The Half-Life of a 'Teachable Moment': The Case of Nobel Laureates

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Abstract
Some science-related events stimulate public interest, and create a teachable moment in which the underlying science temporarily becomes more interesting. Here, media attention, expressed by *Google News* reference volume, and changes in information seeking behavior, expressed by *Google Insights for Search*, were used to estimate the length of a teachable moment for 2004-2011 Nobel Prize announcements. On average, Nobel Prize announcements attracted the attention of online users for no longer than a week. News coverage declined slower and occasionally displayed seasonal trends. A closer look at the 2011 Nobel Prize announcements revealed over 50% drop in searches between the day of the announcement and the following day, as well as an analogous pattern for the news coverage of all laureates with different amplitude for different disciplines. Results point to the affordances of using publicly available online data to identify the most effective teachable moments relating to science and their length.

Keywords: data mining, Nobel prize, media effect, teachable moment, quantitative analysis.

Introduction
Some science-related events—real or fictional—stimulate public interest, and make the underlying science temporarily more interesting as well. After a major earthquake, for example, people tend to be more attentive to information about plate tectonics and the logarithmic basis of the Richter scale. Adult educators are constantly searching for that *teachable moment* where learners are open to new information (Leist & Kristofco, 1990). Teachable moments have been used to motivate people to spontaneously adopt risk-reducing health behaviors; for example being diagnosed with cancer may prompt people to get involved in campaigns to stop smoking (McBride, Emmons, & Lipkus, 2003). A teachable moment was also generated by the film *The Day After Tomorrow*, as shown by the fact that global warming related websites had higher levels of web traffic proceeding its screening (Hart & Leiserowitz, 2009).

When formal education in science ends, the media become the primary source of science-related information for the public (National Science Board, 2010). However, when looking for specific information, people in Western cultures turn to the internet (Horrigan, 2006). This enables researchers to use computational social science approaches to study public interest in science. Online searches, which reflect a conscious effort to acquire information, have been used successfully to measure issue salience and public agendas. This approach can be employed to study trends in health, economics, and science information seeking (e.g. Anderson, Brossard, & Scheufele, 2010; Baram-Tsabari & Segev, 2011; Choi & Varian, 2009; Ginsberg et al., 2009).
In this study, publicly available tools are harnessed to evaluate the aggregated real-time interests of online users and their media environment. Media attention, as expressed by *Google News*

reference volume, and changes in information seeking behavior, as expressed by *Google Insights for Search*, were used to estimate the length of a teachable moment for a science related event. Specifically we ask how long is the teachable moment for Nobel Prize announcements?

Methodology

Selecting search queries

The focus of this study was on the names of Nobel laureates between 2004 and 2011 obtained from the official Nobel Prize committee website[1]. Searches and coverage of Nobel laureates were chosen as the subject of investigation for several reasons:

(a) searches for Nobel winners are highly correlated with news attention (Baram-Tsabari & Segev, 2011; Segev & Baram-Tsabari, 2012);
(b) the prize is a predictable annual event enabling several repetitions of similar measurement;
(c) due seasonal events should usually be studied separately in different countries, Nobel Prize announcement is truly a global event, differing only at the time of day (or night) in different countries;
(d) the names are written in the same way in many languages allowing for data from many non-English speaking countries to be included in the analysis;
(e) Nobel laureates in the sciences are usually unknown to the lay public prior to the award. Searches and news related to their names are therefore solely related to the specific Nobel Prize event.

For all these reasons Nobel laureates in the sciences provide a very clean but still authentic case study for measuring public online interest in science.

Data sources

As users become more experienced online, they increasingly become dependent on search engines for finding answers to their information needs (Howard & Massanari, 2007). *Google Search* provided 76.7% of online global searches in February 2012, followed by Baidu with 11.3% (Netmarketshare, 2012). Since it is the most widely used, we chose *Google* and its advanced features as our data source.

