NBER WORKING PAPER SERIES

CROWDFUNDING SCIENTIFIC RESEARCH

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Working Paper 24402
http://www.nber.org/papers/w24402

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
March 2018

We thank Experiment.com co-founder Cindy Wu for help with data collection and for extremely helpful insights on the platform and its projects. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 24402
March 2018
JEL No. I23,O31,O32

ABSTRACT

Crowdfunding may provide much-needed financial resources, yet there is little systematic evidence on the potential of crowdfunding for scientific research. We first briefly review prior research on crowdfunding and give an overview of dedicated platforms for crowdfunding research. We then analyze data from over 700 campaigns on the largest dedicated platform, Experiment.com. Our descriptive analysis provides insights regarding the creators seeking funding, the projects they are seeking funding for, and the campaigns themselves. We then examine how these characteristics relate to fundraising success. The findings highlight important differences between crowdfunding and traditional funding mechanisms for research, including high use by students and other junior investigators but also relatively small project size. Junior investigators are more likely to succeed than senior scientists, and women have higher success rates than men. Conventional signals of quality - including scientists' prior publications - have no relationship with funding success, suggesting that the crowd applies different decision criteria than traditional funding agencies. Our results highlight significant opportunities for crowdfunding in the context of science while also pointing towards unique challenges. We relate our findings to research on the economics of science and on crowdfunding, and we discuss connections with other emerging mechanisms to involve the public in scientific research.

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Introduction

Crowdfunding – an open call for money from the general public – has become a major source of funding for entrepreneurial, artistic, and social projects [1-4]. More recently, scientists and policy makers have suggested that crowdfunding could also be valuable to support scientific research [5-7] and some universities actively encourage their researchers to start crowdfunding campaigns [8]. The public discussion as well as related work on crowdsourcing and Citizen Science suggest several potential benefits [9-11]. One hope is that funding from the crowd can expand the total amount of resources available for science, or at least partly compensate for tighter budgets of traditional funding agencies [6]. In light of the increasing difficulties especially junior scientists face in getting funding through traditional channels [12], some observers highlight that the crowd may be more willing to fund researchers who do not yet have an established track record [7]. Finally, "broadcasting" proposals to a large number of potential funders may allow researchers to identify those supporters who share an interest in the same topics, even if these topics are not mainstream or priorities for traditional funding agencies [10, 13].

Despite these hopes, however, the potential of crowdfunding for scientific research is not clear. Many crowdfunding campaigns in other domains fail, suggesting that raising money from the crowd can be quite challenging [2, 14]. Moreover, research projects have characteristics that would be expected to make it challenging to raise funding from the crowd. Among others, scientific research is often risky, while members of the crowd may have a preference for projects that are likely to succeed [15]. Similarly, there is an asymmetry in the knowledge of highly trained scientists and potential "citizen" funders, such that the latter may find it difficult to assess the quality and merit of research proposals [15, 16]. Research projects also cannot typically offer the tangible outputs that are often "pre-sold" on general-purpose platforms such as Kickstarter, and scientific research projects may generally be perceived to have less direct use value than other types of projects [15, 17]. On the other hand, crowdfunding platforms that specialize in scientific research projects may attract backers with different kinds of motivations and decision criteria than general-purpose platforms. Moreover, they may be able to offer tools that are tailored to the needs of scientists and their funders and may help increase the odds of fundraising success.

To assess the potential of crowdfunding for scientific research, we report initial evidence from Experiment.com, the currently largest dedicated platform for crowdfunding research. We first provide descriptive information on the creators seeking funding, the projects they are seeking funding for, and features of the crowdfunding campaigns. We then investigate how these various characteristics are related to campaign success. We compare the results to prior research on the predictors of fundraising success in crowdfunding but also to research on traditional scientific funding mechanisms such as government grants. Finally, we examine whether and how predictors of crowdfunding success differ from the factors that predict attention from a more professional audience – journalists covering scientific research.

Our analysis provides new evidence on the state of crowdfunding in scientific research and should be of interest to scholars in the economics of science as well as to scientists who consider starting their own crowdfunding campaigns. By providing empirical evidence from the specific context of science, this study also contributes to the broader literature on crowdfunding, which tends to focus on general-purpose platforms.

Prior research

Although prominent success stories such as the Pebble Watch or the Oculus Virtual Reality Headset have demonstrated the potential of crowdfunding, many campaigns fail to reach their funding targets [2, 14]. As such, a growing literature in fields as diverse as economics, management, and the sciences has started to examine crowdfunding from a descriptive perspective, and to explore potential drivers of fundraising success [18]. Most of these contributions, however, have looked at crowdfunding for startups, technology development, or projects in the arts or cultural industries. In contrast, there is little evidence on the potential of crowdfunding as a tool to raise resources for scientific research [17, 19].

Although a unified framework for studying crowdfunding has not emerged yet [20], most of the prior literature examines how crowdfunding success relates to factors in the following three broad domains.

First, many studies have examined how fundraising success is related to certain characteristics of the individuals who are seeking to raise funding (i.e., the "creators" of a campaign). In particular, several studies have explored gender differences in funding success, finding that female creators, or teams that have at least one female creator, are more likely to achieve success compared to male creators [21-23]. Other studies have considered creators' broader social networks, highlighting the role of the social interconnectedness of the creator in explaining funding outcomes [2, 23-25]. Related work has considered the geographic location of creators, finding that crowdfunding provides a wider reach than traditional funding mechanisms such as venture capital, although geographic distance still seems to matter [26, 27].

Second, several papers have studied how fundraising success is related to characteristics of the project, i.e., what funding is raised for. The existing evidence suggests that projects aimed at non-profit goals are more likely to be funded than projects with for-profit goals [28, 29]. Moreover, there is robust evidence that projects with smaller budgets are more likely to achieve their targets [2, 23, 24]. Recent work studying technology-related projects on Kickstarter has found that projects attempting radical innovations were less likely to be funded than projects proposing incremental innovations, perhaps reflecting that backers doubt the feasibility of radical proposals or that radical proposals appear less useful in addressing currently perceived needs [15].

Third, much attention has been directed at features of the campaign itself, e.g., what information is presented, how it is presented, and how creators interact with the crowd. Research has found that the amount of information provided about a project is positively correlated to funding success [23, 25], particularly when the information makes the project more understandable and relatable to the crowd [30]. Information given in a visual form, including videos, is particularly useful [2, 23, 31]. Relatedly, project updates during the campaign can further increase the likelihood of success [32]. Endorsements by a third party, such as business angels or venture capitalists, correlate positively with fundraising success, perhaps because they serve as a signal of quality and reduce the information asymmetry between the creator and the crowd [33, 34]. Finally, a study in the context of scientific research suggests that campaigns were more successful when scientists started nurturing an audience for their projects before the crowdfunding campaign, taking advantages of their social networks [19].

We build on this existing work to provide insights into crowdfunding campaigns in an understudied context – scientific research. In considering specific factors within each of the three domains, we can thus also draw on prior research in the economics of science, including work on predictors of fundraising success in the traditional (grant-based) system. With respect to creator characteristics, for example, we distinguish junior versus senior researcher status as well as academic versus industry affiliations [35, 36]. Similarly, we classify projects based on their research objectives, develop a proxy for the riskiness of the research, and examine what kinds of research expenses creators plan to cover with the funding raised [37-39]. For campaign characteristics, we consider a range of factors such as "lab notes", as well as the listing of prior publications, which are often taken as signals of quality by traditional funding agencies [35].

Crowdfunding platforms for scientific research projects

Our data come from the platform Experiment.com, which is dedicated to crowdfunding for scientific research. This US-based platform was established in May 2012 under the name Microryza and was later renamed. The platform allows investigators to create a profile and post a campaign webpage to raise the desired funds. The campaign stays open for a limited amount of time, typically 30-45 days. Experiment.com uses an "all-or-nothing" mechanism, i.e., donors are charged and the pledged funds are transferred to the campaign creators only if the pre-determined funding goal is reached. In this sense, campaigns resemble the all-or-nothing nature of competitive grant proposals made to traditional funding agencies.

There are several other platforms for crowdfunding scientific research, following a similar model as Experiment.com. Table 1 provides examples of other relevant platforms, with basic information such as founding date and number of projects hosted. The table shows that some of these platforms are independent, while others are run by universities or funding agencies primarily for their own purposes. While some have been operating for several years, others have failed. Experiment.com is, to the best of our knowledge, the largest dedicated platform for the crowdfunding of scientific research projects.

For the purpose of our study, it is important to distinguish dedicated crowdfunding platforms such as Experiment.com from two related, but different types of platforms that may also be used by researchers. First, there are charity fundraising platforms such as Benefunder and Thecommongood. Such platforms differ from Experiment.com in that funds are typically raised for an organization or general cause rather than specific research projects, fundraising remains open for an extended time, there is no explicit fundraising goal, and there is no all-or-nothing funding mechanism. Thus, these platforms are similar to traditional charity institutions, except that they use the online channel for fundraising.

