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, Google
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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). Searches on nanotechnology, for
example, were studied using the monthly averages of *Google Search* volume, indicating that the public was mostly interested in future directions and applications of nanotechnology, but was less interested in policy and regulatory aspects (Anderson et al., 2010).

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 Nobel Prize announcements.

Nobel prizes “which represent the apex of the hierarchy of the honorific awards” (Crawford, 1992) play an important institutional and social function. Because of their prominence and indisputable scientific status, Nobel laureates were studied in sociology and history of science, as a subpopulation of national science elite. This population was used, for example, when examining the tension between nationalism and internationalism in science (Crawford, 1992), or when looking at the stratification of American science (Zuckerman, 1970). Similarly, Jank, Golden and Zantek (2005) used the geographical distribution of Nobel prizes to identify international trends in 20th century science. Zuckerman (1972) examined the strategy and tactics of interviewing Nobel laureates in science, as an example for interviewing the ultra-elite for the purposes of qualitative research.

Likewise, this study does not focus on Nobel laureates for their own sake, such as to describe their social role, coverage pattern of Nobel prize winnings (De Cheveigne &
Véron, 1994), related controversies (Crawford, Lewin Sime, & Walker, 1996) or research productivity (Zuckerman, 1967). Rather it uses Nobel laureates as a relatively clean and homogenous sample for estimating the length of a science related teachable moment.

Why should Nobel announcements create a teachable moment? Indeed, audience who reads or hears Nobel announcements in the news may seek further information and may not. In fact, De Cheveigné and Véron (1994) showed that some newspapers choose not to explain the underlying science when they cover Nobel laureates. However, the ‘teachable moment’ does not refer to the scientific content of the coverage, nor to its quality. It refers to the intensified public attention to a science-related event, for whatever reason, which in turn, yields a surge of self-motivated online search for more information (Segev & Baram-Tsabari, 2012).

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\textsuperscript{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/) 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.

GIS also shows the top searches and searches that experienced significant growth in a specific period and topical category, provides related searches to the original search query, and allows for a cross-national comparison using a visual world map. This tool is still in the beta stage of development.

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, 2010). 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 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. At first, all names of Nobel laureates since 2004 were included in the analysis. However, many of the peace and literature laureates (e.g. Al Gore and Barak Obama) were public figures prior to the award, and therefore the news coverage and searches could not be attributed solely to the Nobel Prize event. For this reason 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.

**Results**

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.
In order to provide a point of comparison the average half-life of science-related laureates was compared with that of non-science related laureates. The average half-life of searches for non-science related laureates was 2.3 weeks for peace Nobel laureates, 1.8 weeks for literature laureates, and, finally, one week for economy laureates. News attention for non-science related laureates was 12.33 weeks—much longer than the half-life of their searches. Here too, peace Nobel laureates were those with the longest half-life (19.6 weeks), followed by literature (11 weeks), and economy (6.83 weeks) laureates. The reason is that peace Nobel laureates (for example, Al Gore, Barak Obama, and the Intergovernmental Panel on Climate Change) are often mentioned in the news and being searched in many other contexts other than their Nobel award, while scientific-related laureates are usually less-known among wide publics and are very often searched only in the context of their winning.

[Figure 1 about here]

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 1). 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 about here]

The duration of people’s searches for laureates names might be only a partial proxy for the duration of a ‘teachable moment’, because people might pursue the new interest in other ways after an initial search. For example, as information is retrieved, keywords may change because new information is available: one might initially search for the name of a scientist and then look for the topic that he/she studies. Indeed, people may be more interested in the discoveries than in the scientists behind them. In order to investigate the relation between the laureates and their discoveries we used Google Trends to analyse the longitudinal changes of searches for several laureates and their relevant discoveries. The relevant science concepts were obtained from the headline announcing the winning at the Nobel prize website. Our findings show that while the widespread scientific topics such as “RNA” or “ribosome” are searched in accordance with the academic calendar regardless of the Nobel nominations, the more specific queries are perfectly aligned with the nomination period. Figure 2 shows the trends of three such topics: “magnetoresistance”, “telomeres”, and “graphene” as well as the Nobel laureates associated with them “Albert Fert”, “Elizabeth Blackburn”, and “Andre Geim” respectively. It shows that searches for both laureates and their discoveries are exclusively concentrated in October, the month of nomination. In other words, when it comes to rare science-related search terms, the half-life
of both laureates and their discoveries is similar. User’s interests in Nobel laureates and their discoveries rise and decline simultaneously.

