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YouTube or You Lose: Grand Challenges Canada Explores Whether Scientists Are Ready for Web-Based Grant Competitions

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It is not hard to trace the influence of technology on the way we read the literature or give scientific presentations. Not so long ago, chemists used hard copies of *Chemical Abstracts* to find papers and sticks of chalk to deliver talks. Only over the past decade have computer presentations become the norm. In contrast, the way that grants are evaluated has remained relatively unchanged: scientists submit written proposals that are then evaluated by committees of scientists in the field. Might this process soon change as well?

The not-for-profit organization Grand Challenges Canada (GCC) recently sponsored a competition in which researchers presented audacious ideas to attack problems related to global health (Figure 1). In its search for bold ideas from scientists, the GCC organization tested a bold idea as well: each proposal had to be accompanied by a 2-min-long video for public consumption on the Internet. Web users were encouraged not only to view these video summaries but to participate in the evaluation of the proposals by means of clicking on a "thumbs up" button (similar to the "like" buttons found on YouTube and Facebook). The votes from the public video were used by GCC to evaluate each applicant's ability to "engage the public and increase awareness in the grand challenges facing global health today".[1] The competition collected over 180,000 votes and over 100,000 unique online visits from 156 countries in a mere 4 weeks—staggering statistics for scientific videos. While each applicant also submitted a written version of the proposal, which was privately evaluated by "standard" peer-review, the public video feature was one of the first direct implementations of Web 2.0 technology (user-interactive sites and applications) to evaluate scientific proposals. The competition raises an important question: to what extent, if any, should Web 2.0 technology or other direct evaluation by the public be used to determine the outcome of scientific grant proposals?

Figure 1. A new format for grant applications from Grand Challenges Canada.

Grand Challenges Canada (http://www.grandchallenges.ca/).

A BRIEF OVERVIEW OF WEB 2.0 AND THE GCC COMPETITION

The use of online scientific videos is already on the rise in the academic community. Several journals, including the *Journal of the American Chemical Society*, are experimenting with video abstracts to enhance the standard publication of scientific articles.[2] The Bill and Melinda Gates Foundation, which funds projects aimed at improving global health and lowering poverty, highlights successful applications using 2-min-long videos generated by the Foundation. The *Journal of Visualized Experiments* is wholly dedicated to publishing peer-reviewed videos that portray research procedures in the life sciences.[3] ABC News and the Duke Global Health Institute recently awarded $10 K to the winner of a competition whose call for video proposals attracted over 65 applicants with ideas or products to improve maternal health care.[4] On some Web sites, such as kickstarter.com, anyone can post short videos to raise small sums of money ($5−50 K). These sites, however, target mostly nonacademic projects. The GCC competition for Rising Stars in Global Health appears to be the first example of a large-scale grant competition to award large levels of funding, up to $1 M per applicant in the second round of funding, and require the submission of a video for public feedback. The competition was restricted to researchers who have had their doctoral degrees for fewer than 10 years. This restriction on experience helped to attract younger applicants who are likely to be more familiar with Web 2.0 products. The projected funding rate was similar to that of other grant agencies (ca. 20%). The competition exposed several positive and negative aspects of video-proposal competitions that should be instructive for other funding agencies considering similar use of Web 2.0 technology.

THE BRIGHT SIDE OF WEB 2.0-BASED COMPETITIONS

The creation of these scientific video proposals comes with several obvious benefits (see Box 1−3). Technical information presented in a visual format is often more easily understood and quickly processed than prose. The open videos also allow the public to become better informed about prospective projects and their importance. Such a model establishes a direct link between research scientists and the public that is unfiltered by politicians

Published: August 19, 2011

or journalists. In cases where the source of funding is a federal agency, such a competition allows the taxpayer to have a voice in deciding how grant money is allocated. Even if votes carry little weight, the public can appreciate the ability to be engaged in deciding the future of science. Aside from the ability of the videos to serve as educational tools, they can also be used to influence opinion and advance political messages in support of science. For instance, publically accessible videos can serve to pushback against concerns voiced by some members of Congress that federal funding is being wasted on projects of questionable value. Specifically, a program termed YouCut encourages citizens to browse the database of NSF-funded grants to "identify grants ... which [they] don't think are a good use of taxpayer dollars".[5] The call to "YouCut" funding rang alarm bells on the opinion pages of both *Nature*[6] and *Science*.[7] Short, publically accessible video proposals allow laypeople to learn about the importance of the projects that might be otherwise misjudged from just a title or a written abstract.

