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The Google generation: the information behaviour of the researcher of the future

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Abstract

Purpose – This article is an edited version of a report commissioned by the British Library and JISC to identify how the specialist researchers of the future (those born after 1993) are likely to access and interact with digital resources in five to ten years' time. The purpose is to investigate the impact of digital transition on the information behaviour of the Google Generation and to guide library and information services to anticipate and react to any new or emerging behaviours in the most effective way.

Design/methodology/approach – The study was virtually longitudinal and is based on a number of extensive reviews of related literature, survey data mining and a deep log analysis of a British Library and a JISC web site intended for younger people.

Findings – The study shows that much of the impact of ICTs on the young has been overestimated. The study claims that although young people demonstrate an apparent ease and familiarity with computers, they rely heavily on search engines, view rather than read and do not possess the critical and analytical skills to assess the information that they find on the web.

Originality/value – The paper reports on a study that overturns the common assumption that the "Google generation" is the most web-literate.

Keywords Students, Information retrieval, Young adults, Internet

Paper type Research paper

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Aims

This article constitutes an edited version of a report commissioned by the British Library and JISC in April 2007 to identify how the specialist researchers of the future, currently in their school or pre-school years, are likely to access and interact with digital resources in five to ten years' time[1]. The purpose of the report was to guide library and information services to anticipate and react to any new or emerging behaviours in the most effective way. For the purposes of this paper we define the "Google generation" as those born after 1993 and explore the world of a cohort of young people with little or no recollection of life before the web.

The broad aims of the study were to gather and assess the available evidence to establish:

- whether, as a result of the digital transition and the vast range of information resources being digitally created, young people, the "Google generation", are searching for and researching content in new ways and whether this is likely to shape their future behaviour as mature researchers;
- whether new ways of researching content will prove to be any different from the ways that existing researchers and scholars carry out their work; and
- to inform and stimulate discussion about the future of libraries in the internet era.

These questions are of enormous strategic importance but they need to be balanced against considerable media hype surrounding the "Google generation" phenomenon, so a healthy degree of critical distance is needed. A bewildering array of titles has attached itself to a younger generation that is growing up in an internet-dominated, media-rich culture: "Net generation", "Digital natives", "Millennials" and many others. The untested assumption is that this generation is somehow qualitatively "different" from what went before: that they have different aptitudes, attitudes, expectations and even different communication and information "literacies" and that these will somehow transfer to their use of libraries and information services as they enter higher education and research careers.

Methods

The most appropriate methodology for tackling this study would, of course, have been a longitudinal study over a lengthy period that tracked the same cohort of young people through their schooling, their time as undergraduates and their early research careers, as graduate students or doctoral fellows. This was obviously impossible, given the time frame agreed for this enquiry (eight months), so in approaching this task, we developed a methodology that tries, within the considerable limitations of the current evidence base, to recreate a longitudinal study from the literature (including previous survey materials) together with some new primary data from a study of how people actually use British Library and JISC web sites. In effect, it represents a "virtual" longitudinal study.

There were a number of components to the study:

- An evaluation of the published literature on the information behaviour and preferences of young people over the past 30 years. The aim was to compare studies from the 1980s and earlier (Generation X), with those published around the early 1990s (Generation Y) and more recently, post-1993 (the Google

generation). This was a desk-based exercise which sought to isolate any critical differences between these three generations at the same point in their development.

- The identification of longitudinal studies which might enable us to determine whether or to what extent the same cohorts of older researchers adapt to the immense changes in information provision taking place around them as they progress through their careers.
- The gathering of fresh evidence regarding any differences in information behaviour that can be measured at one point in time. In other words, do schoolchildren and adults approach the same search platform in essentially the same way, or are there clear age-related preferences? For this part of the study, we used deep log analysis techniques to profile the users of two web-based information resources that appeal to a wide variety of ages: BL Learning (CIBER, 2007a,) and Intute (CIBER, 2007b). We believe this is the first time that anyone has actually profiled on any real scale the information seeking behaviour of the virtual scholar by age.
- A broad sweep of literature on the information behaviour of academic researchers before, during and in the wake of the digital transition to provide the essential context for the study.
- A large-scale literature based review of how new technologies, especially those relevant to this study such as Web 2.0, and how these become adapted by users.

In addition, throughout this paper, more general findings about the digital behaviour of young adults from CIBER's Virtual Scholar programme are referred to.

Findings

What is the Google generation?

The "Google generation" is a popular phrase that refers to a generation of young people, born after 1993, growing up in a world dominated by the internet.

> Most students entering our colleges and universities today are younger than the microcomputer, are more comfortable working on a keyboard than writing in a spiral notebook, and are happier reading from a computer screen than from paper in hand. For them, constant connectivity – being in touch with friends and family at any time and from any place – is of utmost importance (Frand, 2000, p. 15).

According to Wikipedia, the phrase has entered popular usage as "a shorthand way of referring to a generation whose first port of call for knowledge is the internet and a search engine, Google being the most popular". This is offered in contrast to earlier generations who "gained their knowledge through books and conventional libraries".

Later in this article, we will deal with some of the myths and realities that surround the Google generation, and we will explode some of them, but the notion has a strong intuitive appeal.

Some headline findings from a recent global survey by OCLC (2006) suggests that the Google generation stereotype may be broadly true:

- 89 per cent of college students use search engines to begin an information search (while only 2 per cent start from a library web site);

- 93 per cent are satisfied or very satisfied with their overall experience of using a search engine (compared with 84 per cent for a librarian-assisted search);
- search engines fit college students' life styles better than physical or online libraries and that fit is "almost perfect";
- college students still use the library, but they are using it less (and reading less) since they first began using internet research tools;
- "books" are still the primary library brand association for this group, despite massive investment in digital resources, of which students are largely unfamiliar.

