How Readers Discover Content in Scholarly Publications

Trends in reader behaviour from 2005 to 2021

By Tracy Gardner and Simon Inger
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1. INTRODUCTION

This report is the output of a large-scale survey of readers of scholarly publications (n=15143) and their behaviour in the discovery of journal articles and video. The survey was conducted during January, February, and March of 2021.

As a consultancy, we work in all areas of content delivery and discovery, and we see how obfuscated user navigation can be. Many institutions around the world use proxies to access scholarly content and authentication is often highly integrated with an institutional single sign-on (SSO) solution which makes it difficult for publisher analytics tools to identify information such as the country of origin of the reader.

Reader navigation is also complicated. There are simple, straightforward journeys of course, perhaps from Google to content, or social media posting to content. But where library technology becomes involved, link servers hide from the target website (i.e. the publisher) the navigational origin of the reader.

For these two reasons we have found that surveying is a useful technique to get to what at least the reader believes they are doing, even though we know surveys have their own problems, especially around perception. However, this brings with it another significant benefit of surveying: the reader perception of what they do will define how they relate the publications landscape to others, and those in a senior position will strongly influence expenditure and strategy in their institutions. Perception of reality is often more important than reality itself.

This survey builds upon previous surveys conducted by the authors in 2005, 2008, 2012, 2015 and 2018. We have included longitudinal and trend analysis over time where it is relevant to do so. The subtle shifts over time in reader preferences provide a valuable insight into reader navigation, the features that they find useful in publisher websites, and the role and effectiveness of library technologies. Please refer to section 6 Methodology and section 7 Demographics, for a full discussion of the survey methodology and the demographics of those responding to the survey.

*This report is just a snapshot of the highlights we discovered. There are many more charts we could produce with different demographics. If you have a question you would like to ask, or a graph with a specific demographic you would like to see, please get in touch with us via emailing tracy@renewconsultants.com and we would be happy to produce the graphs for you, if we have sufficient data to support them.*
2. HEADLINE FINDINGS

- In terms of overall trend, A&Is are still the most important search tool for people in high-income countries working in the broad subject area of life sciences (either in the medical or academic sector). This has been consistently true since 2005. However, Google Scholar is catching up. Figure 1, p9.

- People in the medical sector value A&Is significantly more than Google Scholar, and more so than people in the academic sector. The conclusion is that medics are still very much tied to A&Is whereas academics rate Google Scholar as just as important, if not more so than A&Is. Clinicians rate A&Is as more important whereas researchers rate Google Scholar as the most important resources. Figure 19, page 17. It is only those in life sciences who value A&Is more than Google Scholar and this is likely to be down to PubMed. Google Scholar is rated as most important throughout the rest of the science subjects. Figure 11, page 17.

- Social and Professional networking sites have increased significantly in importance. Publisher and society sites are more important as a discovery resource than they were in 2018, perhaps as a result of the amount of reader marketing publishers are carrying out. Figure 1, p9

- Google Scholar is by far the most important discovery resource for people working and studying in the broad area of Humanities and Social Science. The library is still much more important to this group of people than it is to people in STEM subjects (Scientific, Technical, Engineering and Medical) and in Humanities the library is just as important as Google Scholar as a discovery resource. Figure 8, page 14 and Figure 9, page 15.

- People in physics value preprint repositories significantly more than A&Is as a discovery resource, and they value them significantly more than people working and studying in other fields. Figure 10, page 15

- People in chemistry and engineering/technology value the publisher website as a discovery resource more than people in other subject areas. Figure 10, page 15

- Social media as a source of discovery is far less important to people in North America than any other region. Figure 13, page 18

- Google Scholar continues to be the dominant search engine used for journal discovery in the US and most European countries. It is also the most popular search engine for journal discovery in China, although the popularity of Baidu continues. Figure 21, page 24

- Search is the dominant discovery behaviour in all sectors. Recommendations either via email or on social media account for between 20—30% of all articles accessed (depending on sector). Figure 23, page 26