BOX 1: "I view the role of video, and the various media associated with viewing, sharing, and dissemination of it, as critical for the future of academic funding and innovation in general. Jurisdictions face an ever-increasing demand for financial resources, and funding for research and innovation is just one of the competing facets. The very nature and complexity of many high-tech research initiatives can lead to difficulty in translating the importance of these public expenditures in the face of this competitive funding environment. A clear, concise, and technically sound video that can be viewed and shared by a broader audience that includes taxpayers and legislators can go a long way to enhancing a 'culture of innovation' that will have impacts on research and innovation stakeholders as well as the economy as a whole." Kirk Rockwell, Director for Centres of Research and Commercialization at Alberta Innovates — Technology Futures.

BOX 2: "The positive value of video-based review has its origins in both the Heilmeier Questions, the first of which is 'articulate your approach using absolutely no jargon', and the greater richness of information content and nuance conveyed by 'face-to-face' communication compared to the written word. When ideas are presented simply and in plain language, it is remarkable how well non-scientists can understand even the deepest and most sophisticated scientific concepts. Video presentations that follow this principle allow a meaningful expansion to a broader and more diverse set of reviewers. Furthermore, non-experts often pay more attention to the 'intangible', i.e., non-scientific, aspects that are difficult to capture in the written word, such as excitement, passion, believability, coolness, value, and how the idea relates to themselves and the broader context. Finally, the video presentation requires the proposer to both strive for clarity and forge a connection with the outside world, which strengthens his/her level of understanding of the idea and ability to communicate it." Mitchell Zakin, former program manager at DARPA.

BOX 3: "One of the real revolutions in reporting the science has been YouTube. Twenty, thirty years ago, the science that you could do is the science you could report. With videos you can describe phenomena that are dynamic, which are too complex to describe in words or 2D pictures. The ability to report video opened an enormous range of explorations." George Whitesides, Professor from Harvard University.[9] In addition to reporting new research results, Whitesides also views video as an opportunity to promote science, which is often "embedded in prose that's impermeable even to experts and buried in [scientific] papers".[9]

While videos represent an effective vehicle for the communication of technical information to a lay audience, one concern about a requirement for the inclusion of videos with grant applications is that the production of quality videos is not yet a common skill among scientists. Such an observation, however, should not serve as a deterrent as much as a wake-up call to scientists to work on building this talent. Rejecting popular trends in information technology can be detrimental to the progress of research. For example, poor research Web sites can make it difficult for professors to attract new students or interact with the press. Despite the unquestionable importance of the Web for communicating information, it is perplexing that many scientists have poorly maintained Web sites or no Web sites at all. Adding video production skills to the portfolio of the average scientist will go a long way toward helping our field stay connected to a public that increasingly uses this technology.

From the past, there are many examples where scientists have demonstrated the ability to learn various computer applications quickly and have used them to great effect in the communication of their results. PowerPoint and similar programs have become the standard in science. Photoshop was once used almost exclusively by designers and artists but now is used to great effect in the construction of figures for scientific papers. While scientists who use Photoshop rarely generate art on par with that of Andy Warhol, their images are still invaluable in the communication of ideas. We do not expect scientists to produce video shorts that rival those of Michel Gondry, but their "amateur" scientific videos will still be effective in clarifying and communicating the central ideas of grant proposals.

■ THE DARK SIDE OF WEB 2.0 COMPETITIONS

Not every scientist embraces the idea of video proposals. Some assistant professors lament them as yet another requirement from grant agencies that will siphon time away from research. Other scientists criticize the increased level of disclosure required by public videos (Box 4). Indeed, exposure of authors' gender had greatly influenced the outcome of peer review in the past. It is only in the past decade that male and female applicant achieved near-equal funding success in main funding agencies.[8] Will this balance be preserved after introducing new factors, such as evaluation by the general audience, or exposure of the authors as "actors" and "narrators" in their own video grant applications?