These findings, which are highly consistent with CIBER's research into the information behaviour of young people, as revealed by the analysis of web log files, raise enormous issues for information providers and provide the policy context for this study. There are broader educational concerns, notably whether having "facts at their fingertips" and a surfeit of information is at the expense of creative and independent thinking?

What is the digital transition and how does it affect libraries?

Enormous changes are taking place in the information landscape that are transforming teaching and learning, scholarly communication and the role of "traditional" research library services. Many of these changes have been brought about by technology and the explosion of electronic "content" made possible by electronic publishing, mass digitisation projects, and the internet. The volume of full text information that can be searched, browsed and printed from the convenience of a library user's desktop machine is now almost unimaginable. And, for the first time, so are the choices: library users have rapidly become information consumers who can switch instantly between commercial search engines, social networking sites, wikis, bookmarked resources and electronic services provided by their library to satisfy their information needs (Nicholas and Rowlands, 2008).

Research libraries, once proud curators of historic print collections, face enormous challenges in this digital marketplace. The philosophy of warehousing large book collections, "just-in-case-they're needed", is rapidly becoming redundant as users turn their backs on the library as a physical space. Instead, research libraries are having to adjust to a new reality: the need to compete for attention among user groups, especially the young, who demand involving, dynamic and personalised content experiences that can compete with the likes of Facebook.

The implications of a shift from the library as a physical space to the library as a virtual digital environment are immense and truly disruptive. Library users demand 24/7 access, instant gratification at a click, and are increasingly looking for "the answer" rather than for a particular format: a research monograph or a journal article for instance. So they scan, flick and "power browse" their way through digital content, developing new forms of online reading on the way that we do not yet fully understand (or, in many cases, even recognise).

> While we have highlighted differences amongst scholarly communities in this paper it would be a mistake to believe that it is only students' information seeking that has been fundamentally shaped by massive digital choice, unbelievable (24/7) access to scholarly material, disintermediation, and hugely powerful and influential search engines. The same

> has happened to professors, lecturers and practitioners. Everyone exhibits a bouncing/flicking behaviour, which sees them searching horizontally rather than vertically. Power browsing and viewing is the norm for all (CIBER, 2007c, p. 21).

The trends in the content space are not just technological. Research libraries also have to learn how best to manage a shifting world of formally published, self-published and unpublished materials, new licensing and business models, both paper and digital. It is an enormous challenge.

How do people currently behave in digital libraries?

In a digital information world that is characterised by massive choice, easy access and simple to use tools, it is not surprising that librarians are feeling anxious. Their traditional role as intermediaries, helping users to navigate large and complex library systems, is being threatened by services, like Google, that seem to offer almost unlimited information choice and by-pass the library.

In fact, research libraries offer an enormous range of valuable publisher content to their users, but often through systems that seem far less intuitive than the ubiquitous search engine. So librarians need to gain a much better understanding of how people actually behave in a virtual library setting and use their expensive content. Without this, there is a real danger that the library professional will be swept aside by history, as relevant to twenty-first century Britain as the hot metal typesetter. The popularity of desktop access to electronic journals is already immense and use is growing very rapidly as publishers open up their content to be indexed by Google and other search engines. The major journal platforms like Blackwell's *Synergy* or Elsevier's *ScienceDirect* attract literally millions of hits each month (CIBER, 2007c, pp. 3, 8).

The latest CIBER research[2] suggests that e-books will be the next publishing success story, although demand here could be even more spectacular, simply as a result of the enormous size of the student population, hungry for highly digested content.

All the available evidence shows that people behave in very diverse ways when using electronic information resources. We know this because their detailed behaviour is recorded in the form of computer log trails. CIBER has spent more than five years studying the digital evidence that millions of scholars leave behind them when they search e-journal databases, e-book collections and research gateways. Our findings are of enormous relevance for librarians.

In general terms, this new form of information seeking behaviour can be characterised as being horizontal, bouncing, checking and viewing in nature. Users are promiscuous, diverse and volatile and it is clear that these behaviours represent a serious challenge for traditional information providers, nurtured in a hard-copy paradigm and, in many respects, still tied to it. Libraries must move away from bean counting dubious download statistics, and get much closer to monitoring the actual information seeking behaviour of their users.

The main characteristics of digital information seeking behaviour (CIBER, 2007c) in virtual libraries are:

- *Horizontal information seeking*. A form of skimming activity, where people view just one or two pages from an academic site and then "bounce" out, perhaps never to return. The figures are instructive: around 60 per cent of e-journal users view no more than three pages and a majority (up to 65 per cent) never return.

- *Navigation*. People in virtual libraries spend a lot of time simply finding their way around: in fact they spend as much time finding their bearings as actually viewing what they find.
- *Viewers*. The average times that users spend on e-book and e-journal sites are very short: typically four and eight minutes respectively. It is clear that users are not reading online in the traditional sense, indeed there are signs that new forms of "reading" are emerging as users "power browse" horizontally through titles, contents pages and abstracts going for quick wins. It almost seems that they go online to avoid reading in the traditional sense.
- *Squirreling behaviour*. Academic users have strong consumer instincts and research shows that they will squirrel away content in the form of downloads, especially when there are free offers. In spite of this behaviour and the very short session times that we witness, there is no evidence as to the extent to which these downloads are actually read.
- *Diverse information seekers*. Log analysis reveals that user behaviour is very diverse: geographical location, gender, type of university and status are all powerful consumer demographics. One size does not fit all.
- *Checking information seekers*. Users assess authority and trust for themselves in a matter of seconds by dipping and cross-checking across different sites and by relying on favoured brands (e.g. Google).