Second, there are general-purpose "rewards-based" platforms such as Kickstarter or Indiegogo. These platforms are project-based and follow an all-or-nothing model, but are primarily for business or artistic projects and rarely host campaigns that focus on scientific research. They usually require creators to give rewards to the backers and have other specific provisions that make the fundraising for scientific research projects difficult. For example, Kickstarter explicitly excludes projects aimed at the treatment or prevention of illnesses [40], and Indiegogo stopped accepting non-profit projects in February 2018 [41].

Data and Measures

We obtained from Experiment.com leadership the links to all crowdfunding campaigns that were started since the platform launch in May 2012 and for which success or failure status was known in August 2015. We scraped the webpage content of these campaigns to obtain measures for a wide range of project characteristics as well as funding outcomes. In addition, we hand-coded additional variables based on project descriptions on the campaign webpages and profile pages of campaign creators. Experiment.com terms of use do not prohibit data collection for scientific purposes and the leadership's cooperation in providing data access also indicates permission.

We dropped from the analysis 16 campaigns with incomplete webpages. Our final sample includes 728 campaigns. Of these campaigns, 68% were started by a single creator. The remaining campaigns were posted by teams ranging from 2 to 7 individuals, for a total of 1,153 creators in our sample.

In the following, we describe our variables and measures. Table 2 shows summary statistics at the level of individual creators; Table 3 shows summary statistics at the level of campaigns.

Creator characteristics

Affiliation. Campaigns typically provide information on the background of the creators. If the campaign did not provide this information, we searched the internet. We hand-coded the organizational affiliations of the creators using the following categories: Educational institution (including universities, colleges, and high schools); company/firm (including startups as well as established firms); and other organization (including non-profits or government research institutes). Some creators acted without organizational affiliation, sometimes explicitly stating that they were "independent"; these are coded as "no affiliation/independent".

Position. We coded creators' position using the following categories: Student below PhD/MD level; PhD/MD student; Postdoctoral researcher; Assistant Professor; Associate/Full Professor; Employee/Affiliate (if not one of the above categories); individual (no affiliation); and other. If campaigns listed teams of individuals with clear organizational positions (e.g., a team of undergraduate students participating in an iGEM contest), we coded them accordingly. The "other" category of positions includes cases where the creators are teams of unknown composition or organizations (e.g., a foundation).

Gender. We coded creators' gender primarily based on first names using the API of genderize.io. The algorithm returns the gender and a probability that a specific name-gender attribution (male or female) was correct; in case it cannot decide, the algorithm returns none. In a second step, we double-checked the accuracy of the codes and completed missing data with additional help from the profile pictures of creators or Googling their name. Gender is set to "N.A./unknown" if the primary organizer is a team or an organization.

Region. Many campaigns include a tag indicating the primary affiliation of the creators (e.g., name of a university or company). If such an affiliation was not provided, we coded the location of the researchers based on the project description or researcher profiles. Only 5% of campaigns have more than one location and we thus focus on the primary one. Note that the coding reflects the location of the researchers, which may differ from the location where research is performed (e.g., a campaign by Duke University researchers to study the Brazilian rainforest would be coded as located at Duke). We code the following broader regions: Non-US (11%), US-Northeast (IL, IN, OH, PA, NJ, RI, CT, MA, NH, VT, ME, NY, MI, WI), US-South (FL, MS, AL, GA, SC, NC, TN, KY, WV, VA, DC, MD, DE), US-West/Midwest (TX, LA, AR, OK, NM, AZ, NV, UT, CO, KS, MO, IA, NE, WY, ID, MT, SD, MN, ND), and US-Pacific (CA, OR, WA, AK, HI). Although it would be desirable to analyze data at the level of individual states, many states have too few cases for reliable inference.

Creator count. This is the count of creators listed on the campaign webpage.

Project characteristics

Field. Creators indicated up to 5 field classifications on the campaign website. We coded a series of 20 dummy variables taking the value of one if a particular field was selected (see Table 3). We collapsed small fields (fields with less than 5% of cases) into the field "Other".

Project objective. We coded the substantive project objective by manually classifying projects into the following categories: Project whose main objective is conducting scientific research; projects that focus on development (e.g. the development of devices, tools, software, and methods); and projects with other objectives (e.g., the restoration of objects or the protection of animals and ecosystems). We classified projects as research if they focused on identifying general mechanisms or empirical regularities. In many cases, creators of research projects also stated their goal to publish results in a scientific journal.

Funding target. Once the campaign is closed, Experiment.com does not show the funding target but shows the amount raised and the percentage of the target that has been raised. We recover the target by dividing the amount raised by the percentage raised. This variable is missing for 21 campaigns that raised zero percent of their target. For descriptive analyses, we report figures in U.S. Dollars. Given the skewed distribution of funding targets, regression analyses use logarithmized values of the variable.

Pilot project. We coded a dummy variable as one if the project description stated that the project was a pilot study or that it involved data collection or testing for a larger follow-on project. For example, one campaign stated, "It is almost impossible to achieve funding without substantial preliminary data. This fundraiser will help fund this initial experiment and provide data for future grant proposals." [42]

Budget. Campaigns include a budget that shows the intended use of funds. Experiment.com does not provide pre-defined budget categories and we hand-coded expenses into the following categories: Salaries for organizers (individuals listed as creators on the campaign); salaries for non-organizers (e.g., students, research assistants); equipment, materials, supplies, software, and analysis services; travel (including conferences and field trips); other direct costs (e.g., compensation for patients, publications, open access fees); indirect costs (overhead); other (including budget without details). We then compute for each project the share of costs in each category.

Risk score. To obtain a proxy for project risk, we analyze the content of the project description. We use the word list developed by Loughran and McDonald [43], which is based on the union of uncertainty, weak modal, and negative words. Examples of uncertain words include *believe*, *pending*, *approximate*, *uncertain*, and *uncertainty*. Examples of negative words include *failure*, *decline*, and *difficult*. Examples of weak modal words include *could*, *might*, *nearly*, *maybe*, and *possibly*. We calculate a score based on the Term Frequency-Inverse Document Frequency (TF-IDF) weighting scheme, which gives more weight to words that are relatively rare in the entire corpus of documents [44]. The formula also includes normalization to account for the fact that campaigns differ in the length of their project descriptions. The word list used to construct our measure has been used in several studies [e.g., 45, 46] and although it was not developed specifically for scientific risk, we suggest that projects with higher scores on this measure are likely to be perceived as more uncertain and risky by potential backers who consider whether to provide resources. For a robustness check, we also construct a simpler measure by just computing the frequency with which the words from the above list appear in a project description.

Campaign characteristics

Endorsements 01. Experiment.com offers creators the option to show endorsements by well-known scientists or other individuals. We coded a dummy variable equal to one if the campaign lists at least one endorsement.

Prior papers 01. Dummy variable equal to one if the campaign lists at least one prior scientific publication by at least one of the creators. Listing prior publications may allow researchers to signal their accomplishment and scientific credibility.

Video 01. Dummy variable equal to one if the campaign includes a video that introduces the creators and/or the project.

Lab notes pre closing 01. Experiment.com allows creators to provide background information and campaign updates in the form of "lab notes". We created a dummy variable equal to one if creators posted at least one lab note prior to the closing of the campaign. This variable may reflect that creators are willing to engage more actively with potential funders.

Rewards 01. Campaigns may offer rewards to donors for making a pledge. Examples of rewards include photographs of animals, lab visits, or T-shirts. We coded a dummy variable equal to one if a campaign offered any rewards. Although some campaigns make access to lab notes contingent on a donation, contingent lab note access is not counted as a reward in our coding.

Platform age. Campaigns run at different points in the platform's life cycle, which may affect their likelihood of success. To capture the age of the platform at the time that a particular campaign is run, we compute the time difference between the closing of the focal campaign and the closing of the first campaign on the platform (May 18, 2012), measured in weeks.

Outcomes

Funded 01. Dummy variable equal to one if the campaign raised at least 100% of its target.

Amount raised. Amount raised by the campaign (in U.S. Dollars), regardless of whether the target was reached. In rare cases, this figure includes funds raised outside the platform, e.g., at in person events. Given the skewed distribution of this measure, regression analyses use logarithmized values.

Press coverage 01. Some campaigns have a section that lists coverage of the campaign by science journalists. We coded a dummy variable equal to one if the campaign lists at least one press item. Assuming that science journalists typically have scientific training or relevant experience [47], we interpret this measure as reflecting success in attracting attention from a more professional audience. We also include this variable in regressions of financial funding outcomes because press coverage listed on the campaign website may serve as a quality signal for potential backers. Excluding this variable from the latter regressions does not change our results.

Results

Selected descriptive insights

Creator characteristics. We first examine key characteristics of the creators starting crowdfunding campaigns. Panel A in Fig. 1 shows the affiliation of the creators. Over 80% are affiliated with educational institutions (e.g., universities and colleges), 4.58% are affiliated with firms, and 8.45% with other organizations such as foundations, museums, non-profits, or research institutes. Roughly 5% of creators are un-affiliated, sometimes explicitly calling themselves "independent researcher". The preponderance of campaigns involves creators from just one type of affiliation. In particular, of all the campaigns with at least one creator from an educational institution, only 1.7% also have a creator affiliated with a firm, and only 6.3% also have a creator affiliated with an "other" organization (e.g., nonprofit, research institute).

