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Obituaries Can Popularize Science and Health: Stephen Hawking and Interest in Cosmology and Amyotrophic Lateral Sclerosis

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Obituaries are an understudied form of popular media culture. Well-known scientists can inspire the general public to learn more about their field of study, and such exposure can occur posthumously through obituaries and related press coverage of a scientist's passing. In the current studies, we examined the influence of physicist Stephen Hawking's death on public interest in science topics related to his work. We also examined whether the representation of male versus female physicists quoted in the obituary increased perceptions of gender equity in science. Study 1 found that reading Hawking's obituary increased interest in both physics and amyotrophic lateral sclerosis but that the number of female physicists quoted did not affect interest levels. Study 2 showed that following Hawking's death, there was a marked increase in Wikipedia page views on related topics in cosmology (but not necessarily other areas of physics) and on amyotrophic lateral sclerosis. Taken together, the present research shows the influence of obituaries on public attention, as well as the outsized influence that Hawking has had on public interest in science, even in death.

Public Policy Relevance Statement

Celebrity scientists can play an important role in increasing public interest in science. The two studies presented here show that the death and the obituary of a famous physicist can increase interest in physics, specifically the area of physics the scientist studied.

Keywords: obituary, physics, celebrity scientist, Stephen Hawking, ALS

Public figures can inspire interest in both their fields and their lives. In the domain of public health, celebrity deaths due to illness and illness disclosures have increased the public's interest in the specific illness. For example, when Charlie Sheen disclosed his HIV status, Internet searches for HIV increased (Ayers, Althouse, Dredze, Leas, & Noar, 2016) as did purchases of at-home HIV test kits (Allem et al., 2017). Similarly, searches for pancreatic cancer increased after Patrick Swayze's diagnosis (Noar, Ribisl, Althouse, Willoughby, & Ayers, 2013), searches for cervical cancer and smear test increased after Jade Goody's diagnosis and death (Metcalfe, Price, & Powell, 2011), and searches related to breast cancer increased after Angelina Jolie's prophylactic mastectomy (Noar,

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C The experiment materials are available at https://osf.io/kp3ts/?view_ only=c478bce3014d4aae860c47eaddcfce94

The preregistered design and analysis plan is accessible at https://osf io/kp3ts/?view_only=c478bce3014d4aae860c47eaddcfce94

Correspondence concerning this article should be addressed to Gili Freedman, Department of Psychology, St. Mary's College of Maryland, 18952 East Fisher Road, St. Mary's City, MD 20686. E-mail: gili.freedman@gmail.com Althouse, Ayers, Francis, & Ribisl, 2015). However, the effects of the lives and deaths of celebrities likely extend beyond health topics.

Public Scientists

Can the deaths of famous scientists have a similar effect beyond illness, to increase public interest in science? Furthermore, can more subtle aspects of the portrayal of scientists within obituaries have a broader influence on issues such as gender representation in science? Stephen Hawking, who died on March 14, 2018, was one of the most famous modern scientists and a pioneer in the field of cosmology (White & Gribbin, 2002). Hawking held an esteemed place not only in the world of cosmology but also in the public imagination, publishing scientific journal articles and books for the public (White & Gribbin, 2002), most famously, A Brief History of Time (Hawking, 1988). Beyond his many contributions to science, he also was an advocate for disability rights and brought amyotrophic lateral sclerosis (ALS) to the forefront (BBC News, 1999; Hawking, 2017; Ruiz, 2018). Furthermore, the film The Theory of Everything (Bevan, Fellner, Bruce, & McCarten, 2014) depicted key events in Hawking's personal and professional life and earned Eddie Redmayne an Academy Award for his portrayal of the scientist.

Scientists like Hawking, who are public science communicators in addition to being scientists, play an important role in the public understanding of science. Since Goodell's description of "visible scientists" (Goodell, 1977), researchers have been examining the role of scientists in the media more closely (Fahy, 2017). These scientists who have a prominent role in the media have the opportunity to educate, inform, and shift opinions related to science and policy, though the effects are not always positive; at times, the result of the communications about science is misinformation or increased polarization (Johnson, Ecklund, Di, & Matthews, 2018; Scheitle & Ecklund, 2017).