Confidence level: very high.

The Google generation

What do we know about young people's information behaviour? Research into how children and young people become competent in using the internet and other research tools is patchy but some consistent themes (Williams and Rowlands, 2007, pp. 8-11) are beginning to emerge:

- The information literacy of young people, has not improved with the widening access to technology: in fact, their apparent facility with computers disguises some worrying problems.
- Internet research shows that the speed of young people's web searching means that little time is spent in evaluating information, either for relevance, accuracy or authority.
- Young people have a poor understanding of their information needs and thus find it difficult to develop effective search strategies.
- As a result, they exhibit a strong preference for expressing themselves in natural language rather than analysing which key words might be more effective.
- Faced with a long list of search hits, young people find it difficult to assess the relevance of the materials presented and often print off pages with no more than a perfunctory glance at them.

These points relate both to the current use of the internet by young people and, a technology generation earlier, to their use of early online systems and CD-ROMs. There is little direct evidence that young people's information literacy is any better or worse

than before. However, the ubiquitous use of highly branded search engines raises other issues (Large, 2006):

- Young people have unsophisticated mental maps of what the internet is, often failing to appreciate that it is a collection of networked resources from different providers.
- As a result, the search engine, whether Yahoo! or Google, becomes the primary brand that they associate with the internet.
- Many young people do not find library-sponsored resources intuitive and therefore prefer to use Google or Yahoo! instead: these offer a familiar, if simplistic solution, for their study needs.

Confidence level: very high[3].

The huge question raised above is whether, and to what extent, the behaviour, attitudes and preferences of today's Google generation youngsters will persist as they grow up and some of them become academics and scholars. In the absence of properly constructed longitudinal studies that tracked the information behaviour of a single cohort of young people through to maturity, it is impossible to answer this question directly.

Circumstantial evidence that today's undergraduates, just a little older than the Google generation, are "different" from older adults is presented on the following pages. The relative value that members of the academic community place on a range of methods for finding articles is of particular interest as the age differences are startling and they suggest that the shift away from the physical to the virtual library will accelerate very rapidly and that tools like GoogleScholar will be increasingly a real and present threat to the library as an institution.

Confidence level: medium.

How do young people currently behave in virtual libraries? This is a powerful reminder that people have different information needs at different points in their lives. There are very few controlled studies that account for age and information seeking behaviour systematically: as a result there is much mis-information and much speculation about how young people supposedly behave in cyberspace.

A central plank of this study is an analysis comparing the information behaviour of a wide range of ages using the same platforms: BL Learning, a service aimed at schoolchildren and teachers, and Intute, a JISC service that is aimed across the whole university community.

The key points to emerge from this analysis (CIBER, 2007a, b) are:

- Both services are very popular, across the UK and USA, and attract a great deal of use (in the case of BL Learning, 14 per cent of all British Library traffic) strongly suggesting that they contain content that users value highly.
- The popularity of both sites suggest they have significant brand presence.
- For both sites, the majority of visits were traffic directed from a search engine, and they were interrogated from home, rather than from school, college or university.
- About 40 per cent of school search engine users found BL Learning using an image search, suggesting a preference for this kind of retrieval.

- Those entering BL Learning via a blog type link were in a very small minority and these were predominantly Americans (and core site users), no evidence yet that social networking has really caught on in the context of library sites.

Young scholars are using tools that require little skill: they appear satisfied with a very simple or basic form of searching. However, this was not so much the case with persistent users. Thus in the case of Intute it was found that the more pages viewed in a session the greater the likelihood that that session clicked through to another site (an outcome in the case of a "gateway" site like Intute).

Findings from CIBER's deep log analysis work are very consistent with the information seeking literature and other research based on observations or surveys. For example, observational studies have shown that young people scan online pages very rapidly (boys especially) and click extensively on hyperlinks – rather than reading sequentially. Users make very little use of advanced search facilities, assuming that search engines "understand" their queries. They tend to move rapidly from page to page, spending little time reading or digesting information and they have difficulty making relevance judgements about the pages they retrieve.

> Students usually approach their research without regard to the library's structure or the way that library segments different resources into different areas of its website. Library websites often reflect an organizational view of the library . . . they do not do a particularly good job of aggregating content on a particular subject area (Lippincott, 2005, p. 57).

Children (especially) tend to make very narrow relevance judgments by considering the presence or absence of words exactly describing the search topic: as a result they miss many relevant documents and end up repeating searches. Information seeking tends to stop at the point at which articles are found and printed, especially for younger users, with little regard to the document content.

The literature also shows that many of these characteristics pre-date the web (as studies in the 1980s on CD-ROM, for example, demonstrate (Williams and Rowlands, 2007, p. 7)) and so they cannot be projected on to the internet as something completely new.

There is very little evidence of generational shifts in the literature: that Google generation youngsters are fundamentally "different" from what went before. This is of course difficult to interpret: there are no longitudinal studies to show one way or the other. On balance, the literature appears to point to a big distinction between young children and teenage groups, probably due to the fact that small children have not yet developed the cognitive and motor skills to be effective searchers. Beyond age 11, the message is continuity, they do not seem especially different in their behaviour from young adults, although CIBER studies have shown that search engine image search (Yahoo! and Google) is proving very popular with the young and this may indicate a genuine difference in information behaviour.