We further distinguish creators affiliated with educational institutions by their position (Fig. 1, Panel B). We find that a large share of these creators are students, including over 30% undergraduate or master's students and 25% PhD or MD students. Roughly 7% are postdocs, 11.6% assistant professors, and 17% associate or full professors.

With respect to gender, 56.6% of all primary campaign creators are male and 39.7% female. In the remaining cases, gender could not be determined or did not apply because an organization, not a person, was listed as the creator.

As noted earlier, 68% of campaigns were started by a single creator while 32% were started by teams ranging from 2 to 7 creators. Table 2 shows creators' characteristics separately for all creators (column 1), and for only one creator per campaign, taking the first-listed creator in case of teams (column 2). For team-based projects, we further show creators' characteristics separately for the investigator listed first in the team (column 3), and for all other team members who were not listed first (column 4). First and non-first listed individuals in teams are quite similar in terms of affiliation, reflecting the low rate of cross-affiliation collaborations. However, first listed creators in teams are somewhat more senior (in particular, less likely to be student below PhD/MD level) and less likely to be female.

The vast majority of creators on the platform Experiment.com are located in the U.S. (89%) and 11% are located in other countries. The US-based creators were distributed across all regions, including northeastern states (31%), southern states (15%), states bordering the Pacific (22%), and states in the west/midwest (17%). We compared the geographic distribution of funded US-based campaigns to the distribution of awards by NIH and NSF over a comparable time period (2012-2015). Fig. S1 shows that Experiment.com has a somewhat larger share of successful projects in the Pacific region and a smaller share in the northeast compared to NSF/NIH, likely because Experiment.com was started on the West Coast. However, Experiment.com funding volume is much more concentrated in the northeast region, which is largely due to an extremely successful outlier project located in Massachusetts (see below). While the specific patterns are unlikely to generalize, two observations may be more general. First, at least in the first years of their operation, crowdfunding platforms may be more localized than traditional funding sources, serving primarily their home regions [see 26]. Second, while government grants tend to be of similar sizes [48], amounts raised in crowdfunding can vary quite dramatically. As such, the regional distribution of amounts raised may differ quite substantially from the regional distribution of the number of successful campaigns.

Project characteristics. After providing insights on campaign creators, we examine more closely what kinds of projects these creators propose. First, the most frequently listed field classifications are (in descending order of frequency): Biology, Ecology, Medicine, Engineering, Education, Psychology, and Social Sciences (Tab. 3).

In terms of their substantive objectives, roughly 78% of projects aim at the scientific investigation of a topic (e.g. the impact of climate change on oak trees, the use of computer games to develop team skills in autistic children, the testing of a drug against kidney cancer), and 12% aim at the development of devices, tools, software, or methods. The remaining 10% have other types of objectives, such as the restoration of objects (e.g. dinosaur skeletons) or the protection of animals and ecosystems.

As a proxy for project size, we examine the amount of funding creators seek to raise. Funding targets ranged from $100 to over $100,000. One extreme project had a target of $1 million to find a cure for the rare Batten disease [49]. The average project target was $6,425, the median $3,500. Thus, while some campaigns reach the scale of traditional funding requests, most seek to raise small amounts. One possible explanation is that crowdfunding is used for pilot studies that are intended to lead to larger follow-on projects. Our coding shows that 16% of projects were pilot studies.

Campaigns also include a budget, allowing us to explore for what kinds of expenses creators seek to raise funds. The average campaign requested the majority of funds for materials, equipment and services (59%), followed by travel (16%) and salaries for personnel other than the creators (e.g. research assistants) (11%). Compensation or salary for creators constituted only 3% of the average budget.

Predictors of fundraising success

Experiment.com campaigns typically last 30-45 days and work with an all-or-nothing policy, i.e., creators receive pledged funds only if the campaign achieves the pre-defined target at the closure date. The success rate in our sample was 48%, higher than the success rate of projects on the general-purpose platform Kickstarter (36%) [40] and considerably higher than the success rates at NSF (23% in competitive grants in 2014) and NIH (16% for new research applications in 2015) [50, 51]. Conditional upon funding success, projects raised a total of $4.37 million, distributed in a range from $110 to an extreme of $2.6 million for the Batten disease project, with an average of $12,617 and median of $3,103. We now turn to the question how funding success is related to characteristics of the creators, the projects, and the campaigns.

Empirical approach. We examine predictors of fundraising success using regression models that routinely control for factors such as scientific field or age of the platform (Tab. 4). For the 32% of campaigns that were posted by a team of creators, our main analysis focuses on the characteristics of the *first* listed creator. The rationale is that in the sciences, first listed authors are typically those who “own” the project and make the largest substantive contributions

[52]. Campaign descriptions also typically provide more information about first authors than non-first authors, providing support for the notion that these individuals are driving the project. Robustness checks using team averages of individual characteristics (e.g., the share of female team members) rather than the characteristics of the primary creator show very similar results (reported in Tab. S1).

We use two different variables to capture fundraising outcomes: The first is the dummy variable indicating whether a campaign achieved its target (Table 4, Models 1-3). These models are estimated using logit regressions, and we report odds ratios for ease of interpretation (odds ratios greater than one indicate a positive relationship, odds ratios smaller than one indicate a negative relationship). The second dependent variable is the continuous measure of pledges received regardless of whether the funding target was achieved (Models 4-6). These regressions are estimated using OLS. All regressions use heteroscedasticity-robust standard errors.

For each of the two outcome variables, we estimate three models. The first model includes all control variables as well as characteristics of the primary campaign creator but does not include project or campaign characteristics. The second additionally includes characteristics of the project. The third additionally includes characteristics of the campaign. This stepwise approach allows us to first examine differences in success rates for different types of individuals, and to then examine the extent to which these differences may be explained by differences in the types of projects they seek funding for or differences in the way campaigns are implemented. And of course, the degree to which project and campaign characteristics predict funding success is of interest in its own right.

Funding success and creator characteristics. Model 1 in Table 4 shows that that junior scientists (students and postdocs) as well as independent researchers are more likely to reach their funding targets than associate and full professors. These differences remain significant even accounting for the fact that their targets tend to be lower and thus easier to achieve (Model 2; a regression with funding target as the dependent variable is shown in Model 7). There is no significant difference between junior and senior scientists in the amount of pledges received (Table 4, Model 4), although the former raise more money conditional upon a particular funding target (Model 5). Thus, while there are concerns that junior investigators are at a disadvantage when applying to traditional funding agencies [12], the crowd appears favorable towards junior scientists. While we can only speculate, this result may reflect that backers consider perceived need in addition to scientific merit, or that backers derive utility from supporting the education and professional development of junior scientists.

We find no systematic differences in funding success between creators affiliated with educational institutions versus any other type of organizations. Since measures of positions are correlated with affiliation types, we also re-estimate regressions with these variables separately; the substantive results are unchanged (Tab. S2, Models 1-6).

Consistent with prior research [53], we find significant gender differences in crowdfunding success: Women have higher odds of reaching their funding goal than men (Table 4, Model 1) and also raise significantly more money (Model 4). While higher success rates of women on Kickstarter have been partly attributed to the fact that women have a tendency to propose smaller projects [53], we find no such evidence in science: Funding targets of campaigns created by men and women show no significant difference (Model 7) and the gender dummy changes little when project and campaign characteristics are included (Models 2, 3, 5, and 6). Women's significantly higher success rates in crowdfunding contrast with similar or slightly lower odds of success than men when competing for grants from government agencies such as NIH or NSF [54, 55]. Future research is needed to explore potential drivers of the observed gender differences in crowdfunding success, and better data on the project backers (including their gender) would be particularly valuable [21].

Funding success and project characteristics. We now turn more explicitly to the characteristics of the project for which funding is sought (Table 4, Models 2 and 5). We find no significant differences in funding success between projects pursuing research versus development objectives, or between pilot and non-pilot projects. Projects with larger funding targets are less likely to get funded, consistent with prior evidence [2]. At the same time, campaigns with higher targets receive a larger volume of pledges, highlighting the challenge of setting funding targets that are achievable but also result in meaningful resources when achieved.

To investigate whether fundraising success is correlated with the riskiness of the project, we include the text-based measure of risk. This measure has no relationship with funding success or the amount of money raised (Table 4, Models 2 and 5). Robustness checks using an alternative simpler risk measure (see variables and measures above) give the same result (Table S2, Models 7-8). Although our analysis cannot address the question whether the crowd funds more or less risky projects than traditional funding agencies [56], it suggests that backers on dedicated platforms for funding scientific research pay little attention to risk when deciding which particular research projects to support.

Funding success and campaign characteristics. The data show several relationships between funding success and features of the campaign itself (Tab. 4, Models 3 and 6). First, a potential challenge in crowdfunding research is that backers – especially those without a background in science – may find it difficult to assess the scientific merit of projects or creators. Campaigns can address this challenge by using various quality signals [1]. For example, Experiment.com offers campaign creators the option to include endorsements by well-known scientists or other individuals. We find that campaigns with endorsements (15% of all campaigns) have significantly higher odds of success and raise more funds than campaigns without endorsement. Another potential quality signal is the listing of prior publications that are (co-)authored by the creators. Surprisingly, while 25% of campaigns list prior publications, these campaigns are not more likely to be funded and do not raise more money. This result is particularly interesting given the important role that prior publications play in traditional grant applications [35].