Two publicly available online tools were employed for the data collection:

1. *Google Insights for Search (GIS)* (www.google.com/insights/search/ today redirects to *Google Trends*) analyzes and displays the proportion of searches for terms, compared to the total number of searches made on *Google* over a defined period of time (between 2004 and the present). The numbers provided by *GIS* indicate the query share of specific queries, based on a sample of all actual searches. The results are normalized both for place (country, city) and time (day or more). In order to conceal the actual traffic on *Google Search*, at least 50 observations from distinct IP addresses are needed in order for *GIS* to return an answer (Varian, 2010). Otherwise the answer is indicated as no searches at all.
2. *Google News (GN)* (news.google.com) is an automated news aggregator available to the public since January 2006 (and in a beta version since 2002). The exact list of news sources is not known outside of *Google*, but *Google* itself reports of over 4,500 English-language news sites, including blogs (Segev, 2008; Segev & Baram-Tsabari, 2012). It aggregates several million articles a day and sends about 1 billion clicks each month to news publishers worldwide (Bharat, 2010), which makes it a reasonable proxy for broader media coverage of news.

Data mining procedure

a. 2004-2010

For each search query (the full name of the laureate) data were collected from *Google* regarding its search volume and news volume. For each laureate's name *GIS* and *GN* provided data on a weekly basis from January 4, 2004 to February 27, 2011. For this purpose we developed online software to automatically mine *GIS* and *GN*. For *GIS*, *Google* provides a weekly data on the share of searches per a query, normalized to the week with the maximum searches for a given period. For *GN*, *Google* allowed mining the number of search results for a query in a given week. However, *Google* has blocked this option since January 2011. In total, we could gather searches and news data for 374 weeks between 2004 and 2010 for the Nobel laureates of that period. Unfortunately, *GIS* provides no data prior 2004.

b. 2011

A different approach to data mining was employed for the seven laureates of 2011 to ensure a higher resolution of analysis. Daily search data were collected from *GIS* between the 1st and 22nd of October 2011. Multiple recordings of *GN* coverage were gathered manually every two hours between the 3rd and 7th of October, 2011. This period covers the announcement of Nobel laureates and lasts two days after the announcement.

Data analysis. Only physiology or medicine, physics and chemistry were included in the sample. After examining the names of these laureates, seven other names that yielded irrelevant search results were omitted (e.g. John Hall, George Smith, Martin Evans). Our final sample of names included 51 Nobel Laureates.

Half-life. Half-life refers to the period of time it takes for a substance undergoing decay, such as radioactive material, to decrease by half. We were inspired to use this measure by a study about the half-life of the teachable moment for alcohol misusing patients arriving at emergency departments (Williams, Brown, Patton, Crawford, & Touquet, 2005). In this work the half-life for the length of a teachable moment in online environment was calculated as the number of weeks or days in which the value of searches or news coverage was higher than half of the maximum value in that period.

Findings

In order to estimate the length of a teachable moment for a science related event, public and media attention for Nobel prize announcements were recorded for all physiology, physics and chemistry laureates in the years 2004-2011. The average half-life of the online searches for names of Nobel laureates was about one week. For media coverage the average half-life was 1.39 weeks – about 10 days (table 1). When it comes to online searches, Figure 1 indicates that relatively few laureates experienced a half-life longer than one week (e.g. Ada Yonath in 2009) or had high volume of searches during the week of the Nobel award ceremony (e.g. Luc Montagnier in 2008). In terms of news coverage, relatively few laureates extended the half-life to include the week following their winning (e.g. Aaron Ciechanover, Avram Hershko, and Irwin Rose in 2004), or during the Nobel ceremony itself (e.g. Irwin Rose in 2004). News about Nobel laureates sometimes mentioned previous winners (e.g. Craig Mello in 2006 and again in 2007), and thus also displayed seasonal trends.

Half-life constitutes a relatively high threshold compared to the maximum for searches and news coverage, which occur on the day of the announcement. This justified using a more relaxed threshold. Using a more permissive threshold equal to 25% of the maximum interest, or two elapses of half-life, the teachable moment lasted 9.5 weeks in the media versus seven-eight

days in public's online searches (1.07 weeks; Table 2). Although both news and searches always concentrated around the announcement period, our findings show that in general media coverage was longer than searches. This is mainly due to continuous coverage of a small number of specific laureates, such as Aaron Ciechanover and Robert Grubbs and to mentioning previous winners. Interestingly, for very permissive threshold, such as 10% of the maximum value, the ratio of News/Searches duration of interest decreases. When looking at lower interest rates of 10% of the maximum, searches usually last for a longer period of two weeks or more after the announcement, and proceed also in the week of the award ceremony on the 10th of December (table 1).

