Science information in the digital world: The Internet versus the mass media

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Abstract
Science is a major part of our everyday lives and being knowledgeable about scientific developments can help people make informed decisions about the world around them. Traditionally, the mass media have been the major source of scientific and technological information for most people. However, recent surveys find increasing numbers of people turning to the Internet for this information. Outside the United States there has been little investigation as to where and why the public seek scientific and technological information. In this New Zealand study we used diverse focus groups to explore this issue. The findings revealed that all age groups reported the Internet as their most important source of science information, although the news media frequently prompted their searches. Notwithstanding the popularity of the Internet, the participants showed a strong awareness that there was enormous variation in the reliability of Internet sources and that they needed to exercise caution.

Introduction

Everyday life relies on the fruits of scientific endeavour, yet large swathes of the public distrust and question fundamental tenets of science (Bucchi, 2009). Scientists are bewildered by the Pew Center's 2009 findings that just 32% of Americans believe in evolution, and the strident rejection of climate change by some business interests, politicians and churches. The mass media, drawn into the debate as major conveyors of science information, have been condemned for failing their social responsibility role. While the economic and strategic importance of science innovation drives interest and investment in science communication, the parlous state of public trust in science indicates many unanswered questions about what makes for effective science communication.

The media's reporting of science has been the subject of much research. In recent years in Australia and New Zealand this research has focussed on how particular areas of science have been reported, in particular biotechnology and climate change. In terms of biotechnology the reporting was positive towards the science despite strong public opposition (Ashwell, 2011; Petersen, 2002; Rupar, 2002). However, this positive framing appears to have come at the cost of the media exercising its role as the Fourth Estate with a lack of in-depth reporting and a bias towards particular institutionalised sources and themes while others are marginalised (Ashwell, 2011; Salleh, 2008). While there have been fewer studies of climate change reporting conducted in Australia and New Zealand those that exist indicate that the reporting is, on the whole, accurate, although inaccuracies and exaggerations exist which have been prominently reported (Bell, 1994).

While these studies illustrate that science reporting in Australia and New Zealand is not without problems there has been little research on how much or how often the public turn to the media for information about science. Therefore, our qualitative study investigated the potential audience of science communication. A major question was whether, in the Internet era, mainstream media remain the primary source of science information. After establishing what

our participants understood by 'science', we asked what types of science they had heard about in recent weeks and from what source. Next, we asked for participants' most preferred source of science information and why. Finally, participants discussed where they went for further science information.

Science information and the media

In the past 50 years science coverage has increased in a number of countries including Italy, Germany, Australia and the United Kingdom (Bucchi, 2009). According to Ho et al. (2011), surveys show news media still constitute the main source of information about science and technology for people after they end their formal education. Not only do the media inform people about scientific developments, but they can also influence how the public perceive the risks and benefits of these developments through the story frames used (Ho et al., 2011; Stewart et al., 2009). Segev and Baram-Tsabari (2010: 815) cite a number of studies, finding "What people know usually corresponds to scientific topics that received the most persistent media coverage" .

However, the role of the media has rapidly changed, with the digital environment contributing to a crisis for traditional news media. As viewing and readership numbers have steadily dwindled, media have responded by increasingly commercialising news content, blurring traditional boundaries of news and entertainment (Bennett, 2009; Franklin, 1997). Sensational infotainment journalism struggles to give the in-depth coverage required for understanding major issues such as food security, peak oil or climate change. The global financial crisis and consequent drop in advertising resulted in most news media, including Fairfax Ltd in New Zealand and Australia, further cutting staff numbers, often jettisoning more experienced journalists.

On the other hand, while traditional news media is struggling, the jury is out on whether the Internet is killing it (Gaskins and Jerit, 2012; Stempel et al., 2000). Newspaper circulation has declined in the Western world, but not, for instance, in India. Surveys in Britain, Australia and New Zealand have found that television viewing has been on the increase, but news and current affairs

audiences are declining (Nielsen, 2012a; Nielsen, 2012b; Plunkett, 2010). Many more people now access news for free from the online services of 'traditional' media companies that struggle to make the Internet pay. Moreover, Bird (2009: 350) states that the 'news habit' of young people is completely different as they "essentially consume news in a steady stream of information bites... constantly connected, through computers and cell phones, both with each other and multiple media sources". Nevertheless, McNair (2009) and Gans (2011) believe technology offers potential for more diverse and inclusive news, and argue journalism will adapt and survive because it is needed.

