rules were more likely to be enacted if Congress imposed a statutory deadline on the rule-making process (80 percent finalized) than if there was no deadline (66 percent of proposed rules) (Lavertu and Yackee 2012; Yackee and Yackee 2010).
- In a content analysis of therapist emails, patients experienced better outcomes when therapists offered them less flexibility in completing the “homework” that was a part of their therapy (Paxling et al. 2013).
- In a retrospective study of peace negotiations, negotiations conducted under arbitrary deadlines were no more likely to produce an agreement than those conducted in the absence of deadlines (Pinfari 2010, 2011).<sup>39</sup>
- In an experimental study of peer reviews, 32 percent of peer reviews that were assigned a six-week deadline were accepted and submitted on time, but only 24 percent of reviews with a four-week deadline were accepted and submitted on time (Chetty et al. 2014).<sup>40</sup> Even though people in the short-deadline condition completed their reviews sooner, their submissions did not offset the more aggressive completion date.

Though illustrative of the potential impacts of deadlines on complex behaviors, most of the above studies suffer from serious potential confounds. For example, the imposition of statutory deadlines on the types of rules that are likely to require finalization might reflect the same forces that motivate Congress to set deadlines (such as a category of rules affecting the national interest), spurring rule makers either to be more thoughtful about the rules they propose or to act quickly to finalize them. Similarly, people may be less willing to impose deadlines on others when they foresee a failure to meet those deadlines, especially if failing to meet a deadline might impede future progress. Chetty et al.’s (2014) examination of journal reviews uses random assignment to avoid potential confounds, but it does not include a no-deadlines comparison.

We also identified a meta-analysis examining the effect of deadlines on survey response. Edwards et al. (2009) found no effect of deadlines on response to mail surveys ( $d = 0$ , 6 studies, 5,661 participants) and a small effect of deadlines on email survey response ( $d = .09$ , one study, 8,586 participants).

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<sup>39</sup> A supplementary analysis of the authors’ data treating deadline pressure as continuous rejected the hypotheses that deadline pressure predicted the likelihood that an agreement would be produced,  $r(66) = -.23$ ,  $p = .06$ .

<sup>40</sup> This finding is based on a supplementary analysis of the authors’ data: 48 percent (207/432) of accepted reviews with a 28-day deadline were completed by day 28, and 38 percent (151/401) of accepted review invitations with a 45-day deadline were completed by day 45, a significant difference, Fisher’s exact  $p = .003$ .

### Exhibit 13. Studies that examine the impact of deadline pressure on task completion

| Study   | Contrast  | Method           | Outcome                          | Sample size          | Effect Size ( <i>d</i> ) |
|---|---|------------------|----------------------------------|----------------------|--------------------------|
| <b>High-quality studies</b>                       |   |                  |                                  |                      |                          |
| Chen et al. (2011)                                | 6 day deadline vs. 7 day deadline               | RCT              | Hotel room booking               | 167                  | -0.02                    |
| Chetty et al. (2014)                              | 4 week deadline vs. 6 week deadline             | RCT              | Submitted journal review on time | 1114                 | -0.23                    |
| Damgaard and Gravert (2017; email sample)         | 3 day <sup>a</sup> deadline vs. 34 day deadline | RCT              | Charitable donation              | 20,293               | 0.16                     |
| Damgaard and Gravert (2017; text message sample)  | 2 day <sup>a</sup> vs. 34 day deadline          | RCT              | Charitable donation              | 32,996               | 0.05                     |
| Janakiraman and Ordóñez (2012), Study 1           | 2 day deadline vs. 7 day deadline               | RCT              | Product returns                  | 149                  | 0.65                     |
| Janakiraman and Ordóñez (2012), Study 2           | 2 day deadline vs. 7 day deadline               | RCT              | Product returns                  | 128                  | 0.36                     |
| Knowles et al. (2021)                             | 1 week <sup>b</sup> deadline vs. no deadline    | RCT              | Survey response                  | 2,133                | -0.14                    |
| Zamir et al. (2017), Study 3                      | 2 day deadline vs. "The coming weeks"           | RCT              | Survey response                  | 197                  | 0.43                     |
| <b>Low-quality studies</b>                        |   |                  |                                  |                      |                          |
| Berman (2016)                                     | Unspecified vs. no deadline                     | Not specified    | Loan application                 | na                   | na                       |
| Bolderston (2015)                                 | 1 week <sup>c</sup> deadline vs. no deadline    | QED <sup>d</sup> | Charitable donation              | 173                  | 0.15                     |
| Lavertu and Yackee (2012); Yackee & Yackee (2010) | Various deadlines vs. no deadline               | QED <sup>e</sup> | Federal rule finalization        | 5,516 proposed rules | 0.43                     |
| Liao et al. (2020)                                | 2 week deadline vs. no deadline                 | RCT              | Vaccination                      | 231                  | 0.01                     |
| Paxling et al. (2013)                             | Rigid deadline vs. flexible deadline            | Correlational    | Therapy compliance               | 44                   | 0.8                      |
| Pinfari (2010; 2011)                              | Continuous (deadline pressure)                  | Correlational    | Negotiation completion           | 68                   | -0.48                    |
| Zamir et al. (2017), Study 4                      | 3 day deadline vs. 1 week deadline              | QED <sup>d</sup> | Grade appeal                     | 8,160 exams          | 0.12                     |

Note: This exhibit summarizes studies that examine the impact of deadline pressure on task completion including the study design, outcomes measured, sample size and observed impact of more deadline pressure. Sample sizes are individual respondents, unless noted otherwise. na is not available. Effect sizes are expressed in Cohen's *d*, which is the difference between the mean outcomes for two groups divided by the pooled standard deviation for the data. Outcomes from studies with continuous predictor variables are converted to Cohen's *d* and represent the difference between the mean outcomes of individuals with predictor variable scores that are one standard deviation above and one standard deviation below the mean.

<sup>a</sup> This study also included a 10-day deadline condition.

<sup>b</sup> This study also included a one-month deadline condition.

<sup>c</sup> This study also included a two-week deadline condition.

<sup>d</sup> This study compared students enrolled in two different years.

<sup>e</sup> This study compared rules with and without congressionally mandated deadlines for rule finalization.

### *Studies that examine other characteristics of deadlines*

Four other studies examined how manipulating other features of deadlines (aside from the presence or absence of one and the length) affected task completion.

- Richberg-Hayes and colleagues (2017) reported results of three studies that found that making deadlines more salient increases completion rates. These studies tried to improve the uptake of social programs by redesigning application reminders. Unfortunately, increasing the salience of the deadline was bundled with several other design changes, making it impossible to isolate a deadline-specific effect.
- Tu and Soman (2014, Study 1) challenged Indian farmers who attended a financial literacy class to achieve a specific savings goal. The authors offered a financial incentive to participants who could save at least Rs 5,000 within the next six months. For one group, the six-month deadline fell in December of the current year, and for the other group, the six-month deadline fell in January of the following year. Farmers challenged to meet a deadline that fell within the present year were six times more likely to meet the savings goal than farmers challenged to meet a deadline that fell within the following year. Ariely and Wertenbroch (2002, Study 2) and Bisin and Hyndman (2020) examined how intermediate deadlines might support completion of a larger task and found conflicting results. Ariely and Wertenbroch (2002, Study 2) found that people asked to complete three proofreading tasks were more likely to do so when provided with separate deadlines for each than when provided with a single deadline to complete them all. Using a similar task (alphabetizing words), Bisin and Hyndman (2020) found the opposite effect.

### **Findings on work quality**

#### *Studies that manipulate the presence of deadlines or deadline length*

Five studies measured the effect of the length of deadlines ( $n = 3$ ) or perceived deadline pressure ( $n = 2$ ) on work quality. None of these studies were rated as providing high-quality evidence. Exhibit 14 presents summary information for each study, including study quality, methods, outcomes of interest, sample size, and effect size.

One study of performance found evidence that shorter deadlines were associated with lower-quality output. Journalists faced with tight deadlines rely more on frequently used sources and press releases than on novel sources and are less likely to corroborate claims by consulting a variety of sources (Reich and Godler 2014). In a different context, Pinfari (2010, 2011) reported that, although the outcomes of peace negotiations conducted under deadlines tend to be more comprehensive (closer to “complete”), they also tend to be less durable, suggesting that a rush to conclude negotiations might undermine efforts to address adequately all issues or underlying disagreements among the affected parties.<sup>41</sup>

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<sup>41</sup> This claim by Pinfari (2010, 2011) is based on their own analysis of dichotomized data. A supplementary analysis treating deadline pressure as a continuous variable rejected the hypotheses that deadline pressure predicted the breadth of the agreement produced,  $r(59) = .01$ .



#### Exhibit 14. Studies that examine the impact of deadline pressure on work quality

| Study                       | Contrast                                     | Method           | Outcome                    | Sample size | Effect size ( <i>d</i> ) |
|-----------------------------|--|------------------|----------------------------|-------------|--------------------------|
| <b>Low-quality studies</b>  |  |                  |                            |             |                          |
| Chetty et al. (2014)        | 4 week deadline vs. 6 week deadline          | RCT              | Reviewer/ editor agreement | 1,265       | -0.02                    |
| Pinfari (2010)              | Continuous (deadline pressure)               | Correlational    | Duration of agreement      | 61          | 0.04                     |
| Reich and Godler (2014)     | Deadlines ranged from 15 minutes to > 1 day  | Correlational    | Number of sources          | na          | 0.79                     |
| Whitworth and Wright (2015) | 2 week deadline vs. 4 week deadline          | QED <sup>a</sup> | Assignment grade           | 136         | na                       |
| Wijaya and Yulyona (2017)   | Continuous (self-reported deadline pressure) | Correlational    | Audit quality              | 216         | na                       |

Note: This exhibit summarizes studies that examine the impact of deadline pressure on work quality including the study design, outcomes measured, sample size and observed impact of more deadline pressure. All sample sizes are individual respondents. na is not available. Effect sizes are expressed in Cohen's *d*, which is the difference between the mean outcomes for two groups divided by the pooled standard deviation for the data. Outcomes from studies with continuous predictor variables are converted to Cohen's *d* and represent the difference between the mean outcomes of individuals with predictor variable scores that are one standard deviation above and one standard deviation below the mean.

<sup>a</sup>This study compared students enrolled in two different years.

Three studies found no evidence that deadlines compromise quality of work. Examining peer reviews, Chetty and colleagues (2014) found that shortening the peer review deadline did not prompt reviewers to write shorter reviews or decrease the rate of agreement between the reviewer's recommendation and the editor's decision to accept or reject a manuscript. Financial auditors reported that time pressure and perceived audit quality were unrelated (Wijaya and Yulyona 2017). Whitworth and Wright (2015) observed that shortening the deadline to complete a class assignment from four to two weeks improved student grades.

The extent to which deadlines affect task performance may depend on whether tightening a deadline either reduces the time that can be devoted to moving a project toward completion or simply eliminates the time during which people are committed to but do not perform a task. More time allows journalistic sources to reply to requests for information or comments; peace negotiations are complex such that poorly considered elements can threaten an entire agreement. In contrast, academics and students often have ample time between a deadline's announcement and the deadline. Supporting the possibility, theorists have noted that a primary benefit of longer deadlines is greater flexibility to respond to unforeseen circumstances (Monahan, Cottelear, and Fisher 2016). Shah, Harrold, and Sinha (2014) interviewed software engineers who made similar observations.

#### *Studies that examine other characteristics of deadlines*

Four studies (all in educational settings) examined how setting intermediate deadlines can support task performance. Ariely and Wertenbroch (2002, Study 1) assigned students to either complete assignments according to evenly spaced deadlines or turn them in all at once. Those who were given evenly spaced deadlines earned higher class grades than those who did not. Surprisingly, however, in a supplemental analysis of these data, Bisin and Hyndman (2002) found that assignment grades (which should be most

affected by the deadline) did not differ between the treatment and control groups. Withington and Schroder (2017) compared students enrolled in classes with prescribed deadlines with those enrolled in classes where they could set their own deadlines and found that those who set their own deadlines were less likely to earn a passing grade.

In a high-quality RCT, Ariely and colleagues (2002, Study 2) found that people given evenly spaced deadlines identified more errors in a series of proofreading tasks than those who set their own intermediate deadlines. In turn, the intermediate-deadline group outperformed the group with a single deadline at the end of the experiment.

### *Insights from theory and literature reviews*

In general, providing people with clear standards improves performance per a meta-analysis of over 100 studies that found that people perform at a higher level when pursuing specific, challenging goals rather than simply “doing their best” (Locke and Latham 1990). These effects are largest for simple tasks but remain substantial even for complex tasks such as those performed by scientists and engineers working on R&D (for a meta-analytic review, see Wood, Mento, and Locke 1987). However, this performance gain may only be realized for the criteria that are clearly specified and not for other, unrelated criteria.

Most theories of goal pursuit conceptualize goals as discrepancies between the current state of the world and the goal state and assume that people are motivated to eliminate these discrepancies (for a review see Austin and Vancouver 1996). For specific goals—especially those set by others or to which someone has publicly committed—this discrepancy can be resolved only through action. When goals are vague or private, the discrepancy can also be resolved by revising the goal downward to meet performance (Mitchell et al. 2008; Waller et al. 2001). The literature we reviewed does not address goals that are a blend of vague and specific criteria (such as “write your best grant application by a set date”).

As noted earlier, proximity to deadlines tends to increase the intensity of emotional experience<sup>42</sup>, with effects on task performance that depend on the blend of effort, focus, and cognitive ability that is optimal for completing a task. While very simple or overlearned tasks benefit from increased time pressure, for complex or novel tasks (such as idea generation or writing), some level of increased intensity improves performance, while too much pressure impedes performance (Acar, Tarakci, and Knippenberg 2019; Bluedorn and Denhardt 1988; Zhou and Hoever 2014).

In contrast, for simple tasks, intense emotional experiences generally increase performance. This pattern is thought to occur because intense emotions have two simultaneous effects. Although they increase the level of effort put into a task, they simultaneously lead to narrowed cognitive focus that can reduce cognitive flexibility and impair deliberative judgments (Ariely and Zakay 2001; Malhotra, Ku, and Murnighan 2008; Ordóñez, Benson, and Pittarello 2015; Teichman and Zamir 2020).

## **Findings on work creativity**

### *Studies that manipulate the presence of deadlines or deadline length*

Work creativity is a special case of work quality that may be especially relevant for academic grant applications. Four studies examined the association between deadline pressure and work creativity. None

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<sup>42</sup> In psychology, this intensity is referred to as *arousal*, which refers to a general drive state and accompanying physiological activation that is usually associated with emotional experiences but is distinct from emotional valence.

of these studies were rated as providing high-quality evidence. Exhibit 15 presents summary information for each study, including study quality, methods, outcomes of interest, sample size, and effect size.

**Exhibit 15. Studies that examine the impact of deadline pressure on work creativity**

| Study                          | Contrast  | Method           | Outcome   | Effect size                | Effect size ( <i>d</i> ) |
|--------------------------------|---|------------------|---|----------------------------|--------------------------|
| <b>Low-quality studies</b>     |   |                  |   |                            |                          |
| Amabile, Mueller et al. (2002) | Continuous (self-reported deadline pressure)      | Correlational    | Creativity of tasks described in diary entry              | 177 (> 8,000 observations) | -0.08                    |
| Baer and Oldham (2006)         | Continuous (self-reported creative time pressure) | Correlational    | Self-reported creativity                                  | 170                        | -0.49                    |
| Noefer et al. (2009)           | Continuous (self-reported time pressure)          | Correlational    | Average of self and supervisor ratings of idea generation | 395                        | 0.65                     |
| Chae et al. (2015)             | Project task force teams vs. R&D teams            | QED <sup>a</sup> | Self-reported creativity                                  | 164                        | na                       |

Note: This exhibit summarizes studies that examine the impact of deadline pressure on work creativity including the study design, outcomes measured, sample size and observed impact of more deadline pressure. All sample sizes are individual respondents. na is not available. Effect sizes are expressed in Cohen's *d*, which is the difference between the mean outcomes for two groups divided by the pooled standard deviation for the data. Outcomes from studies with continuous predictor variables are converted to Cohen's *d* and represent the difference between the mean outcomes of individuals with predictor variable scores that are one standard deviation above and one standard deviation below the mean.

<sup>a</sup>This study compared staff assigned to project teams with staff assigned to R&D teams.