Confidence level: very high.

The social networking phenomenon: is it important? The emergence of social web sites is changing the nature and fabric of the world wide web: we have moved from an internet built by a few thousand authors to one being constructed by millions. Social networking is of particular interest to librarians and publishers because it is part of a wider trend: users creating and posting content for themselves, blurring the age-old

distinction between information producers and information consumers. And as desktop publishing software becomes the norm, it is sometimes almost impossible to tell the difference between formally published and self-published material.

This is a phenomenon affecting the whole of society and the current popularity of social networking among the young perhaps diverts attention from who actually generates (as opposed to who consumes) user-generated content: Wikipedia and YouTube both exhibit a marked age separation between viewers of content (mainly 18-24s) and content generators (mainly 45-54s and 35-44s respectively) (Horrigan, 2007).

Many librarians have started to experiment with social software in an attempt to get closer to their users. They have a problem. Although research libraries spend millions of pounds providing seamless desktop access to expensive copyrighted electronic content: journals, books and monographs, much of this is news to their users. Either they do not know that the library provides this material, or they get to it, possibly via Google, and assume it is "free". Libraries are increasingly between a rock and a hard place: the publisher or search engine gets the credit; they just pick up the tab.

So, a number of progressive librarians have started building a presence in MySpace and Facebook by creating profiles. It is too early for a solid evidence base to emerge to see whether this kind of initiative will bear fruit, but there are clearly dangers in trying to appear "cool" to a younger audience. In fact, there is a considerable danger that younger users will resent the library invading what they regard as their space. There is a big difference between "being where our users are" and "being *useful* to our users where they are".

This seems to be the message from a 2007 OCLC survey (OCLC, 2007) in which college students and members of the general public were asked the following question:

- How likely would you be to participate in each of the following activities on a social networking or community site if built by your library?

The numbers are those who say they are "extremely likely" or "very likely" to do so (general public responses in parentheses):

- self-publish creative work: 7 per cent (6 per cent);
- share ideas with about library services: 10 per cent (7 per cent);
- share your photos/videos: 7 per cent (6 per cent);
- participate in online discussion groups: 6 per cent (6 per cent);
- meet others with similar interests: 6 per cent (7 per cent);
- describe your own personal collections: 9 per cent (6 per cent);
- view others' personal collections: 12 per cent (6 per cent).

Thus, most college students say they are not interested. Clearly it is very early days, but these survey findings do not provide much confidence that social software, yet, has much to contribute to the rebuilding of relationships with users in an increasingly dis-intermediated environment.

There are many other examples of library experimentation with Web 2.0 technologies: for example, to enrich catalogue entries with user reviews and ratings, but it is again simply too early to assess their impact or effectiveness. But there is no

doubting that social networking is a major success story and that libraries should be keeping a watching brief over developments in this areas, especially as there is evidence from the US that most students with online access use social networking technologies at least sometimes and that many report using these networks to discuss education-related topics.

CIBER's considered view is that the real issue that the library community should be concerned about is the rise of the e-book, not social networking. It should certainly continue to experiment and to keep a watching brief on these tools, especially for examples of best practice from serious business use (e.g. in marketing) and in course delivery.

Confidence level: medium to low.

The Google generation: myth or reality?

> Kids are so different today. I bet every adult says that about the young people of their time, but kids today really are different from the kids of any other age (Long, 2005).

Many of the claims made on behalf of the Google generation in the popular media fail to stack up fully against the evidence (Williams and Rowlands, 2007, pp. 11-18). Over the following pages, we try to assess these claims on the basis of the very scant available evidence.

- *They are more competent with technology*[b] (see confidence level at the end of this list). Our verdict: generally true, we think, but older users are catching up fast. However, the majority of young people tend to use much simpler applications and fewer facilities than many imagine.
- *They have very high expectations of ICTs*[b]. Our verdict: probably true, since we live in a global web culture dominated by a handful of unifying brands. Again, this expectation is relative; all of us are information consumers now.
- *They prefer interactive systems and are turning away from being passive consumers of information*[b]. Our verdict: generally true, as borne out by young people's media consumption patterns: passive media such as television and newspapers are in decline.
- *They have shifted decisively to digital forms of communication: texting rather than talking*[a]. Our verdict: open. It is very difficult to see messaging being a fundamental trend; its current popularity is certainly influenced by its relatively low cost compared with voice.
- *They multitask in all areas of their lives*[a]. Our verdict: open. There is no hard evidence. However, it is likely that being exposed to online media early in life may help to develop good parallel processing skills. The wider question is whether sequential processing abilities, necessary for ordinary reading, are being similarly developed.
- *They are used to being entertained and now expect this of their formal learning experience at university*[a]. Our verdict: open. Information media must be interesting or they will fail to be used: this is a circular argument. We are a little concerned by the current interest in using games technologies to enhance students' learning and library-based experience. When broadcast news makers introduced entertainment show production techniques 20-30 years ago, research

showed that these enhanced "interest" but impeded the absorption of information.

- *They prefer visual information over text*[a]. Our verdict: a qualified yes, but text is still important. As technologies improve and costs fall, we expect to see video links beginning to replace text in the social networking context. However, for library interfaces, there is evidence that multimedia can quickly lose its appeal, providing short-term novelty.
- *They have zero tolerance for delay and their information needs must be fulfilled immediately*[a]. Our verdict: no. We feel that this is a truism of our time and there is no hard evidence to suggest that young people are more impatient in this regard. All we can do is repeat the obvious: that older age groups have memories that pre-date digital media experiences, the younger generation does not.
- *They find their peers more credible as information sources than authority figures*[b]. Our verdict: on balance, we think this is a myth. Research in the specific context of the information resources that children prefer and value in a secondary school setting shows that teachers, relatives and textbooks are consistently valued above the internet.