- People actively search for open access articles, and unsurprising the wealth of their country has an impact on this. People in poorer countries actively search for OA content more than people in richer countries. People in the corporate sector search for OA content more often than their counterparts in the academic and medical sectors. Figure 15, page 20

- 80% of article downloads are believed by readers to be the Version of Record. As only around 40% of article downloads are obtained from publisher-controlled resources, we presume that readers are accessing Version of Record articles from repositories. Figure 24, page 27, Figure 31, page 32

- Only around a third of people working and studying in STEM discover academic videos via search, the rest of the time they are doing something else. One in five videos are accessed as part of a journal article. Social media and recommendations are important for video discoverability. Figure 26, page 28

- People discover articles through search around 45% of the time. 55% of the time they are doing something else. However, discovery via search has increased over time. Figure 22, page 25

- Despite under half of content downloads coming from publisher web sites, readers are obtaining the Version of Record (VoR) 80% of the time. Figure 27, page 9
PubMedCentral is likely to account for the popularity of subject repositories in Medicine. Scientific social networking sites are responsible for around 15% of article reads. Figure 28, page 30

For approximately 60% of the time, readers in high income countries in the academic sector are accessing articles from a free resource rather than a publisher-approved web site (some of which may be open and free anyway). This means that they are at least 1.5 times as likely to be reading an article from a free resource than a paid-for resource. In lower income countries this rises to over 2.5 times as likely. Figure 30, page 31

Related-articles remains the most popular feature of a publisher website. Table of Contents alerts have significantly decreased in importance, once the most popular feature it is now relegated to being one of the least. That is not to say journal alerts are not important per se, it could just be that people are signing up for alerts on other websites. Figure 33, page 35
3. SEARCH

During the lifetime of this series of reports, search has evolved greatly, and in many ways content discovery outside of the publisher silos has become quite a battleground for competing services and approaches. This survey looks at search in a number of ways. It looks at how people rate in importance a number of search options, looks at the competition between mainstream search engines, and also seeks to find out what proportion of the time people are actually doing something they would consider ‘search’ in the first place.

Content owners want to know where people start their journey of discovery so that they can optimise their working relationships with key discovery services and tailor their regional and sectoral marketing messages to suit the behaviour of the individuals in those markets.

One of the big questions it is very hard to answer with just analytics is “Where do people start their search when they are looking for journal articles?” – analytics will only tell you which resource people came to your site from and not where they started on their journey. Only by understanding where people start will publishers be able to ensure their content distribution priorities are in order, and librarians will be able to ensure they are helping their patrons on their journey of discovery. There are many variances in the search behaviour of people by sector, region, job type and subject discipline and to date the only practical way to get a true understanding of their chosen discovery resources is to ask them. Given that we have been asking this question of researchers, students, information professionals, lecturers and others over the last sixteen years, we are able to show how search behaviour has changed over time.

It is important to note that the results from 2012, 2015, and 2018 have been normalised to match the demographic sample of 2005 and 2008 where comparisons have been made over the full sixteen years (see section on Methodology). Therefore, these 16-year results show the responses biased towards (but not exclusively) researchers working within STM subjects, in academia, in the US and Europe.

TREND ANALYSIS: JOURNAL ARTICLE SEARCH

LONG TERM TREND FROM 2005 – 2021 (DATA NORMALISED TO 2005 DEMOGRAPHIC)

Our Methodology section describes the demographic for our 2005-2021 comparisons, which are biased to STM (Scientific, Technical and Medical) over HSS (Humanities and Social Sciences), and within STM biased more toward life sciences and medicine.
We can see from this data that A&Is are still the most important discovery resources, and actually have grown in importance since 2018, back to its 2012 level. However, Google Scholar has definitely increased in importance since 2018. It is important to note that the demographic for this data, as already indicated, is dominated by academic researchers in life sciences and medicine and this shows us that PubMed is still a very important discovery resource for those people.

It is interesting but not unsurprising that the social or professional networking site has significantly grown in importance since 2018. Publishers and learned societies should also note that the importance of their websites as a discovery resource has also increased. The publisher web site popularity is quite volatile, this is maybe down to sample selection as the supporting publishers change from year to year.