It is not surprising, therefore, that the type of media informing the public on science and technology is changing. In the United States, people are as likely to obtain information about science from the Internet as they are from television. The number of people citing the Internet as their primary source of science information has been growing since 2001 (National Science Board, 2012). In 2010 the General Social Survey (GSS) found 35% of Americans named the Internet as their primary source of science information, up 6% from 2008. Figures cited by Segev and Baram-Tsabari (2010: 815), focussing on information seeking behaviour, led them to conclude the Internet "has become the primary source for specific science-related information for Western adults". Television, however, still has a place. The GSS found 34% of Americans cited it as their main source of science information, although the figure was down 5% from 2008 (National Science Board, 2012).

Despite the widespread decline in newspaper titles, revenue and circulation (OECD, 2010), the GSS found 16% of Americans still considered newspapers their primary source of news about current events, yet "print media organizations are less dominant as sources of news about general science and technology information" (National Science Board, 2012: 11). For example, when Americans were asked where they seek specific science information "12% would rely on online information from print media organizations, and 48% would rely on other online sources" (National Science Board, 2012: 11). However, the

Science Board report says little has been done to explore how and why American people seek science information.

Likewise little has been done in New Zealand. The last published survey specifically examining where New Zealanders received science and technology information was conducted in 1991. Unsurprisingly, respondents were not asked about the Internet and were only asked about television and print media. The majority (64%) indicated they gained most information from newspapers (Billington and Bibby, 1991). New Zealand surveys conducted since have focused on attitudes to science, asking respondents what source of science information they believed most trustworthy. These surveys consistently found television documentaries were rated the most trustworthy, followed by television news and current affairs programmes, newspapers, the Internet and radio talkback (MoRST, 2010). However, if New Zealanders have followed international trends to rely increasingly on the Internet – a less trustworthy source – it could have interesting implications for their attitudes to new and emerging science and technology.

Therefore, we were particularly interested in exploring where contemporary New Zealanders receive science information from and in investigating roles of the Internet and traditional media. We used focus groups to provide rich data on participants' views and a basis for a subsequent national survey.

Methodology

Four naturally occurring groups, who meet on a regular basis and have a shared common identity, and a fifth group of selected volunteers, took part in the study. Pre-existing groups provide participants with "one of the social contexts within which their ideas are formed and decisions made" (Kitzinger, 1994: 105). Groups were also chosen to provide demographic diversity in gender, age, educational attainment and, where possible, ethnicity. We aimed especially to recruit those over 65 (normally less frequent users of digital technology), a high percentage of younger people (under 30) and a representation of Māori (New Zealand's indigenous people). To achieve this, the following four groups were

selected: Grey Power members (12); parents of children from a multi-ethnic pre-school (9); a group of Māori triathletes (8); and a church youth group (8). The pilot group of four consisted of two university students in their 20s and two people in their fifties, one a mature student and the other a blue collar worker. Bearing in mind some focus group members might feel challenged by the formality of ethical procedures and the apparent intellectual content of the topic, the researchers took care to build empathy, encourage responses from all participants and reassure them all responses were of value (Stewart et al., 2007).

Procedures

A contact person for each group was approached who then recruited other members of the group. Where possible focus groups were held at locations where members normally met. Discussions began by welcoming participants. Then members individually listed what they thought science was. These ideas were shared with the wider group. Participants were then asked where they had seen or heard about science recently. Next they were asked for their preferred source of science information, and why they preferred that source. Group members were encouraged to think broadly about 'science', and to consider a wide range of possible information sources. Finally, participants were asked what science topics they were most likely to seek information on and why. Discussions lasted between 35 and 45 minutes and were conducted in the early part of 2012.

Data analysis

Using a "grounded" approach (Miles and Huberman, 1994) and following Owen's (1984) criteria of recurrence, repetition and forcefulness, a number of consistent themes were identified. These themes are reported below, approximately following the order of the focus group questions.

Findings

In all there were 41 participants across five focus groups. Their demographic details, provided in Table 1, show a relatively broad demographic spread, with good representation in the older and younger age groups. The figures also reflect the relatively high education level in the city where the research was undertaken.