Given that they rely on correlational or quasi-experimental designs, all four studies investigating associations between deadlines and creativity are rated as providing low-quality evidence. The correlational designs used in these studies are of special concern because the study samples include people with different types of jobs, which is an obviously relevant confounding variable. Jobs differ in unnumerable ways and potentially cause both the time pressure experienced by employees and the opportunities for creativity.<sup>43</sup>

Of the four studies, the relatively most rigorous analysis examined a 30-week daily diary study completed by 177 people working on projects requiring creativity (Amabile, Mueller et al. 2002). Using a cross-lagged correlational design, Amabile, Mueller et al. (2002) found that increased time pressure for one day predicted fewer descriptions of creative cognitions at work in subsequent days.<sup>44</sup> Their analysis controlled for project stage, ruling out the possibility that creativity plays a larger role in early (less time-pressured)

<sup>43</sup> The longitudinal data collected by Amabile, Mueller et al. (2002) could be analyzed in a way that does not confound job type or other individual differences with time pressure because it measures many different experiences for each participant. When data is measured in this way, within-individual associations between time pressure and creativity can be modeled and participant-level variation in these measures can be statistically controlled for. Unfortunately, the authors do not analyze the data in this manner.

<sup>44</sup> The lagged analysis of time pressure on later creativity does not control for either creativity experienced during the first day or time pressure experienced in subsequent days as is standard in cross-lagged correlational designs. The omission of these covariates weakens the assumption that time pressure causes a lack of creativity because it temporally precedes it.

stages of the project. However, they did not observe a relationship between time pressure and self-reported creativity.

Two studies using cross-sectional designs reported conflicting results. Baer and Oldham (2006) reported that people who reported more time pressure also reported less creativity at work. However, using third-party (supervisor) ratings, Noefer and colleagues (1999) found that people who characterized their jobs as time-pressured jobs generated and implemented more creative ideas at work.

The relationship between deadlines and creativity may be complex. Amabile, Mueller and colleagues (2002) found that creative activities were especially infrequent following days when people reported the highest level of time pressure, even after controlling for the linear relationship between time pressure and creativity. Similarly, the decline in creativity under time pressure observed by Baer and Oldham (2006) was traceable to employees who felt that their employer did not support creativity. Among those feeling that their employer did support creativity, moderate levels of time pressure increased performance relative to low or high time pressure.

Finally, one study suggests that how people identify creative solutions may vary under low and high time pressure. Chae, Seo, and Lee (2015) observed that R&D project team members (who develop technology to be used in future products and presumably experience less time pressure) tend to approach complex tasks differently than do ad hoc project teams (such teams resolve specific product issues quickly). R&D team members tend to spend time individually thinking through challenges, whereas task force members respond to challenges by seeking out others in the group with the expertise needed to solve the problem.

Creative professionals interviewed by Moriarty and Vandenberg (1984) had mixed feelings about the impact of deadlines on their work. On one hand, they note that the constant pressure of deadlines can have negative effects and undermine creativity. At the same time, they report that the pressure and frustration introduced by a deadline is often essential to pushing teams to find good solutions. This study is unclear on whether these seemingly conflicting opinions reflect individual differences in preferences for deadlines, conflicting opinions about jobs with many deadlines versus opinions about specific deadlines, or ambivalence towards deadlines.

## **Findings on other outcomes**

### *Studies that manipulate the presence of deadlines or deadline length*

Four studies measured the effects of a deadline ( $n = 1$ ), the length of a deadline ( $n = 1$ ), or perceived deadline pressure ( $n = 2$ ) beyond the task itself. None of these studies were rated as providing high-quality evidence. Exhibit 16 presents summary information for each study, including study quality, methods, outcomes of interest, sample size, and effect size.

Chetty and colleagues (2014) found that authors who accepted article reviews with different deadlines were equally likely to accept review requests sent by other journals and complete these reviews with the same length and dwell time. Likewise, Wolfson and colleagues (2019) did not observe a relationship between time pressure and pursuit of informal field-based learning (learning on the job).

## Exhibit 16. Studies that examine the impact of deadline pressure on other consequences

| Study                      | Contrast  | Method           | Outcome   | Sample size | Effect size ( <i>d</i> ) |
|----------------------------|---|------------------|---|-------------|--------------------------|
| <b>Low-quality studies</b> |   |                  |   |             |                          |
| Chetty et al. (2014)       | 4 week deadline vs. 6 week deadline                 | RCT              | Acceptance rate of other review assignments <sup>b</sup>    | 1,968       | -0.04                    |
| Chae et al. (2015)         | Project task force teams vs. R&D teams              | QED <sup>a</sup> | Perceived willingness to share knowledge among team members | 164         | na                       |
| Wilson and Sheetz (2010)   | Continuous (self-reported time pressure)            | Correlational    | Intergroup conflict   | 130         | -0.35                    |
| Wolfson et al. (2019)      | Continuous (time pressure inferred from occupation) | Correlational    | Informal learning   | 378         | -0.02                    |

Note: This exhibit summarizes studies that examine the impact of deadline pressure on second-order consequences including the study design, outcomes measured, sample size and observed impact of more deadline pressure. All sample sizes are individual respondents. na is not available. Effect sizes are expressed in Cohen's *d*, which is the difference between the mean outcomes for two groups divided by the pooled standard deviation for the data. Outcomes from studies with continuous predictor variables are converted to Cohen's *d* and represent the difference between the mean outcomes of individuals with predictor variable scores that are one standard deviation above and one standard deviation below the mean.

<sup>a</sup>This study compared staff assigned to project teams with staff assigned to R&D teams.

<sup>b</sup>This study also measured the dwell time and length of concurrently accepted review invitations.

Two other studies reported conflicting impacts of deadlines on group functioning. Chae and colleagues (2015) compared (time-pressured) "project task force" teams with (less time-pressured) R&D teams. Project task force members were less likely to share knowledge with peers but acknowledged that these project task forces were temporary while R&D teams were not. Wilson and Sheetz (2010) found that students reported less conflict when working on group projects under deadlines, but also found that people reported that they knew their peers for longer in the time pressured groups. The increased collaboration observed in both studies could be caused by closer relationships with other group members.<sup>45</sup>

### *Studies that examine other characteristics of deadlines*

Gevers and colleagues (2006) and Wilcox and colleagues (2016) did not compare deadline lengths but do highlight other potentially relevant outcomes of deadlines. Gevers and colleagues (2006) argue that discussing temporal reminders helps align temporal cognitions (such as the importance of the deadline and the appropriate timing and pacing of task activities). They found that these discussions enhance the performance of groups that begin work upon task assignment but impede performance in groups that delay work until just before the deadline (Gevers et al. 2006).

<sup>45</sup> For example, when students were asked to recall group projects, those that were conducted under more time pressure tended to have less intergroup conflict than those conducted under less time pressure (Wilson and Sheetz 2010). However, the groups that worked under time pressure tended to include peers that the students had known for longer and the authors did not control for this in their analysis.

Wilcox et al. (2016) suggest that missing deadlines can lead people to redouble their efforts on other tasks leading to increased productivity. In an analysis of tasks submitted to a task management app, the authors found that busy people (defined as those facing many incomplete tasks) increased their effort to complete tasks after missing a deadline, while less busy people did not. In laboratory studies, asking people to recall a time that they missed a deadline increased busy people's motivation (and decreased less busy people's motivation) to complete future tasks.

### *Insights from theory and literature reviews*

Theory papers and literature reviews on topics closely related to deadlines suggest that deadlines might have differential effects on individuals and groups. There is a small literature (reviewed by Gevers et al. 2006 and Shipp and Cole 2015) that has identified individual differences in pacing styles: some people work methodically towards a goal, others respond exclusively to deadlines, and some begin work as soon as possible (Gevers et al. 2006). Shipp and Cole (2015) have also argued that people differ in their experience of time urgency and their willingness to impose internal deadlines even in the absence of external deadlines. We believe it is likely that removing a deadline will have different effects on people with different pacing styles, privileging people with less deadline-sensitive work styles.

The existing literature treats pacing styles as an individual difference to be understood and accommodated or optimized within teams. In a review of the literature, Ancona, Okhuysen, and Perlow (2001) note that some researchers even treat pacing styles as a personality trait. We are unaware of research examining demographic correlates of pacing style. However, social theorists have noted cultural differences in the closely related topic of time perception. Crossan and colleagues (2005) and Duncheon and Tierney (2013) draw on anthropological studies to assert that Western industrialized societies emphasize “clock time” (setting specific dates and time), while other cultures rely much more on “event time” (sequencing events in response to internal and environmental cues).

Theory also suggests that it is important to consider how people in different contexts prioritize tasks to complete. In particular, people with tighter schedules—whether because of a more job demands, more personal responsibilities, or less experience (efficiency) on the job—may be less likely to pursue important but less urgent work. For example, some worry that consistent deadlines in the workplace are particularly burdensome for women because of the additional burdens placed on them at home (McKinsey & Company 2020).

Finally, some theorists argue that externally imposed deadlines play a role in providing structure for organizations, likely signaling when faculty and staff are more or less likely to be needed to work on grant applications. As Ancona, Okhuysen, and Perlow (2001) note, coordination is especially challenging when trying to coordinate across groups with different “temporal activity maps” (calendars and other time commitments). Shared deadlines may solve difficult coordination problems within and between groups (Blount and Janicik 2001; Gevers et al. 2006).

## 7. Insights from stakeholder interviews

### Conducting interviews

We conducted 34 interviews across three different respondent types. We conducted 22 NSF staff interviews<sup>46</sup>, 5 interviews with staff from other organizations that use a no-deadlines approach, and 7 interviews with PIs who had also served as reviewers. Exhibit 17 shows the type of respondents interviewed, the strategy for identifying respondents, and interview topics. We interviewed 25 NSF staff including directorate-, division- and program-level staff, 5 staff from other organizations, and 7 PIs and reviewers. We identified respondents using online resources and personal recommendations. Interview topics differed by respondent type but generally explored their experience with a no-deadlines approach including motivations and outcomes.<sup>47</sup>

**Exhibit 17. Interview respondent types, counts, and topics**

| Respondent type and characteristics   | Identification strategy   | Interview topics  |
|---|---|---|
| NSF staff<br>Directorate-level staff and staff who presented findings on no-deadlines implementation and program directors (PD)<br>N = 25 | Identified directorate-level respondents from online NSF staff directory and collected PD recommendations from directorate staff in initial interviews  | NSF staff with no-deadlines approach: Addressed the motivation, theory, implementation, and outcomes of a no-deadlines approach; asked about the feasibility of rigorously evaluating the efficacy of a no-deadlines approach and the results of internal assessments they may have conducted.<br><br>NSF staff without no-deadlines approach: Asked about the theory or rationale of maintaining deadlines for their program and any concerns about the no-deadlines approach. |
| External organization staff<br>Representatives of other federal agencies, foundations, and international programs<br>N = 5                | Identified organizations in landscape scan; conducted interviews with organizations that responded to outreach: (1) National Institute on Drug Abuse (NIDA) at National Institutes of Health (NIH); (2) National Aeronautics and Space Administration (NASA); (3) Alfred P. Sloan Foundation; (4) Fanconi Anemia Research Fund (FARF); (5) Adenoid Cystic Carcinoma Research Foundation (ACCRF) | Focused on the motivation, theory, and implementation of no-deadlines approaches in different organizational contexts outside NSF. In addition, topics included perceived or documented outcomes of a no-deadlines approach.  |

<sup>46</sup> The 22 NSF staff interviews included 4 group interviews with 2 people each, and one respondent participated in 2 group interviews.

<sup>47</sup> During interviews, we worked in pairs. One team member conducted the interview, and the other took near-verbatim notes (with a recording for backup) to ensure accuracy and reduce bias in the analysis stage. We coded the notes in NVivo to identify common themes in the interview findings. See Section A2 in Appendix A for additional information on the interview methodology, including details on the sampling design, communication strategy, protocols, and the codes applied in analysis.

**Exhibit 17 (continued)**

| Respondent type and characteristics   | Identification strategy  | Interview topics   |
|---|--|--|
| PIs and reviewers<br>Experienced researchers who have submitted proposals and completed reviews for NSF programs<br>N = 7 | Collected recommendations from NSF PDs; selected sample with balanced demographic characteristics and scientific disciplines | Explored the outcomes and perceptions of the efficacy of a no-deadlines approach from PIs' perspective. Topics included respondents' personal experience in applying for NSF funding in both a deadline and no-deadlines context and how either context may have affected motivation and proposal quality. |

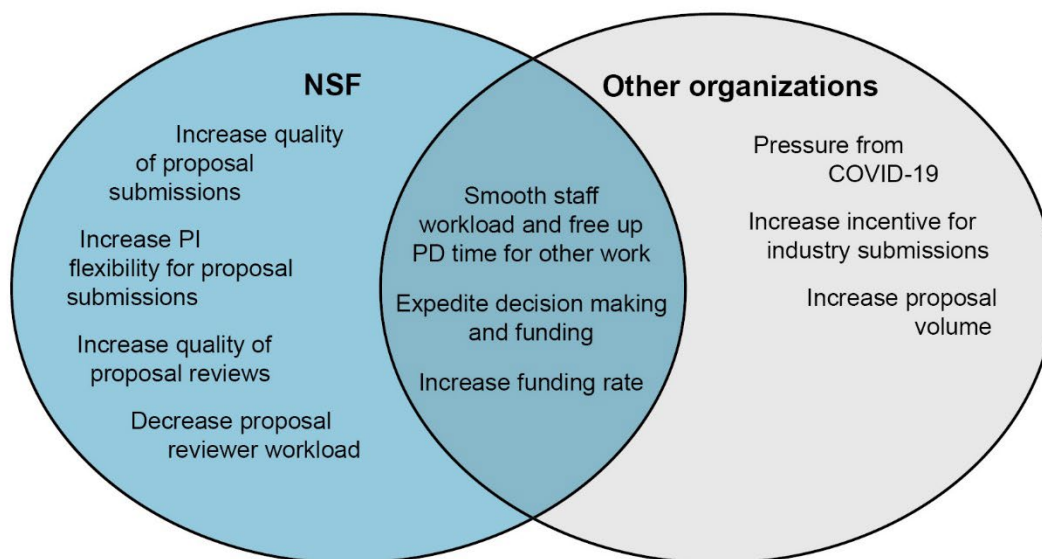
Note: This exhibit shows respondent type and corresponding characteristics, the number of respondents per type (N), information on how we identified each respondent type, and interview topics for each respondent type. Information on how respondents were identified, including how many respondents were contacted and responded is in Section A2 of Appendix A.

**Findings from the interviews**

**Motivators for using a no-deadlines approach**

Exhibit 18 highlights interview findings on the motivators for implementing a no-deadlines approach as reported by NSF staff and staff from other organizations. We found that NSF and other organizations shared common motivators for adoption of a no-deadlines approach: (1) smooth staff workload and free up PD time for other work; (2) expedite decision making and funding; and (3) increase funding rate.

**Exhibit 18. Diagram of motivators for NSF and other organizations**



Note: This exhibit is a Venn diagram that lists the motivators for using a no-deadlines approach as reported by NSF staff and staff from other organizations. NSF staff mentioned only items on the left; staff from other organizations mentioned only items on the right; NSF staff and staff from other organizations mentioned items in the middle. We interviewed 25 NSF staff and 5 staff from other organizations.



A smoothing of staff workload and decreased proposal pressure was a commonly cited motivator across respondent type. NSF staff noted that pre-proposal and other review responsibilities with associated deadlines exerted significant pressure on staff, especially PDs. A no-deadlines approach, however, would not only decrease proposal volume but also eliminate the seasonality and rapid influx of proposal submissions tied to grant solicitation deadlines. With a smoothing of workload throughout the year, staff would be able to improve management of their work and devote more time to other important tasks. For example, respondents explained to us that the distribution of work throughout the year would allow staff to think more strategically and gain time for outreach and conversations with PIs. One respondent from another organization was similarly motivated to use a no-deadlines approach to decrease both proposal pressure and staff workload. As at NSF, the organization's high proposal volume overwhelmed staff, who desired a more flexible workload throughout the year.

Another motivator shared by NSF and 4 other organizations was the ability to expedite decision making and funding by reducing dwell time, which is the time between the day a PI submits a proposal and the day the PI receives notification of a decision. For example, one organization found that its review processes were taking too long (up to 10 months), and it wanted to expedite the funding of important research. It viewed a no-deadlines approach as a way to achieve that goal. Another respondent explained how industry applicants cannot afford to wait long for decisions, stating, “[I]f you’re spending \$30,000 with a group of people writing a grant application, you need to know very quickly if that application is going to move forward or not, because if not then you just stop paying those people and move to something else.”

A couple of NSF staff and one respondent from another organization cited an increase in success rates as a motivator. One NSF respondent explained that the submission of fewer proposals competing for the same budget permitted the funding of more proposals. In other words, higher funding rates would mean less “churn in the system” as a consequence of fewer proposal submissions. Another organization was also motivated by the opportunity to increase funding rates in view of dissatisfaction within the research community. The organization's respondent reported that some programs' selection rates reached historic lows before implementation of the no-deadlines approach.

Other motivators for using a no-deadlines approach were only mentioned by NSF staff: (1) increase quality of proposal submissions, (2) increase quality of proposal reviews, (3) increase PI flexibility for proposal submissions, and (4) decrease proposal reviewer workload (Exhibit 18).