**A&Is are still the most important search tool for academics in high-income countries working in life sciences. However, Google Scholar is catching up.**

**Social and Professional networking sites have increased significantly in importance in the academic sector.**

**Publisher and society sites appear to be more important as a discovery resource than they were in 2018. Perhaps as a result of the amount of reader marketing publishers are carrying out.**

**TREND BY SUBJECT, 2012 – 2021**

We can see from this graph that there has been a shift from library web pages and aggregations to other resources, particularly Google Scholar in the humanities, the subject area where we see the most engagement with the library. Social media has grown quite substantially which reflects the growth in other subject areas.

It is interesting to look at this data another way; that is to compare a single discovery resource by subject over time.

**Figure 2 – article search in humanities, 2012-2021**

We can see from this graph that there has been a shift from library web pages and aggregations to other resources, particularly Google Scholar in the humanities, the subject area where we see the most engagement with the library. Social media has grown quite substantially which reflects the growth in other subject areas.

It is interesting to look at this data another way; that is to compare a single discovery resource by subject over time.
Figure 3 – importance of social media, academic sector, by subject, 2012-2021

This shows that social media has grown in importance across the board but is particularly important in Earth Sciences. There is indicative evidence that it is at its least importance in medical subjects.
Library discovery has decreased in importance in most subject areas, although some science subjects are showing a slight increase. This might be because library discovery resources are so embedded in universities now, people working in the sciences are just simply getting used to using them.

This shows the relative importance of A&Is across the subject areas and also shows that they have stayed relevant and important, particularly to people in medical subjects and life sciences. They are far less important to HSS subjects, physics, computer science and maths.

**Trend by Job Role, 2012 – 2021**

We looked to see if there were any differences in the importance of different discovery methods by job role. Here we look at academic researchers, lecturers and teachers. There were not enough librarian respondents in the later years of this survey to make any meaningful conclusions.
Academic researchers have stayed fairly consistently tied to the A&I. However, we have seen in growth in the importance of Google Scholar. Their reliance on social media as a discovery resource has grown fairly significantly over time.

Lecturers seem to think A&Is are slightly more important than they did in previous years so they are somewhat bucking the trend. Their reliance on library web pages and journal aggregations as a discovery source have decreased. They interest in social media has increased significantly.
Figure 8 shows that there are significant variations in the search behaviour of people by broad subject area. A&Is are the most important resource for people working and studying within medicine, we presume this is the impact of PubMed which endures as an important discovery resource. Whilst people in HSS think library web pages and journal aggregations are significantly more important than do people working in other subject areas, the academic search engine is the most important discovery resource for those people. For people in STE (Scientific, Technical and Engineering), the academic search engine is the most important, but A&Is still feature strongly. Pre-prints are more important to people in STE than in other subject areas. Google Scholar is now far more important in all broad subject disciplines than Google.

Google Scholar is the most important discovery resource for people working and studying in HSS. The library is still much more important to this group of people than it is to people in STEM subjects.
As we dig further down into the subject results, Figure 9 shows us that there is some variation within HSS, the most significant being that it is people in humanities who rely on library provided resources just as much as Google Scholar. The academic search engine clearly dominates as a discovery resource for people in other areas of HSS, library web pages and journal aggregations are just as important as A&I services. The publisher website, journal homepage and social media are all fairly important to this group of people, particularly those in humanities.

In humanities, the library is just as important for discovery as Google Scholar. More so than to people in other HSS subjects.
And delving further into STEM subjects we see a different picture once again. A&Is are the most important discovery resource for people in life sciences, for people in chemistry they are equally as important as the academic search engine. People in physics value preprint repositories significantly more than A&Is, and significantly more than people in other fields. The publisher’s website is clearly important to people in chemistry and engineering, indicating a high level of brand awareness and engagement with publishers in these subject areas. Library related resources are more important to people in psychology but it’s Google Scholar which is the most important resource for this group. A general search engine is significantly less important to psychologists than it is to all the other subject areas. People in life sciences are still very loyal to the A&Is, again this leads us to the importance of PubMed to this group.