Although Hawking appeared within popular media culture in a variety of ways during his lifetime, his death sparked a new round of media coverage. Obituaries for Hawking told the story of his life and his illness and highlighting his scientific ideas and his influence on the field. These obituaries also included other scientists, either by quoting their views on Hawking and his contributions or by describing their interactions with Hawking. Thus, the obituaries had the potential to influence readers about the primary topic (Hawking's life, his scientific contributions, and his illness), as well as about more subtle issues (e.g., whether women scientists were represented among those quotes in the obituaries).

Obituaries in Media Culture

Obituaries are a unique type of media presentation that provide an important opportunity to remind the public of individuals' scientific contributions, as well as other aspects of their lives. Obituaries of public figures often receive prominent media coverage and are widely shared. Although obituaries for average individuals may be as simple as providing dates of birth and death or names of family members, our focus here is on more elaborated: feature-length obituaries written for public figures. These obituaries provide narratives of individuals' personal and professional journeys, giving an opportunity for audiences to learn about a public figure in more depth. Obituaries also have emotional resonance because of the grief or sadness that accompanies the loss of a known or admired public figure; they typically also mention the important relationships in the deceased person's life, which can evoke more positive emotions or provide a sense of meaningfulness. Both narratives and emotional messages have been shown to capture audiences' attention and potentially lead to change in attitudes and behaviors (Bartsch, Kalch, & Oliver, 2014; Myrick & Oliver, 2015; Nabi & Green, 2015). Because of these qualities, obituaries may be particularly well-positioned to encourage readers' interest in topics related to the deceased person.

Obituaries can provide valuable information for researchers; for example, a famous analysis of over 1,000 obituaries showed a higher incidence of mental illness among artists compared with other professions (Ludwig, 1995). Although obituaries have also been studied for the types of values they convey (Alfano, Higgins, & Levernier, 2018), the views they present about particular career paths (Tight, 2008), and whether individuals are willing to "speak ill of the dead" in response to obituaries (Rusu, 2017), their effect on public views of broader topics or issues has not received as much attention. One exception appears to be the influence of reporting celebrity suicides on suicide contagion, which suggests that celebrity death reporting can have negative effects on vulnerable populations (Ma-Kellams, Baek, & Or, 2018).

Communication research suggests that one powerful function of the media is agenda-setting: Higher levels of media coverage for an issue leads citizens to believe that this issue is more important (see McCombs, Shaw, & Weaver, 2014 or Wanta & Ghanem, 2007 for overviews). However, most agenda-setting research has examined media trends over time, for example, considering the number or placement (e.g., front page) of stories on issues such as the environment, the economy, or political scandals. The studies reported in this article extend this research to examine whether an obituary can prompt increased public interest in topics beyond the particular person who has died. Although obituaries are typically featured for only a limited period of time (a day or a few days), they may nonetheless draw attention to particular topics (such as scientific discoveries), and spark audiences' interest in learning more about those topics.

Thus, our study draws on theories of narrative influence and agenda setting to propose that scientist obituaries may help inspire interest in topics related to the deceased person's work. Specifically, the studies reported here investigated how the coverage of Hawking's death affected public interest in both cosmology and ALS. Study 1 used a pretest/posttest design to examine the effect of reading the *New York Times* obituary on Hawking on interest in physics and ALS (as assessed by self-reported interest and by desire to read a related article), and Study 2 used real world data on Wikipedia page views to assess the relative impact of Hawking's death on decisions to read more about cosmology and ALS.

Gender, Science, and Obituaries

Given Hawking's place in science and in the public's perception of physics, it is important to consider broader effects of the way Hawking was memorialized. More subtle aspects of obituaries may also convey information about related topics. For example, different terms are often used to describe deceased male versus female leaders (Radtke, Hunter, & Stam, 2000; Rodler, Kirchler, & Hölzl, 2001). The *New York Times* obituary of rocket scientist Yvonne Brill attracted controversy because it begin with her skill at cooking beef stroganoff rather than leading with her scientific accomplishments (Roiphe, 2013). Even when the subject of the obituary is male, men and women can be represented in the obituary as collaborators, family members, or individuals selected to provide quotations about the personal or professional qualities of the individual.