  We feel this statement has more to do with social networking sub-culture and teenagers' naturally rebellious tendencies. Its specific application to the world of education and libraries is pretty questionable.
- *They need to feel constantly connected to the web*[a]. Our verdict: we do not believe that this is a specific Google generation trait. Recent research by Ofcom (2007) shows that the over-65s spend four hours a week longer online than 18-24s. We suspect that factors specific to the individual, personality and background, are much more significant than generation.
- *They are the "cut-and-paste" generation*[b]. Our verdict: we think this is true, there is a lot of anecdotal evidence and plagiarism is a serious issue.
- *They pick up computer skills by trial-and-error*[b]. Our verdict: this is a complete myth. The popular view that Google generation teenagers are twiddling away on a new device while their parents are still reading the manual is a complete reversal of reality, as Ofcom's (2007) survey findings confirm.
- *They prefer quick information in the form of easily digested chunks, rather than full text*[c]. Our verdict: this is a myth. CIBER deep log studies show that, from undergraduates to professors, people exhibit a strong tendency towards shallow, horizontal, "flicking" behaviour in digital libraries. Power browsing and viewing appear to be the norm for all. The popularity of abstracts among older researchers rather gives the game away. Society is dumbing down.
- *They are expert searchers*[c]. Our verdict: this is a dangerous myth. Digital literacies and information literacies do not go hand in hand. A careful look at the literature over the past 25 years finds no improvement (or deterioration) in young people's information skills.
- *They think everything is on the web (and it's all free)*[a]. Our verdict: open. Anecdotally, this appears to be true for a large minority of young people, but no one seems to have framed a research question in this form and investigated it

more deeply. Certainly this was a prevalent view earlier in the evolution of the internet, indeed its central ethos.

To reverse the question, there is much evidence that young people are unaware of library-sponsored content, or at least reluctant to use it. This is the library's problem, not the fault of young people.

- *They do not respect intellectual property*[b]. Our verdict: this seems to be only partly true. Findings from Ofcom (2007) surveys reveal that both adults and children (aged 12-15) have very high levels of awareness and understanding of the basic principles of intellectual property. However, young people feel that copyright regimes are unfair and unjust and a big age gap is opening up. The implications for libraries and for the information industry of a collapse of respect for copyright are potentially very serious.
- *They are format agnostic*[a]. Our verdict: this may be true of some users, young and old, but not all. We have not found any careful analysis of this question, which is surprising given its import for libraries and publishers alike. We suspect that this is no longer a meaningful issue: content is no longer format-dependent in cyberspace.

Confidence level: low [a], medium [b] or high [c].

What do we really know about the Google generation? In a real sense, we are all Google generation now: the demographics of internet and media consumption are rapidly eroding this presumed generational difference. The evidence indicates that more people across all age groups are using the internet and Web 2.0 technologies widely and for a variety of purposes. The young (not just the Google generation but also Generation Y, the next one up) may have been the earliest adopters but now older users are fast catching up... the so-called Silver Surfers. In many ways the Google generation label is increasingly unhelpful: recent research finds that it is not even accurate within the cohort of young people that it seeks to stereotype.

A 2007 survey by Synovate (2007) finds that only 27 per cent of UK teenagers could really be described as having the kind of deep interest and facility in IT that the label implies. The majority ("average Joes", 57 per cent) use relatively low level technology to support their basic communication or entertainment needs and there is a substantial residuum of 20 per cent ("digital dissidents") who actively dislike technology and avoid using it wherever possible. The demographics are clearly very complicated and resistant to neat generational labelling. Much of the evidence gained from our analysis (Williams and Rowlands, 2007, pp. 3-5) of the surveys by Carol Tenopir and Don King suggest that the differences in information behaviour, at a single point in time, between young and early middle-aged students and faculty are much less significant than those between young and more mature (40 and 50-year old) students.

Whether or not our young people really have lower levels of traditional information skills than before, we are simply not in a position to know. However, the stakes are much higher now in an educational setting where "self-directed learning" is the norm. We urgently need to find out:

> Virtually 100 per cent of students use word processors and utilize the Internet for coursework. But the impression of broad competence slips when percentages are revealed for other applications, such as those for presentation development (65 per cent), spreadsheets (63 per cent), graphics (49 per cent) or creating web pages (25 per cent) (Oblinger and Hawkins, 2006, p. 12).

Our overall conclusion is that much writing on the topic of this article overestimates the impact of ICTs on the young and underestimates its effect on older generations. A much greater sense of balance is needed.

Confidence level: high.