BOX 4: "Public videos should not be used to evaluate grant proposals until two critical issues are resolved: discrimination and intellectual property. Discrimination, or mere personal bias, often can result from exposing the ethnicity, race, or gender of the presenter. Additional bias due to

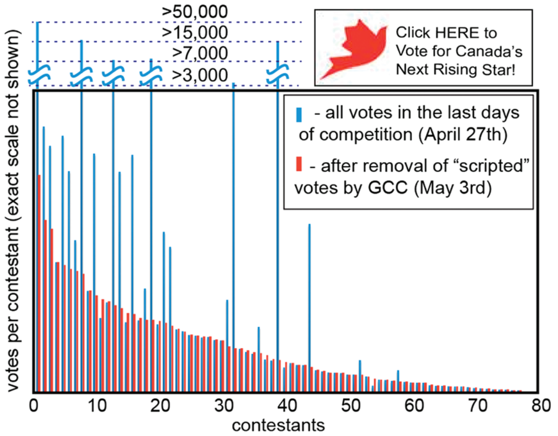

Figure 2. Results of the voting from GCC competition. To preserve the anonymity of the contestants, the exact values for votes are not shown. For more information on the compilation process, please refer to the Supporting Information and Disclaimer.

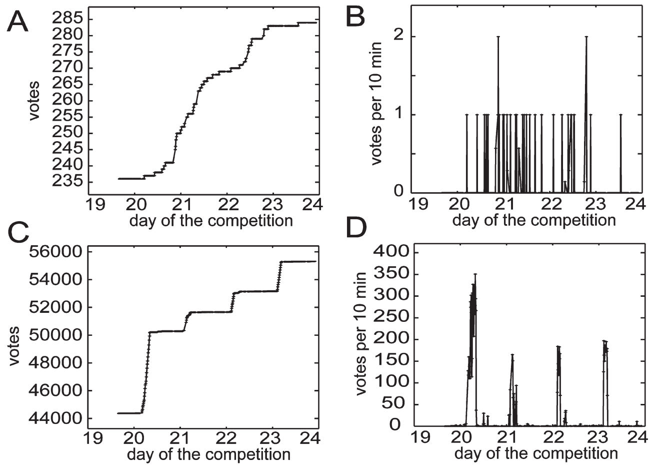

Figure 3. Voting profile during a four-day period for two applicants. For more information on the generation of this figure, please refer to Supporting Information and Disclaimer.

differences in charisma or attractiveness might influence the audience irrespective of the intellectual merit of the proposal. Conversely, the anonymous grant review process allows submissions to be reviewed without exposing reviewers to factors that may stimulate bias or discrimination. Public video submissions do not offer the same level of legal protection to intellectual property as the anonymous grant review process. Once an idea has been publicly disclosed, it may not be eligible for patent protection. A proposal submitted in an anonymous review process may not count as a public disclosure, while ideas presented in public videos may very well be counted as a public disclosure. Grant-based videos, thus, may have a net negative effect because they could preclude the legal protection that would encourage translating research into products that benefit society." Renee Fuller, postdoctoral fellow at Harvard University.

Open voting on the Web as a method for evaluation by the public has other potential problems. Perhaps the biggest threat to the integrity of the process is the possibility of vote manipulation using programmed scripts. At the end of the GCC competition, the organizers reported to the participants that "It has come to our attention that scripts have been written to falsely increment the ratings on some of the applications. Where we have found evidence of this and to keep the ratings fair, we have taken out the associated ratings". Figure 2 shows the real-time votes collected by the authors in the final days of the GCC competition alongside the final results of the voting. The GCC organizers used a conservative criterion for detecting votes generated by scripts: votes that came in regular intervals from a single IP address were tagged as "scripted" and eliminated (ca. 130,000 out of 170,000).

The organizers of the GCC grant competition were the first to test the large-scale Web 2.0-based evaluation of grants, and they did not expect to encounter such an excessive amount of scripted votes. Fortunately, the mechanism and transparency of online voting made it simple to detect the problem and adjust the rule, even after the competition had started. The impetus for the elimination of scripted votes was, most likely, the result of concerns raised by participants who observed "videos receiving an extraordinary amount of votes within seconds".[10] Figure 3 illustrates an example of such behavior. It displays a 4-day-long profile of votes and "vote differential" (number of votes acquired per 10 min) for two applicants. One video received a steady rise of votes, on average 1–2 votes every 10 min (Figure 3A,B). Figure 3C,D, however, describes an interesting pattern in which the votes for an applicant rose in one specific time-window of the day. In this window, the video received 10–30 votes per minute. During the rest of the day, it only received a few votes. One possible method to expose such practices in future competitions would be to post plots similar to Figure 3 alongside the online applications as a means of monitoring trends in voting in real time.