Table 1. Average weeks of news coverage and searches during 2004-2010 for various thresholds

Intensity (Max/x)	News (n=44)	Searches (n=44)	News/Searches
1.5	1.14	1	1.14
2	**1.39**	**1**	**1.39**
3	4.64	1.02	4.55
4	9.5	1.09	8.72
6	18.02	1.61	11.19
8	26.95	1.98	13.61
10	33.64	2.52	13.35
12	35.95	3.66	9.82

As was mentioned earlier, in order to compare online searches and media coverage we used the common time unit of one week for the 2004-2010 laureates available by *GIS*. However, this type of data restricts our sensitivity to processes of week or more and by default sets the half-life of the teachable moment to a minimum of one week. When looking at shorter periods of up to three months, *GIS* provides search data on a daily basis. In order to study daily search trends day-to-day searches of the seven 2011 Nobel laureates were extracted for October 1-22, 2011 (Table 2). For six of the seven laureates the half-life of searches was one day, with searches on the day following their winning being at least 50% less intensive than those of the winning announcement day (with the exception of Brian Schmidt). The search values for third day after the announcement showed another elapse of the half-life, being at least 50% less intensive than those of the second day (table 2). Six of the seven laureates experienced 2-4 days of relatively intensive online searches, before searches were once again too scarce to be reported by *GIS*. The exception was Ralph Steinman with eight days of relatively intensive search (table 2). This is probably due to the growing public interest in his sudden death on September 30, 2011, few days prior to receiving the phone call he was awaiting for many years.

Table 2. Close up: the relative values provided by *Google Trends* for day-to-day searches of the seven 2011 Nobel laureates between October 1 and October 14, 2011

Date	Bruce Beutler	Jules Hoffmann	Ralph Steinman	Adam Riess	Saul Perlmutter	Brian Schmidt	Daniel Shechtman
1-Oct.	0	0	0	0	0	0	0
2-Oct.	0	0	0	0	0	0	0
3-Oct.	22.4	21.8	14	0	0	0	0
4-Oct.	6.4	6.4	6.3	22.8	18.6	16.4	0
5-Oct.	2.4	2.8	1.8	8.2	7.9	10.6	23.8
6-Oct.	0	0	5.1	0	2.7	3.9	5.2
7-Oct.	0	0	1.8	0	1.8	0	2
8-Oct.	0	0	0.8	0	0	0	0
9-Oct.	0	0	0.7	0	0	0	0
10-Oct.	0	0	0.5	0	0	0	0
11-Oct.	0	0	0	0	0	0	0
12-Oct.	0	0	0	0	0	0	0
13-Oct.	0	0	0	0	0	0	0
14-Oct.	0	0	0	0	0	0	0

News coverage of the 2011 Nobel Prize announcement was followed closely during the relevant days (Figure 1). It revealed very similar patterns for people who shared a prize (e.g. Beutler, Hoffmann and Steinman) as well as a common trend in coverage of all the three prizes. All were characterized by a wild growth rate of about 1.2% to 1.3% per minute in the first 9-10 hours following the announcement, which then declined to less than 0.1% per minute (Figure 1).

Although the trends in coverage were very similar for the physiology, physics and chemistry prizes, they were quantitatively distinct from each other. While the Nobel laureates in physiology were mentioned in about 6000 news items, the physics laureates were mentioned in about 5000, and the chemistry laureate was mentioned in about 3000 news items (Figure 1). This pattern was not exclusive to 2011, but was apparent in news coverage data from 2004-2010 as well: on the average, physiology laureates were mentioned in 388.3 items, that is 62.2% more news items than physics laureates (239.3 items) and in 117.7% more news items than chemistry laureates (178.4 items)[2]. Since the order of the prize announcements is constant between years this phenomena might be due to the novelty of the first announcement, rendering it more newsworthy than the other announcements, or due to repeating the names of yesterday's laureates on the coverage of the second and third announcements at the same year. Another possible reason for the prominence of the physiology laureates in coverage might be the greater interest of the mass media in biomedical issues.