By implementing a no-deadlines approach, NSF staff sought to increase the quality of proposal submissions. With the elimination of deadlines, PIs could submit fully developed proposals instead of rushing to meet a deadline. At the same time, NSF staff would be far less likely to receive poorly conceived and written and mistake-prone proposals. One respondent reported that a no-deadlines approach could potentially disincentivize PIs from submitting unfinished proposals for the sole purpose of receiving feedback from reviewers.

**“My understanding was [a no-deadlines approach] was partly to encourage PIs to only send us a proposal when it was ready as opposed to forcing them to hit an artificial deadline and give us something half baked.”**

**–NSF staff person**

Furthermore, NSF staff saw a no-deadlines approach as way to increase the quality of proposal reviews. Using a no-deadlines approach would lead to fewer submissions, which would mean fewer proposals to be reviewed. This decrease in submissions would afford reviewers more time to review each proposal

thoroughly, to conduct in-depth reviews as a panel member, and to provide thoughtful feedback to PIs. Overall, the no-deadlines approach was attractive when circumstances gave rise to concerns about workload burden and merit review quality.

Closely related to proposal quality as a motivator was an increase in PI flexibility for proposal submissions. The prospect of positively impacting the proposing community by allowing PIs to submit fully developed proposals without time pressure was a motivator for some staff. Respondents also noted the added benefit that PIs can revise and then resubmit proposals more quickly under a no-deadlines approach if needed.

**“I think it creates flexibility on the PI side and on the community side. They can take the time to formulate and write a good proposal.”**

**–NSF staff person**

Respondents from other organizations cited a few motivators not shared by NSF staff: (1) pressure from COVID-19, (2) increase industry submissions, and (3) increase proposal volume (Exhibit 18).

One organization reported on pressure from the research community to delay deadlines because of COVID-19. This organization typically allows delays under certain circumstances, such as natural disasters; therefore, COVID-19 motivated the organization to eliminate deadlines, averting delay requests for individual circumstances. For another organization that traditionally receives submissions largely from academia and not from industry, the main motivation was to increase industry submissions of grant applications. The organization thought the approach would allow it to provide more rapid funding decisions which would incentivize industry applicants that need quicker responses. Finally, and in contrast with a motivation shared by NSF staff, one organization has set forth a goal to increase proposal volume. It implemented a no-deadlines approach with the aim of increasing proposal submissions by not discouraging PIs from applying if they missed the deadline.

### **Implementation challenges of using a no-deadlines approach**

Implementing the no-deadlines approach at NSF has generally proceeded without major delays or roadblocks. However, interview respondents told us about both the technical and logistical challenges that divisions or directorates encountered during implementation but subsequently addressed during the implementation process. Respondents from other organizations that use a no-deadlines approach to grant solicitations reported some similar challenges to implementation. PIs and reviewers provided their perspectives on the challenges as well. In Exhibit 19, we present common challenges and solutions related to scheduling and conducting panels and ad-hoc reviews, program data and budget management, changes in practices and behaviors among PIs and PDs, and resistance from colleagues and researchers. The solutions demonstrate how NSF and other organizations have managed these challenges, and PI and reviewer perspectives demonstrate how members of the research community have been affected by the challenges.

In terms of scheduling and conducting panels, a primary challenge is structuring the review cycles, especially when it may take some time to receive enough proposals to convene a panel. Some solutions used by NSF and two other organizations included using smaller panels, using more ad-hoc reviews, using three review cycles per year, and using micro-panels. Relatedly, NSF found it difficult to manage the workload of reviewers conducting ad-hoc reviews because of a lack of predictability of when proposals will be submitted; the solution was to ask reviewers about their capacity and schedules and work with them to be flexible. One organization found it challenging to accumulate several proposals to send to a reviewer at once, which would allow them the opportunity to compare. Their solution was to

send proposals to more seasoned reviewers who may be able to make more accurate judgments without a comparison and to send proposals one at a time as they come in. A reviewer shared the perspective that it is easier to conduct an objective assessment of a proposal when looking at only one at a time.

Interview respondents also brought up logistical concerns related to program data and budget management. The challenge of a constant flow of information into systems designed to accommodate processes with deadlines highlighted the need to develop robust tracking systems tailored to the no-deadlines approach. NSF, one other organization, and a PI shared that it was also challenging to manage budgets so that funding was available for good ideas throughout the year and that it was not more advantageous to submit during certain times of the year. This challenge was not addressed in the same way by respondents; some tried to spread budgets evenly and some funded good ideas as they were submitted.

Other challenges related to the unpredictability of and resistance to the no-deadlines approach. PDs and PIs mostly shared trying out new processes and becoming accustomed to the new pace and structure over time. One PI worked with a PD to set a self-imposed deadline; another did not think the approach was much different. Respondents also shared that the no-deadlines approach was not universally welcomed and emphasized the need to have open dialogue about the approach and its potential positive and negative effects.

**Exhibit 19. Common challenges and solutions to implementing no-deadlines approaches**

| Common challenge                         | NSF  | Other organizations   | PI/reviewer perspective  |
|--|--|---|--|
| Scheduling and conducting panels         | <p>Challenge: In small or scientifically specific programs, it can take a long time to receive enough proposals to convene a full panel review.</p> <p>Solution: Schedule more frequent or smaller panels; use ad hoc review processes.</p>  | <p>Challenge: It is challenging to structure review cycles.</p> <p>Solution: Use a no-deadlines approach but with cut-off dates, which help to structure reviews into three cycles per year.</p> <p>Challenge: It is challenging to accumulate enough proposals to organize a full panel.</p> <p>Solution: Run micro-panels that review 4 to 5 proposals rather than 10 to 15 proposals per panel.</p>  | <p>NSF PI: You do not know when the review panel will review your proposal. It would be helpful to have more information from NSF.</p> <p>NSF reviewer: A certain number of proposals is needed for a panel. Proposals are grouped together as they arrive and may address topics beyond the scope of some experts.</p> <p>NSF reviewer: Review quality increases because reviewers do not have to budget their time to review 10 to 15 proposals.</p> |
| Scheduling and conducting ad-hoc reviews | <p>Challenge: Not knowing how many or when proposals will come in makes it difficult to manage ad-hoc reviewers' workloads.</p> <p>Solution: Ask reviewers about their capacity to conduct reviews; do not push too hard; recognize that they are a fully volunteer workforce.</p> | <p>Challenge: Reviewers struggled to determine the quality of a proposal without a comparison.</p> <p>Solution: Ask seasoned reviewers to review the proposals because they have more experience in evaluating the quality of proposals and can do so more easily without a comparison.</p> <p>Challenge: It is challenging to accumulate 2 or 3 proposals to send together to reviewers.</p> <p>Solution: Send proposals one at a time as they arrive.</p> | <p>NSF reviewer: Looking at several proposals side by side can lead to implicit bias. It is easier to evaluate a proposal at face value and maintain objectivity when focused on one proposal.</p> <p>NSF reviewer: The review process is similar to the review process associated with deadlines.</p>   |

Exhibit 19 (continued)

| Common challenge                                     | NSF   | Other organizations  | PI/reviewer perspective  |
|--|---|--|--|
| Program data management                              | <p>Challenge: Tracking tools, including Excel templates and budget visualization tools, were designed for a deadline-based context.</p> <p>Solution: Invest time upfront to create new trackers.</p>  | <p>Challenge: There is a constant flow of items coming in at different levels.</p> <p>Solution: Use a robust tracking system.</p>  |  |
| Budget management                                    | <p>Challenge: It is challenging to balance the budget to ensure that the timing of proposal submissions does not affect the chances of award.</p> <p>Solution: PDs manage budgets differently, and it is a learning process; one PD makes sure not to spend all funds in first few panels; another PD instructed reviewers to fund good proposals as they come in instead of holding out.</p> | <p>Challenge: There is concern about a clear budget draw-down plan to ensure funding availability throughout the year.</p> <p>Solution: Spread budgets evenly throughout the year, and there may be need to hold off on making final decisions on proposal submissions based on budget availability.</p>   | <p>NSF PI: There is a strategy related to when to submit a proposal based on when money is still available.</p>  |
| Changes in practices and behaviors among PDs and PIs | <p>Challenge: There is a less predictable pace of work, and PDs need to manage distinct types of tasks simultaneously.</p> <p>Solution: Adopt an adaptive and collaborative approach; PDs developed new processes that worked for them and shared them with their colleagues. Over time, NSF staff grew accustomed to the new pace of their work.</p>   | <p>Challenge: Some PIs stated that they do not know how to submit without deadlines. Using a no-deadlines approach creates uncertainty, is more dynamic, and requires more mental exercise.</p> <p>Solution: People will become accustomed over time.</p> <p>Challenge: A no-deadlines approach may require more administrative support to provide structure for PIs.</p> <p>Solution: Stepped in to provide some structure and guidance to applicants who lacked administrative support from their institution.</p> | <p>NSF PI: It was a little easier to work with a deadline, which allows planning backwards from the hard deadline.</p> <p>NSF PI: A self-imposed deadline allowed for planning. The deadline was based on communication with the PD, who suggested submitting by December to meet the next review cycle.</p> <p>NSF PI: The proposal preparation and submission process is the same as with deadlines.</p> |

**Exhibit 19 (continued)**

| Common challenge                          | NSF   | Other organizations  | PI/reviewer perspective   |
|---|---|--|---|
| Resistance from colleagues or researchers | <p>Challenge: There was initial concern or fear about changing the approach.</p> <p>Solution: Keep lines of communication between divisions and with management open; make sure that staff have the opportunity to ask questions, voice concerns, and troubleshoot challenges; offer several avenues for communication with the research community (Dear Colleague letters, office hours, presentations, etc.).</p> | <p>Challenge: A colleague does not like the no-deadlines approach.</p> <p>Solution: Opposition is framed as a positive, noting the benefit of dissent in the room.</p> | NSF PI: The no-deadlines approach is a terrible change that makes it hard to get proposals out the door; it has negative effects on proposal quality and early-career scientists. |

Note: This exhibit includes common challenges and solution reported by NSF staff, staff from other organizations, and PIs and reviewers during interviews. We provide examples of the challenge and solutions from each respondent type, where applicable. Three of the PIs/reviewers were from BIO, three were from GEO, and one was from EHR.

## Perspectives from interview respondents on the effects of a no-deadlines approach

During the interviews, we asked respondents about the intended and unintended effects or outcomes that they observed as a result of the no-deadlines approach. Their responses were informed by their own observations as well as internal data and presentations that some of them had been involved in or seen. The outcomes measured in the internal presentations can be seen in Exhibit 9. They include outcomes related to proposal volume, proposal quality, the merit review process, and diversity and representation among PIs and institutions. Not all effects that respondents reported on were measured in the internal data.

The most commonly cited effect by respondents was that adoption of a no-deadlines approach led to a reduction in proposal volume. While some NSF staff shared observations of receiving fewer proposals, some staff members cited specific measurements. One Deputy Division Director reported a 50% decrease, while another reported a 50% decrease in the first year which then rose in the following two years and plateaued at 60-65% of the original submissions amount. One PD reported a more moderate decrease of about 20%.

A reduction in proposal volume is interconnected with many of the intended outcomes that were motivators, including a smoothing of workload and decreased proposal pressure, increased funding rates, and expedited decision making and funding. Staff pointed to effects such as even distribution of the NSF staff's workload throughout the year, the improved quality and efficiency of the merit review process, and an increased funding rate. PIs' experiences support these effects. PIs reported that the no-deadlines approach reduced stress, afforded them time to solidify findings, enabled them to perform higher quality reviews with in-depth discussion, and provided the flexibility to submit proposals when they determined them to be of highest quality in terms of evidence and writing.

**“I had time to think about the problem from front to back and get a better hold of the state of science in the field.”**

**–PI**

During interviews NSF staff indicated, however, that the effects of no-deadlines approaches are not always evident throughout NSF and the research community. In the case of dwell time, for example, NSF staff reported both longer and shorter times based on observations. In addition, in terms of proposal quality, some NSF staff reported improved proposal quality, while others did not notice such a change. One reviewer felt that proposal quality declined under the no-deadlines approach. Some reports on proposal quality were anecdotal and acknowledged that measuring quality is difficult. One NSF staff respondent cited data from an assessment where the number of highly competitive proposals increased percentile wise but acknowledged they can only say higher quality proposals are correlated, not caused by a no-deadline approach. Furthermore, an NSF staff member expressed concern that the funding rate obscured the nuance of cross-directorate differences in merit review process norms and the contexts of the scientific disciplines. Funding rate is often the single statistic of interest to external individuals, including elected officials who make funding allocation decisions. One concern was that if no-deadlines approaches led to a dramatic increase in the funding rate, the approaches would translate to reduced funding allocations.

NSF staff noted several unintended effects, some positive and some negative, of a no-deadlines approach. For example, one negative unintended effect was that despite expectations of a decline in proposal volume that would smooth out workload and decrease proposal pressure, some NSF staff reported a sustained decline, meaning their programs were receiving fewer submissions over time. One solution to

this unintended effect was increasing proposal solicitations to compensate for an overall reduction in proposal submissions. The sustained reduction of proposals prompted NSF members to formulate theories to explain the decline. One theory is that PIs are prioritizing submission of proposals to NSF grant solicitations and other organizations that have deadlines. In fact, such was the case for one PI who submitted several proposals outside NSF before submitting an NSF proposal without a deadline. In this instance, the PI took six to nine months to complete the other proposals and two years to complete the NSF proposal.

Another potentially negative unintended effect of a no-deadlines approach concerned the operation of grant offices at institutions. One NSF respondent reported hearing that PIs were experiencing difficulty with sponsored research offices that were prioritizing with-deadlines proposals. Two PIs echoed the same report, noting that when proposals have no deadlines, they seemed to be assigned to a slower review track. However, two other PIs, both from the same institution, commented that with-deadlines proposals did not appear to receive priority over no-deadlines proposals.

**“If they have a deadline they’re dealing with, say, NIH proposals with deadlines, they [grant offices] put you at the back of the line.”**

**–PI**

Many NSF staff expressed concern about the unintended effects of the no-deadlines approach on historically underrepresented PIs and early career scientists, and one respondent from another organization speculated the applicant pool was less diverse. However, none identified evidence that the approach had disadvantaged these individuals, but many recommended more rigorous study of data on submission and funding decisions. A few PIs expressed concern about the effects of a no-deadlines approach on early-career scientists. One PI mentioned that a no-deadlines approach is difficult for early-career scientists who face competing demands on their time and might benefit from a hard stop. Another PI who is an early-career scientist and a new professor pointed to a lack of confidence when submitting and reported time spent seeking more internal reviews before submitting. This experience aligns with a more senior PI’s observation that early-career scientists may postpone submitting because they want to perfect their proposals. Delaying submission for too long results in fewer opportunities for funding which can have negative consequences for PIs’ research and tenure process.

Some NSF staff wondered whether a no-deadlines approach would reduce or add burden to the workload of institutional grant offices. One PI stated that the grants office at the respondent’s university preferred no-deadlines proposals because the office did not have to meet a deadline and could instead turn to the proposal as time permitted. A respondent from another organization shared it is possible that, in comparison with well-heelled grant office operations, grant offices at less-resourced institutions and their PIs might be more greatly affected by a no-deadlines approach to proposal submissions. However, the six university-based PIs whom we interviewed held positions at R1 institutions.

An unintended positive effect was easy internal collaboration at NSF. Two NSF staff members found it easier to collaborate with colleagues and recognize opportunities to bundle related proposals since workload was distributed over time. According to one respondent, when there are no-deadlines, “people across divisions can crosswalk and think differently about how to group proposals.”

Importantly, NSF staff acknowledged that observed effects cannot be attributed solely to the change to a no-deadlines approach. Respondents noted other potential contributing factors, including the pandemic, budget changes, submission requirements, and government shutdowns.



## **Perspectives from interview respondents on the effects of deadlines**

NSF staff highlighted various possible, positive benefits of deadlines. Primary benefits of a deadlines-based approach shared by NSF staff included the clarity, structure, and predictability associated with deadlines, the ability to compare a larger batch of proposals at one time, and some individuals' overall preference for deadlines. Some respondents mentioned instances of PIs asking for a deadline or an indication of when panels would take place as an illustration that some people like to work toward deadlines.

Even though the majority of PIs interviewed preferred the no-deadlines approach, they noted the benefits of a deadline. One benefit is the ability to collaborate consistently with the same team when preparing a proposal. A couple of PIs noticed a change in a group's ability to adhere to a schedule when the group was not facing a deadline. Given that everyone had their own obligations, the group had to extend the proposal writing process beyond the original time it allotted. Similarly, a few found it easier to work with a deadline; they organized their time backwards and relied on an established approach to proposal submissions.

## **8. Discussion by research question**

### **What motivates the use of a deadline-free approach to grant solicitations (or similar situations)?**

Internal NSF presentations and reports, a publicly available NASA presentation, and interviews with NSF staff respondents ( $n = 25$ ) and staff from other organizations ( $n = 5$ ) provided insights into the motivations that drive the implementation of a no-deadlines approach. No other literature addressed the motivation behind eliminating deadlines for grant solicitations.