The selective quoting of men as experts is a common occurrence in the media (Desmond & Danilewicz, 2010; Freedman, Fico, & Love, 2007; Kitzinger, Chimba, Williams, Haran, & Boyce, 2008), even in countries with high levels of gender equity (Niemi & Pitkänen, 2017). Despite the frequency at which men are quoted as experts in the media, little is known about the effects of this gender gap on readers. Thus, as an additional research question, we examined the effects of gender representation in a prominent obituary of Hawking. Specifically, in Study 1, we varied the number of male and female physicists quoted in the article to see if such representation affected perceptions of women's participation in science more broadly (e.g., the percentage of physicists who are women and the likelihood of using a feminine rather than a masculine pronoun when writing about a physicist). As an exploratory measure, we also examined whether these perceptions might extend to participants' views of the climate for women in science, technology, engineering, and mathematics (STEM; e.g., women's comfort and likelihood of success in STEM fields).

There are several reasons why having women quoted in a science obituary might affect perceptions of women in science. First, the mere presence of women scientists in popular media culture might affect individuals' judgments about the frequency or acceptability of women in science, as suggested by cultivation theory (Gerbner, Gross, Morgan, Signorielli, & Shanahan, 2002). Cultivation theory suggests that media presentations help shape social reality. Similarly, work on media representation has highlighted the importance of showing members of social groups in nonstereotyped ways (Smith & Granados, 2009). Having women shown as part of the physics community, even if they are not the main topic of the article, can provide important representation. Research suggests that feelings of belongingness are an important factor in retaining women in science fields, and showing higher numbers of women participating can increase that sense of belongingness (Good, Rattan, & Dweck, 2012; Murphy, Steele, & Gross, 2007).

In addition, including women scientists in the Hawking obituary might have conferred additional legitimacy in two ways. First, scientists who were associated with Hawking might be seen as more qualified or eminent due to their connection with him. Second, the fact that the scientists were being interviewed by the *New York Times* may have also served as evidence of their status in the field.

Overview

To test these ideas, we used a slightly modified version of the obituary published in the *New York Times*, which was viewed by over 1.5 million people (D. Overbye, personal communication, March 27, 2018). In this obituary, the author detailed Hawking's scientific contributions and also his experience with ALS. A key part of the obituary was quotations from other renowned physi-

cists. In the published obituary, seven physicists were quoted, and all seven of these physicists were men. In fact, the only women mentioned in the over 4,000-word obituary were Hawking's wife, ex-wife, and daughter. Therefore, the present research examined how readers (college students) respond to the obituary when all of the quoted scientists are men versus when some of them are women.

Study 1

In Study 1, we examined the impact of reading an obituary of Stephen Hawking on interest in physics and ALS. This study was preregistered at the Open Science Framework (https://osf.io/kp3ts/ view only = c478bce3014d4aae860c47eaddcfce94) and was designed to test how students respond to a scientist's obituary when either all seven of the scientists quoted are male or when three of the seven are female. Open Science Framework is a free, opensource platform that researchers can use to upload time-stamped preregistrations and share their open materials and data to facilitate collaboration and increase reproducibility (The Center for Open Science, 2018). We hypothesized that reading the obituary would increase interest in physics but that this increase would be particularly high for women who read the version of obituary in which female scientists were quoted. We expected that the presence of women scientists in the obituary might encourage interest among women readers above and beyond learning about Hawking himself because it might provide an extra signal that women belong in physics. We did not have a priori predictions for interest in ALS.