Where are the skills gaps? Much has been said recently about the apparent expertise of children using electronic resources, and there are claims that young people are using the internet more creatively and are becoming more proficient in their use than their teachers, that they tend in any case to be more proficient using information technologies than are their parents or teachers and that they are, in short, "technologically savvy". Indeed, this is the popular perception of young people and information technology generally. But there is no evidence in the serious literature that young people are expert searchers, or that the search skills of young people has improved with time (Williams and Rowlands, 2007, pp. 8-10). Studies pre-dating the widespread public use of the internet have reported that young searchers often display difficulty in selecting appropriate search terms, and research into internet use has consistently found similar difficulties. One issue that has persisted throughout the period of electronic searching is the prevalence of full-phrase searching (e.g., "What are the three most common crimes in California?") by young people. It would be tempting to attribute this activity to the rise in the accessibility of the internet. The web, of course, may be searched with impunity using natural language. This is taken to its logical conclusion in "Ask.com", which encourages users to enter such full phrases as search terms. However, a scrutiny of the literature shows that the practice of formulating queries in this way pre-dates the web. Thus the wider availability of technology and the near blanket exposure to it in recent years does not appear to have improved search performance in any significant way. A persistent theme in the information literacy literature is that we need a fully developed mental map to make effective use of internet search tools (Large, 2006). We need not only a broad understanding of how retrieval systems work and how information is represented within bibliographic or full text databases, but also some appreciation of the nature of the information space, and of how spelling, grammar and sentence structure contribute to effective searches. Paradoxically, children (under 13 years) and older adults (46 and older) are often unable to construct effective searches and evaluate the results. In the case of children, this is very largely due to their lack of knowledge of the kinds of information content that exist in a particular domain, as well as struggling to a greater or lesser extent with the other elements: a mental map of how search engines work, difficulties in moving from natural language to search queries and less command of vocabulary required to consider synonyms or other alternatives. In the case of the older generation, the key problem, of course, is that many lack a useful mental map of how the internet "works".

One area of current interest, and, indeed, concern, is the way young people evaluate – or rather fail to evaluate – information from electronic sources. Here, too, there is little evidence that this has improved over the last ten to 15 years. Early research suggested nearly 15 years ago (and pre-dating the internet) that teenagers did not review information retrieved from online databases for relevance (e.g., from online databases) and, consequently, undertook unnecessary supplementary searches when they had already obtained the information required. internet research has shown that the speed of young people's web searching indicates that little time is spent in

evaluating information, either for relevance, accuracy or authority and children have been observed printing-off and using internet pages with no more than a perfunctory glance at them. Researchers have similarly found young people give a consistent lack of attention to the issue of authority. In one study, many teenagers thought that if a site was indexed by Yahoo! it had to be authoritative, and so the question did not arise. Other studies have also found little attempt to check the veracity of information retrieved.

> The most significant finding [of our study] was that, although the teachers interviewed were information literate, their skills with and attitudes towards information literacy were not being transferred to their pupils (Merchant and Hepworth, 2002, p. 81).

There is little research in the UK into the information skills of young people in and entering higher education. This is symptomatic of a lack of strategic government support for information literacy programmes. A much fuller research picture (see for example Gross and Latham, 2007) is available in the USA, however, and it paints a picture of a large minority of freshmen entering college and university with low levels of information literacy and high levels of library anxiety. As might be expected, information skills correlate positively with entry-level SAT scores and subsequent grades.

It is not reasonable to translate these findings into the UK context but, since information literacy training is so patchy and inconsistent in this country, the US experience is worth noting. There are two particularly powerful messages emerging from recent research. When the top and bottom quartiles of students - as defined by their information literacy skills – are compared, it emerges that the top quartile report a much higher incidence of exposure to basic library skills from their parents, in the school library, classroom or public library in their earlier years. It seems that a new divide is opening up in the USA, with the better-equipped students taking the prizes of better grades. At the lower end of the information skills spectrum, the research finds that intervention at university age is too late: these students have already developed an ingrained coping behaviour: they have learned to "get by" with Google. The problem here is that they simply do not recognize that they have a problem: there is a big gap between their actual performance in information literacy tests and self-estimates of their information skill and library anxiety. The findings of these studies raise questions about the ability of schools and colleges to develop the search capabilities of the Google generation to a level appropriate to the demands of higher education and research.

If a similar pattern obtains in the UK, the key point is that information skills have to be developed during formative school years and that remedial information literacy programmes at university level are likely to be ineffective. The big question is what form that training should take: perhaps we should go with the flow and help children to become more effective information consumers?

Confidence level: likely in relation to the UK, high for the USA.

Looking to the future

What might the information environment be like in 2017? A decade is a very long time ahead to make predictions at a time when the library and information world is in such

a state of turmoil and anxiety, but it is possible to identify some powerful trends that seem very unlikely to be reversed.

- *A unified web culture.* It is self-evident that by 2017 the internet will have come of age for all ages and be completely integrated into most homes. The world wide web will become just that: survey research is showing us already that a remarkably unified set of online attitudes, activities and behaviours is beginning to emerge across many different countries as a few powerful brands (e.g., eBay, Amazon, Facebook) become globally dominant. These services will become more personalised, more mobile, and even more intuitive: values that librarians both respect and are, in some cases, already emulating.

  In this unified global web culture, national library services and provision will become far less meaningful, even quaint concepts (for example, research shows that British Library web sites are very popular outside of the UK).

- *The inexorable rise of the e-book.* Outside of leisure markets, we expect print sales to diminish sharply as electronic publishing initiatives such as blogs, RSS, integrated media players, pod casting and publishing-on-demand devices become established parts of the information landscape.

  Electronic books, driven by consumer demand, will finally become established as the primary format for educational textbooks and scholarly books and monographs, as well as reference formats.

  However, the most significant impact for research will not be how things get published, but how they get accessed. In particular OLED (organic light-emitting diode) technology will allow the widespread publishing of information on demand, wirelessly delivered to an incredibly niche demographic (Greenemeier, 2007, p. 7). This kind of publishing will be a potential headache for both research activity and archiving, since these publications can literally appear and disappear in an instant.