Overall, there was no single motivation for the adoption of a no-deadlines approach. Rather, the motivations for using a no-deadlines approach are interconnected. At NSF, reducing workload for reviewers and smoothing workload for NSF staff were commonly cited motivators that could be addressed by adopting a no-deadlines approach that reduces and smooths proposal volume. Increasing funding rates was another motivator shared by NSF staff that could be accomplished through a reduction in proposal volume. By removing the pressure to submit by a deadline, NSF staff also sought to provide PIs greater flexibility to submit proposals when they are ready, thereby increasing the quality of proposals. Receiving more fully-developed proposals and fewer that require resubmission could further reduce workload and increase funding rates. Lastly, in conjunction with these motivators, NSF staff expressed interest in maintaining a rigorous and equitable merit review system under a no-deadlines approach.

NSF and some of the other organizations we interviewed (NIDA, NASA, FARF, Sloan Foundation, and ACCRF) shared common motivations including smoothing staff workload and freeing up PD time, expediting decision making and funding, and increasing funding rates. Other organizations using a no-deadlines approach were also motivated by contextual factors including the COVID-19 pandemic, wanting to increase submissions from industry, and wanting to increase their proposal volume which was lower than desired. For NASA, the motivators included providing flexibility for proposers, providing flexibility for NASA staff to manage workload, spreading budget risk, and reducing proposal pressure (Rinehart 2021).

## What theories or hypotheses undergird the removal, or adoption of no deadlines in different contexts, particularly with regards to grant solicitations?

How people think and feel about tasks changes as a function of how far in the future the tasks must be completed. Several different theories are relevant for understanding how shrinking temporal distance between the present and task completion might affect behavior. Delay discounting models (Ballard et al. 2008) widely agree that the subjective importance of goals increases as temporal distance shrinks. Construal level theory (Trope and Liberman 2010) further predicts that as temporal distance decreases, people adopt a more implementational mindset. Activational theories (Markman and Brendl 2000) predict that motivational drive increases as deadlines approach, leading people to try harder to complete tasks with deadlines than tasks without deadlines. Importantly, externally imposed deadlines compel people to shift their mindset; when a deadline is self-imposed rather than externally imposed, it can easily be pushed farther into the future, leading people to persist in discounting outcomes, avoid planning how to implement their goals, and remain relatively less motivated to take action.

Researchers interested in individual differences argue that temporal orientation is stable and akin to a personality trait: some people complete tasks as they are accepted, others work at a steady pace, and some respond to deadlines. These differences mean that some people are more sensitive to changes in temporal distance than others. The literature we reviewed does not examine whether pacing style is correlated with differences in demographic characteristics.

While empirical studies of deadlines focus on the impact of the presence or absence of a deadline on a single outcome, theorists note that in practice, most people pursue multiple goals at the same time. This implies that task completion and task performance depend not only on whether a deadline is set for a task, but also the number and urgency of other tasks that compete for PIs' time. These demands also may or may not be correlated with demographic characteristics of potential grant applicants.

## How are these deadline-free or no deadlines approaches implemented? By which types of organizations and in what situations?

Our exploration revealed that there is no single model for a no-deadlines approach. We identified 173 organizations outside NSF as using a no-deadlines approach if any of their programs do not list deadlines on their websites. However, eliminating formal deadlines for applicants is not the only component of implementation. For example, career development programs and fellowships at universities or academic centers are often tied to an academic calendar, so that even when applications are accepted on a rolling basis, the start of the school year may act as an implicit deadline. In other cases, organizations may communicate soft deadlines even when formal deadlines are removed. One organization we interviewed relies on a soft deadline that PIs must meet for their submission to be reviewed at a particular meeting. Therefore, the amount of structure within a no-deadlines approach can vary across funding opportunities and organizations.

With regards to the types of organizations that implement a no-deadlines approach, the majority of organizations that we identified were foundations, biotechnology and pharmaceutical companies, or universities. While none of the organizations' websites provided a rationale for using no-deadlines approaches with specific types of programs, select interviews with representatives of other organizations provided insights into the situations under which organizations implemented a no-deadlines approach. For example, one organization we interviewed shifted to a no-deadlines approach to encourage more PIs to submit proposals. The respondent noted that PIs might be discouraged from focusing on the

organization's area of research if they miss a deadline. In the case of another organization, its leaders were looking for ways to incentivize industry to submit grant applications. Industry wants rapid funding decisions, and they believe a no-deadlines approach permits faster decisions. Another organization reflected on COVID-19 and all of the other reasons beyond PIs' control that make them unable to meet deadlines every year and decided to remove deadlines to give more flexibility to PIs.

### What methodologies have been used to study no deadline approaches? What has been the focus of these studies—outcomes, impacts, implementation benefits, and so on? How rigorous have these approaches been, quantitatively and qualitatively?

Within the core literature (examining grant submission deadlines), we identified 9 inferential studies that all used NSF data to look at changes in outcomes after the implementation of no-deadlines approaches in various NSF units. These studies used ITS designs (including pre/post designs), and one included a non-equivalent comparison group. Some of these studies included lessons learned or challenges and benefits of implementing the no-deadlines approach. Across these studies, the outcome variables of interest varied and included measures of submission volume, at least one measure of submission quality, and at least one measure of potential effects on outcomes related to the review process for the GEO, BIO and ENG directorates and the SaTC program. BIO, GEO and ENG directorates also examined PI diversity.

All of the studies in the core literature received a low rating for the strength of causal evidence meaning the observed changes in outcomes could not be confidently attributed to the no-deadlines approach. The strength of causal evidence would be more compelling if the analyses included many programs that implemented no-deadlines approaches at different times in combination with several data points before and after implementation of the no-deadlines approaches. These features would increase confidence that changes in outcomes were not due to other factors that changed at the same time as implementation of the no-deadlines approaches and help determine whether the changes were temporary or permanent and real or noise. Although the results of existing studies are not reported in such a way that they could be combined,<sup>48</sup> a future evaluation might combine programs, divisions, or directorates to produce stronger evidence about the no-deadlines approach. It could also consider the use of comparison programs that did not implement the no-deadlines approach to help isolate the effect of the approach.

We also found four descriptive studies in the core literature. One was a brief news item that reported on the drop in proposal submissions after programs in GEO adopted a no-deadlines approach. Another used NSF data to model proposal submissions as a function of time, and another was an NSF presentation that focused on outcomes in MPS, but only included data from time points after the implementation of the no-deadlines approach. The only study not related to the NSF was a survey of Australian grant applicants that focused on their perspectives and experiences with a single annual grant deadline.

Within the adjacent literature (examining other, non-grant related deadlines), researchers explored the impact of eliminating or changing deadlines in contexts other than grant solicitations and proposal submissions. Of the 82 relevant adjacent literature studies we identified, 39 were inferential, 4 were qualitative descriptive studies, and the remaining 39 were theory papers or literature reviews. The focus of the inferential studies was roughly evenly spread across tasks performed at work ( $n = 14$ ), school ( $n = 11$ ), and home ( $n = 13$ , mostly related to financial decisions). Most of these studies (29 primary data collections and a meta-analysis) concerned the presence or absence of deadlines or deadlines of different

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<sup>48</sup> As one example, in some cases outcome data is reported for every single year and in other cases, years are aggregated together making it impossible to estimate year-to-year variance before and after the implementation of the approach.

lengths. The remainder examined the effects of changing other features of deadlines (such as their spacing). As discussed in the findings section, researchers largely examined how deadlines influenced productivity (task initiation, effort, and completion) and performance (quality and creativity of work).

Of the inferential adjacent studies we reviewed, about half ( $n = 20$ ) were RCTs. Most of these RCTs ( $n = 16$ ) received a high rating for their analysis of at least one outcome. The RCTs that received a low-quality evidence rating confounded the treatment with group membership (randomly assigning one group to each condition) or with other treatments (simultaneously changing many variables in the treatment group). There were also 6 studies that used a QED (comparing groups without random assignment) and 13 correlational studies (examining associations between continuous variables).

A major limitation of applying the findings in the adjacent research to the context of grant applications is that the more rigorous studies almost always focus on relatively simple tasks performed over relatively short time periods that yield small rewards (such as completing a school assignment or a survey). Data about how deadlines might affect more complex tasks (such as those with discrete subgoals or those requiring coordination) usually come from non-experimental studies in which obvious confounding variables might influence both whether deadlines are set and performance. The only study that examined a more complex task was an RCT to examine how different deadline lengths affected reviewers of academic journal articles. The limited focus of the literature is probably not surprising given the complexity and cost of longitudinal field experiments and the difficulty of gaining access to organizations within which deadlines could be studied (Ancona, Goodman, Lawrence, and Tushman 2001).

Writing complex grant applications differs from the simple tasks often studied in the adjacent literature. Unlike simple tasks in which the goal is often to perform at a level that is “good enough,” a PI’s goal is to submit a proposal that is awarded funding. Unlike simple tasks, where the stakes are quite low, the average annual award from NSF in FY21 was \$231,202 (NSF 2021) which is magnitudes greater than the potential benefits of the tasks studied using RCTs. Finally, the tasks studied in the adjacent literature were completed by individuals or weakly connected groups and had few, if any, reputational consequences. In contrast, the completion and quality of grant applications has consequences for an applicant’s reputation among peers, collaborators, supervisors, and PDs.

A further limitation is that half ( $n = 8$ ) of the adjacent RCTs compared deadlines of varying length and it is unclear whether long deadlines are conceptually equivalent to no deadlines. This might be the case when (1) researchers select long deadlines that offer ample time to complete the task (so that there is essentially no deadline pressure) and (2) the difference between the “short” and “long” deadline conditions is sufficient to be meaningful. The deadline lengths necessary to produce the feeling that a deadline is short or long vary across studies, depending on task complexity and participants’ other time commitments. Unfortunately, authors generally do not provide a rationale for their decisions about deadline length or participants’ subjective experience of them. Even if these concerns were addressed, it is unclear whether a long deadline can ever be the same as no deadline because a task with a long deadline provides temporal information that can be used to plan behavior while a task without a deadline does not provide such information.

### What outcomes are associated with no deadlines? What are the impacts of no deadlines?

Most research on the effects of deadlines (and, notably, all of the high-quality studies we identified) focuses on volume of work (task initiation and completion). This is true for both the core literature on

grant applications (where it is measured through proposal volume) and in the adjacent literature (where task initiation, task effort, and task completion are operationalized in various ways). In both literatures, shorter deadlines usually increase task completion relative to longer deadlines or no deadlines. More specifically, all of the NSF studies showed a reduction in proposal volume following the adoption of the no-deadlines approach.

Another focus of the literature is how deadlines affect work quality. The core literature, while limited, finds that a no-deadlines approach is associated with higher quality submissions as measured by average reviewer scores (Hare et al. 2017; Ray and Virella 2020), but there are some inconsistencies when looking at the proportion of proposals in each category of quality. For example, Miller et al. (2020) found that in BIO, the proportion of proposals in the highest category of quality decreased and the proportion of proposals in the lowest category increased; however, Yuan et al. (2020) found the opposite in ENG. Lastly, Ray and Virella (2020) found that in SaTC, the proportion of proposals in the highest and lowest category of quality both increased.

In the adjacent literature, the available evidence about work quality (including creativity) is correlational, tends to use smaller samples, and has produced conflicting results. For example, the studies we reviewed that measure quality of output generally find no effect. The only exception was Reich and Godler's (2014) study of news media that found declines in quality under deadlines that are far shorter than those associated with grant applications.

Additionally, the studies of creativity found inconclusive results. Noefer and colleagues (2009) used a between-subjects study that incorporated third-party ratings of creativity and found enhanced performance under time pressure. In contrast, Baer and Oldham (2006), albeit using within-subjects analysis of self-reported creativity, found impaired performance under time pressure. These conflicting findings suggest further research is needed to understand the effects of deadlines on creativity. One possible explanation for these differing results is that Noefer and colleagues (2009) measured job deadline pressure while Baer and Oldham measured task deadline pressure; it is possible that more creative people could self-select into jobs that are characterized by tight deadlines, even if such deadlines undermine creative performance.

We also reviewed studies that examined the effect of deadlines on various other outcomes of deadlines apart from task initiation, progress, effort, completion, quality, and creativity. Multiple studies in the core literature found that under the no-deadlines approach, dwell time decreased (in GEO, BIO, ENG, and SaTC), funding rates increased (in GEO, BIO, ENG, and SaTC), and reviewer workload decreased (in GEO and BIO). Although no individual study was deemed rigorous, the changes in these outcomes, as well as the changes in proposal volume and average proposal quality mentioned above, are generally consistent in directionality, suggesting that at least part of the change may be attributable to the no-deadlines approach.

In the adjacent literature, we found three studies that examined how the imposition of a project deadline might affect work outside the project. Chetty and colleagues (2014) found that agreeing to review a manuscript under a tight deadline did not reduce the volume or quality of other, concurrent journal reviews. There is conflicting evidence about how deadlines impact team collaboration. Chae and colleagues (2015) found that working under time pressure might be associated with a less collaborative work culture (people share less knowledge with their peers), and Wilson and Sheetz (2014) found that students reported less conflict when working on group projects under deadlines.

Lastly, none of the studies in the adjacent literature provide insights into the equity implications of switching to no-deadlines, but we believe it is likely that removing a deadline will have different effects on people with different pacing styles and different professional and personal demands and supports. In the core literature, multiple NSF studies provided evidence that the no-deadlines approach has maintained the diversity of the applicant pool in terms of PIs characteristics but two studies documented a decrease in the number of unique institutions.

## **9. Implications for the evaluation of a no-deadlines approach at NSF**

The primary implication of our findings is that NSF could consider investigating a broad set of outcomes in a future evaluation. Our review of the literature demonstrated that many outcomes could change when using a no-deadlines approach. For example, switching to a no-deadlines approach could change the applicant pool, the number of proposals, the quality of the proposals and ideas submitted, and the review processes used, and these outcomes could also affect one another. It is difficult to predict how these interrelated outcomes might change for programs at NSF given the dearth of high-quality empirical evidence on the impacts of no-deadlines approaches. The array of hypothesized changes and weak basis for a logic model in the literature suggest the need to examine a wide range of outcomes to capture possible intended outcomes and unintended outcomes of no-deadlines approaches.

Some intended outcomes that would lend themselves to future in-depth study are proposal quality and review quality. However, some staff expressed concern about the reliability of current proposal quality measures and their comparability across directorates and divisions. NSF could assess the reliability and validity of its current metrics for proposal and review quality and, as appropriate, use those metrics as outcomes in a future evaluation. One respondent said that the OIA might already be conducting such an assessment.

Another set of intended outcomes recommended for future investigation relates to workload for NSF staff, PIs, and reviewers. Internal NSF assessments showed a consistent reduction in proposal volume following the implementation of a no-deadlines approach, but there is limited evidence about its effect on workload for the various contributors. One possible reason for the lack of evidence is that standardized measures of workload are not readily available for tracking, and each division and directorate has approached its review process under a no-deadlines approach in its own way. A future evaluation could consider creating measures and collecting data for these types of outcomes for use in analyses.

One potential unintended effect of no-deadlines approaches is a reduction in the diversity of research portfolios, particularly in terms of PI characteristics. To understand the equity implications of a switch to a no-deadlines approach, future research could investigate whether similar proportions of early-career researchers, researchers from underrepresented communities, researchers from minority-serving institutions, and researchers from less-resourced institutions submitted successful proposals under a deadlines-based approach versus a no-deadlines approach. It could also be useful to develop a sense of what types of applicants would no longer submit proposals under a no-deadlines approach. NSF could look for patterns in characteristics of PIs who submitted several proposals before the implementation of the no-deadlines approach but did not submit proposals thereafter or vice versa. NSF could also collect survey or qualitative data from PIs about whether and why the no-deadlines approach helps or impedes their proposal submissions and where PIs who no longer submit proposals to NSF now submit proposals.

## Appendix A: Methodological details

This appendix provides the technical details of the approach for investigating the implementation and potential outcomes of a no-deadlines approach to grant solicitations. We list the strategies used to uphold NSF’s Evaluation Policy and present details about the interview process and identification of non-NSF programs that have used a no-deadlines approach.

### A1. Strategies used to adhere to NSF’s Evaluation Policy

The study adheres to the five key principles described in NSF’s Evaluation Policy (Exhibit A1).