A competition for votes from the public also introduces perils associated with marketing and propaganda. In their drive to garner as many votes as possible, the competing scientists stand to benefit by promoting their videos. While standard methods for doing so include highlighting their research on the Web pages of their universities, departments, and alumni organizations, more aggressive campaigns to attract attention could mislead the public. Posts trumpeting "Vote for me and I'll cure [disease]" make grandiose claims that are unrealistic and more commonly encountered in political elections. While the promotion of videos associated with grant proposals has the potential to favorably increase public awareness of scientific pursuits, not all publicity is good publicity for science. A recent example of the adverse effects of unwarranted publicity was evident with the recent announcement of "arsenic-based" bacteria by NASA-funded researchers.[11] The attention the authors sought by promoting their results in an online press conference backfired when the focus quickly shifted to the weaknesses of the study.[12−14]

To address this "dark side" of Web 2.0-based competitions, one needs to outline what is ethical in terms of scientific self-promotion, but arriving at a well-defined set of black-and-white criteria may prove difficult. Most applicants would agree that writing scripts to generate automated votes is not ethical. On the other hand, the original call for proposals by GCC did not foresee the exploitation of scripts and updated rules dynamically to counteract the unforeseen problems; some scientists might view rule changes "on the fly" as unfair. Even if GCC had published its definition of "scripted votes"—periodic bursts from the same

IP address—prior to the competition, one could easily tweak a script to bypass the criteria for disqualification. One approach is to write scripts that do not generate periodic burst of votes but instead spread the votes out over longer time spans. Another approach is to use proxy servers to make it appear as if the votes originate from all over the globe instead of a single location. Intuitively, we understand that both behaviors would also be unethical, but both hypothetical examples would exploit loopholes in the GCC's definition of "scripted votes". In a less clear-cut example, consider that many scientists pay professional designers to construct Web sites for their laboratories. Given this accepted practice, should it also be acceptable to pay for crowdsourcing services that promote grant proposals specifically to generate "clicks" and raise votes?

It is clear that all of the stakeholders in the scientific Web 2.0 enterprise, scientists, journals, and funding agencies, must become educated about "online misconduct" and start to address it. Useful inspiration can be found in recent technological developments to counteract the unethical processing of digital images in scientific publications. Many journals employ software that detects inconsistencies in images arising from digital manipulation. It is important to note that the development of this software has not driven scientists to spend time searching for its loopholes, but instead to learn what boundaries they should not cross in processing their images. We foresee that a simple and logical set of ethical guidelines regarding scripts and crowdsourced votes will eventually be effective at maintaining integrity. The definition of what constitutes "overselling" of scientific ideas is more difficult, but this is not a problem new to Web 2.0 technology. It is unfortunate that the public is easily deceived, and accounting for such misconduct is more difficult than detecting a script or a fabricated image. The transparency and mechanisms for user feedback that are the hallmarks of Web 2.0 technology will undoubtedly help the community identify and chastise those scientists who challenge the boundaries of good taste in self-promotion. While there will undoubtedly be challenges in their effective implementation, public Web 2.0-based grant competitions offer a valuable new aspect to funding research by democratizing the process and enhancing how the public interacts with the scientific community.

■ ASSOCIATED CONTENT

S Supporting Information. Overview of the MatLab programs used to process the statistics of the competition. This material is available free of charge via the Internet at http://pubs.acs.org.

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Notes

Disclaimer: The cited comments represent the opinion of the authors and not that of any other agency or entity. R.D. was a participant of the GCC grant described here. The images in Figures 1 and 2 (logo) were retrieved from the Grand Challenges Canada Web site by the authors. The data for Figures 2 and 3 were collected from the Web site of the competition (gcc.eyeptv.net) by the authors during April 19−May 6, 2011 or provided by GCC. The data was processed to generate Figures 2 and 3 using MatLab. The use of the images or data does not imply the endorsement of the contents of the article by Grand Challenges Canada.

■ ACKNOWLEDGMENT

R.D. acknowledges funding from the University of Alberta (UofA), Alberta Innovates Centre for Carbohydrate Science and GCC, Canadian Rising Stars in Global Health. P.J.B. is graciously supported by an NSF American Competitiveness in Chemistry postdoctoral fellowship (CHE -0936996). We thank Dr. Todd Lowary (UofA), Dr. Chris Cairo (UofA), Dr. Sindy Tang (Stanford University) for their evaluation of the manuscript.

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