- *More content explosions.* Scholars and researchers will benefit enormously from the huge mass book digitization programmes that are currently underway (e.g., Google Print) and from moves to archive research data as well as research findings. It is hard to predict the rate at which open access publishing and institutional archiving will increase, but libraries should start to plan now for a time, perhaps not so far off, when most scholarly articles are available to anyone from their desktop machine. This is both a major threat and an opportunity for libraries: it is likely to further fuel interest in scholarly content by people concerned about their health or the environment, from small businesses and the "amateur scholar".

  Each month, across the globe, nearly a million new users join the internet, joining the 750 million already connected. Most are already generating their own content in the form of emails, blogs, wikis and personal web sites and many more will follow. The scale of this phenomenon is unprecedented in human history: user-generated content is growing much faster than publisher or content with inevitable consequences. Library-sponsored content is shrinking in relative terms and it will become more difficult to find as users land where the search engines take them, not where librarians think they "ought" to land.

- *Emerging forms of scholarship and publication.* As the information landscape is changing, so are the very processes of research. Scholars are beginning to employ methods unavailable to their counterparts a few years ago, including pre-publication release of their work, distributing it through non-traditional outlets such as institutional repositories, blogs, wikis and personal web sites.

  They are also trying out new forms of peer review using online collaboration. This presents libraries with new challenges: archiving and managing different versions of scholarly material as they appear (and rapidly disappear) from the web. The key challenge for the whole academic community, including libraries, is how to take advantage of new interactive media while still protecting the integrity of scholarly media.
- *Virtual forms of publication.* Already, real world information providers, from commercial publishers to university tutors, are engaging with Second Life to provide services for members of that virtual world and many see a long-term future in this kind of virtual publishing and broadcasting. The relevance of this for the virtual scholar is that it is indicative of new modes of engagement between content producers and consumers in the online world, and it is almost impossible to guess where this might lead.
- *The semantic web.* The world wide web as we have seen and experienced it so far could be completely revolutionised by the advent of the "semantic web". A system where, currently, humans express simple searches in everyday language, to order groceries, reserve a library book or look up a railway timetable, could be superseded by a system in which computers become capable of analysing all the data on the web. In the words of Tim Berners-Lee, this could mean eventually that "the day-to-day mechanisms of trade, bureaucracy and our daily lives will be handled by machines talking to machines". Some pundits believe that this scenario is very far away and, indeed that it may never happen on a wide scale. Our view is that the semantic web is a tool that will reach its tipping point fairly soon. In five years, 2013, there could be substantial developments that might allow a whole generation of undergraduates to begin to experience its potential.

  This is especially likely to be the case in niche areas, like e-Science, especially biology, creating new opportunities for major research libraries to be involved in completely new forms of activity such as real-time publishing and the sharing of experimental data on the internet.

Confidence level: medium to high.

What are the implications for "information experts"? There are several messages in this article for information professionals.

Gradually, the internet is sinking into the background as a tool that everyone takes for granted – but libraries are not keeping up with the demands of students and researchers for services that are integrated and consistent with their wider internet experience (including Google and other tools). Information consumers – of all ages – use digital media voraciously, and not necessarily in the ways that librarians assume. Any barrier to access: be that additional log-ins, payment or hard copy, are too high for most consumers and information behind those barriers will increasingly be ignored.

Given current levels of investment by the big corporate search engines, and static or declining library R&D budgets, it would seem that the only effective strategy is for

tighter integration of library content with commercial search engines. This is urgent given that the business case for libraries is beginning to look weak to many outside the profession. It also fits with time-poor student experience as they work their way through college or study part-time or at a distance.

CIBER's Virtual Scholar programme has found evidence – everywhere where we look – of clear differences in information-seeking behaviour by subject, by gender, and by work role. It is increasingly clear that a "one-size-fits all" policy towards library or system design is not going to be effective: there is as much (albeit, largely unacknowledged) diversity in today's scholarly population as is likely to exist between today's scholars and tomorrow's. Without a detailed handle on these issues, it becomes impossible to target services effectively.

Our final message, one which information professionals have exactly the right skills set to address is the need for greater simplicity. We know that younger scholars especially have only a very limited knowledge of the many library-sponsored services that are on offer to them. The problem is one of both raising awareness of this expensive and valuable content and making the interfaces much more standard and easier to use. The cognitive load on any library user (or librarian) in trying to work through such complexity is at present immense. Librarians are guilty of complacency here.

What are the implications for research libraries? The main message of this article for research libraries is that the future is now, not ten years away, and that they have no option but to understand and design systems around the actual behaviour of today's virtual scholar.

The picture that emerges from internet research is that most visitors to scholarly sites view only a few pages, many of which do not even contain real content, and in any case do not stop long enough to do any real reading. This is either a symptom of a really worrying malaise – failure at the library terminal – or maybe a sign that a whole new form of online reading behaviour is beginning to emerge, one based on skimming titles, contents pages and abstracts: we call this "power browsing". We urgently need to understand the root causes of this phenomenon.

> Students usually prefer the global searching of Google to more sophisticated but more time-consuming searching provided by the library, where students must make separate searches of the online catalog and every database of potential interest, after first identifying which databases might be relevant. In addition, not all searches of library catalogues or databases yield full-text materials, and NetGen students want not just speedy answers, but full gratification of their information requests on the spot (Lippincott, 2005, p. 57).

It can be said with confidence that librarians do not currently design information systems around this form of user behaviour and how best to accommodate it represents their real challenge. The way forward has to be via a flexible, "suck-it-and see" model. Trying things out in the digital space, monitoring the reaction and adjusting accordingly. Moving from counting hits to watching users.