#### Exhibit A1. Key principles of NSF’s Evaluation Policy and related features

| Principle                        | Features of this study that align with this principle   |
|----------------------------------|---|
| Relevance and utility            | <ul style="list-style-type: none"> <li>We presented interview protocols and literature review processes to NSF to ensure that the team would capture information of interest to NSF.</li> <li>In collaboration with NSF and early in the study, we interviewed NSF staff with deep knowledge of no-deadlines approaches and used their recommendations for other interview respondents.</li> <li>In this report, we reflect the perspectives of NSF staff across the agency, including those working in directorates or divisions that do not rely on no-deadlines approaches.</li> <li>We presented a final briefing to NSF staff for use as a basis for future conversations and decisions about evaluating the no-deadlines approach.</li> </ul>   |
| High quality and rigor           | <ul style="list-style-type: none"> <li>We used several data sources to address the research questions.</li> <li>We used several methods across the study.</li> <li>We include a clear logic model of the no-deadlines approach at NSF.</li> <li>In this report, we include clear communication of findings and limitations.</li> <li>A senior team member reviewed screening decisions and information from literature reviews to ensure accuracy and completeness.</li> <li>Notetakers completed interview notes within two days of each interview for review by the interviewer for accuracy and completeness.</li> <li>Members of the interview team met daily to norm on consistent use of the coding scheme for analyzing interviews.</li> </ul> |
| Independence and objectivity     | <ul style="list-style-type: none"> <li>Interview questions were asked in a neutral manner.</li> <li>An independent reviewer reviewed the written report.</li> <li>In this report, we include all findings, whether positive, indeterminant, or negative.</li> <li>The NSF Contracting Officer Representative and Contracting Officer Technical Representative were not involved in any no-deadlines programs or decision-making.</li> </ul>   |
| Transparency and reproducibility | <ul style="list-style-type: none"> <li>We defined study objectives and study design prior to starting the study.</li> <li>We developed interview protocols before conducting interviews.</li> <li>We documented the literature search strategy and inclusion criteria before beginning the literature search.</li> <li>We recorded search strings, databases, access date, and number of results for all searches.</li> <li>We developed standardized literature review templates before conducting reviews.</li> <li>We developed coding schemes before coding and documented additional codes.</li> <li>In this report, we clearly explain methods and findings.</li> </ul>   |
| Ethics                           | <ul style="list-style-type: none"> <li>We safeguarded the privacy of respondents, sensitive documents, and data.</li> <li>Discussion of findings includes contextual factors that could influence interpretation of findings.</li> </ul>  |

Source: Adapted from NSF’s Evaluation Policy, September 2020.

Note: This exhibit demonstrates the ways the study adhered to NSF’s Evaluation Policy by listing the features of the study that contributed to upholding each principle.

## A2. Interviews

Using a standardized set of protocols, we conducted interviews with NSF staff members, staff from non-NSF programs that use or have considered a no-deadlines approach to grant proposals, and NSF-funded PIs and experts who have served on NSF review panels. We obtained approval to conduct the interviews under NSF's "Generic Clearance for the Collection of Qualitative Feedback on Agency Service Delivery" (OMB control number 3145-0215). Below, we describe the process of identifying and communicating with interview respondents and conducting and coding the interviews. We then show the results of the coding followed by the protocols that interviewers used.

### Identifying interview respondents

We sought to interview the most staff from NSF because of the importance of understanding their experiences with the no-deadlines approach. We also wanted to include the perspectives of other organizations and PIs but sought to interview a smaller number of respondents from those groups that would be feasible to interview within the study timeline.

Using the publicly available staff directory on NSF's website, we identified individuals representing each directorate. Using documents that NSF provided to us, we identified additional NSF staff who had presented findings on no-deadlines implementation. We shared this list with NSF for input. NSF provided additional names of individuals to interview early in the study. We asked the initial set of interview respondents, who generally were leaders in their directorate, to identify staff with practical or direct experience in managing proposal submissions under a no-deadlines approach. We supplemented these recommendations with additional individuals identified from NSF's website to create a sample that spanned many directorates and divisions.

We asked NSF program directors to recommend PIs who could speak to the experience of applying to NSF funding under a no-deadlines approach. From the group of recommended PIs, we built a sample with an approximately even balance of PIs by gender, location in the United States, type of institution (public or private university). We also considered which directorate the recommending program director was from to ensure that PI perspectives did not overly represent a particular scientific discipline. We also used the Solr database to confirm that the PIs had submitted a proposal under a no-deadlines approach and checked whether the PIs had also served as reviewers under a no-deadlines approach. In addition, drawing on the results of the searches for other organizations that use a no-deadlines approach, we identified respondents from other funding organizations with a focus on R&D whose size, needs, and processes could be similar to those of NSF and spoke with individuals who agreed to be interviewed.

For NSF staff, we reached out to 31 people and spoke with 25. NSF respondents spanned all 7 directorates as well as OIA and 16 subunits (for example, divisions) within the directorates. The respondents included 12 directorate or division leadership (for example, directors, assistant directors, deputy directors), 12 program-level staff (for example, directors, associate directors, analysts), and 1 Data and Analytics Officer.

For staff from other organizations, we reached out to 12 people and spoke with 6. However, during an interview, we learned that one organization (National Headache Foundation) uses deadlines even though it did not post any deadlines on its grant programs website. Among the 5 respondents from other grant-making organizations that use a no-deadlines approach, 2 worked for federal agencies and 3 for foundations that fund research (National Institute on Drug Abuse at National Institutes of Health;



National Aeronautics and Space Administration; Alfred P. Sloan Foundation; Fanconi Anemia Research Fund; and Adenoid Cystic Carcinoma Research Foundation).

For PIs, we reached out to 14 people and spoke with 7. Six of the PIs were employed at institutions of higher education, and one at an independent research organization. Across these respondents, they had received funding from three directorates (BIO, CISE, and GEO). One PI had served as a deputy division director at NSF and answered a few questions related to experiences at NSF with no deadlines. All 7 PIs had served as reviewers under a no-deadlines approach as well.

### **Communicating with interview respondents**

NSF gave us access to NSF staff members' calendars. We identified time periods when staff appeared to be available for an interview and sent an email that specified several time and date options, requesting that staff identify their preferred time. For the external organizations and PIs, we asked respondents to recommend two to three times when they expected to be available over the following two weeks. For the PIs, we had a shorter time in which to conduct the interviews; we began by offering a menu of interview times and asked respondents either to select a time or recommend another time. We then identified two study team members who were available during the respondent's preferred time. We set up a calendar event and provided an individualized link to a WebEx meeting. We sent a reminder email one business day before the interview and followed up with a thank-you email after the interview.

### **Conducting interviews**

Interviews involved two study team members, one primary interviewer and a notetaker. The majority of NSF interviews included one respondent. Four NSF interviews were group interviews with 2 interviewees each based on respondents' requests. Topics explored during interviews with NSF staff and staff from other organization included motivations for a no-deadlines approach, implementation and expected outcomes of a no-deadlines approach, and any observed effects of the transition.

The NSF interviews also included questions related to NSF internal assessments, when applicable to the respondent, and the feasibility of an effectiveness study. Topics explored during interviews with PIs included how submitting under no-deadlines differed from submitting with deadlines, their experience with grant offices at their institution, and observed effects. We also asked questions related to their experience as a review under a no-deadlines approach. We conducted the interviews from November 2021 to January 2022. Copies of the protocols are in this appendix.

### **Coding interviews**

We compiled the finalized interview notes and, using NVivo, undertook an iterative and collaborative coding and analysis process. The team compiled a preliminary list of codes based on themes observed while conducting the interviews. The coding team reviewed the preliminary code list to ensure a consistent, shared understanding of each code. Over the course of a week, the coding team conducted close reviews of the notes from an assigned subset of interviews. If a coder found a salient point or concept that did not fit within an existing code, the coder created a new code and documented the addition in a shared workbook. The coding team met daily to discuss the recommended new codes and continually norm on the codes' consistent use. The final list of codes is shown in Exhibit A2.

## Exhibit A2. Codes used in interview analysis

| Codes                                  | People who mentioned topic at least once | Number of times topic was mentioned |
|--|--|-------------------------------------|
| <b>Confounding factors</b>             | 0  | 0                                   |
| Budget                                 | 4  | 5                                   |
| COVID                                  | 14                                       | 27                                  |
| Cross-directorate programs             | 2  | 2                                   |
| Disturbances in academic year          | 1  | 1                                   |
| Government shutdown                    | 1  | 1                                   |
| Lapse in appropriations and operations | 0  | 0                                   |
| New programs introduced                | 1  | 1                                   |
| None                                   | 3  | 3                                   |
| Research area norms                    | 5  | 6                                   |
| Scientific workforce                   | 2  | 2                                   |
| Submission requirements                | 3  | 3                                   |
| <b>Implementation</b>                  | 2  | 2                                   |
| Challenges                             | 22                                       | 46                                  |
| Communication                          | 18                                       | 31                                  |
| Other groups                           | 11                                       | 13                                  |
| Process                                | 15                                       | 34                                  |
| Reactions                              | 21                                       | 46                                  |
| Recommendations and reflection         | 17                                       | 32                                  |
| Review process                         | 18                                       | 24                                  |
| Ad hoc                                 | 8  | 14                                  |
| Internal                               | 1  | 1                                   |
| Panels                                 | 22                                       | 34                                  |
| Successes                              | 4  | 5                                   |
| <b>Motivation</b>                      | 2  | 2                                   |
| COVID                                  | 1  | 1                                   |
| Expedite funding research              | 5  | 6                                   |
| Funding rate                           | 4  | 4                                   |
| Incentivize industry                   | 1  | 3                                   |
| NSF staff quality                      | 6  | 10                                  |
| NSF staff workload                     | 19                                       | 36                                  |
| Other organization staff workload      | 2  | 2                                   |
| Panel flexibility                      | 1  | 1                                   |
| PI experience                          | 15                                       | 19                                  |
| Proposal quality                       | 18                                       | 31                                  |
| Proposal volume                        | 15                                       | 21                                  |
| Reviewer quality                       | 9  | 17                                  |
| Reviewer workload                      | 9  | 14                                  |
| Theory                                 | 5  | 7                                   |
| Literature                             | 0  | 0                                   |
| NSF experience                         | 14                                       | 19                                  |

**Exhibit A2 (continued)**

| Codes                                   | People who mentioned topic at least once | Number of times topic was mentioned |
|---|--|-------------------------------------|
| <b>Outcomes and consequences</b>        | 0  | 0                                   |
| Award size                              | 4  | 4                                   |
| Better quality proposals                | 25                                       | 50                                  |
| Budget management                       | 14                                       | 19                                  |
| Communication and collaboration         | 11                                       | 22                                  |
| Comparison proposals                    | 2  | 4                                   |
| Dwell time                              | 6  | 8                                   |
| Longer                                  | 3  | 5                                   |
| Shorter                                 | 3  | 4                                   |
| Increase solicitations                  | 2  | 4                                   |
| Funding rate                            | 5  | 6                                   |
| Fewer proposals                         | 26                                       | 52                                  |
| Submission competition                  | 1  | 2                                   |
| More proposals                          | 1  | 1                                   |
| More proposals for deadline programs    | 1  | 1                                   |
| NSF staff workload dispersed            | 16                                       | 29                                  |
| PI flexibility                          | 23                                       | 44                                  |
| PI diversification                      | 1  | 1                                   |
| PI submission process                   | 7  | 19                                  |
| PI submission timing                    | 17                                       | 24                                  |
| Resubmissions                           | 6  | 7                                   |
| Review                                  | 2  | 3                                   |
| Efficient use of reviewers              | 5  | 6                                   |
| Less pressure on reviewers              | 2  | 2                                   |
| More reviewers                          | 1  | 1                                   |
| Panels                                  | 18                                       | 33                                  |
| Richer panel summaries                  | 2  | 3                                   |
| Review process                          | 6  | 19                                  |
| Review quality                          | 2  | 3                                   |
| University grants office experience     | 2  | 4                                   |
| <b>PI experience_Other funders</b>      | 6  | 11                                  |
| <b>PI_reviewer preference</b>           | 4  | 8                                   |
| With deadlines                          | 1  | 2                                   |
| Without deadlines                       | 3  | 6                                   |
| <b>Question 15a comparison programs</b> | 2  | 2                                   |
| <b>Study outcomes</b>                   | 2  | 2                                   |
| Prior work                              | 11                                       | 20                                  |
| Suggestions for future work             | 21                                       | 48                                  |
| <b>Unintended consequences</b>          | 4  | 4                                   |
| Early-career researchers                | 14                                       | 20                                  |
| Fiscal year timing                      | 1  | 1                                   |
| Penalized                               | 7  | 11                                  |
| Relationship with scientific community  | 1  | 1                                   |

**Exhibit A2 (continued)**

| <b>Codes</b>                           | <b>People who mentioned topic at least once</b> | <b>Number of times topic was mentioned</b> |
|--|---|--|
| Smaller institutions                   | 11  | 13   |
| Sponsored Research Office difficulties | 8   | 9  |
| Too few proposals                      | 6   | 10   |
| Underrepresented communities           | 16  | 25   |
| Worse quality proposals                | 1   | 7  |
| <b>Value of deadlines</b>              | 14  | 24   |

## Interview protocols

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### Protocol for interviews with NSF staff using a no-deadlines approach

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[Note: To be tailored to each respondent as needed given individuals' roles in the agency]

#### Introductory remarks

Hi, I'm [name] from Mathematica, and I'm here with my colleague, [notetaker name], who will be taking notes. Thank you for taking the time to speak with us today.

As you know, NSF has contracted with Mathematica to learn more about the use of a no-deadlines approach for proposal submissions. The goal is to understand why and how a no-deadlines approach to proposal submissions has been implemented, as well as the possible outcomes of using this approach.

*[Interviewer note: Only include this text if a respondent did not receive the initial outreach from Taylor; check tracker.]* Taylor Rhodes, in EAC, is overseeing our work under guidance from Robyne McRey, the Contracting Officer Representative or COR for the project. They are providing guidance in close collaboration with Clemencia Cosentino [Chief Evaluation Officer and Evaluation and Assessment Capability Section Head].

During our conversation today, we would like to get your insights regarding a no-deadlines approach, including when and why your program or directorate implemented this approach, how the approach was implemented, and what the outcomes and effects of no deadlines have been. *[If applicable: We'd also like to discuss the results of the internal assessments you were involved in conducting regarding no deadlines. Lastly, we would appreciate hearing your ideas on potentially more rigorous ways to study a no-deadlines approach.]*

Everything you say will remain confidential. We will not attribute any information to you in anything that we produce.

Before we continue, we would like to record today's session. We'll use the recording to help fill in our notes. The recording will not be shared outside of the project team and will be deleted after the notes are finalized. Do you mind if we record this conversation?

Do you have any questions before we begin?

#### A. About the respondent

1. What has been your role with respect to a no-deadlines approach to proposal submissions for your [program/division/directorate] *[Probe: To what extent were you involved in deciding whether to use this approach for your program? How have you been involved in how it was designed or conceptualized?]*
2. What are your top-of-mind thoughts on a no-deadlines approach to proposal submissions?

## B. About the no-deadlines approach

[Note to interviewer: Modify or skip questions that the respondent may have already addressed in response to Q1-2.]

3. [If the date that no deadlines were adopted is not known] How long has/have [your program/programs in division/directorate] been using a no-deadlines approach?

OR

[If the date that no deadlines were adopted is known] We have noted that your [program/division/directorate] adopted a no-deadlines approach on [date]. Is that correct?

4. Do you know what motivated your [program/division/directorate] to implement a no-deadlines approach? If so, what were the challenges or difficulties that you and your [team/colleagues] were facing that led to the implementation of a no-deadlines approach? [Probe: Was it based on NSF findings from other programs that implemented a no-deadlines approach? Or a broader literature on no deadlines? If so, what literature was relied upon? What arguments were considered for and against it at the time?]
- a. How did you think that the no-deadlines approach might help address these issues? In other words, what was the theory behind eliminating proposal deadlines?
5. Do you think the no-deadlines approach has effectively addressed those issues? Why or why not? [Note to interviewer: Probe on each issue identified.]
6. If you were involved in the decision to implement a no-deadlines approach, to what extent did you and your [team/colleagues] discuss the possibility that adopting the no-deadlines approach would create unintended effects? What unintended effects did you identify or discuss? How were these addressed or mitigated?
7. Thinking back to [YEAR] when the no-deadlines approach was implemented in your [program/division/directorate], do you know:
- a. ...how it was communicated to people who might be affected by the change (program officers, supporting staff at NSF, proposal reviewers, potential principal investigators, etc.)?
- b. ...what the initial reception was among these people regarding the change?
- i. How, if at all, has their reaction changed over time?
- ii. Have you received any feedback from the broader research community, and, if so, how would you summarize it?
- c. ...how much notice was given about the change?
- d. ...what challenges, if any, you faced in rolling it out?
- e. If you and your [team/colleagues] identified possible unintended effects from adopting the no-deadlines approach, how did the implementation efforts minimize or address these concerns, if at all?
- f. Were any other new policies put into place around the same time that might have also affected proposal submissions—that is, potentially confounding any observed changes?
8. Has the no-deadlines approach changed the merit review process or the quality of proposal reviews? [Probe: This could include steps taken in convening panels, identifying reviewers, use of ad hoc reviewers, scheduling panels, discussions of applications, making funding decisions.]