Table 1. Demographic characteristics of the focus groups

Gender	
Male	46.3% (n=19)
Female	53.7% (n=22)
Total	100.0% (n=41)
Age	
16 - 20	7.3% (n=10)
21 – 30	22.0% (n=9)
41-50	14.6% (n=6)
51-60	12.2% (n=5)
65+	26.8% (n=11)
Total	100.0% (n=41)
Ethnicity	
Māori	12.2% (n=5)
Pākehā/NZ European	68.3% (n=28)
Other	19.5% (n=8)
Total	100.0% (n=41)
Employment	
Full-time	29.3% (n=12)
Part-time	7.3% (n=3)
Casual	4.9% (n=2)
Retired	31.8% (n=13)
Student	17.0% (n=7)
Unemployed	7.3% (n=3)
Other	2.4% (n=1)
Total	100.0% (n=41)

Education	
Up to 3 years secondary	19.5% (n=8)
4 or more years secondary	34.1% (n=14)
Up to 3 years tertiary	12.2% (n=5)
3 or more years tertiary	34.1% (n=14)
Total	100.0% (n=41)

Where did people learn about science?

Groups were asked where they had recently heard, seen or read about science. Table 2 lists sources of science information mentioned by participants and the number of times these sources were mentioned in the discussion. While we recognise the data is qualitative we used this frequency count as a broad indicator of 'intensity' or importance.

Table 2. Sources of science information

Source	Mentioned	Details
Internet	79	Google, Wikipedia, Facebook, iTunes U, YouTube, Slashdot, Internet Hospital
Television	35	Discovery channel, TV3
Books	34	Fiction and non-fiction
Interpersonal communication	19	Children (schooling), friends, sales people (products), people's stories
Radio	10	National programme
Magazines	10	New Scientist, Creation, Dairy Magazine, Time
Newspapers	8	Dominion Post, Manawatu Standard
Academic journals	8	Online academic journals
Professionals	4	Healthline, Nurse, Midwife, Doctor, Medical specialist,
School	3	Previous schooling
Museum	1	
Posters	1	Medical reception
Church	1	

The Internet was the most prominent source, mentioned frequently in every group including the Grey Power/older group. All but one of the participants said they used the Internet to source science information. Google was the most mentioned and preferred site for beginning to find out about a topic. Additionally, younger participants mentioned Facebook as a major source of science information. As one youth group member stated:

> On Facebook I'll find a group or community to do with a certain discipline about science and then I subscribe to their page and then I scroll through

> my news feed ... it's just a real good way of glancing through and when something catches my attention I can click on the link and read about it in more depth.

Another participant agreed: "Honest, if anyone pastes a link on Facebook about anything they have seen on the news about science I just start reading about it."

While Google was the first site used by many participants to learn more about science, some listed other sites as their first choice. For example, one participant working in the technology sector used Slashdot.com, while others stated they would use academic databases before Google.

Eight respondents mentioned the variable quality of Internet information. One stated when using the Internet, "I have heard you have to triangulate your information". Others said they would use the Internet first, before going on to other sources: "I use the Internet first, if it is a broad question, and you usually get a lot of junk you have to filter and sift through, but it can lead you to other good sources".

Television was the next major source mentioned for all the groups. The Discovery Channel was singled out by a number of participants as a particularly good source of science information. Only one participant reported not owning a television.

Books received almost as many mentions as television and were a major information source for those 50 and over. Two members of the youth group said they read books to learn more after first finding information on the Internet. A number of participants viewed books as more credible than other sources. Books were also seen as convenient because they could be picked up and put down at any time.

A few people in the oldest and youngest age groups mentioned newspapers as a source. One person from the youth group reported reading two newspapers a

day. However, those in the younger age group were more likely to source information from online newspaper sources such as Stuff.co.nz, a website maintained by Fairfax New Zealand Limited. Moreover, most participants outside of the Grey Power group had to be prompted before recognising newspapers as a source of their science information.

Radio was mentioned 10 times. All mentions related to New Zealand's public service radio station, National Radio, that runs extended current affairs interviews and has a science programme.

Magazines were mentioned as frequently as radio. *New Scientist* was most frequently mentioned. Also discussed were *Time*, *Dairying* and *Creation* magazines. One person named *Reader's Digest*. Eight participants (all undertaking some form of tertiary study) said they used academic journals as a source of science information.

Interpersonal communication was another information source. Often information came in the form of friends telling participants what they had heard about recently or children talking about their school activities. In other face-to-face communication, participants with young children or who were pregnant reported they used professionals, including doctors, nurses and midwives when they had issues with their own health or when their children were ill. Another participant gained information about the chemicals used at work from sales representatives.

Three respondents mentioned past schooling and museums, while medical posters and church were each mentioned once by different individuals.