**People in physics value Preprint repositories significantly more than A&Is, and significantly more than people in other fields.**

**People in chemistry and engineering/technology value the publisher website as a discovery resource.**

**People in psychology think Google is less important than social media or the library. They value Google Scholar and then A&Is as the most important.**

**People in life sciences think the A&I is the most important discovery resource**

**SEARCH BY SECTOR: 2021**

Figure 11 shows us the sectoral differences in search behaviour. The most significant difference in behaviour is in the medical sector which is dominated by the A&I, with a resultant decrease in importance of academic search engines in that space.

People working in the corporate sector rely on free search engines more than anything else. People in all sectors appear to rely on Google Scholar more than Google.
This graph shows that A&Is are extremely important to people in the medical sector and far less so for people working in charities/NGOs. Google Scholar is more important than Google in all sectors, this is particularly true for people in academia where the difference is significant. A&Is are slightly less important as Google Scholar to people in academia.

A&Is are significantly more important in the medical sector than for all other sectors. Google Scholar is significantly more important than Google to people in academia and slightly more important than A&Is.

SEARCH BY JOB ROLE: 2021

Figure 12 shows how search behaviour differs by job role across all sectors and regions – the differences are significant.
Following on from the results by sector shown in Figure 11, clinicians rely heavily on the A&Is. Researchers rely on Google Scholar more than any other resource and more so than other job roles. Unsurprisingly the librarians use the library web pages and aggregations more than other roles. Masters students think the A&Is are the most important discovery resource. Researchers and librarians seem to be most engaged with the publisher website.

![Librarians behave quite differently to everyone else in search, preferring professional search databases and library-acquired resources. This may point to a continued significant gap between what librarians recommend, and how their patrons behave.]

**SEARCH BY REGION: 2021**

![Figure 13 - article search, by region in academic sector, 2021](image)

There are significant regional differences in the importance of search resources. People in Asia, Africa and South America think publisher and society websites are more important than general search engines and nearly as important as academic search engines. It appears that these groups are more engaged with publisher and journal brands than people in other regions. There are quite a few similarities in the responses from people in Africa and

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Asia. People in North America and Europe seem think academic search engines and A&Is are significantly more important than general web search engines, and indeed any other discovery route.

Journal aggregations are less important in Europe than they are in North America and social media is far less important in North America than any other region.

There are significant differences in how people view the importance of different search resources. People in lower incomes countries perhaps value a wider range of search resources than those in wealthier countries who seem to settle on fewer methods.

**OPEN ACCESS SEARCHING**

This year we asked how many people actively searched for content that was open access. The options were frequently, occasionally and never.
Figure 15 - searching for open access articles, by country income band, STE subjects, 2021

It is perhaps not unsurprising that people in poorer countries actively search for open access content far more frequently than people in higher income countries. However, it is interesting to note that even if the richest countries, 25% of the people frequently search for OA content. Publishers need to ensure their OA content is as discoverable in all of the usual discovery resources as their non-OA content.

Figure 16 - searching for open access articles, academia, high-income countries, by broad subject area, 2021

We looked to see if there were any differences in responses by other demographics. This shows that the results are exactly the same for people in academia in high income countries, regardless of the subject area, around 20% of respondents frequently search for OA content.
Whilst there isn’t a significant difference by subject area, there is a difference by sector. This shows that people in the corporate sector search specifically for OA significantly more than people in academia. We know that corporate libraries have been significantly downsized and sometimes disbanded altogether. This could either be an indication that corporate organisations are subscribing to less, or just that their access is less well organised and communicated.

**People do actively search for open access articles, and unsurprising the wealth of the reader’s country has an impact on this. People in poorer countries actively search for OA content more than people in richer countries. People in the corporate sector search for OA content more often than their counterparts in the academic and medical sectors.**

Selected Journal Search Comments

A number of questions in the survey allowed for additional comments, and amongst the most revealing of these are the comments on search behaviour. The comments were highly focussed on how good both Google Scholar and PubMed are at getting you to the content. Several people mentioned how useful it is that Google Scholar points out the open access version available.