Second, Experiment.com allows creators to provide background information and campaign updates in the form of "lab notes". Campaigns that posted lab notes prior to closure (67% of all campaigns) have significantly higher odds of success and raise more money than projects without lab notes. Campaigns featuring a video presentation (57%) are also more likely to succeed, consistent with other crowdfunding contexts [2]. These results reinforce the notion that effort in designing campaigns as well as reaching out and interacting with the crowd can be an important predictor of funding success [19, 57].

Finally, prior studies argue that research projects find it difficult to offer the kinds of tangible rewards that are often central to crowdfunding campaigns on platforms such as Kickstarter [17]. Consistent with this concern, most projects in our sample do not offer any rewards. However, 11% of projects offer – sometimes quite creative – rewards such as visits to the research lab, acknowledgement on future publications, photographs of animals observed, or the naming of a shark. Projects offering a reward have a higher likelihood of achieving their target and also raise significantly more funds. This observation suggests that backers of scientific research may not only contribute for the sake of supporting science or to help individual researchers but may also respond to explicit incentives and rewards.

Comparing crowd versus expert audiences

Our finding that junior scientists tend to be more successful and that prior publications appear to matter little suggests that the crowd may apply quite different criteria than a traditional scientific audience when deciding which projects to support. To further explore this possibility, we examine which campaigns receive press coverage from science writers (Tab. 4, Models 8-10). Our conjecture is that science writers are more likely than the general public to have advanced scientific training [47] and subscribe more strongly to traditional criteria when evaluating the importance and promise of research. As expected, we find intriguing differences between the factors that predict funding success versus attention from the press. First, junior scientists are more likely to be funded than senior scientists, but they are less likely to receive press coverage. Second, lab notes and rewards are associated with significantly higher funding success but they are not correlated with press attention. Third, listing creators' prior publications – a potential quality signal – does not increase the chances to be funded, but it does have a positive relationship with press coverage. Science writers' preferences are not necessarily representative of those of scientists generally or of decision makers at traditional funding agencies. However, our results provide some tentative evidence that the crowd judges projects differently from evaluators who have a more professional scientific background. Similar evidence has been found in recent work comparing crowd and expert evaluations in the context of the arts [58].

Before we conclude, we note that all regressions should be interpreted as correlational in nature. Thus, significant coefficients on independent variables do not necessarily imply a causal effect of these variables on funding outcomes or on press attention. Causal interpretation is difficult because independent variables may proxy for otherwise unobserved factors, such as differences in the nature of research or unobserved outreach activities by creators. On the other hand, concerns about reverse causality can largely be excluded since most of our independent variables are fixed before funding outcomes are observed. In light of remaining endogeneity concerns, the statistically and economically significant relationships observed in our data suggest fruitful avenues for future research examining why exactly certain characteristics of creators, projects, and campaigns are associated with higher fundraising success.

Discussion

Crowdfunding for scientific research is still in its early stages, but the considerable number of funded projects suggests that it can provide important financial support. Moreover, crowdfunding seems to differ in important ways from traditional funding mechanisms such as grants from government agencies [12, 35, 39, 54, 55, 59]: Success rates are comparatively high, junior scientists tend to be more successful than senior scientists, and female investigators are more likely to be funded than male investigators. Furthermore, we find no evidence that riskier projects have a lower likelihood of being funded and creators' prior publications appear to matter little for funding success. Fundraising is also faster than in the traditional grant-based system. At the same time, the amounts raised with crowdfunding tend to be much smaller and funds are used primarily for materials and travel rather than salaries or tuition.

Our results support the view that crowdfunding of scientific research broadens access to resources for groups that have been excluded or disadvantaged in traditional funding systems, similar to what has been shown in crowdfunding of business initiatives [27]. However, the amount of resources raised – at the level of individual projects but also the platform as a whole – is presently too small for crowdfunding to serve as a substitute for traditional funding mechanisms. As such, crowdfunding for research may best be seen as a complement to such traditional sources. In particular, crowdfunding appears to be particularly useful for students or (aspiring) researchers who do not have the track record required by most traditional funding agencies, and it may be suitable for smaller pilot studies without preliminary evidence. In these areas, even a relatively small grant can enable a project to proceed and may also make a long-term difference by allowing researchers to increase their chances of subsequent funding in the traditional system [see 27].

Despite these benefits, there are also potential concerns. First, the crowd may fund projects that are in legal (or political) grey zones. For example, some creators in our sample noted that traditional funding sources would not support projects on gun culture [see 60], on the impact of the legalization of marijuana, or on the development of molecules that can lead to mutations in humans. Second, although Experiment.com encourages academics to obtain study approval from their Institutional Review Boards, it is not clear whether all creators who work with human subjects – especially those outside academia – understand and follow guidelines for ethical and responsible research [6]. A final concern is that crowdfunding sidesteps traditional peer review and the crowd may support projects with low scientific merit [61]. Of course, backers may deliberately ignore some of the selection criteria used by traditional funding agencies (such as prior publications) and may also support campaigns for reasons other than scientific merit, e.g., to help a passionate student or enable a “fun” project. Nevertheless, platforms should require that projects provide enough information to allow potential backers to make informed decisions.

To raise meaningful amounts of funding, campaign creators need to reach beyond family and friends to engage broader audiences [57, 62]. Yet, reaching a broad audience requires significant effort, e.g., to develop videos, write engaging lab notes, or respond to backers’ comments and suggestions (see Fig. S2 for an example). Some creators may come to realize that the relatively small amount of money that can be raised is not worth these costs in terms of time and effort [63]. Indeed, our finding that crowdfunding is used especially by junior scientists may reflect that these scientists have lower opportunity costs of time than senior researchers, while also having less access to traditional funding sources. Junior scientists may also feel more comfortable using social media, an important component of many crowdfunding campaigns [19, 57]. More generally, the rise of crowdfunding is likely to increase the value of skills in communicating research and interacting with “citizen” audiences [56]. In addition to dedicated programs such as the recently launched Lab for Open Innovation in Science [64], educators and PhD advisors should consider how they can help students develop such skills as part of the regular research training.

Although our analysis focused on financial resources, crowdfunding may also provide several non-financial benefits. Creators can receive feedback on their research, achieve greater visibility of their work, and may enjoy interactions with broader audiences [57]. Moreover, backers may continue to support projects in other ways, e.g., by offering access to infrastructure and research sites (see Fig. S2). The public can benefit from crowdfunding by gaining direct insights into the research process (e.g., via lab notes), participating in the allocation of resources for research, and by feeling empowered to contribute to the progress of science [56, 57]. Future research is needed to quantify these non-financial benefits and to develop tools that increase scientists’ ability to achieve the financial as well as non-financial objectives of their crowdfunding campaigns.

This discussion of non-financial benefits of crowdfunding highlights potential ties to another recent development - namely “crowd science” or “citizen science” projects, where scientists ask the public not for financial resources but for inputs in the form of time and knowledge [9, 65]. We suggest that future research could benefit from considering similarities (and differences) between these mechanisms for involving the public in different aspects of the scientific research process. Some of the tools and best practices developed in the context of citizen science [66, 67] may prove useful in crowdfunding efforts, while findings from crowdfunding research may help citizen science projects to understand the dynamics of project participation and to increase participant engagement [2, 9]. Among others, future research could explore whether individuals who are willing to support a project with money are also more likely to support projects with time or other contributions. Similarly, some crowdfunding campaigns seek funding to support citizen science projects, and it would be important to know whether researchers can benefit from asking for financial and non-financial contributions at the same time, or whether platforms can increase their effectiveness by co-hosting crowdfunding and citizen science projects.

Even though our focus is on understanding crowdfunding as a mechanism to raise resources for scientific research, our findings also contribute to the broader crowdfunding literature. First, some of our results corroborate prior findings in a new empirical context, suggesting broader generalizability of those prior findings. Among others, we confirm that women are not at a disadvantage but tend to be more successful than men in raising crowdfunding [21-23]. Using a rich set of measures on projects and campaigns, we also find that this advantage holds even when we account for campaign targets or characteristics of the campaign. Our finding that campaigns with endorsements are more successful than campaigns without endorsements is consistent with prior evidence from Kickstarter [33]. Finally, we confirm that active engagement with the crowd (e.g., in the form of lab notes) can increase fundraising success [32, 57] and that visual information such as videos is particularly beneficial [2, 23, 31].

Perhaps more importantly, we add to the crowdfunding literature by exploring aspects that have received less attention in prior work. Unlike prior studies, for example, we can observe creators' substantive experience (proxied by position such as student versus professor) and show that experience has a *negative* relationship with funding success. This relationship is surprising, at least if we believe that more experienced scientists are better able to identify important research questions and are better able to execute a given project [35, 68]. This counterintuitive result suggests that funders may support projects not only for their stated project objective but also for other reasons such as the perceived need of the creator. Of course, it may also be that less experienced scientists have more creative project ideas [69] or that they are better able to relate to and communicate with non-expert audiences. Either way, future research should examine how creators' experience is related to funding success in other contexts, including settings where backers have a clear personal interest in project success (i.e., in rewards-based campaigns that pre-sell products).