Method

Participants. A total of 284 students on Prolific Academic participated. Of those, 54 failed at least one of the attention checks and were excluded from analyses. This left an analytic sample of 230 participants (134 male, 93 female, and three responding as either agender or nonbinary; $M_{age} = 24.66$, SD = 6.84; 5.7% African or African American, 23.0% Asian or Asian American, 9.1% Hispanic/Latinx, .9% Native American, 56.1% Caucasian, and 5.2% other or multiracial). In terms of year in college, 13.5% were first-year students, 17.0% were second-year students, 19.6% were third-year students, 24.3% were fourth-year students, and 25.7% marked "other." Those who marked "other" were graduate students, professional students, or individuals just finishing or starting their academic studies. In all, 59% of participants indicated that they were majoring in STEM.

Procedure. Participants completed a set of questionnaires about their interest in physics, ALS, and religion (a control topic unrelated to Hawking), before and after reading one of two versions of an obituary for Stephen Hawking. The obituary was a shortened version of the one published on March 14, 2018 in *The New York Times*. Half of the participants read the shortened obituary with no changes made, and the other half of the participants read the shortened version with the names of three of the quoted physicists (Michio Kaku, Andrew Strominger, and Leonard Susskind) replaced with the names of three female physicists (Janna Levin, Lisa Randall, and Eva Silverstein).

Measures

Topic interest. Interest in physics, ALS, and religion was assessed in two ways. First, participants completed a three-item measure for each topic in which they expressed their level of agreement on a 1 (*strongly disagree*) to 7 (*strongly agree*) scale with the following statements: I am interested in learning about [physics, ALS, religion], I am curious about [physics, ALS, religion], I would not enjoy learning about [physics, ALS, religion] (reverse-scored). Three composite measures were created by averaging responses within the topic. Second, participants indicated how interested they would be in reading the following: (a) a 500-word article about black holes, (b) a 500-word article about degenerative diseases, and (c) a 500-word article about beliefs in God. The two interest assessments were completed before and after reading the obituary.

Women in physics. To assess whether reading the obituary changed beliefs about women in physics, participants completed two measures. The first measure was a written response to two prompts, which were counterbalanced such that half of the participants received one prompt before the obituary and the other prompt after, and the order was reversed for the other participants. The two prompts were as follows:

Dr. Smith is a physicist. Please write three or four sentences that describe a typical day for Dr. Smith.

Dr. Jones is a physicist. Please write three or four sentences that describe a time when Dr. Jones went to a scientific meeting.

The responses to these prompts were coded for the presence of masculine and feminine pronouns. The use of feminine pronouns could indicate an implicit acceptance of women as physicists. The second measure related to women in physics was the following question: What percent of physicists do you think are men?

Climate for women in STEM. As an exploratory measure, perceptions of climate for women in STEM were assessed by asking participants to judge the likelihood that a woman in STEM would: (a) feel comfortable, (b) succeed, (c) be happy in her career, and (d) experience instances of bias because of her gender (reverse-scored). These four items were averaged into a composite score.

Quality checks. Finally, participants completed two attention checks and one manipulation check. The attention check questions asked participants to identify the type of passage they read (book review, obituary, or textbook excerpt) and to identify where Stephen Hawking was born (United States, Canada, or England). Participants were only included in analyses if they correctly answered both attention check questions. The manipulation check asked participants how many female physicists were quoted in the article on a 0 to 7 scale.

Results

Manipulation check. Responses to the manipulation check indicated no difference in the number of women physicists participants thought were quoted based on condition, t(225) = .98, p = .330, d = .13 (male obituary M = 2.25, SD = 2.76; male and female obituary M = 2.59, SD = 2.39), indicating that the two obituary conditions were not perceived differently. The null find-

ing indicates that the two obituary conditions were not perceived differently.