The significance of this for research libraries is threefold:

(1) they need to make their sites more highly visible in cyberspace by opening them up to search engines;

(2) they should abandon any hope of being a one-stop shop;

(3) they should accept that much content will seldom or never be used, other than perhaps a place from which to bounce.

The strategic implications of a shift from the physical to the virtual are profound for all industries, especially libraries. Yet no one has done any longitudinal analysis through time to see how today's library users are responding to the changes taking place around them, let alone tomorrow's users. Without addressing these issues now, librarians will continue to become even more marginal players in the digital scholarly consumer marketplace. Possible strategies that might be adopted include the provision of better gateways to the literature and making simplicity their core mission.

What are the implications for policy makers? The research literature is inadequate in this area and what serious material there is is eclipsed by anecdotal or un-evidenced claims. The library community needs to invest more in data collection and analysis and to take its examples from commercial leaders (for example, Tesco) that have a much more detailed and insightful understanding of their customer base and preferences. In particular, there is a need for ongoing longitudinal data and intelligence functions to provide a vital early radar warning of oncoming change. Why don't major national libraries have in-house user studies departments? Without this intelligence, service stereotypes can easily become detached from reality.

At national level, there is a desperate need for a well-funded programme of educational research and inquiry into the information and digital literacy skills of our young people. If the erratic behaviour we are seeing in digital libraries really is the result of failure at the library terminal, then society has a major problem. Information skills are needed more than ever and at a higher level if people are to really avail themselves of the benefits of an information society.

Emerging research findings from the US points to the fact that these skills need to be inculcated during the formative years of childhood: by university or college it is too late to reverse engineer deeply ingrained habits, notably an uncritical trust in branded search engines to deliver quick fixes.

This will require concerted action between libraries, schools and parents.

Confidence level: high (and the stakes are enormous).

Challenges for us all. So what are the main challenges to libraries and their information services in meeting the needs of tomorrow's scholars and researchers?

- Taking full advantage of the popularity of scholarly information and at the same time dealing with the fact that UK users are the minority group for many UK-funded, cash-strapped information services.
- Reversing the process of dis-intermediation in a full-blown do-it-yourself consumer marketplace. As they say "we are all librarians now". For, instance, how to sell the key library role of a safe and authoritative information haven and the need for digital information literacy training. Libraries are handicapped here by a lack of brand, although there is evidence that the British Library has a good international presence. Publishers are better able to offer something here with their strong commercial and academic brands and their rapidly expanding "walled garden" information products, and strategic partnerships should be considered.

- Becoming much more e-consumer-friendly and less stodgy and intellectual. Many digital library services make no real attempt to connect to the larger digital consumer world: they do not chime with Facebook, YouTube, Amazon or even for that matter, ScienceDirect. Libraries could learn a lot from the personal/social searching guidance offered so successfully by Amazon for many years.
- Avoiding the decoupling scenario – libraries being decoupled from the user and the publisher. With the arrival of the e-book libraries will become even more remote from their users and publishers will become even closer as a result of consumer footfalls occurring in their domain. The fall out with publishers over open access and institutional repositories has caused a schism between librarians and publishers and the increasing willingness of the user to pay for information (a trend noticed by all publishers) will increase the isolation of libraries.
- Introducing robust, fit-for-purpose mechanisms for monitoring and evaluating their users (and information services). Faced with the prospect that the future scholar will only ever want to use them remotely it is absolutely crucial that libraries have a means of monitoring and evaluating what they do. Furthermore, it is not sufficient to just listen and monitor it is also necessary to change in response to this data. Otherwise libraries will be increasingly marginalized and anonymized in the virtual information world. No private sector corporation would survive on the basis of failing to invest in consumer profiling, market research and loyalty programmes. No library we are aware of has a department devoted to the evaluation of the user, how can that be?
- Really getting information skills on the agenda because clearly people are having great difficulties navigating and profiting from the virtual scholarly environment. To succeed it will be necessary to lead on outcomes/benefits (better researchers, degrees etc.) and work closely with publishers.
- The library profession desperately needs leadership to develop a new vision for the twenty-first century and reverse its declining profile and influence. This should start with effecting that shift from a content-orientation to a user-facing perspective and then on to an outcome focus.

Conclusions

The article's main findings are that much professional commentary, popular writing and PowerPoint presentations overestimates the impact of ICTs on the young, and that the ubiquitous presence of technology in their lives has not resulted in improved information retrieval, information seeking or evaluation skills. Really the main message to take away from the research described here is that all of us have changed the way they seek information. We are all the Google generation, the young and old, the professor and the student and the teacher and the child. Furthermore, we should worry more about what has happened and not will happen, as we are only just waking up to the fact that a fundamental shift in the way people seek and read information has already occurred and that the impact of the shift has yet to be understood by information providers and educators (Naughton, 2008). But you can bet that Google has.

Notes

1. The report was itself a summary of the key findings of a number of individual studies conducted as part of the project. The reports of these studies, together with the original report itself, can be found on the CIBER web site (www.ucl.ac.uk/slais/research/ciber/downloads/).
2. CIBER SuperBook project, see: www.ucl.ac.uk/slais/research/ciber/superbook
3. The confidence levels offered in this article represent summary judgments by the CIBER team. They were arrived at iteratively and were determined by the weight of the evidence collected across all seven work packages. In cases where that evidence was incomplete, contradictory, or lacking in validity, we have recorded "open verdicts".

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