Relatedly, we find that projects pursuing research versus development objectives are similarly likely to succeed. This result seems at odds with recent work showing that funding success on Kickstarter is higher for incremental than for radical innovations [15]. Although the research vs. development and radical vs. incremental distinctions are conceptually different, an intriguing conjecture for the different findings is that Kickstarter and Experiment.com have different types of "dominant crowds": While backers on Kickstarter may be more concerned with the likelihood of success and the usefulness of project outcomes for their own needs, backers on Experiment.com may not expect to benefit personally from project results and may thus be willing to support also projects that are riskier or that promise general insights rather than tangible outcomes. More generally, our findings highlight the need for future research that examines the predictors of funding success across a range of different platforms and that explores the role of contingency factors such as the type of crowdfunding (e.g., rewards-based vs. donations) as well as the goals and motives of the typical backers.

The results presented in this paper suggest a number of additional questions for future research. First, we observed that several characteristics of creators, projects, and campaigns are significant predictors of funding success, but we cannot establish the causal nature of these relationships. Experimental studies that assign key characteristics randomly or exploit suitable natural experiments could provide causal evidence and identify tools creators can use to improve the performance of their campaigns. Second, our data include no information about the backers, which is a challenge with crowdfunding research generally [20]. It would be interesting to know whether backers tend to come from particular parts of the general population (e.g., with respect to education, science background, or age), and which creators are more successful in reaching beyond their friends and family. Third, future research is needed on why backers support scientific research projects, how their motivations differ from those of traditional funding agencies, and how backer motivations shape their interactions with creators. Finally, while we provided insights into campaigns' ability to raise funding, we do not observe whether funded projects achieve their scientific objectives. Future research is needed to measure the scientific output resulting from crowd-funded projects, explore which projects are more likely to be successful, and whether interacting with the crowd can allow researchers to improve the quality and impact of their scientific work.

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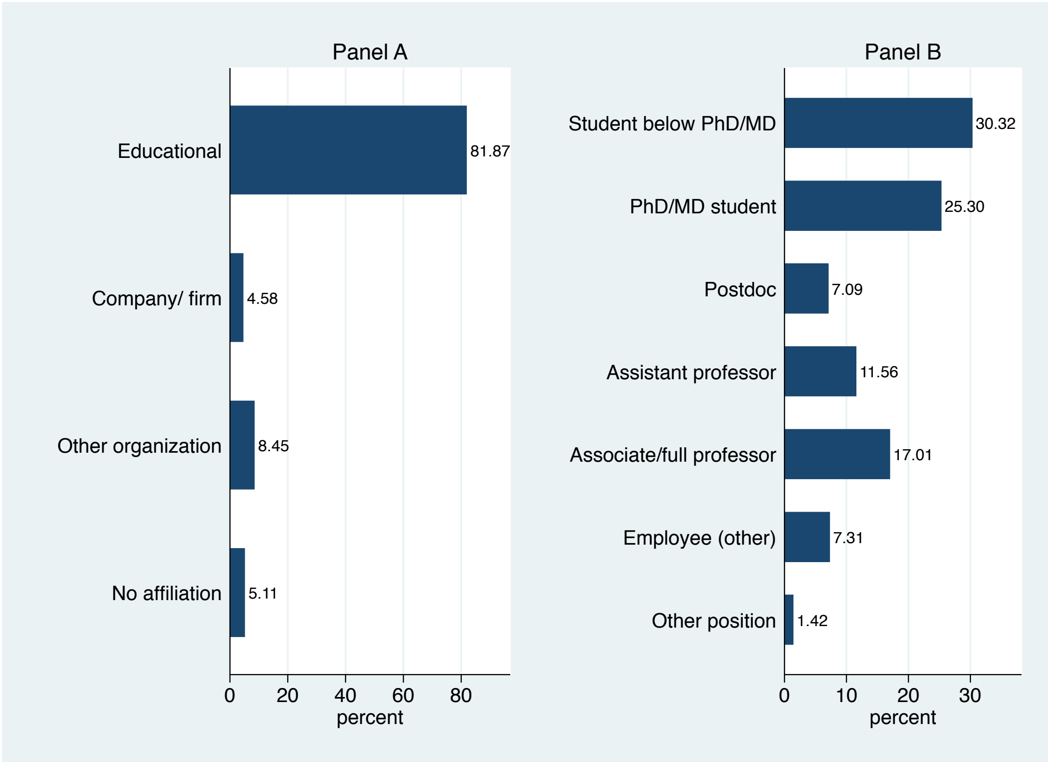

Fig. 1: Affiliation of all project creators (Panel A, N=1,136) and position of creators who are affiliated with an educational institution (Panel B, N=917). Excludes cases with missing data.

Tab. 1: Examples of dedicated platforms for crowdfunding scientific research

Name	URL	Opened	Status as of January 2018
Independent platforms			
Experiment	https://www.Experiment.com	2012	Active. 1820 projects hosted.
Petridish	http://www.petridish.org	2012	Closed. 32 projects hosted.
Davincicrowd	http://www.davincicrowd.com	2012	Active. 92 projects hosted.
Consano	http://www.consano.org	2013	Active. 67 projects hosted.
Donorscure	http://www.donorscure.org	2013	Active. 16 projects hosted.
Wallacea/Crowdscience	http://crowd.science	2014	Active. 36 projects hosted.
Futsci	http://futsci.com	2015	Active. 12 projects hosted.
Science Starter	http://www.sciencestarter.de	2015	Active. 122 projects hosted.
Institution-specific platforms			
Cancer Research UK	http://myprojects.cancerresearchuk.org	2008	Closed.
Georgia Institute of Technology	http://starter.gatech.edu	2013	Closed.
UCLA	http://spark.ucla.edu	2014	Active. 15 projects hosted.
Virginia Tech	http://crowdfund.vt.edu	2017	Active. 29 projects hosted.

Tab. 2: Summary statistics at the creator level

Variable		All creators N=1,153	First listed N=728	In team: first N=231	In team: not first N=425
Affiliation	Educational institution	0.81	0.80	0.83	0.81
	Firm	0.05	0.05	0.04	0.03
	Other organization	0.08	0.08	0.10	0.08
	None/independent	0.05	0.06	0.03	0.04
	Affiliation unknown	0.01	0.00	0.00	0.04
Position	Below PhD/MD	0.24	0.21	0.17	0.29
	PhD/MD	0.20	0.23	0.21	0.15
	Postdoc	0.06	0.05	0.08	0.07
	Assistant professor	0.09	0.10	0.11	0.07
	Associate/Full professor	0.14	0.14	0.20	0.13
	Employee	0.17	0.18	0.17	0.15
	Individual/no affiliation	0.05	0.06	0.03	0.04
	Other position	0.02	0.02	0.03	0.02
	Position unknown	0.03	0.01	0.01	0.07
Gender	Male	0.57	0.59	0.56	0.53
	Female	0.40	0.37	0.39	0.45
	Gender N/A or unknown	0.04	0.05	0.04	0.02

Tab. 3: Summary statistics at the campaign level (including average creator characteristics)

Variable		Mean	SD	Min	Max
Affiliation	Share educational	0.80		0	1
	Share firm	0.05		0	1
	Share other organization	0.09		0	1
	Share none/independent	0.06		0	1
Position	Share below PhD/MD	0.23		0	1
	Share PhD/MD	0.22		0	1
	Share Postdoc	0.05		0	1
	Share assistant professor	0.10		0	1
	Share associate/full professor	0.12		0	1
	Share employee	0.18		0	1
	Share individual/no affiliation	0.06		0	1
	Share other position	0.03		0	1
Gender	Share male	0.58		0	1
	Share female	0.38		0	1
	Share n/a or unknown	0.04		0	1
Region	US south	0.15		0	1
	US northeast	0.32		0	1
	US pacific	0.22		0	1
	US west/midwest	0.17		0	1
	Non-US	0.11		0	1
	Unknown	0.03		0	1
Other creator characteristics	Creator count	1.58	1.10	1	7
Field	Biology	0.51		0	1
	Ecology	0.32		0	1
	Medicine	0.25		0	1
	Chemistry	0.05		0	1
	Engineering	0.13		0	1
	Education	0.12		0	1
	Psychology	0.11		0	1
	Social Science	0.08		0	1
	Other field	0.24		0	1
Objective	Research	0.78		0	1
	Development	0.12		0	1
	Other goal	0.10		0	1
Budget	Total budget	7,763	38,108	50	1,000,000
	Share creator salary	0.03		0	1
	Share other salary	0.11		0	1
	Share equipment	0.59		0	1
	Share travel	0.16		0	1
	Share other direct	0.10		0	1
	Share indirect cost	0.00	0.01	0	0.3
	Share other	0.01		0	1
Other project characteristics	Funding target	6,425	37,956	100	1,000,411
	Pilot project	0.16		0	1
	Risk score	15.77	8.81	0	60.44
	Risk score simple	13.45	10.04	0	70
Campaign characteristics	Endorsement 01	0.15		0	1
	Prior papers 01	0.25		0	1
	Video 01	0.57		0	1
	Lab notes pre closing 01	0.67		0	1
	Rewards 01	0.11		0	1
	Platform age	109.42	34.07	0	179.14
Outcomes	Funded 01	0.48		0	1
	Amount raised	6,333	98,001	0	2,641,086
	Raised percent	62.70	71.56	0	1,000
	Average pledge	101.20	188.54	5	3,110
	Press coverage 01	0.34		0	1