Topic interest. For the analyses, we excluded the three individuals who responded with "other" to the gender question. To test the hypothesis that reading the obituary with female physicists quoted would increase interest in physics particularly for women, we ran a 2 (Gender) \times 2 (Condition) \times 2 (Time) mixed analysis of variance (ANOVA), which found only a significant main effect of time, F(1, 223) = 36.39, p < .001, $\eta_p^2 = .14$, such that participants were more interested in physics after reading the obituary (M = 5.20, SD = 1.36) than before reading the obituary (M = 4.80, SD = 1.48). There was no main effect of gender, F(1, 1)223) = .47, p = .465, $\eta_p^2 = .002$, condition, F(1, 223) = .36, p =.548, $\eta_p^2 = .002$, interaction between gender and condition, F(1, 1) $(223) = .05, p = .825, \eta_p^2 = .000$, interaction between time and gender, F(1, 223) = .79, p = .375, $\eta_p^2 = .004$, interaction between time and condition, F(1, 223) = .21, p = .648, $\eta_p^2 = .001$, or interaction of time, gender, and condition, F(1, 223) = .00, p =.999, $\eta_p^2 = .000$. This finding was consistent with our expectation that reading the obituary would increase interest in physics but inconsistent with our prediction that there would be different effects based on gender.

For interest in reading an article about black holes, a mixed ANOVA on gender, condition, and time found no significant main effects or interactions. There were no main effects of time, F(1, 222) = .69, p = .407, $\eta_p^2 = .003$, gender, F(1, 222) = 1.55, p = .214, $\eta_p^2 = .007$, or condition, F(1, 222) = .50, p = .480, $\eta_p^2 = .002$. There were also no interactions between gender and condition, F(1, 222) = .14, p = .287, $\eta_p^2 = .005$, time and gender, F(1, 222) = .001, p = .981, $\eta_p^2 = .000$, or time, condition, and gender, F(1, 222) = .59, p = .444, $\eta_p^2 = .003$.

Women in physics. For perceptions of what percent of physicists are men, a mixed ANOVA on gender, condition, and time found a significant main effect of time, F(1, 223) = 3.96, p = .048, $\eta_p^2 = .017$, such that participants thought there were fewer male physicists after reading the obituary (M = 71.52, SD = 12.75) than before reading the obituary (M = 72.44, SD = 11.72). Contrary to our hypotheses, there were no other main effects,

 Table 1

 Hawking-Related Words and Comparison Words

Obituary word	Number of times mentioned in obituary	Nonobituary word comparison
Black hole	38	Superconductor
Gravity	12	Entanglement
Cosmology	5	Condensed matter physics
Entropy	4	Laws of Thermodynamics
Singularity	3	Quantum critical point
String theory	3	Quantum Supremacy
Hawking radiation	3	Cooper pair
Hubble space telescope	1	ARPES
Information paradox	1	EPR paradox
General relativity	1	QED

Note. ARPES = Angle-resolved photoemission spectroscopy; EPR paradox = Einstein–Podolsky–Rosen paradox; QED = quantum electrodynamics. March 2018 Wikipedia Page Views: Hawking-Related Words

gender: F(1, 223) = .90, p = .344, $\eta_p^2 = .004$; condition: F(1, 223) = .20, p = .658, $\eta_p^2 = .001$, and there were no interactions (Gender × Condition: F(1, 223) = .25, p = .615, $\eta_p^2 = .001$; Gender × Time: F(1, 223) = .15, p = .699, $\eta_p^2 = .001$; Condition × Time: F(1, 223) = .29, p = .591, $\eta_p^2 = .001$; Gender × Condition × Time: F(1, 223) = .33, p = .565, $\eta_p^2 = .001$). Finally, Condition did not impact pronouns used to describe a physicist in the writing prompt, $\chi^2(1) = .13$, p = .721, with 68.9% of participants in the male obituary condition using a masculine pronoun in

a

the second writing prompt, and 71.2% of participants in the male and female obituary condition using a masculine pronoun in the second writing prompt.