The most preferred source

Respondents were next asked for their preferred information source. Again, the most preferred source was the Internet, followed by television. These were followed, in order of preference, by books, interpersonal communication,

magazines, newspapers, academic journals, professionals, schooling, museums, medical posters and church. Preferences were related to the age of the participants. Those in the older age groups were more likely to mention television, books, radio, magazines and newspapers. While television was the preferred source for at least some participants in all the age groups, the Internet (in particular Google and Facebook) was clearly the most preferred source for those under 30.

When asked why Google was their preferred source of information, younger participants gave a number of reasons. One said, "because you can type in your question, rather than have to look through a book on the topic that doesn't answer your question till the 50th page." Another simply said Google is "worldwide". One responded, "It's laziness for me. If I want an answer quick and fast I will Google it". For another, Google was "just a perfect first port of call. It just points you in the right direction". Not only was Google regarded as speedy and convenient, but two people praised its clarity, with one saying its information was in "layman's terms rather than some complex, academic spiel". While three participants preferred other Internet sites, it appeared most began with Google.

Why seek science information?

Groups were asked what type of science information they actively sought and why. By far the most common information sought was about health and medical conditions, mentioned once or more by each group. Botanical information, technology, computer science and meteorology were the next most sought after topics. Other areas mentioned once only were cosmetic ingredients, technology, new discoveries, aviation, solar power, fish, and university degrees in science.

The reasons given for seeking out these science topics varied. For several participants it was their job. For example, one participant in the cosmetic industry said, "If a customer asks me about a particular ingredient I go home and look it up. If a customer asks you have got to know." Another worked as a

personal trainer and tried to keep up with developments in exercise science. For some older participants their former occupation, for instance science teaching, gave them an interest in certain science topics.

A number of participants said they were motivated to seek health information because they, their children or grandchildren had specific medical conditions. As reported above, this was particularly the case for participants who were pregnant or had young children. While generally this information would be sought directly from professionals, participants also accessed medical information from the Internet, even though they recognised not all of it was reliable.

General interest and hobbies motivated others to seek information about meteorology and fish. Another participant, considering alternative energy sources at home, was investigating solar power. Finally, one participant had a relative studying science and had examined the composition of science degrees.

Interpersonal communication also played a role in motivating some participants. For example, one participant said, "I remember having a conversation with my family and then we got online and Googled and looked at El Nino and what caused it and what it was going to mean for us here."

One major reason participants sought more science information was because of something seen, heard or read in the media. This media link could be direct or indirect. As already noted, younger participants found information from postings on their Facebook pages. However, these postings were generally from friends who had heard about the topic from the news. Television was another trigger that set 19 participants searching for more information. As one said, "Now when something interests you, you don't just accept it, you actually go and check it out". For others, what they heard on the radio or read in newspapers and magazines triggered a desire to learn more. Therefore, while many respondents followed the overseas trends in having the Internet as their

preferred source of science information, it appears the traditional media still have an important role to play as a trigger for people to seek further information.

Discussion

This project is clearly qualitative and exploratory. It has, however, thrown light on some interesting patterns in the way a variety of people find out about science in the contemporary digital world. The media preferences of our participants, including the reliance on Internet sources, reflect broad global and national trends. Although access to and use of the Internet in New Zealand has soared since an in-depth survey of use (Comrie et al., 2007), trends in media usage remain the same. Those over 65 years old are least likely to be heavy Internet users while those aged between 15-25 are most likely to be heavy users of the Internet.

Television was still an important source for participants. Television viewing in New Zealand has in fact risen steadily since 2000 and maintained its peak in 2011 (Nielsen, 2012a). Heavy television viewing (over 23 hours a week) is highest among those over 65 years old and lowest among those 15-25 years old. Newspapers in New Zealand are struggling, with circulation of dailies dropping, although readership figures have remained relatively constant (Mace, 2012). Again, those over 65 are most likely to read six or more papers a week; 60% of over 65 year olds, compared with 16% of 15-25 year olds. The finding that a large proportion of our participants had to be prompted to think about newspapers may be reflected in the fact that nearly 28% of New Zealanders over 15 years old do not read newspapers (Comrie et al., 2007).

Overall, the findings of the key place of the Internet, along with a lesser but still significant reliance on television as a source of science information, are consonant with results from the 2010 General Social Survey in the United States (National Science Board, 2012). They also reinforce the 'down but not out' verdict about the continuing place of traditional media versus the Internet given by authors such as Gaskins and Jerit (2012) and Stempel et al. (2000).