Tab. 4: Main regressions

	Funded 01			(Ln) amount raised			(Ln) target	Press coverage 01		
	1	2	3	4	5	6	7	8	9	10
	logit	logit	logit	OLS	OLS	OLS	OLS	logit	logit	logit
Position: Below PhD/MD	4.212**	3.007**	3.223**	-0.137	0.570*	0.522*	-0.825**	0.343**	0.478*	0.604
	[1.359]	[1.026]	[1.226]	[0.237]	[0.222]	[0.211]	[0.119]	[0.107]	[0.159]	[0.218]
Position: PhD/MD	2.392**	1.861+	1.516	0.019	0.549**	0.367+	-0.677**	0.428**	0.550*	0.485*
	[0.739]	[0.609]	[0.534]	[0.228]	[0.206]	[0.192]	[0.116]	[0.125]	[0.168]	[0.160]
Position: Postdoc	3.644**	3.255**	1.972	0.422	0.744**	0.355	-0.529**	0.723	0.865	0.537
	[1.519]	[1.387]	[0.881]	[0.267]	[0.260]	[0.253]	[0.166]	[0.306]	[0.374]	[0.248]
Position: Assistant professor	1.241	1.046	0.799	-0.182	0.175	-0.010	-0.442**	0.540+	0.655	0.522
	[0.456]	[0.394]	[0.329]	[0.263]	[0.248]	[0.231]	[0.137]	[0.197]	[0.250]	[0.212]
Position: Associate/Full professor	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted
Position: Employee	1.370	0.966	0.864	-0.531+	0.169	0.156	-0.850**	0.544	0.732	0.618
	[0.615]	[0.451]	[0.413]	[0.320]	[0.305]	[0.274]	[0.183]	[0.245]	[0.334]	[0.283]
Position: Individual/no affiliation	2.954*	2.210+	1.850	-0.147	0.554+	0.381	-0.797**	0.420+	0.566	0.501
	[1.273]	[0.966]	[0.989]	[0.303]	[0.295]	[0.300]	[0.188]	[0.193]	[0.269]	[0.276]
Position: Other position	2.684	2.880	3.535+	0.639	0.666	0.707	0.017	1.238	1.363	1.014
	[1.777]	[1.925]	[2.439]	[0.668]	[0.571]	[0.541]	[0.384]	[1.005]	[1.120]	[0.817]
Affiliation: Educational institution	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted
Affiliation: Firm	0.956	1.397	1.549	0.599	-0.006	0.024	0.771**	0.919	0.880	0.995
	[0.512]	[0.805]	[0.913]	[0.383]	[0.372]	[0.332]	[0.217]	[0.514]	[0.496]	[0.572]
Affiliation: Other organization	1.782	2.065	1.868	0.801*	0.390	0.205	0.494*	1.275	1.062	1.245
	[0.789]	[0.937]	[0.893]	[0.330]	[0.311]	[0.283]	[0.203]	[0.597]	[0.514]	[0.604]
Gender: Female	1.505*	1.538*	1.539*	0.395**	0.406**	0.359**	-0.022	1.023	1.061	1.084
	[0.277]	[0.288]	[0.306]	[0.131]	[0.116]	[0.107]	[0.073]	[0.194]	[0.201]	[0.222]
Gender: N/A or unknown	0.644	0.712	0.692	0.024	-0.200	-0.165	0.268	1.699	1.449	1.789
	[0.312]	[0.345]	[0.348]	[0.415]	[0.353]	[0.317]	[0.194]	[0.879]	[0.790]	[0.969]
(Ln) target		0.674**	0.518**		0.779**	0.647**			1.518**	1.333**
		[0.067]	[0.060]		[0.063]	[0.061]			[0.158]	[0.148]
Objective: Research		omitted	omitted		omitted	omitted	omitted		omitted	omitted
Objective: Development		0.818	0.895		-0.189	-0.138	-0.116		0.830	1.049
		[0.254]	[0.288]		[0.193]	[0.182]	[0.132]		[0.264]	[0.346]
Objective: Other		1.236	1.260		0.011	0.029	-0.156		1.246	1.464
		[0.417]	[0.456]		[0.224]	[0.219]	[0.138]		[0.413]	[0.527]
Pilot project		0.957	0.899		0.002	-0.062	0.132		0.640+	0.586*
		[0.253]	[0.256]		[0.164]	[0.155]	[0.101]		[0.165]	[0.153]
Risk score		0.989	0.994		-0.009	-0.003	0.000		0.986	0.987
		[0.009]	[0.010]		[0.006]	[0.006]	[0.004]		[0.010]	[0.011]
Press coverage 01			1.382			0.088	0.137+			
			[0.318]			[0.127]	[0.076]			
Endorsement 01			2.401**			0.446**	0.167			2.149**
			[0.653]			[0.131]	[0.102]			[0.569]
Prior papers 01			1.260			0.121	0.036			4.910**
			[0.298]			[0.132]	[0.085]			[1.133]
Video 01			1.500*			0.303*	0.329**			1.951**
			[0.308]			[0.122]	[0.073]			[0.421]
Lab notes pre closing 01			3.713**			1.020**	0.182*			1.106
			[0.820]			[0.131]	[0.077]			[0.245]
Reward 01			2.202*			0.472**	-0.009			1.491
			[0.770]			[0.160]	[0.103]			[0.430]
Creator count	1.190*	1.225*	1.157	0.187**	0.153*	0.103+	0.030	1.137	1.127	1.180+
Region: US northeast	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted
Region: US south	0.958	0.992	1.035	0.056	0.005	0.057	0.082	0.882	0.871	0.755
Region: US pacific	1.854*	2.018**	1.960*	0.476**	0.329*	0.232	0.146	0.786	0.724	0.647
Region: US west/midwest	1.203	1.159	1.094	-0.205	-0.068	-0.116	-0.145	0.917	1.012	0.839
Region: Non-US	0.591+	0.601+	0.595	-0.594**	-0.633**	-0.629**	0.059	0.843	0.879	0.785
Region: Unknown	0.591	0.594	0.664	-0.586	-0.505	-0.404	-0.020	0.462	0.517	0.383
Field: Biology	1.624*	1.649*	1.362	0.296+	0.402**	0.231+	-0.154	0.832	0.854	0.655
Field: Medicine	1.470	1.640+	1.691+	0.407*	0.319+	0.309+	0.097	1.138	1.174	1.179
Field: Ecology	2.459**	2.601**	1.592+	0.662**	0.628**	0.229	-0.092	2.309**	2.301**	1.891*
Field: Chemistry	1.852	1.771	1.137	0.169	0.421	0.155	-0.344+	1.499	1.756	1.199
Field: Engineering	0.785	0.839	0.679	0.012	0.086	-0.020	-0.013	1.829+	1.975*	1.799+
Field: Education	1.640+	1.626	1.207	0.378*	0.417*	0.173	-0.083	1.475	1.458	1.269
Field: Psychology	0.645	0.624	0.523+	-0.351	-0.223	-0.291+	-0.156	1.020	1.067	0.871
Field: Social sciences	5.778**	5.230**	5.142**	0.524+	0.825**	0.661**	-0.435**	0.882	0.995	0.761
Field: Other	2.213**	2.041**	1.676+	0.362*	0.629**	0.421**	-0.356**	0.603+	0.658	0.478*
Platform age	0.957**	0.956**	0.946**	-0.029**	-0.023**	-0.021**	-0.004	1.147**	1.176**	1.190**
Platform age squared	1.000**	1.000**	1.000**	0.000**	0.000**	0.000**	0.000	0.999**	0.999**	0.999**
Constant	0.521	18.064*	103.487**	7.024**	0.028	0.533	8.751**	0.000**	0.000**	0.000**
	[0.421]	[22.446]	[157.565]	[0.574]	[0.726]	[0.702]	[0.357]	[0.000]	[0.000]	[0.000]
Observations	703	703	703	703	703	703	703	703	703	703
df	28	33	39	28	33	39	38	28	33	38
R-squared				0.163	0.325	0.430	0.253			

Note: +=sig. at 10%, *=sig. at 5%, **=sig. at 1%. Robust standard errors. Odds ratios reported for logits.