Exploratory Analyses

For perceptions of how positive the climate is for women in STEM, a 2 (Condition) \times 2 (Gender) between-subjects ANOVA found no main effects of condition, F(1, 223) = .66,

120000 100000 Black hole 80000 General relativity Hubble Space Telescope Entropy 60000 String theory Information paradox Cosmology 40000 Gravity Singularity Hawking radiation 20000 0 3/1/18 -3/4/18 3/5/18 3/6/18 3/7/18 3/8/18 3/9/18 3/12/18 3/13/18 3/14/18-3/17/18 3/18/18 3/19/18 -3/20/18 3/21/18 3/10/18 3/11/18 3/15/18 3/16/18 3/2/18 3/3/18 b March 2018 Wikipedia Page Views: Comparison Words 3500 3000 2500 Condensed matter physics Entanglement (physics) 2000 Ouantum critical point Ouantum supremacy Laws of thermodynamics 1500 ARPES EPR paradox 1000 Cooper pair QED 500 0 3/14/18 3/21/18 -3/10/18 3/11/18 3/12/18 3/13/18 3/15/18 3/16/18 3/17/18 3/18/18 3/19/18 3/20/18 3/1/18 3/2/18 3/3/18 3/4/18 3/5/18 3/6/18 3/7/18 3/8/18 3/9/18

Figure 1. (a) Wikipedia page views for words related to Hawking's obituary. The date of Hawking's death is marked by the vertical black line. (b) Wikipedia page views for comparison words. The date of Hawking's death is marked by the vertical black line. (c) Average number of Wikipedia page views for words related to the Hawking obituary and comparison words. The date of Hawking's death is marked by the vertical black line. See the online article for the color version of this figure.



Figure. 1 (continued)

 $p = .416, \eta_p^2 = .003, \text{ gender}, F(1, 223) = 1.67, p = .197, \eta_p^2 = .007, \text{ or interaction}, F(1, 223) = .37, p = .547, \eta_p^2 = .002.$ Reading the obituary increased participants' interest in physics, $t(225) = 3.42, p = .001, d = .22; M_1 = 4.80, SD_1 = 1.48; M_2 = 5.20; SD_2 = 1.36, \text{ and ALS}, <math>t(225) = 2.11, p = .036, d = .14; M_1 = 4.64, SD_1 = 1.41; M_2 = 5.02; SD_2 = 1.33, \text{ but did not affect interest in religion, <math>t(226) = .27, p = .788, d = .02; M_1 = 4.45, SD_1 = 1.67; M_2 = 4.34; SD_2 = 1.75.$ Furthermore, reading the obituary increased interest in reading an article about degenerative diseases, $t(225) = 2.51, p = .013, d = .17; M_1 = 3.09, SD_1 = 1.16; M_2 = 3.23; SD_2 = 1.19, \text{ but did not affect interest in reading about black holes, <math>t(225) = .64, p = .523, d = .04; M_1 = 3.59, SD_1 = 1.12; M_2 = 3.62; SD_2 = 1.13$ or beliefs about God, $t(226) = -1.38, p = .169, d = .10; M_1 = 2.67, SD_1 = 1.26; M_2 = 2.61; SD_2 = 1.29.$

Discussion

Study 1 results showed that the presence of female physicists in the Hawking obituary did not affect interest in physics. Based on the failed manipulation check, it is likely that the differences between conditions were too subtle. Readers were likely focused on Hawking himself and did not notice the gender of the individuals quoted. However, the predicted main effect of reading an obituary about Stephen Hawking was supported: Interest in physics increased after reading the obituary. Furthermore, exploratory analyses found that interest in ALS also increased after reading the obituary.

Study 2

Study 1 provided empirical evidence that reading Stephen Hawking's obituary increased interest in both physics and ALS regardless of gender or condition. Because our first study showed stronger effects of the obituary on interest in science and ALS, rather than gender effects, we chose to focus only on these interest effects in our second study. In addition, search history data provided us with an opportunity to examine these effects outside of an experimental setting. In Study 2, we considered the real-world data available on influence of Stephen Hawking's death on interest in physics and ALS. Specifically, we examined Wikipedia page views using Wikimedia's page view tool: https://tools.wmflabs .org/pageviews/. Based on Study 1, we predicted that there would be increased interest for topics related to cosmology, Stephen Hawking's field, and ALS, but not for other physics subfields or other diseases/disorders.