*[Note to interviewer: Ask a–d only if not already addressed.]*

- a. To what extent do you think a no-deadlines approach changes program officers' behaviors and practices? [*Probe*: How do their behaviors and practices change? Why do you think these changes occur?]
  - b. To what extent do you think a no-deadlines approach changes proposal reviewers' behaviors and practices? [*Probe*: How do their behaviors and practices change? Why do you think these changes occur?]
  - c. To what extent do you think a no-deadlines approach changes potential principal investigators' behaviors and practices (such as how they collaborate, when they submit, quality of submissions, frequency of submissions)? [*Probe*: How do their behaviors and practices change? Why do you think these changes occur?]
  - d. Are there any other groups of individuals whose behaviors and practices might have changed as a result of a no-deadlines approach? [*If yes*]: How and why?
9. Are there any other outcomes or effects that you have observed of a no-deadlines approach that you have not already mentioned?
- a. Have you observed any other potentially unexpected or unintended effects of a no-deadlines approach? If so, do you have any theory as to why they are occurring?
10. [*Note to interviewer: Ask only if not already addressed,*] Have you observed any changes in applicant characteristics, institutions, research topics, quality of proposals, or any other aspects of proposal submissions that you would attribute to the no-deadlines approach?
11. Do you have any concerns about the no-deadlines approach? Do you think NSF should consider expanding it to more programs? Why or why not?

### **C. About internal assessments**

*[Note to interviewer: Skip this section if running short on time. This module will be applicable to only a subset of respondents.]*

Next, we want to talk about the internal assessment of no deadlines in [program] that you were involved with. We've had a chance to look at the materials from [date] and would like to learn a little more about what you examined and if you have any additional findings.

12. Were the findings surprising to you? Why or why not?
13. Did you continue the analysis with any more recent data? If so, how, if at all, did that affect your findings?
14. Do you mind if we reach out via email if we have more questions about the internal assessment as we continue to review material?

### **D. About the feasibility of an effectiveness study**

We understand that NSF is interested in conducting a comparative study to evaluate the effects of using a no-deadlines approach.

15. How [else would/would] you study the effects of the no-deadlines approach for your specific [program/division/directorate]?

- a. Are there any programs similar to the ones you are connected with that never adopted a no-deadlines approach, or adopted a no-deadlines approach at a different time than your program, that could be used as a comparison in a study?

16. What are the most important outcomes that the study should capture?

17. Do you have any suggestions about how NSF might evaluate the overall effects of using a no-deadlines approach across most or all of the programs that do so? What potential challenges, if any, do you think there would be to evaluating the overall efficacy of using a no-deadlines approach across programs?

## E. Closing

18. To wrap up, is there anything else you think we should consider as we continue learning about the no-deadlines approach to proposal submissions?

19. *[Note to interviewer: Do not ask if the respondent is a PD or PO.]* Are there any particular program directors or officers from your division/directorate that you think would be willing to speak with us and provide their perspective on the use of no deadlines?

20. Could you please provide the names of three PIs you've worked with using a no-deadlines approach who might be willing to speak with us and provide their perspective on using no deadlines (or is there someone else we should talk to get those suggestions)? Do you know if the PIs you recommended have served as reviewers as well? *[Note to interviewer: We are happy to get any recommendations. If asked for parameters, we are interested in speaking with a wide range of PIs that have different experience levels (including early-career PIs) and are from a different institution size/type (including smaller and minority-serving institutions).]*

21. Is there anyone else, either within NSF or from other organizations, that you would recommend we consider interviewing to get their perspective on the no-deadlines approach? If so, why are you suggesting them?

22. Do you have any questions for us?

Those are all the questions I have for you today. We know you are busy and sincerely appreciate your time. If you think of anything else that you would like us to keep in mind as we proceed with this study, please feel free to reach out to me, Taylor, or Robyne.

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## Protocol for interviews with NSF staff not using a no-deadlines approach

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[Note: To be tailored to each respondent as needed given individuals' roles in the agency]

### Introductory remarks

Hi, I'm [name] from Mathematica, and I'm here with my colleague, [notetaker name], who will be taking notes. Thank you for taking the time to speak with us today.

As you may know, NSF has contracted with Mathematica to learn more about the use of a no-deadlines approach for proposal submissions. The goal is to understand why and how a no-deadlines approach to proposal submissions has been implemented, as well as the possible outcomes of using this approach. As part of this work, we are also interested in speaking with folks in directorates, divisions, and/or programs at NSF that do *not* currently use a no-deadlines approach.



Taylor Rhodes, in EAC, is overseeing our work under guidance from Robyne McRey, the Contracting Officer Representative or COR for the project. They are providing guidance in close collaboration with Clemencia Cosentino [Chief Evaluation Officer and Evaluation and Assessment Capability Section Head].

During our conversation today, we would like to get your insights regarding a no-deadlines approach, including any considerations of implementing it in your [directorate/program] and motivations for not doing so.

Everything you say will remain confidential. We will not attribute any information to you in anything that we produce.

Before we continue, we would like to record today's session. We'll use the recording to help fill in our notes. The recording will not be shared outside of the project team and will be deleted after the notes are finalized. Do you mind if we record this conversation?

Do you have any questions before we begin?

#### **A. About the respondent**

1. Can you please share a bit about your understanding of the no-deadlines approach at NSF?
2. Have any programs you worked with considered a no-deadlines approach?  
[\*Note to interviewer: If No, skip to Q7\*.]
3. To what extent were you involved in any discussions regarding the potential use of a no-deadlines approach to proposal submissions for [your program and directorate]?
  - a. When did those take place, and who were the key decisionmakers? [*Probe*: What "outside" perspectives may have been taken into account?]

#### **B. About the no-deadlines approach**

[*Note to interviewer: Modify or skip questions that the respondent may have already addressed in response to Q1–3.*]

4. What were the challenges or difficulties that you and your [team/colleagues] were facing that led to the consideration of a no-deadlines approach?
5. How did you think that the no-deadlines approach might help address these issues? In other words, what was the theory behind possibly eliminating proposal deadlines? [*Probe*: Was it based on NSF findings from other programs that implemented a no-deadlines approach? Or a broader literature on no deadlines? If so, what literature was relied upon?]
6. What arguments were considered for and against no-deadlines at the time?
  - a. To what extent did you and your [team/colleagues] discuss the possibility that adopting the no-deadlines approach would create unintended effects? What unintended effects did you identify or discuss?
7. What were your [program/division/directorate]'s primary motivation(s) for retaining deadlines, while many core programs in other directorates have shifted to a no-deadlines approach?

8. Do you have any concerns about the current use, or potential future adoption, of the no-deadlines approach elsewhere at NSF?
9. Do you think your directorate, division, or program should [consider/reconsider] adopting it? Why or why not?
  - a. If not, is there any evidence that might lead you to reconsider that position?

### **C. Closing**

10. To wrap up, is there anything else you think we should consider as we continue learning about the use of the no-deadlines approach to proposal submissions at NSF?
11. Are there any particular program officers from your division/directorate that you think would be willing to speak with us and provide their perspective on no deadlines?
12. Is there anyone else, either within NSF or from other organizations, that you would recommend we consider interviewing to get their perspective on the no-deadline approach? If so, why are you suggesting them?
13. Do you have any questions for us?

Those are all the questions I have for you today. We know you are busy and sincerely appreciate your time. If you think of anything else that you would like us to keep in mind as we proceed with this study, please feel free to reach out to me, Taylor, or Robyne.

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## **Protocol for interview with organizations that use a no-deadlines approach for proposal submissions**

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A few years ago, NSF eliminated proposal deadlines for its GEO directorate, and since then this approach has been expanded to other parts of NSF. NSF is interested in assessing the pros and cons of this approach, and, as part of that assessment, learning about the experiences of other funders. We wanted to talk with you because we understand that your organization has eliminated deadlines for proposal submissions for at least some of the funding streams.

Before we continue, we would like to record today's session as back-up to the notes. The recording will not be shared outside of the project team and will be deleted after the notes are finalized. Do we have your permission to record?

### **Introductory remarks**

1. What is your role in program/announcement development, proposal submission, and review of applications?

### **A. About the no-deadlines approach**

2. Can you briefly summarize your proposal submission and review process?
3. Are there certain types of programs/funding streams that use no deadlines for proposal submissions, or do all programs use this approach? If the former, what types of programs have deadlines and which do not and why?

4. To the best of your knowledge, has your organization always used a no-deadlines approach for at least some programs or funding streams?
5. *[If a change was made during respondent's time]* What motivated your organization to use a no-deadlines approach?  
Probes: Was it based on any research about the benefits of this approach? Was it related to the volume of applications, ability to recruit reviewers, availability of staff to manage reviews, something else?
6. *[If a change was made during respondent's time]* In your view, how has the no-deadlines approach changed the review process? The applicant pool? The quality of proposals submitted? Have you observed any other consequences, intended or unintended, of the change? How was the change received by your research community?
7. Thinking about how you are implementing the no-deadlines approach:
  - a. What challenges, if any, did you face in doing so?
  - b. If you and your colleagues identified possible unintended effects from adopting the no-deadlines approach, how did the implementation efforts minimize or address these concerns, if at all?
8. What do you see as the pros and cons of the no-deadlines approach? Do you prefer a submission process that does or does not include deadlines and why?
9. NSF found that eliminating deadlines led to a sharp decline in the number of proposal submissions. Do you have any theories why this may have happened? How do you think eliminating deadlines affects applicant and reviewer behavior? Quality of proposals?

## Closing

10. Is there anything else you would like to share with us about the no-deadlines approach?
11. Are you aware of other funders of research and development that use this approach? Could you recommend someone at this organization for us to talk to?

A federal agency may not conduct or sponsor a collection of information unless it displays a currently valid OMB control number; the number for this is 3145-0215. We estimate that participating in this interview should take no more than 30 minutes, including the time for reading the instructions.

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## Protocol for interviews with principal investigators and proposal reviewers

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### Introductory remarks

Hi, I'm [name] from Mathematica, and I'm here with my colleague, [notetaker name], who will be taking notes. Thank you for taking the time to speak with us today.

NSF has contracted with Mathematica to learn more about the use of a no-deadlines approach for proposal submissions. Through this effort, the goal is to understand why and how a no-deadlines approach to proposal submissions has been implemented, as well as the possible outcomes of using this approach, including any second-order consequences.

During our conversation today, we would like to get your insights as a principal investigator (or PI) [and as a proposal reviewer] regarding the no-deadlines approach used by NSF, including your perspective on the effects this approach may have had on the application and review process.

Everything you say will remain confidential. We will not attribute any information to you in anything that we produce. You can choose to not answer any question.

Before we continue, we would like to record today's session to help fill in our notes. The recording will not be shared outside of the project team and will be deleted after the notes are finalized. Do you mind if we record this conversation?

Do you have any questions before we begin?

### **A. About the respondent**

1. Have you submitted a proposal as a PI or co-PI to a program that uses a no-deadlines approach? If so, which one(s), and when? How many proposals?

### **B. About the no-deadlines approach as a PI**

*[If the respondent is NOT also a proposal reviewer]* I have some questions for you about your experience with the no-deadlines approach from the perspective of an applicant for funding.

*[If the respondent IS also a proposal reviewer]* I'll be asking you about the no-deadlines approach from the perspective of a PI and a proposal reviewer, but for this first set of questions, please focus on your perspective as a PI, and we'll then turn to a second set of questions where you can share your perspective as a proposal reviewer.

2. As a PI applying for funding, how would you compare the no-deadlines mode of submission relative to having deadlines? Specifically, how (if at all) did it change:
  - a. The substance or quality of your proposal?
  - b. Your proposed team or the nature of your collaborations?
  - c. When you submitted a proposal or the amount of time you spent on its preparation?
  - d. Your motivation to apply?
  - e. How often you submitted proposals?
  - f. The quality or timeliness of reviews that you received?
3. Has your institution handled submissions of proposals with no deadlines differently than those with deadlines? How so?
  - a. *[If not addressed in response to #3]* Specifically, has your engagement or experience with grant-related support staff or offices within your institution been different? If so, in what ways?
4. Have you observed any potentially unexpected or unintended effects of a no-deadlines approach from the perspective of an applicant? If so, what are they, and do you have any theory as to why they are happening or how they could be mitigated?
5. Have you submitted proposals with no deadlines to other funders?
  - a. Can you describe these?
  - b. How are they different from NSF?

6. On balance, which mode do you prefer as an applicant: with or without deadlines for proposal submissions? Why?

**C. About the no-deadlines approach as a proposal reviewer**

[If respondent is also a proposal reviewer] Next, I have some questions for you on your experience with the no-deadlines approach as a proposal reviewer.

7. How would you compare your most recent experience reviewing proposals with no deadlines to those that had a deadline, in terms of:
  - a. The quality of proposals?
  - b. The applicant pool?
  - c. Types of research projects proposed?
  - d. Any other differences?
8. Why do you think these differences emerged?
9. Again, compared to your most recent experience reviewing proposals with deadlines, how did the no-deadlines approach affect the panel review *process*?
  - a. Did you have more or less time to complete your review?
  - b. For panel reviews, was it easier or harder to reach a consensus with other panel reviewers? Why?
  - c. For panel reviews, were you more or less satisfied with the composition of the panel? Why?
  - d. Were there any other differences both in how the review was organized and how it was ultimately conducted?
10. Are there specific advantages of a no deadlines approach for the proposal review process? If so, what are they? Are there specific disadvantages that the no-deadlines approach introduced? If so, what are they?
11. Have you observed any potentially unexpected or unintended effects of a no-deadlines approach, specifically from the perspective of a proposal reviewer? Do you have any theory as to why that is happening?
12. Have you reviewed proposals with no deadlines for other funders?
  - a. Can you describe these?
  - b. How are they different from NSF?
  - c. On balance, which mode do you prefer as a proposal reviewer: with or without deadlines for proposal submissions? Why?

**D. Closing**

13. To wrap up, is there anything else you think we should consider as we continue learning about the no-deadlines approach to proposal submissions?
14. Is there anyone else that you think we should speak with about a no-deadlines approach? Why?
15. Do you have any questions for us?

Those are all the questions I have for you today. We know you are busy and sincerely appreciate your time. If you think of anything else that you would like us to keep in mind as we proceed with this study, please feel free to reach out to me.

### A3. Website searches for organizations that use a no-deadlines approach

The organizations we identified as having used a no-deadlines approach and their websites are listed in Exhibit A3.

#### Exhibit A3. Organizations that have adopted a no-deadlines approach

| Organization   | Website   |
|--|---|
| A Kids' Brain Tumor Cure Foundation                    | <a href="https://akidsbraintumorcure.org">https://akidsbraintumorcure.org</a>                                       |
| Adenoid Cystic Carcinoma Research Foundation*          | <a href="https://www.accrf.org/">https://www.accrf.org/</a>   |
| Adira Foundation                                       | <a href="https://adirafoundation.org/">https://adirafoundation.org/</a>   |
| African Academy of Sciences                            | <a href="https://www.aasciences.africa/">https://www.aasciences.africa/</a>   |
| Alcon Foundation                                       | <a href="https://www.alcon.com/">https://www.alcon.com/</a>   |
| Alfred P. Sloan Foundation*                            | <a href="https://sloan.org/">https://sloan.org/</a>   |
| Alzheimer's Drug Discovery Foundation*                 | <a href="https://alzdiscovery.org">https://alzdiscovery.org</a>   |
| American Association for Cancer Research               | <a href="http://www.aacr.org">http://www.aacr.org</a>   |
| American Association of Critical Care Nurses           | <a href="https://www.aacn.org/">https://www.aacn.org/</a>   |
| American Syringomyelia & Chiari Alliance Project*      | <a href="https://asap.org/">https://asap.org/</a>   |
| American Vein and Lymphatic Society                    | <a href="https://www.myavls.org">https://www.myavls.org</a>   |
| Amgen Foundation, Inc.*                                | <a href="https://www.amgen.com">https://www.amgen.com</a>   |
| Argonne National Laboratory                            | <a href="https://www.aps.anl.gov/">https://www.aps.anl.gov/</a>   |
| Association for Frontotemporal Degeneration            | <a href="https://theaftd.org">https://theaftd.org</a>   |
| Association of Clinical Pathologists                   | <a href="https://pathologists.org.uk/">https://pathologists.org.uk/</a>   |
| AstraZeneca Canada                                     | <a href="https://www.astrazeneca.ca/en">https://www.astrazeneca.ca/en</a>   |
| ASXL Rare Resource Endowment                           | <a href="https://arrefoundation.org">https://arrefoundation.org</a>   |
| Audacious Project                                      | <a href="https://audaciousproject.org/">https://audaciousproject.org/</a>   |
| AVRDC—The World Vegetable Center                       | <a href="http://www.avrdc.org/">http://www.avrdc.org/</a>   |
| Banner Health Foundation of Arizona                    | <a href="https://www.bannerhealth.com/">https://www.bannerhealth.com/</a>   |
| Bausch and Lomb  | <a href="https://www.bausch.com/">https://www.bausch.com/</a>   |
| Bausch Foundation                                      | <a href="https://www.bauschfoundation.org/">https://www.bauschfoundation.org/</a>                                   |
| Biogen, Inc.   | <a href="https://www.biogen.com/en_us/home.html">https://www.biogen.com/en_us/home.html</a>                         |
| Biomedical Advanced Research and Development Authority | <a href="https://www.phe.gov/about/barda/Pages/default.aspx">https://www.phe.gov/about/barda/Pages/default.aspx</a> |
| Biosense Webster                                       | <a href="https://www.biosensewebster.com/">https://www.biosensewebster.com/</a>                                     |
| Biotronik, Inc.  | <a href="https://www.biotronik.com/">https://www.biotronik.com/</a>   |
| Bloomberg Philanthropies                               | <a href="https://www.bloomberg.org/">https://www.bloomberg.org/</a>   |
| Boehringer Ingelheim Fonds                             | <a href="http://www.bifonds.de/">http://www.bifonds.de/</a>   |
| British Society for Rheumatology                       | <a href="https://www.rheumatology.org.uk/">https://www.rheumatology.org.uk/</a>                                     |
| Buscaglia (Leo) Foundation                             | <a href="http://leobuscaglia.org/">http://leobuscaglia.org/</a>   |
| Campbell Foundation                                    | <a href="https://www.campbellfoundation.net/">https://www.campbellfoundation.net/</a>                               |
| Canadian National Railway Company                      | <a href="http://www.cn.ca/">http://www.cn.ca/</a>   |
| Canterbury Medical Research Foundation                 | <a href="http://www.cmrfr.org.nz/">http://www.cmrfr.org.nz/</a>   |
| Case Western Reserve University                        | <a href="https://case.edu/">https://case.edu/</a>   |
| Cayman Chemical  | <a href="https://www.caymanchem.com/Home">https://www.caymanchem.com/Home</a>                                       |
| Cedars-Sinai Medical Centre                            | <a href="https://www.cedars-sinai.org/">https://www.cedars-sinai.org/</a>   |