- I search PubMed and/or Google, if that doesn’t work, it doesn’t exist. I don’t trust any pre-prints that have not completed peer review.

- After taking this survey, I realized that I really only use Google Scholar because it is too easy and accessible.

- I will use google for a quick and dirty search for an article on a topic, but turn to subscription databases such as Web of Science when that fails or I want to try and find all sources on a topic.

- Almost always search on PubMed, which redirects me to Journal page in case of open access. Otherwise, I log in into my University institutional account and paste the doi to be redirected to the Journal site, where I access the pdf copy. In case I do not have an institutional account I paste the doi on Sci-hub search field and most of the time get the article I was looking for. This last situation happens around 50% of times.

- First I search the subject through internet, if I find the article which belongs to a prestigious journal I download the article. What is important to me is the index of the journal then the publisher.
Google and pubmed are the most important search tools. They have some non-overlapping areas and different search criteria that makes them effective in tandem. For chemical compounds and reaction I use SciFinder, which is also excellent and performs task neither google nor pubmed can.

I frankly find the pre-publication versions of papers difficult to work with—they are very difficult to cite, since the citations are always incomplete (no page numbers). I am therefore very reluctant to use them. Citing pre-, early, or online publication needs to be standardised among publishers and referencing formats.

I only search for articles on Google Scholar because I am then sure that I have covered any and all scientific published material, including conference proceedings which sometimes are more actual than peer-reviewed published articles.

It would be useful to have an AI tool that picks-out articles of interest to me on a regular (e.g. weekly/monthly) basis.

Serendipity! Searching for one article (or using certain key words/MeSH terms) can reveal a really interesting and useful one.

Probably 80% to 90% of my searches are driven by topic, either by searching directly or following up sources cited by another manuscript on the same topic. Most of my activities include a literature search, for designing a study to publish results for journals. The source (e.g., specific journal, open access) is irrelevant.

SEARCH ENGINE PREFERENCE

Since 2012 we have surveyed people’s search engine choice, to understand the shifting behaviour of search engine preference when looking for scholarly articles. To simplify the situation this year we only surveyed three main options.

SEARCH ENGINE PREFERENCE – TREND

Figure 18 - search engines, China, 2012-2021

Figure 18 studies the trend in search engine usage for respondents in China. It shows that as the use of Google (and even Google Scholar to some extent) is apparently in decline in China. It means more than ever publishers need to
be working with Baidu and in combining this data with previous findings on open access content, this applies particularly to those publishers with open access content.

**Figure 19 - search engines, medical sector, 2012-2021**

Figure 19 shows that in the medical sector, Google is still dominant, although Google Scholar is growing at the expense of Google. We know that A&Is are still important to the medical sector, Figure 8 and Figure 11 demonstrate this.

**SEARCH ENGINE PREFERENCE - 2021**

**Figure 20 - search engines, high-income countries, by sector, 2021**

Figure 20 shows that people in the academic sector use Google Scholar significantly more than Google, and more than respondents in other sectors. Google Scholar is now very well embedded into academic discovery, and this is true across subject areas.
Only the academic sector uses Google Scholar more than Google. The corporate sector continues makes the least use of Google Scholar, and this may be an awareness issue. People in Government use Google and Google Scholar equally as much.

![Diagram showing search engine usage by country in academic sector, 2021](image)

**Figure 21 - search engines, academic sector, by country, 2021**

There are significant regional variations in the adoption of Google Scholar over Google within all sectors. Figure 21 shows the differences for the academic sector only. Google Scholar is used more than Google in the USA, a behaviour that we found mirrored in a large number of countries, such as United Kingdom, Italy, and Spain. We see that Germany is very similar to the US and this is true for most European counties. The use of Google Scholar seems to be reduced in many African and Asian countries. We presume this is a problem of awareness, since it cannot be a problem of price (since not only is Google Scholar free, but it also exposes many free versions of the content itself). Use of Google in China is known to be restricted to a degree, but we can see from these results that Google and Google Scholar account for around 60% of search engine use.