Method

Procedure. To examine the influence of Stephen Hawking's death on interest in physics, key words mentioned in the obituary were compared with other physics terms, specifically physics terms from condensed matter physics (Table 1). In addition, three famous scientists were mentioned in the obituary (Isaac Newton, Albert Einstein, and Galileo Galilei), and the page views for those were compared with three famous scientists not mentioned or related to Hawking's work (Marie Curie, Charles Darwin, and Nikola Tesla). We selected these scientists due to their high name recognition; we wanted scientists in both conditions to be easily recognized by members of the general public. Furthermore, the relative influence of Hawking's death on page views to another highly publicized event related to science were examined: the Nobel Prize in Physics announcement in 2017 for the Laser Interferometer Gravitational-Wave Observatory (LIGO) project. To

examine the influence of Hawking's death on interest in ALS, the number of page views for ALS were compared with other diseases with high page view counts: cancer, diabetes, HIV, measles, and schizophrenia. Results

As expected, terms closely related to Stephen Hawking's work (i.e., ones mentioned in the obituary) spiked on the day of his death



Figure 2. (a) Wikipedia page views for scientists mentioned in the Hawking obituary. The date of Hawking's death is marked by the vertical black line. (b) Wikipedia page views for famous scientists not mentioned in the Hawking obituary. The date of Hawking's death is marked by the vertical black line. (c) Average number of Wikipedia page views for scientists mentioned in the Hawking obituary and scientists not mentioned. The date of Hawking's death is marked by the vertical black line. See the online article for the color version of this figure.



Figure. 2 (continued)

(Figure 1a), whereas less closely related physics words did not show a similar spike (Figures 1b and 1c). In addition, page views of the famous scientists mentioned in the obituary increased on the day of Hawking's death (Figure 2a), but there was no similar increase in page views for three other famous scientists (Figures 2b and 2c). Based on the number of page views on Wikipedia for related terms, Hawking's death seems to have had a greater influence on interest in physics than the LIGO discovery and subsequent Nobel Prize, with 54,305 page views for Rainer Weiss and 14,353 page views for LIGO on the day of the Nobel Prize announcement, and 7,126,234 page views for Stephen Hawking and 52,667 page views for black holes on the day of Stephen Hawking's death. Furthermore, there were 4,122 page views for physics on the day of the Nobel Prize announcement and 7,938 page views for physics on the day of Stephen Hawking's death. Finally, the number of page views decreases at a similar pace for Hawking's death and the Nobel Prize announcement (Table 2).

As can be seen in Figure 3, there was a large increase in the number of page views for ALS but not for other commonly researched diseases and disorders (Figure 3a). Before Hawking's death, ALS, cancer, diabetes, HIV, measles, and schizophrenia were read about at similar rates (Figure 3b).

Discussion

Study 2 supported the findings from Study 1 that interest in physics and ALS may have increased immediately following Stephen Hawking's death. In addition, by examining specific page views in Wikipedia, Study 2 was able to provide a more detailed picture of the public's interest. Specifically, interest in terms related to cosmology increased, whereas terms related to a different branch of physics did not. Similarly, interest in ALS increased without a concurrent increase in interest in diseases/disorders.

General Discussion

Taken together, these studies suggest that obituaries of wellknown science figures can temporarily increase interest in specific scientific topics. Specifically, Hawking's death prompted Internet searches for terms related to his research and prompted readers of his obituary to report more interest in physics topics. In addition, the findings showed increased interest in ALS following Hawking's death, replicating work on public interest in celebrity health issues.

Contrary to our expectations, the number of women scientists quoted in the obituary did not affect perceptions of women in

Table 2Daily Page Views as Percent of Page Views on the Peak Day

Search term	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
Rainer Weiss	31.65	10.93	6.66	4.16	3.54	4.40	3.42
Hawking Radiation	37.74	15.84	11.03	9.33	7.78	5.83	5.08

Note. For Rainer Weiss, the peak (Day 1) used was the day of the Nobel Prize announcement. For Hawking Radiation, the peak (Day 1) used was the day of hawking's death.