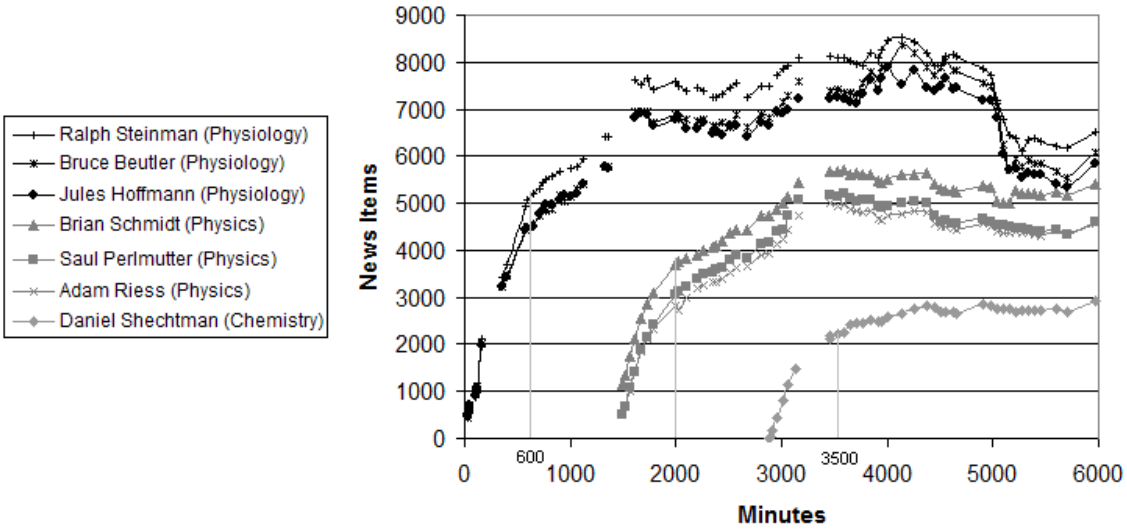

Figure 1. Extreme close up: multiple measures of *Google News* items for the seven 2011 Nobel laureates expressed as a function of number of minutes since the first winning announcement

Discussion

In this paper we demonstrate the significant role played by the media in motivating science information seeking on the web. This is particularly true when looking at event-oriented topics that are not part of the school or university curriculum. Yet, our findings add to the existing literature by suggesting that the overall interests in such events are rather short, with the media showing a longer attention span than online searches. Indeed, media has a short memory, but the publics' memory is even shorter.

Focused media coverage on current science events and concerns can create a teachable moment which motivates people to independently search for related information. Our findings suggest that the average teachable moment stemming from Nobel Prize announcements is no longer than a week. News coverage declines slower and occasionally displays seasonal trends when previous winners are followed up. A closer look based on day-to-day search data indicates that online users search for Nobel laureates mainly on the day of the announcement and half-life elapses with each day.

One elapse of half-life might not be a suitable measure to events such as Nobel Prize announcement due to the fact that science Nobel laureates are hardly searched for before the announcement and the remarkable pick in interest once the announcement is made. A more relaxed measure, such as 25% or 12.5% of the maximum intensity (two and three elapses, respectively) should be used to evaluate the length of public interest in such events. In order to estimate how long does the interest last a more relaxed measure is needed (table 1), or a higher resolution should be used such as days (table 2) or hours (figure 1).

Much of the previous research on teachable moments focused on individuals who experienced a significant health event (McBride et al., 2003), but Cohen et al. (2011) show that teachable moments are also relevant in motivating general changes in health behavior. Success of the teachable moment rests on the physician's ability to identify and explore the salience of patient concerns and recognize opportunities to link them with unhealthy behaviors (Cohen et al., 2011). Similarly, science-related teachable moments should not necessarily be transitional

events. We have demonstrated that a predicted annual event such as Nobel Prize announcement can elevate public interest. Success of the teachable moment rests on the ability of the science communication community to identify and respond to public interests and recognize opportunities to engage them with science.

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