Crowdfunding Scientific Research: Supporting Materials

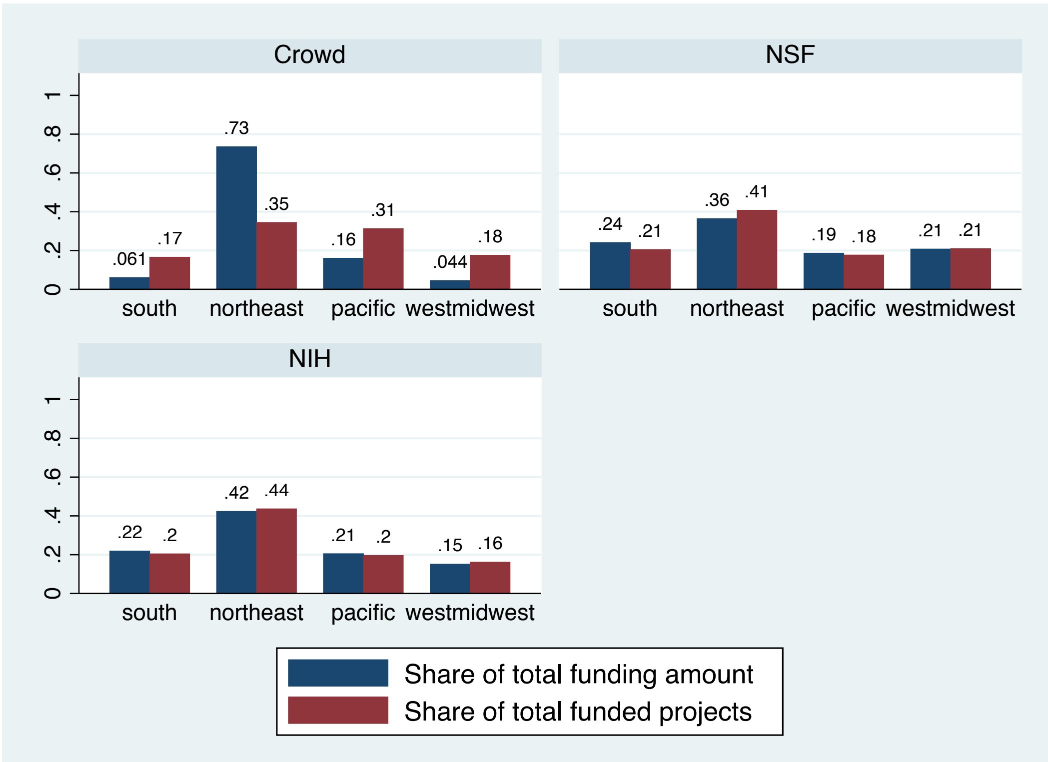

Fig. S1: Region's share of total funding and total number of funded projects, by funding source. NSF and NIH data pooled for years 2012-2015, Sources: dellweb.bfa.nsf.gov and report.nih.gov/award/index.cfm.

Avinash Kumar
Mar 16, 2016

great project and my best wishes to team! i follow project and learn more about genomics, and biohacking and wrote a blog post for it, please visit once :-) here http://biohack.in/open-insulin-project/

♡ 0

Anthony Di Franco Researcher
Mar 17, 2016

Thanks Avinash! I tried to load your link but it's not going through. Looking forward to checking it out when you've sorted it out.

♡ 0

Josh T
Feb 23, 2016

This is great, I'm a ped endo and the cost to families and to our healthcare system (hospitalizations/ER visits when people can't afford insulin) alone make me very excited about the project. If you ever want to run anything by someone on the clinical side, I would love to help.

♡ 0

Maureen Muldavin Researcher
Feb 23, 2016

Thanks Josh! We just might take you up on that at some point. :)

♡ 0

Anita Parsa
Jan 15, 2016

I just learned about this project today after a wine-induced fantasy of starting such a thing myself. ($900 insulin prescription picked up yesterday lead to my drinking lots of wine...) Anyway, how can I help? Is there anything I can do? I want this to happen!!! Thanks for what you're doing.

♡ 0

Maureen Muldavin Researcher
Jan 15, 2016

$900!? That might be the record for cost of insulin. Yes, you can absolutely help :) Send me an email at Muldavin.m@gmail.com and I'll find you an assignment.

♡ 0

Anthony Di Franco Researcher
Jan 19, 2016

Also, if you're in the bay area you can join our weekly meetings at 7 pm Wednesdays and noon Sundays (Sundays are the big days for lab work), and if you're not you can join them via video chat, and we can all figure it out together.

♡ 0

Fig. S2: Excerpt of discussion from the Open Insulin Project (https://Experiment.com/projects/open-insulin/discussion)

Tab. S1: Regressions using team averages of creator characteristics

	Funded 01			(Ln) amount raised			Press coverage 01			(Ln) target
	1	2	3	4	5	6	7	8	9	10
	logit	logit	logit	OLS	OLS	OLS	logit	logit	logit	OLS
Share below PhD/MD	4.084**	2.685**	2.953**	-0.247	0.611*	0.585*	0.287**	0.413*	0.631	-1.002**
	[1.409]	[0.965]	[1.204]	[0.268]	[0.247]	[0.238]	[0.096]	[0.148]	[0.252]	[0.137]
Share PhD	1.787+	1.298	1.052	-0.122	0.518*	0.354	0.331**	0.437*	0.500+	-0.791**
	[0.612]	[0.460]	[0.415]	[0.269]	[0.240]	[0.226]	[0.111]	[0.154]	[0.195]	[0.137]
Share postdoc	2.528+	2.054	1.090	0.113	0.542	0.069	0.563	0.696	0.462	-0.679**
	[1.203]	[0.995]	[0.566]	[0.331]	[0.335]	[0.309]	[0.280]	[0.354]	[0.263]	[0.185]
Share assistant professor	1.071	0.843	0.574	-0.263	0.210	-0.036	0.466+	0.591	0.516	-0.596**
	[0.437]	[0.349]	[0.263]	[0.300]	[0.275]	[0.263]	[0.191]	[0.250]	[0.236]	[0.154]
Share employee	0.839	0.582	0.523	-0.639	0.062	0.104	0.311*	0.415+	0.452	-0.799**
	[0.391]	[0.290]	[0.278]	[0.397]	[0.336]	[0.311]	[0.145]	[0.195]	[0.219]	[0.216]
Share individual/no affiliation	3.026*	2.130+	1.857	-0.091	0.666*	0.508	0.417+	0.564	0.603	-0.874**
	[1.346]	[0.952]	[0.993]	[0.326]	[0.312]	[0.315]	[0.192]	[0.270]	[0.328]	[0.197]
Share firm	1.275	1.745	1.968	0.565	0.029	0.054	1.465	1.445	1.389	0.636**
	[0.707]	[1.056]	[1.295]	[0.436]	[0.394]	[0.361]	[0.855]	[0.839]	[0.832]	[0.231]
Share affiliation other	2.084	2.273+	2.357	0.671+	0.353	0.220	1.336	1.159	1.354	0.363
	[0.959]	[1.111]	[1.256]	[0.407]	[0.334]	[0.310]	[0.646]	[0.575]	[0.676]	[0.235]
Share female	1.749**	1.767**	1.746*	0.496**	0.510**	0.443**	1.000	1.046	1.016	-0.042
	[0.355]	[0.366]	[0.383]	[0.145]	[0.128]	[0.118]	[0.213]	[0.225]	[0.232]	[0.080]
Share gender N/A or unknown	0.522	0.609	0.561	0.146	-0.149	-0.109	2.254	1.857	2.190	0.357
	[0.268]	[0.321]	[0.322]	[0.487]	[0.370]	[0.356]	[1.265]	[1.084]	[1.260]	[0.255]
(Ln) target		0.688**	0.530**		0.801**	0.666**		1.501**	1.341**	
		[0.070]	[0.062]		[0.064]	[0.062]		[0.159]	[0.149]	
Objective: Research		omitted	omitted		omitted	omitted		omitted	omitted	omitted
Objective: Development		0.836	0.944		-0.173	-0.117		0.816	1.053	-0.090
		[0.260]	[0.308]		[0.191]	[0.181]		[0.255]	[0.341]	[0.125]
Objective: Other		1.250	1.254		0.012	0.021		1.250	1.491	-0.153
		[0.423]	[0.452]		[0.222]	[0.216]		[0.411]	[0.533]	[0.138]
Pilot project		0.956	0.911		-0.009	-0.064		0.639+	0.597+	0.147
		[0.253]	[0.261]		[0.166]	[0.157]		[0.166]	[0.158]	[0.101]
Risk score		0.989	0.995		-0.008	-0.003		0.986	0.986	-0.001
		[0.009]	[0.010]		[0.006]	[0.006]		[0.010]	[0.011]	[0.004]
Press coverage 01			1.308			0.087				0.143+
			[0.306]			[0.127]				[0.075]
Endorsement 01			2.493**			0.440**			2.165**	0.168
			[0.694]			[0.133]			[0.572]	[0.105]
Prior papers 01			1.290			0.158			4.876**	-0.013
			[0.306]			[0.133]			[1.141]	[0.083]
Video 01			1.546*			0.316**			1.925**	0.322**
			[0.318]			[0.121]			[0.414]	[0.073]
Lab notes pre closing 01			3.798**			1.023**			1.131	0.201**
			[0.840]			[0.131]			[0.252]	[0.076]
Reward 01			2.376*			0.499**			1.460	-0.024
			[0.826]			[0.160]			[0.425]	[0.106]
Creator count	1.107	1.144	1.075	0.183**	0.128*	0.083	1.176*	1.156+	1.206*	0.050
Region: US northeast	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted
Region: US south	1.043	1.063	1.098	0.074	0.043	0.089	0.862	0.857	0.752	0.058
Region: US pacific	1.855*	1.966**	1.878*	0.446**	0.327*	0.221	0.761	0.711	0.638+	0.105
Region: US west/midwest	1.226	1.176	1.097	-0.210	-0.051	-0.104	0.932	1.038	0.855	-0.169+
Region: Non-US	0.591+	0.597+	0.581	-0.602**	-0.629**	-0.628**	0.840	0.875	0.768	0.039
Region: Unknown	0.597	0.584	0.601	-0.629	-0.486	-0.416	0.470	0.541	0.394	-0.102
Field: Biology	1.596*	1.635*	1.328	0.304+	0.385**	0.220	0.852	0.870	0.678	-0.121
Field: Medicine	1.477	1.652+	1.677+	0.435*	0.334+	0.316+	1.150	1.183	1.205	0.099
Field: Ecology	2.481**	2.644**	1.575+	0.675**	0.629**	0.217	2.382**	2.359**	1.905*	-0.086
Field: Chemistry	1.655	1.592	0.982	0.142	0.368	0.098	1.514	1.733	1.206	-0.306+
Field: Engineering	0.803	0.857	0.661	0.020	0.069	-0.050	1.736+	1.878+	1.722	0.001
Field: Education	1.700+	1.669	1.180	0.372+	0.425*	0.171	1.544	1.536	1.302	-0.114
Field: Psychology	0.700	0.676	0.567+	-0.325	-0.178	-0.249	0.985	1.044	0.872	-0.169
Field: Social sciences	5.602**	5.192**	5.120**	0.496+	0.797**	0.636**	0.931	1.038	0.781	-0.425*
Field: Other	2.024**	1.906*	1.545	0.350+	0.586**	0.387*	0.617+	0.664	0.494*	-0.308**
Platform age	0.955**	0.954**	0.944**	-0.031**	-0.024**	-0.022**	1.147**	1.176**	1.193**	-0.005
Platform age squared	1.000**	1.000**	1.000**	0.000**	0.000**	0.000**	0.999**	0.999**	0.999**	0.000
Constant	0.703	22.655*	129.700**	7.215**	-0.114	0.376	0.000**	0.000**	0.000**	8.909**
	[0.584]	[28.824]	[199.919]	[0.610]	[0.747]	[0.727]	[0.000]	[0.000]	[0.000]	[0.365]
Observations	703	703	703	703	703	703	703	703	703	703
df	27	32	38	27	32	38	27	32	37	37
R-squared				0.156	0.325	0.433				0.255