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.

News coverage of the 2011 Nobel Prize announcement was followed closely during the relevant days (Figure 3). 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 3).

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 3). 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). 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 3 about here]
Discussion

In this paper we demonstrate the significant relation between media coverage and science information seeking, similar to previous studies (Hart & Leiserowitz, 2009; Segev & Baram-Tsabari, 2012). This is particularly true when looking at event-oriented topics that are not part of the school or university curriculum. Various studies on media effects suggest that news has a certain impact on science related knowledge (e.g. Hargreaves, Lewis, & Speers, 2003; Miller, Augenbraun, & Kimmel, 2006; Wade & Schramm, 1969). This is expected in light of the Agenda-Setting model which suggests a strong correlation between mass media emphasis on a certain issue and the importance attributed to these issues by the audience (McCombs & Shaw, 1972). Scharkow and Vogelgesang (2009) argue that Google Trends is a powerful tool for studying agenda setting processes, and Granka (2009, 2010) used Google Trends to test whether aggregate search data volume is consistent with the conclusions of agenda setting research. Indeed, Weeks & Southwell (2010) found that television coverage of the rumor that Barack Obama was Muslim was significantly correlated with same-day Google searches about the rumor.

The ‘adoption of ideas’ (Bentley & Ormerod, 2010) or ‘social interest’ (Nagarajan et al., 2009) could be reflected in people's online searches. Therefore, the interest some people show in seeking further information on science related events might well be a result of agenda-setting on part of the media. 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. This might be a consequence of the
journalistic practice in which covered events tend to be followed-up (Galtung & Ruge, 1965). 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 3).

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.

**Limitations of the proposed procedure**

This study used laureates’ full names in order to include only relevant searches. However, this strategy is blind to public searches for last name only or other search words aiming at the same person (example: “2011 chemistry Nobel”). Due to the use of a conservative measure one can assume that more people were searching for Nobel laureates using different search queries.

The specific nature of the queries is both a blessing and a curse in this case. On the one hand, it ensures a clean sample - if words are proxies for entities, Nobel laureates’ names are very specific and rather comprehensive. On the other hand, it is a very synthetic sample, eliminating other ways of reaching the same information. It is important to note that complex queries decline faster – the half-life of the search query ‘Nobel’ is much longer than the half-life of a specific laureate’s name. It is interesting to note, however, that specific science concepts which are closely related to laureates’ discoveries displayed matching search pattern to the names of the laureates (Figure 2), providing an indication that online interest probably does not develop using other search queries. This important question should be studied further in future research.

It is important to note that the strong correlation found between news mentions and searches for Nobel laureates does not necessarily indicate a causal relationship. It is very
reasonable that people looking for Nobel laureates indeed initially read or heard about it on
the news. Even if people heard or read on this event through a proxy (e.g., teachers,
educators or social networks), it is most likely that the latter got the information from the
news. While Nobel laureate is a classic event that may be triggered by the media, proper
methods are required in order to validate this assumption, especially when using it for other
groups of keywords representing different scientific issues (See Segev & Tsabari, 2012).

Another methodological limitation has to do with news sources indexing. GN does
not reveal its full list of sources, which makes it hard for the researcher to control for a
particular news source leaving or entering the sample. Real-time results are evaluations
based on samples and are prone to change (see coverage of physiology laureates on Figure
3). This method also ignores issues of prominence. It aggregates the number of items with
no sensitivity to the place in the item (title vs. text) or the prominence of the publisher.