**Exhibit A3 (continued)**

| Organization  | Website   |
|---|---|
| Centers for Disease Control and Prevention*                   | <a href="https://cdc.gov">https://cdc.gov</a>   |
| Charles Koch Foundation*                                      | <a href="https://charleskochfoundation.org/">https://charleskochfoundation.org/</a>   |
| CHDI Foundation   | <a href="https://chdifoundation.org/">https://chdifoundation.org/</a>   |
| Childhood Arthritis & Rheumatology Research Alliance          | <a href="https://carragroup.org">https://carragroup.org</a>   |
| Children with Cancer UK                                       | <a href="https://www.childrenwithcancer.org.uk/">https://www.childrenwithcancer.org.uk/</a>   |
| Cisco Systems, Inc.   | <a href="http://research.cisco.com/">http://research.cisco.com/</a>   |
| Clinical Excellence Research Center                           | <a href="http://med.stanford.edu/cerc.html">http://med.stanford.edu/cerc.html</a>   |
| Cordis  | <a href="https://www.cordis.com/en_us">https://www.cordis.com/en_us</a>   |
| Crohn's & Colitis Foundation of America                       | <a href="https://crohnscolitisfoundation.org">https://crohnscolitisfoundation.org</a>   |
| Cure Alzheimer's Fund   | <a href="https://curealz.org/">https://curealz.org/</a>   |
| Cure SMA  | <a href="https://www.curesma.org/">https://www.curesma.org/</a>   |
| Cystic Fibrosis Foundation*                                   | <a href="https://cff.org">https://cff.org</a>   |
| Daiichi Sankyo  | <a href="https://dsi.com/">https://dsi.com/</a>   |
| Dana-Farber Cancer Institute                                  | <a href="https://www.dana-farber.org/">https://www.dana-farber.org/</a>   |
| Davis Foundation  | <a href="https://hpdavis.org">https://hpdavis.org</a>   |
| Defense Advanced Research Projects Agency*                    | <a href="https://www.darpa.mil/">https://www.darpa.mil/</a>   |
| Department of Energy  | <a href="https://www.energy.gov/">https://www.energy.gov/</a>   |
| Department of the Army  | <a href="https://www.army.mil/">https://www.army.mil/</a>   |
| Deutsche Forschungsgemeinschaft                               | <a href="http://www.dfg.de/">http://www.dfg.de/</a>   |
| Diamond Blackfan Anemia Foundation                            | <a href="https://dbafoundation.org/">https://dbafoundation.org/</a>   |
| Dominion Energy Charitable Foundation                         | <a href="https://www.dominionenergy.com/community/dominion-energy-charitable-foundation">https://www.dominionenergy.com/community/dominion-energy-charitable-foundation</a> |
| Emergent Ventures   | <a href="https://www.mercatus.org/emergent-ventures">https://www.mercatus.org/emergent-ventures</a>   |
| Emory University School of Medicine                           | <a href="https://med.emory.edu/">https://med.emory.edu/</a>   |
| Engineering and Physical Sciences Research Council (EPSRC)*   | <a href="https://ukri.org">https://ukri.org</a>   |
| European Society for Pediatric Infectious Diseases            | <a href="https://www.espid.org/default.aspx">https://www.espid.org/default.aspx</a>   |
| Extreme Science and Engineering Discovery Environment (XSEDE) | <a href="https://www.xsede.org/">https://www.xsede.org/</a>   |
| Fanconi Anemia Research Fund, Inc.*                           | <a href="https://www.fanconi.org/">https://www.fanconi.org/</a>   |
| Federal Communications Commission                             | <a href="https://www.fcc.gov/">https://www.fcc.gov/</a>   |
| Federation of American Societies for Experimental Biology     | <a href="https://www.faseb.org/">https://www.faseb.org/</a>   |
| Focused Ultrasound Surgery Foundation                         | <a href="https://fusfoundation.org">https://fusfoundation.org</a>   |
| Foundation for Anesthesia Education and Research              | <a href="https://asahq.org">https://asahq.org</a>   |
| Foundation for Angelman Syndrome Therapeutics                 | <a href="https://cureangelman.org">https://cureangelman.org</a>   |
| Foundation for Innovative New Diagnostics                     | <a href="https://www.finddx.org/">https://www.finddx.org/</a>   |
| Fox (Michael J.) Foundation for Parkinson's Research*         | <a href="https://www.michaeljfox.org/">https://www.michaeljfox.org/</a>   |
| FRAXA Research Foundation                                     | <a href="https://www.fraxa.org/">https://www.fraxa.org/</a>   |
| Friends of the Farlow Graduate Student Fellowships            | <a href="https://harvard.edu">https://harvard.edu</a>   |
| Genentech*  | <a href="https://www.gene.com/">https://www.gene.com/</a>   |
| General Electric Healthcare                                   | <a href="https://www.gehealthcare.com/">https://www.gehealthcare.com/</a>   |
| Gilead Sciences*  | <a href="https://www.gilead.com/">https://www.gilead.com/</a>   |
| GlaxoSmithKline   | <a href="http://us.gsk.com/en-us/">http://us.gsk.com/en-us/</a>   |
| Guthy-Jackson Charitable Foundation                           | <a href="https://guthyjacksonfoundation.org/">https://guthyjacksonfoundation.org/</a>   |



**Exhibit A3 (continued)**

| Organization  | Website   |
|---|---|
| Halliburton   | <a href="https://www.halliburton.com/">https://www.halliburton.com/</a>   |
| Harold and Leila Y. Mathers Foundation  | <a href="http://www.mathersfoundation.org/">http://www.mathersfoundation.org/</a>                                   |
| Health Research Board   | <a href="https://www.hrb.ie/">https://www.hrb.ie/</a>   |
| Hearst Foundations  | <a href="https://www.hearstfdn.org/">https://www.hearstfdn.org/</a>   |
| Hemophilia Association of New York  | <a href="http://www.hemophilia-newyork.org/">http://www.hemophilia-newyork.org/</a>                                 |
| Hemophilia of Georgia   | <a href="http://www.hog.org/">http://www.hog.org/</a>   |
| Hospital for Special Surgery  | <a href="https://www.hss.edu/">https://www.hss.edu/</a>   |
| International Bone Research Association                                       | <a href="http://www.ibra.ch/">http://www.ibra.ch/</a>   |
| International Federation of Clinical Chemistry and Laboratory Medicine (IFCC) | <a href="http://www.ifcc.org/">http://www.ifcc.org/</a>   |
| International Mechanical Diagnosis and Therapy Research Foundation            | <a href="http://imdrf.org/">http://imdrf.org/</a>   |
| International Nut and Dried Fruit Council Foundation (INC)                    | <a href="https://www.nutfruit.org/">https://www.nutfruit.org/</a>   |
| Islamic World Education, Scientific, and Cultural Organization                | <a href="https://www.icesco.org/en">https://www.icesco.org/en</a>   |
| Jain Foundation, Inc.   | <a href="https://www.jain-foundation.org/">https://www.jain-foundation.org/</a>                                     |
| Janssen Biotech, Inc.   | <a href="https://www.janssen.com/us/">https://www.janssen.com/us/</a>   |
| Johnson & Johnson   | <a href="https://www.jnjmedicaldevices.com/en-US">https://www.jnjmedicaldevices.com/en-US</a>                       |
| Josiah Macy Jr. Foundation  | <a href="https://macyfoundation.org">https://macyfoundation.org</a>   |
| Lavelle Fund for the Blind, Inc.  | <a href="https://lavellefund.org/">https://lavellefund.org/</a>   |
| Lewin Fund to Fight Women's Cancers   | <a href="http://www.thelewinfund.org/">http://www.thelewinfund.org/</a>   |
| Lyme Disease Association, Inc.  | <a href="https://lymediseaseassociation.org/">https://lymediseaseassociation.org/</a>                               |
| Lymphatic Malformation Institute  | <a href="https://www.lmiresearch.org">https://www.lmiresearch.org</a>   |
| Magee-Womens Research Institute (MWRI)  | <a href="https://mageewomens.org/">https://mageewomens.org/</a>   |
| Maine Medical Center  | <a href="https://mainehealth.org/maine-medical-center/">https://mainehealth.org/maine-medical-center/</a>           |
| Mary McClellan Foundation   | <a href="https://marymcclellanfoundation.org/">https://marymcclellanfoundation.org/</a>                             |
| MAX IV  | <a href="https://www.maxiv.lu.se/">https://www.maxiv.lu.se/</a>   |
| Mayo Clinic College of Medicine and Science                                   | <a href="https://college.mayo.edu/">https://college.mayo.edu/</a>   |
| Memorial Sloan-Kettering Cancer Center  | <a href="https://www.mskcc.org/">https://www.mskcc.org/</a>   |
| Mercatus Center   | <a href="https://www.mercatus.org/">https://www.mercatus.org/</a>   |
| Merck Company*  | <a href="https://www.merck.com/">https://www.merck.com/</a>   |
| MMS Holdings Inc.   | <a href="https://www.mmsholdings.com/">https://www.mmsholdings.com/</a>   |
| Modell (Jeffrey) Foundation   | <a href="http://www.info4pi.org/home">http://www.info4pi.org/home</a>   |
| Monell Chemical Senses Center   | <a href="https://www.monell.org/">https://www.monell.org/</a>   |
| Muscular Dystrophy Association  | <a href="https://www.mda.org/">https://www.mda.org/</a>   |
| NASA*   | <a href="https://www.nasa.gov/">https://www.nasa.gov/</a>   |
| National Fish and Wildlife Foundation   | <a href="https://www.nfwf.org/">https://www.nfwf.org/</a>   |
| National Hemophilia Foundation  | <a href="https://www.hemophilia.org/">https://www.hemophilia.org/</a>   |
| National Institutes of Health*  | <a href="https://www.nih.gov/">https://www.nih.gov/</a>   |
| National Organization for Rare Disorders                                      | <a href="https://rarediseases.org/">https://rarediseases.org/</a>   |
| National Spasmodic Dysphonia Association                                      | <a href="http://www.dysphonia.org/">http://www.dysphonia.org/</a>   |
| Nevro Corp.   | <a href="https://www.nevro.com/English/us/home/default.aspx">https://www.nevro.com/English/us/home/default.aspx</a> |
| New Zealand Winegrowers   | <a href="https://www.nzwine.com/en/">https://www.nzwine.com/en/</a>   |
| Northwestern University Feinberg School of Medicine                           | <a href="https://www.feinberg.northwestern.edu/">https://www.feinberg.northwestern.edu/</a>                         |

**Exhibit A3 (continued)**

| Organization                                      | Website   |
|---|---|
| Oak Ridge Associated Universities                 | <a href="http://www.oraui.org/">http://www.oraui.org/</a>   |
| Ochsner Health System                             | <a href="https://www.ochsner.org/">https://www.ochsner.org/</a>                                       |
| Oklahoma Medical Research Foundation (OMRF)       | <a href="https://omrf.org/">https://omrf.org/</a>   |
| Otsuka America Pharmaceutical, Inc.               | <a href="https://www.otsuka-us.com/">https://www.otsuka-us.com/</a>                                   |
| Parkinson's Foundation                            | <a href="https://www.parkinson.org/">https://www.parkinson.org/</a>                                   |
| Passano Foundation, Inc.                          | <a href="https://www.passanofoundation.org/">https://www.passanofoundation.org/</a>                   |
| Patient-Centered Outcomes Research Institute      | <a href="https://www.pcori.org/">https://www.pcori.org/</a>   |
| Paul G. Allen Foundation                          | <a href="https://pgafamilyfoundation.org">https://pgafamilyfoundation.org</a>                         |
| Pharmacoclics                                     | <a href="https://www.pharmacoclics.com/home/">https://www.pharmacoclics.com/home/</a>                 |
| Prader-Willi Syndrome Association                 | <a href="http://www.pwsausa.org/">http://www.pwsausa.org/</a>   |
| Prevention Research Center                        | <a href="https://prev.org/">https://prev.org/</a>   |
| Princeton University                              | <a href="https://www.princeton.edu/">https://www.princeton.edu/</a>                                   |
| Public Health Agency of Canada                    | <a href="https://www.canada.ca/en/public-health.html">https://www.canada.ca/en/public-health.html</a> |
| Pulmonary Fibrosis Foundation                     | <a href="https://www.pulmonaryfibrosis.org/">https://www.pulmonaryfibrosis.org/</a>                   |
| Revson (Charles H.) Foundation                    | <a href="https://revsonfoundation.org/">https://revsonfoundation.org/</a>                             |
| Robert Wood Johnson Foundation                    | <a href="https://rwjf.org">https://rwjf.org</a>   |
| Sanofi Genzyme Corporation*                       | <a href="https://www.sanofigenzyme.com/">https://www.sanofigenzyme.com/</a>                           |
| Sarepta Therapeutics                              | <a href="https://www.sarepta.com/">https://www.sarepta.com/</a>                                       |
| Scherrer (Paul) Institute                         | <a href="https://www.psi.ch/en">https://www.psi.ch/en</a>   |
| Silicon Valley Community Foundation               | <a href="https://siliconvalleycf.org">https://siliconvalleycf.org</a>                                 |
| Simmons Foundation for Autism Research Initiative | <a href="https://www.sfari.org/">https://www.sfari.org/</a>   |
| Smith (A.O.) Foundation                           | <a href="http://www.aosmith.com/">http://www.aosmith.com/</a>   |
| Solving Kid's Cancer                              | <a href="https://solvingkidscancer.org">https://solvingkidscancer.org</a>                             |
| Stanford University                               | <a href="https://med.stanford.edu/pain/snap/">https://med.stanford.edu/pain/snap/</a>                 |
| Stauffer (John) Charitable Trust                  | <a href="https://fonline.foundationcenter.org/">https://fonline.foundationcenter.org/</a>             |
| Stern (Sidney) Memorial Trust                     | <a href="https://sidneysternmemorialtrust.org/">https://sidneysternmemorialtrust.org/</a>             |
| Strongbridge Biopharma                            | <a href="https://www.strongbridgebio.com/">https://www.strongbridgebio.com/</a>                       |
| Taiho Oncology                                    | <a href="https://www.taihooncology.com/us/">https://www.taihooncology.com/us/</a>                     |
| Takeda Oncology                                   | <a href="https://www.takedaoncology.com/">https://www.takedaoncology.com/</a>                         |
| Teleflex Foundation                               | <a href="https://www.teleflex.com/usa/">https://www.teleflex.com/usa/</a>                             |
| Teva Pharmaceuticals                              | <a href="http://www.tevarequests.com/">http://www.tevarequests.com/</a>                               |
| The Mayday Fund                                   | <a href="https://maydayfund.org/">https://maydayfund.org/</a>   |
| Thrasher Research Fund                            | <a href="https://www.thrasherresearch.org/">https://www.thrasherresearch.org/</a>                     |
| Thyssen (Fritz) Foundation                        | <a href="http://www.fritz-thyssen-stiftung.de/en/">http://www.fritz-thyssen-stiftung.de/en/</a>       |
| Tres Cantos Open Lab Foundation                   | <a href="http://www.openlabfoundation.org/">http://www.openlabfoundation.org/</a>                     |
| Tulane National Primate Research Center           | <a href="http://www2.tulane.edu/tnprc/">http://www2.tulane.edu/tnprc/</a>                             |
| Turkish Philanthropy Funds                        | <a href="https://www.tpfund.org/">https://www.tpfund.org/</a>   |
| U.S. Agency for International Development         | <a href="https://www.usaid.gov/">https://www.usaid.gov/</a>   |
| Ultragenyx Pharmaceutical                         | <a href="https://www.ultragenyx.com/">https://www.ultragenyx.com/</a>                                 |
| University of Alabama at Birmingham               | <a href="https://www.uab.edu/medicine/">https://www.uab.edu/medicine/</a>                             |
| University of Iowa                                | <a href="https://gme.medicine.uiowa.edu/">https://gme.medicine.uiowa.edu/</a>                         |
| University of Leeds                               | <a href="http://scholarships.leeds.ac.uk/">http://scholarships.leeds.ac.uk/</a>                       |
| University of Melbourne                           | <a href="https://www.unimelb.edu.au/">https://www.unimelb.edu.au/</a>                                 |
| Varian*   | <a href="https://www.varian.com/">https://www.varian.com/</a>   |