Google Scholar continues to be the dominant search engine used for journal discovery in the US and most European countries. It is also the most popular search engine in China, although the popularity of Baidu continues to grow.

**LAST ARTICLE ACCESSED**

**LAST ARTICLE ACCESSED: 2012-2021**

In the past four surveys we asked how people had found the last article they accessed – via a search; clicking on links in social media; following a recommendation in an email; via a journal alert; or by any other means.

The results show that whilst search is dominant, and that search as a behaviour has increased over time, and that people are actively searching more than they are discovering articles any other way – they are still doing other things 55% of time.
People actively searching for journal articles has increased from 30% of the time to 45% of the time over the last 9 years. Discovery via a journal alert has decreased from around 22% of the time to about 10%. This further backs up the findings of this report which shows that journal alerts are becoming less and less important to researchers. Discovery via social media has increased from less than 5% of the time to 10% - this still means that one in ten articles are discovered on social media. Reading an article recommended on email has stayed steady at around 10%.

People discover articles by actively searching around 45% of the time. 55% of the time they are doing something else. Discovery via active search has increased over time.

**Last Article Accessed: 2021**

We wanted to see if there was any difference in the responses to this question by sector. There are some differences, but it is clear that search is still the dominant behaviour but more so for people in the academic and medical sectors than others – around half of our respondents in these sectors found content by actively searching compared with around 40% in the corporate sector. Recommendations, either by email or via colleagues on social media, are an important source of article discovery – between 20-30% of articles (depending on the sector) are discovered this way.
Figure 23 shows that people in the academic and medical sectors actively search for content around 10% more often than people in the other sectors. Recommendations account for around all article reads between a quarter and a third of the time. This is a reminder that all discovery routes need to be optimised, not just traditional search.

Search is the dominant discovery behaviour in all sectors. However, search is more popular in the academic and medical sectors. Recommendations either via email or on social media account for between 20—30% of all articles accessed (depending on sector).
If we look at these results by broad subject area we can see by Figure 24 there is not much difference in behaviour.

Figure 25 shows there are some slight differences by country. People in Brazil and the US actively search for content about half the time, slightly more than people in UK, Germany, and India. People in the US seem to use social media less than people in other countries.

**LAST VIDEO ACCESSED**

Just as with other content types, we took the opportunity to ask the question about how the respondents found their most recent video that they watched. The results are shown in Figure 26.
Whilst search was the dominant behaviour for all subject areas, there are some differences in the magnitudes of their responses. People in STE and Medicine discovered a video as part of a journal article around 20% of the time, whilst this is only true for 10% of people in HSS who are more likely to have been searching. Around 20% of video views came from respondents following a link on social media, a further 10% came from watching a video recommended by a colleague. It’s clear that serendipity plays more of a part for video than it does for journal articles.

Only around a third of people working and studying in STEM discover academic videos via search, the rest of the time they are doing something else. One in five videos are accessed as part of a journal article. Social media and recommendations are important for video discoverability.
4. DELIVERY SITES AND ARTICLE VERSIONS

The rise in popularity of sites like ResearchGate coupled with the increase in the articles being shared in subject and institutional repositories, and the expansion of Sci-Hub, have led publishers and librarians to question where readers are downloading the articles from and whether they are reading the version of record. Please read ‘Delivery Sites’ in section 6, Methodology, for a discussion on the calculations used in this section.

Figure 27 - delivery sites, people in Science/Technical/Engineering subjects by country income, 2021

The use of the publisher web site for article delivery varies by income bracket, with most use being made of the publisher website by people from higher income countries who one presumes are more likely to be in institutions with sufficient funding to purchase these resources. However, with projects like Hinari and Agora in place, one might have expected an improved position for low-income countries.

The reach of the subject repository, however, seems to be much more evenly spread across the world. Sites such as ResearchGate and Mendeley are used slightly less in rich countries.