However, there is less comfort for those arguing for the continuing relevance of current journalism models. While television was important, there was little evidence our participants received their information from television news, and the findings about newspapers are perhaps more depressing. New Zealand newspaper readership is judged to be relatively high (especially against figures from the United States). However, in an environment where participants were encouraged to be specific, there was no reflection in their comments of the resources that relevant dailies (the *Dominion Post* and *Manawatu Standard*) have put into science coverage. These newspapers' emphasis on science topics echoes Bucchi's (2009) findings about increasing science coverage. The *Dominion Post* has a weekly page devoted to environmental issues, while the *Manawatu Standard* (whose circulation area boasts Crown Research Institutes, major science research 'clusters' and a university) has a weekly science page featuring local and international developments and an 'Ask a Scientist' column attracting queries from around the world. Thus, while Ho et al. (2011) report that news media remain the major source of science information for those outside the formal education system, findings from our focus groups are far more equivocal.

Congruent with findings reported by Segev and Baram-Tsabari (2010) the dominance of the Internet was even more marked when participants discussed seeking further specific science information, yet our respondents also repeated the widespread popular critique of the 'unreliable' Internet. Focus group discussion echoes MoRST's (2010) findings that the Internet is not well trusted for science information by New Zealanders. However, participants also reported using the Internet discerningly in response to what they saw as variable information. Some moved on to what they believed were more credible sources, for example books, after their initial search, while others read multiple pages to cross-check or test the accuracy of the information. The considerable proportion of participants taking action to increase the likelihood of finding accurate Internet information may be related to their relatively high education levels. However, tactical approaches to Internet searching were not restricted to those with a tertiary education. This 'sifting' behaviour, combined with motivations

given for seeking science information, reinforces the notion that participants using the Internet were engaged in what Segev and Baram-Tsabari (2010: 815) described as "goal-driven, complex, sophisticated and engaged" behaviour.

The group discussions also threw some light on the complex place of social media in relation to science communication and science information. Those who promote aspects of science are aware of social media's potential and use it strategically (for instance NASA's Mars Curiosity Twitter account). Some of our participants were linked in with science-oriented Facebook feeds, but others came across science topics as a result of interaction with friends. Youth group members in particular pursued further science information mainly from news their Facebook friends had read or heard through more traditional news media channels. Traditional media are still, therefore, apparently playing an important role as a trigger for people to actively seek more information on science. Nonetheless, this evidence of media agenda setting (as alluded to by Segev and Baram-Tsabari, 2010) also demonstrates Bird's comments about the very different news habits of the 'connected' generation.

Conclusion

Our focus group participants appeared to follow international trends in media use when accessing science information, especially in Internet use. However, although the Internet was a preferred information source for the majority, television, books and, to a lesser extent, public radio were also important. Furthermore, it was often traditional media that directly or indirectly motivated respondents to search the Internet for more information.

While we recognise our findings come from a limited number of participants, they do join the body of evidence showing that, despite clear trends, the place of various media in science communication is increasingly complex. For example, our findings indicate the news media are still relevant, although they do not appear to be performing the dominant role they aspire to. News media power is largely legitimised by the place they claim to hold in the public sphere as the

mediator of public information and discussion on important issues. On one level, participants' comments seem to indicate that even those most linked to traditional media are merely abstractly grazing in the news media environment and that their 'real' information is obtained elsewhere. This may be partly related to the nature and breadth of science information. In contrast, traditional media retains a more central place for people seeking political information, although they too regarded the Internet as providing greater variety and convenience (Gaskins and Jerit, 2012). On the other hand, our groups added no evidence to support the views of 'technocrats' – reported in Bucchi (2009) – that the news media are in some way to blame for public ignorance about or hostility to science and scientists. In fact our participants did not regard traditional media as unreliable and they were engaged and active, not passive and ignorant, about science topics relevant to them. Indeed they were discerning users of the Internet, understanding the need to check the information they received by using multiple sources or using the Internet as a guide to more original source material to be found in books or journal articles.

As acknowledged, this is a small study and further research is needed to see whether or not the trends found are present in the wider population. The move away from traditional media sources to the Internet is interesting, given that past surveys have indicated people find the Internet a less reliable source of information about science and technology. Therefore, in the future it would be useful to examine how people search for such information on the Internet, and how they decide what science and technology information is trustworthy and reliable from the myriad of websites made available to them.

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