### Exhibit A3 (continued)

| Organization  | Website   |
|---|---|
| Vision of Children Foundation   | <a href="https://www.visionofchildren.org/">https://www.visionofchildren.org/</a>     |
| von Humboldt (Alexander) Foundation                                     | <a href="https://www.humboldt-foundation.de/">https://www.humboldt-foundation.de/</a> |
| W.K. Kellogg Foundation   | <a href="https://wkkf.org">https://wkkf.org</a>                                       |
| Washington University in St. Louis                                      | <a href="https://pridecc.wustl.edu">https://pridecc.wustl.edu</a>                     |
| Wellcome Trust  | <a href="https://wellcome.ac.uk/">https://wellcome.ac.uk/</a>                         |
| West Coast Consortium for Technology & Innovation in Pediatrics         | <a href="https://www.westcoastctip.org/">https://www.westcoastctip.org/</a>           |
| Williams Syndrome Association   | <a href="https://williams-syndrome.org/">https://williams-syndrome.org/</a>           |
| Willis-Ekbom Disease (WED) Foundation/Restless Legs Syndrome Foundation | <a href="https://www.rls.org/">https://www.rls.org/</a>                               |
| Wings for Life Spinal Cord Research                                     | <a href="https://www.wingsforlife.com/us/">https://www.wingsforlife.com/us/</a>       |
| Women in Medicine Legacy Foundation                                     | <a href="https://www.wimlf.org">https://www.wimlf.org</a>                             |
| Yale University School of Medicine                                      | <a href="https://medicine.yale.edu/">https://medicine.yale.edu/</a>                   |

Source: List compiled through our organizational website searches.

Note: This exhibit shows the organizations we identified as using a no-deadlines approach for one or more of its programs and provides a link to the organization's website. \* denotes the 20 organizations selected for website review in which we searched for additional information on how the no-deadlines approaches are implemented.

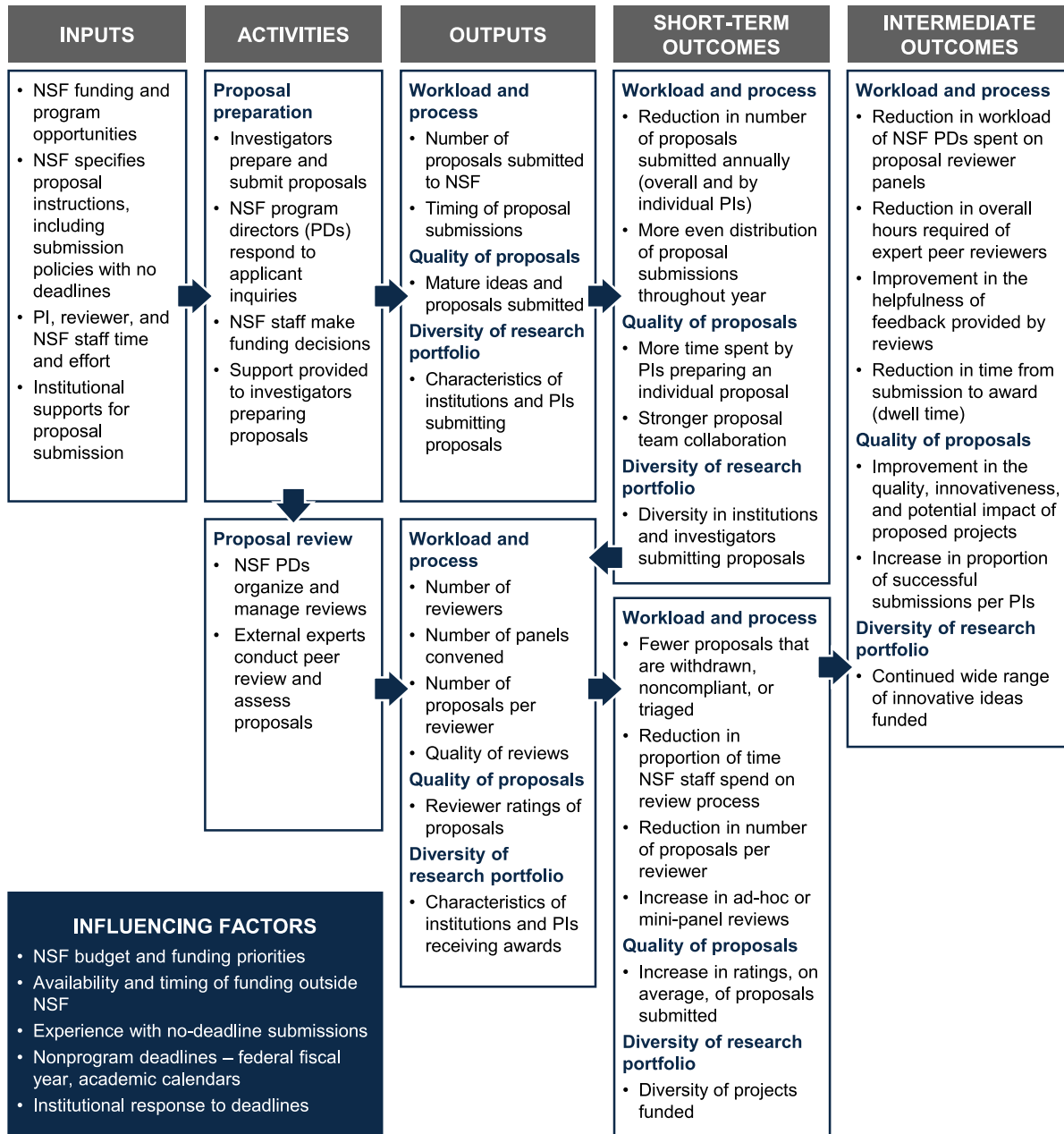
## Appendix B: Supplemental analysis

### Proposed logic model

Exhibit A4 displays a logic model for an NSF research program with a no-deadlines approach. To create the logic model, we reviewed the literature to understand plausible outcomes for the no-deadlines approach as well as mechanisms by which the no-deadlines approach may play out in grant funding programs. Because the literature does not directly address how a no-deadlines approach leads to outcomes in the context of grants, we grouped outcomes into general outcome categories and mapped outcomes to these categories. Task initiation, progress, effort, and completion mapped to workload and process; work quality and creativity mapped to quality of proposals; and other outcomes mapped to diversity of research portfolio. We then filled in specific items using NSF documents and interviews to capture the varying goals, motivations, and hypotheses of divisions and directorates as they chose to adopt the no-deadlines approach.

In general, theory and empirical work support the idea that deadline pressure may prompt action, but there is sparse and inconsistent evidence on the effects of deadlines on work quality and other consequences (see section 6 for a full review). Accordingly, there is likely more support for the pathways related to workload and process than for quality of proposals and diversity of research portfolio. NSF's internal retrospective empirical analyses corroborate this notion. However, none of the pathways in the logic model are supported by rigorous evidence in the context of grant submissions or similar situations.

**Exhibit A4. Proposed logic model for no-deadlines approach in NSF grant programs**



Note. This exhibit shows a logic model for the no-deadlines approach in grant programs, including inputs, activities, outputs, short-term outcomes, and intermediate outcomes. Arrows represent connections.

Exhibit A4 lays out the inputs, activities, outputs, short-term outcomes, and intermediate outcomes that could occur as a result of a no-deadlines approach. The inputs include NSF funding, NSF policies, and time and effort spent by PIs, institutional staff, reviewers, and NSF staff on the proposal submission process. The activities undertaken with these inputs include proposal preparation activities which then lead to proposal review activities. Outputs represent the evidence that the activities occurred. Specifically, after proposals are prepared and submitted under a no-deadlines approach, there is an associated measure of the number and timing of proposal submissions; PIs will submit mature ideas when they are ready rather than rushing to meet a deadline; and the set of submitted proposals is associated with some level of diversity of PIs. Similarly, after proposal review, one could observe the number of reviewers, number of panels convened, quality of reviews, the presence of reviewer ratings, and the diversity of funded PIs.

Several channels could result in the first short-term outcome which is a reduction in proposal submissions. Without the pressure of a deadline, PIs are free to submit proposals when their data and ideas are ready and when they have had time to successfully collaborate with their partners on the proposal; this could result in at least an immediate drop in the number of proposals following the switch to a no-deadlines approach as PIs spend more time preparing the proposal and take longer to submit. A sustained reduction in proposal volume could occur as a result of fewer PIs submitting proposals, either because they are unaware of the opportunities without deadlines, they forget to submit, they perpetually procrastinate the proposal without a deadline, or given time, realize flaws in their proposal and elect not to pursue it. The same number of PIs might also submit fewer proposals if the lack of a deadline makes them feel they have prepared a stronger proposal that is more likely to be funded, PIs are submitting proposals with more collaborators, or they submit more compliant proposals that don't need to be re-submitted. Without a deadline, there is also likely to be a more even distribution of proposal submissions throughout the year. The extent of the smoothing depends on how much PIs are constrained by academic calendars as to when they have time available to work on a proposal. For example, proposal submissions might still cluster in between semesters if that is when PIs have the most time to work on them.

The outputs that occur as a result of the proposal review process are influenced by the short-term outcomes associated with proposal preparation. For example, a reduction in the number of proposals and a more even distribution of submissions throughout the year could affect the number of reviewers and panels used in the review process. If fewer and more mature proposals are received, a number of short-term outcomes associated with proposal review could happen. NSF staff would spend less of their time on the review process, the number of proposals per reviewer could go down, and PDs might choose to use more ad-hoc or mini-panel reviews to accommodate the steadier stream of proposals throughout the year and still provide timely funding decisions. If more mature ideas are submitted without deadline pressure, the quality of proposals might also improve. There may be fewer proposals that are returned without review (which would also contribute to a reduction in future proposal submissions) and average proposal ratings could increase as a result of PIs spending more time thinking creatively and collaborating with others on the proposal.

The intermediate outcomes follow from the short-term outcomes and include several items that represent the goal of doing no harm and ensuring the sustainability of the merit review process. To start, if there is an increase in the use of ad-hoc reviews, NSF staff would experience a reduction in workload associated with reviewer panels. If there is a reduction in the number of proposals, there would be a reduction in the overall hours required of expert reviewers. Relatedly, a reduction in the number of proposals per reviewer in which reviewers have the same amount of time to focus on a smaller set of proposals, could result in an improvement in the quality of reviews. A more even distribution of proposals submitted could reduce

dwell time because of the lack of a surge in workload, but the magnitude of the reduction is dependent on the ability of PDs to assign proposals appropriately and quickly to reviewers which is dependent on the content and timing of the submitted proposals. If submitted proposals receive higher ratings, this could lead to improvements in the quality, innovativeness, and potential impact of proposed projects. The combination of a reduction in proposal volume, more time spent by PIs preparing more fully formed proposals, and stronger collaboration could lead to an increase in the proportion of successful submissions per PI.

Lastly, NSF seeks diversity in its portfolio of funded projects, in both the range of innovative ideas it funds and the characteristics of investigators and institutions receiving awards. Because of differences in how individuals and organizations prioritize activities and tasks among competing demands, the response to a no-deadlines approach may differ by the number and source of competing demands. Thus, the diversity of submitted proposals or the funded portfolio may change.

## Appendix C: Quality assurance

To ensure the overall quality of the project, we conducted the following quality assurance procedures:

- We consulted with a librarian to develop and calibrate our search strategy. The librarian conducted the database searches and returned the results. We replicated the searches to confirm the number of results.
- Records identified through the database and Google searches were screened by a primary reviewer, and a senior reviewer verified all screening decisions.
- Each publication that met the screening criteria was reviewed first by a primary reviewer and a second time by a senior reviewer. These reviews served to verify the study meets the inclusion criteria, is classified as the correct study type, and that the information entered in the review template is accurate, complete, and consistent with the other reviews.
- All tabulations and statistics were completed by one team member and verified by a task leader.
- When conducting the interviews, a team member who was not conducting the interview took notes and recorded the conversation. The notetaker used the recording to fill in notes as needed and completed notes within 48 hours of the interview. A task leader reviewed each set of interview notes for clarity and completeness.
- The coding team conducted close reviews of the interview notes using a preliminary set of codes that was updated as needed in a shared workbook. The coding team met daily to discuss the recommended new codes and continually norm on the codes' consistent use.
- An independent reviewer and the project director reviewed the written report, focusing on relevance, method appropriateness, accurate interpretation, objective conclusions, transparency, writing clarity, and presentation.
- Our editors edited the written report for clarity, succinctness, and consistency.
- Our production staff made this report visually appealing and 508 compliant.

## Appendix D: Key to acronyms

### Exhibit A5. Acronyms used in this report

| Acronym | Definition  |
|---------|---|
| ACCRF   | Adenoid Cystic Carcinoma Research Foundation                  |
| BIO     | Biological Sciences   |
| CBET    | Chemical, Bioengineering, Environmental and Transport Systems |
| CH      | Petrology and Geochemistry                                    |
| CISE    | Computer and Information Science and Engineering              |
| CMMI    | Civil, Mechanical, and Manufacturing Innovation               |
| CRS     | Congressional Research Service                                |
| DMR     | Division of Materials Research                                |
| EAR     | Division of Earth Sciences                                    |
| ECCS    | Electrical, Communications and Cyber Systems                  |
| EEC     | Engineering Education and Centers                             |
| ENG     | Engineering   |
| FARF    | Fanconi Anemia Research Fund                                  |
| GEO     | Geosciences   |
| GG      | Geobiology and Low-Temperature Geochemistry                   |
| GLD     | Geomorphology and Land Use Dynamics                           |
| HS      | Hydrologic Sciences   |
| IF      | Instrumentation and Facilities                                |
| ITS     | Interrupted time series                                       |
| MPS     | Mathematical and Physical Sciences                            |
| NASA    | National Aeronautics and Space Administration                 |
| NHMRC   | National Health and Medical Research Council                  |
| NIDA    | National Institute on Drug Abuse                              |
| NIH     | National Institutes of Health                                 |
| NSB     | National Science Board  |
| NSF     | National Science Foundation                                   |
| OIA     | Office of Integrative Activities                              |
| OPP     | Office of Polar Programs                                      |
| PD      | Program director  |
| PH      | Geophysics  |
| PI      | Principal investigator  |
| R&D     | Research and development                                      |
| RCT     | Randomized controlled trial                                   |
| SaTC    | Secure and Trustworthy Cyberspace                             |
| SGP     | Sedimentary Geology and Paleobiology                          |
| TE      | Tectonics   |
| QED     | Quasi-experimental design                                     |

Note: This exhibit shows the acronyms and definitions used in this report.

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## Acknowledgements, disclosures, and citation

### Acknowledgements

We would like to thank Robyne McRey, Taylor Rhodes, Christina Freyman, Erika Rissi, and Clemencia Cosentino at NSF for their helpful guidance and feedback. We also appreciate all the interview respondents who took the time to speak with us as well as our Mathematica colleagues who contributed to the work including Tara Strelevitz, Semhal Araya, Alex Marketos, Alison Wellington, Jennifer Brown, Carol Soble, Sheena Flowers, Lily Fesler, Andrés Nigenda Zárate, and Jeremy Biggs.

### Disclosures

This report was prepared for the National Science Foundation's (NSF) Evaluation and Assessment Capability (EAC) Section within the Office of Integrative Activities (OIA) under contract number 49100421F0221. The views expressed are those of the authors and should not be attributed to NSF, nor does mention of trade names, commercial products, or organizations imply endorsement of same by the U.S. Government.

### Citation

Fox, Lindsay, Jesse Chandler, Francesca Venezia, Micah Wood, Emily Rosen, Gina Lewis, Alina Martinez, Samantha Zelenack, and Christina Tuttle. 2022. *Understanding the Use and Potential Effects of a No-Deadlines Approach*. Alexandria, VA: National Science Foundation.

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