GIS uses an arbitrary scale system, and does not provide the actual volume of
searches. Its data indicate the query share based on a sample of all actual searches. It only
returns data when the volume of searches for a specific query is high enough.

Finally, another limitation, typically related to Google Trends, is our ignorance
regarding the absolute number and characteristics of the subjects involved. The data
provided by Google Trends is a global aggregation of searches. As such it does not allow
researchers to study who are the people that search for certain keywords. Analysis of this
kind may involve ethical and practical questions. Yet, further studies utilizing Google
Trends may seek to combine large scale surveys in order to get a further understanding of
the different segments in the society and their different search interests in science, or
triangulation with customized website traffic. Further research may look into cross-national
differences in science-related search behavior. This approach poses challenges to the researchers, since it involves using and comparing search queries in different languages.

However, the reliability of this method is supported by the ever growing percentage of Westerners who rely on online search as their source for specific science and technology issues. When Americans are seeking specific information related to S&T, they turn to the Internet as the dominant resource. Asked "If you wanted to learn about scientific issues such as global warming or biotechnology, where would you get information?" 59% of Americans cited the Internet (National Science Board, 2012). A Pew Internet and American Life Project survey (Horrigan, 2006) found that a clear majority of Internet users had engaged in some information search activities, including looking up the meaning of a particular scientific term or concept (70%), looking for an answer to a question about a scientific concept or theory (68%), and learning more about a science story or scientific discovery one first heard or read about offline (65%). This makes online searches the most common way in which the non-technical publics actively seek information about their science interests, far more common than traditional sources, such as the local library.

The reliance on aggregate search behavior made it impossible to examine cognitive and affective mediators of news influence (Segev & Baram-Tsabari, 2012). We could not tell, for example, whether a person searched for 'Dan Shechtman' because she was interested in special characteristics of quasicrystals or intrigued by his personal story of being publicly opposed by Linus Pauling and the scientific leadership of his era. By entering a search query people reveal that they are thinking about a topic but we do not know the nature or the purpose of their thoughts.
Notwithstanding these limitations, this study points at the affordances of using publicly available online data to identify and quantify the most effective teachable moments relating to science. It describes a novel methodology which is not based on surveys and builds on ever updating data sources. It also points to authentic ways in which media coverage is related to public engagement with science. As such it is a tool that can enable science communicators and educators to build on the current interests of the public in science.

Acknowledgments

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Notes

1. www.nobelprize.org

2. Note that the values provided by Google News in retrospect for 2004-2010 were much lower than real-time estimates that were collected for 2011.
References


Table 1. Average weeks of news coverage and searches during 2004-2010 for various thresholds. Note: $x = 2$ is the half-life point, i.e., the average number of weeks in which news coverage and searches were higher than half of the maximum value.

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<th>Intensity (Max/x)</th>
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<th>Searches (n=44)</th>
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<td><strong>3.66</strong></td>
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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.

<table>
<thead>
<tr>
<th>Date</th>
<th>Bruce Beutler</th>
<th>Jules Hoffmann</th>
<th>Ralph Steinman</th>
<th>Adam Riess</th>
<th>Saul Perlmutter</th>
<th>Brian Schmidt</th>
<th>Daniel Shechtman</th>
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<td>0</td>
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<tr>
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<td>21.8</td>
<td>14</td>
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<td>0</td>
<td>0</td>
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<td>6.4</td>
<td>6.3</td>
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<td>7.9</td>
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Figure 1. The half-life of news coverage and searches for 44 Nobel laureates during 2004–2010.
Figure 2. Search trends for specific laureates and science concepts closely related to their discoveries.
Figure 3. 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.

*Note:* The gray lines mark the beginning of a growth rate of less than 0.1% per minute. The growth rate declines for all Nobel laureates after about 500 to 600 minutes from the relevant winning announcement.