March 2018 Wikipedia Page Views:



Figure 3. (a) Wikipedia page views for amyotrophic lateral sclerosis and other highly searched diseases and disorders. The date of Hawking's death is marked by the vertical black line. (b) Wikipedia page views for amyotrophic lateral sclerosis and other diseases/disorders prior to Hawking's death. See the online article for the color version of this figure.

science. However, participants were also largely unable to accurately report the ratio of male to female scientists represented, indicating that the manipulation may have been too subtle. However, our manipulation is typical of news reporting, which often provides only names and brief descriptions (e.g., position or professional affiliation) of people quoted. It is also possible that because the obituary was about a famous male scientist, a few quotes by women were not salient enough to cause an effect. Future research can manipulate the salience of women's voices in an article. For example, examining the placement of quotes (i.e., Do they fall at the beginning, middle, or end of the article?), using pull quotes to emphasize particular quotations, and examining both print and audio or video interviews would be ways to strengthen the manipulation. Additional work is needed to determine which forms of media representation are most effective in increasing women's interest in male-dominated STEM fields, such as physics. It will also be important to continue examining the impact of science-related articles that quote only male scientists, as it is possible that readers may perceive certain fields as even more male-dominated than they actually are due to the gender-biased selection of experts.

Because journalists seek out timely stories (e.g., breaking news and the most up-to-date events), incremental scientific progress may be less likely to gain news attention. However, this research suggests that obituaries of prominent scientists may be a valuable opportunity to increase public interest in science, even among audiences who would not normally seek out science-related content. Obituaries place science in a personal context, which may make science seem more accessible to a general audience member. The interest sparked by an obituary may increase public knowledge on particular topics, such as cosmology, either by providing information within the obituary itself or motivating readers to seek out additional information. In addition, although we did not directly test this possibility in the current study, these obituaries might provide an inspiration to young people for a career path to follow.

Limitations and Future Directions

Although we examined Wikipedia because it is a widely used source of information, there are many other websites that address science and/or diseases. Future research might examine a broader range of searches to provide a fuller view of public informationseeking.

In addition, as mentioned earlier, it is important to consider the limitation in Study 1 that participants had difficulty recalling the number of male versus female scientists quoted in the obituary. The obituary was lengthy, and even though it was shortened for the purposes of the study, it is possible that there was too much information being presented for participants to be able to recall details. In the future, researchers should test how the gender of quoted scientists influences perceptions and understanding of science topics within shorter articles. In addition, an unexpected main effect emerged such that participants in Study 1 thought there were fewer male physicists after reading the obituary, regardless of whether women had been quoted. This was a very small effect that may be due to chance, but future research might examine whether such effects replicate.

Our studies are also limited by the fact that we only examined an obituary for one particularly prominent scientist. Although Stephen Hawking arguably captured the public imagination more than most other scientists, obituaries have brought less well-known researchers to the forefront. For example, Maryam Mirzakhani, the only woman to win the Fields Medal, was relatively unknown to general audiences, but her 2017 obituary was nonetheless widely published and shared. The present research is particularly timely given not only Hawking's death but also the current effort by *The* *New York Times* to provide obituaries for women who have been overlooked (Padnani, 2018). For example, Ada Lovelace received a long overdue obituary in this series. Future research should consider the impact of these new obituaries on interest in the related fields (e.g., math and computer science for Lovelace) and how men and women respond to these obituaries.

Future studies could extend these findings by focusing on mediators or moderators of the effect. For example, does a more emotional obituary that focuses on the personal qualities of a scientist create greater engagement? Do individuals need to feel a sense of connection with the deceased person, or is it more important to evoke curiosity about the scientific phenomenon they studied? It may be that different characteristics of obituaries create different effects, and the effects may also change depending on the audience (e.g., audiences with high or low prior familiarity with the person, or high vs. low prior interest in science).

The current results highlight the potential of obituaries as a tool for increasing public interest in science. To the extent that this interest translates to reading additional resources about these topics, obituaries may also indirectly increase scientific knowledge and understanding among citizens.

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