Note: +=sig. at 10%, *=sig. at 5%, **=sig. at 1%. Robust standard errors. Odds ratios reported for logits.

Tab. S2: Regressions using position and affiliation separately and using simple risk score

	Funded 01	(Ln) amt raised	Press 01	Funded 01	(Ln) amt raised	Press 01	Funded 01	(Ln) amt raised	Press 01
	1	2	3	4	5	6	7	8	9
	logit	OLS	logit	logit	OLS	logit	logit	OLS	logit
Position: Below PhD/MD	4.221**	-0.132	0.342**				3.237**	0.525*	0.601
	[1.370]	[0.237]	[0.107]				[1.232]	[0.211]	[0.216]
Position: PhD/MD	2.396**	0.030	0.425**				1.503	0.363+	0.475*
	[0.744]	[0.227]	[0.124]				[0.528]	[0.192]	[0.156]
Position: Postdoc	3.720**	0.459+	0.727				1.986	0.358	0.534
	[1.552]	[0.266]	[0.308]				[0.881]	[0.253]	[0.246]
Position: Assistant professor	1.246	-0.172	0.540+				0.782	-0.019	0.511
	[0.460]	[0.262]	[0.197]				[0.321]	[0.230]	[0.209]
Position: Associate/Full professor	omitted	omitted	omitted				omitted	omitted	omitted
Position: Employee	1.746+	-0.006	0.591+				0.855	0.155	0.605
	[0.561]	[0.233]	[0.183]				[0.409]	[0.273]	[0.276]
Position: Individual/no affiliation	2.958*	-0.140	0.418+				1.834	0.378	0.489
	[1.281]	[0.302]	[0.192]				[0.976]	[0.300]	[0.271]
Position: Other position	3.386+	0.973	1.368				3.665+	0.714	1.002
	[2.218]	[0.727]	[1.095]				[2.514]	[0.536]	[0.804]
Affiliation: Educational institution				omitted	omitted	omitted	omitted	omitted	omitted
Affiliation: Firm				0.654	0.123	0.898	1.525	0.015	1.000
				[0.261]	[0.294]	[0.375]	[0.899]	[0.331]	[0.572]
Affiliation: Other organization				1.246	0.441+	1.418	1.862	0.200	1.251
				[0.385]	[0.247]	[0.447]	[0.894]	[0.283]	[0.605]
Affiliation: No affiliation				1.380	-0.065	0.811			
				[0.502]	[0.252]	[0.334]			
Gender: Female	1.526*	0.427**	1.030	1.593**	0.408**	0.924	1.538*	0.357**	1.071
	[0.280]	[0.130]	[0.194]	[0.283]	[0.129]	[0.170]	[0.306]	[0.106]	[0.219]
Gender: N/A or unknown	0.645	0.041	1.695	1.034	0.196	1.563	0.686	-0.164	1.805
	[0.309]	[0.423]	[0.875]	[0.478]	[0.425]	[0.730]	[0.347]	[0.318]	[0.971]
(Ln) target							0.519**	0.647**	1.326*
							[0.061]	[0.061]	[0.147]
Objective: Research							omitted	omitted	omitted
Objective: Development							0.893	-0.141	1.029
							[0.287]	[0.183]	[0.337]
Objective: Other							1.257	0.026	1.440
							[0.458]	[0.220]	[0.519]
Pilot project							0.895	-0.062	0.587*
							[0.255]	[0.155]	[0.153]
Risk score									
Risk score simple							1.004	0.000	0.995
							[0.010]	[0.006]	[0.010]
Press coverage 01							1.387	0.090	
							[0.319]	[0.127]	
Endorsement 01							2.385**	0.447**	2.175**
							[0.649]	[0.131]	[0.577]
Prior papers 01							1.251	0.118	4.890**
							[0.295]	[0.132]	[1.126]
Video 01							1.498*	0.303*	1.950**
							[0.308]	[0.122]	[0.420]
Lab notes pre closing 01							3.795**	1.027**	1.114
							[0.846]	[0.131]	[0.249]
Reward 01							2.202*	0.475**	1.508
							[0.770]	[0.161]	[0.435]
Creator count	1.201*	0.188**	1.139+	1.126	0.197**	1.203*	1.156	0.102+	1.180+
Region: US northeast	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted
Region: US south	0.957	0.055	0.883	0.956	0.031	0.860	1.038	0.059	0.760
Region: US pacific	1.851*	0.480**	0.785	1.759*	0.433*	0.778	1.990*	0.239+	0.662
Region: US west/midwest	1.188	-0.235	0.912	1.143	-0.225	0.953	1.083	-0.119	0.839
Region: Non-US	0.608+	-0.564**	0.852	0.608+	-0.626**	0.811	0.595	-0.627**	0.789
Region: Unknown	0.590	-0.580	0.454	0.530	-0.688+	0.458	0.684	-0.391	0.375
Field: Biology	1.615*	0.309+	0.832	1.608*	0.311+	0.856	1.338	0.222	0.641+
Field: Medicine	1.449	0.450*	1.132	1.207	0.455*	1.346	1.678+	0.307+	1.181
Field: Ecology	2.493**	0.675**	2.331**	2.548**	0.688**	2.220**	1.555	0.221	1.874*
Field: Chemistry	1.895	0.228	1.519	1.552	0.214	1.715	1.126	0.149	1.187
Field: Engineering	0.776	0.036	1.819+	0.836	-0.001	1.748+	0.659	-0.033	1.746+
Field: Education	1.663+	0.356+	1.490	1.432	0.332+	1.522	1.214	0.173	1.272
Field: Psychology	0.637	-0.356	1.019	0.633	-0.331	1.032	0.515+	-0.297+	0.850
Field: Social sciences	5.829**	0.523+	0.887	5.590**	0.542*	0.849	5.189**	0.661**	0.767
Field: Other	2.223**	0.394*	0.607+	2.051**	0.392*	0.659	1.661+	0.418**	0.479*
Platform age	0.956**	-0.031**	1.145**	0.956**	-0.030**	1.148**	0.943**	-0.022**	1.187**
Platform age squared	1.000**	0.000**	0.999**	1.000**	0.000**	0.999**	1.000**	0.000**	0.999**
Constant	0.524	7.044**	0.000**	1.374	6.993**	0.000**	102.636**	0.517	0.000**
	[0.422]	[0.579]	[0.000]	[1.112]	[0.548]	[0.000]	[158.165]	[0.703]	[0.000]
Observations	703	703	703	703	703	703	703	703	703
df	26	26	26	22	22	22	39	39	38
R-squared		0.155			0.149			0.429	

Note: +=sig. at 10%, *=sig. at 5%, **=sig. at 1%. Robust standard errors. Odds ratios reported for logits.