We can see that the richest countries do not use SciHub as much as others, but there is not much difference in use between the upper middle-income countries and the low-income countries. The results indicate that around 15% of article downloads in these regions come from SciHub compared with 5% in higher income countries. This is clearly a significant difference.
If we look at this data by broad subject area we see some significant differences. Figure 28 shows that 1 in 5 article downloads are delivered by a subject repository in the medical sector (in high income countries). This must be the impact of PubMedCentral. This data reflects the fact there are no popular repositories in HSS but people working and studying in this field are more likely to use institutional repositories than people in other subject areas. Pre-prints currently account for around 10% of article downloads in the broad field of Science/ Technical/ Engineering. Scientific social networking sites are responsible for around 15% of article downloads in all subject areas.

**PubMedCentral is likely to account for the popularity of subject repositories in Medicine. Scientific social networking sites are responsible for around 15% of article reads.**
If we break this down further and look at some country analysis, we can see from Figure 29 that people in Brazil and India use SciHub far more than people in UK, US and Germany. However, the use of subject repositories like PubMedCentral and institutional repositories is higher in the US than elsewhere. The authors feel this is most likely down to an awareness issue and subsequently a trust issue amongst readers unfamiliar with these resources.

Figure 30 shows the same data, replotted as a sum of publisher-controlled delivery sites, versus those that it doesn’t control. All of the resources listed, apart from the publisher and aggregator category, represent an opportunity to download the article for free. We can see that over half of the downloads are from these sites. In addition, it should be remembered that many publisher sites contain open access journals, open access articles within subscription journals, free access to older material from many subscription journals, or gratis access as part of developing world initiatives. It follows, therefore, that the actual proportion of delivery that is “free to read”, is far greater than the amount shown here.

![What proportion of the journal articles that you read do you access from each of the following resources? Variations by country income, in academia.](image)

*Figure 30 - delivery, free resources vs publisher-controlled sites, 2021*

*For approximately 60% of the time, readers in high income countries in the academic sector are accessing articles from a free resource. This means that they are 1.5 times as likely to be reading an article from a free resource. In lower income countries this rises to over 2.5 times as likely.*

**Version of Record: 2021**

This was a new question for 2021. The survey asked, “for the last article you accessed, what version of the article do you believe you read”. Respondents overwhelmingly believed they were reading the version of record, this was
true regardless of sector, job role, subject area or region. There was an option for people to say they didn’t know, so we assume that respondents did understand the question.

It’s important to note that if an article is downloaded from SciHub or PMC the reader is highly like to be reading the Version of Record. It’s also possible that the version of record could be being downloaded some of the time from ResearchGate or an institutional repository.

If you compare the data which shows that 80% of people are viewing the version of record with the data that shows only around 45-50% of article downloads come from the publisher web site, we can conclude that a significant proportion of Version of Record articles are being obtained from resources outside of publisher control.

![Figure 31 - article version, by broad subject area, 2021](image)

Figure 31 shows that there was not much variation in response by broad subject area. Regardless of the discipline, respondents overwhelmingly believed they were reading the version of record. There is a very slightly variation for people in Science/ Technology/ Engineering but this is not significant.

![Nota](image)

Despite under half of content downloads coming from publisher web sites, readers are obtaining the Version of Record 80% of the time.
Looking at this by sector in high income countries (Figure 32), once again there is not a significant variance. There is an indication that people in the corporate sector believe they are reading the Version of Record slightly less frequently than people in other sectors, but again this is not particularly significant.

80% of article downloads are believed to be the Version of Record. As only around 40% of article downloads are obtained from publisher-controlled resources, we assume that readers are accessing Version of Record articles from many other repositories.
5. JOURNAL WEB SITE FEATURES

The survey asked people to state how useful they found a range of publisher website features. Over the last 10 years we have updated the feature list to reflect changes in web sites. (Respondents aren’t asked to rank the items, merely rate their utility, so changing the number of options does not affect the importance of other features.) Note that the chart comparing 2005 with 2021 uses a normalised population to match the 2005 demographic as noted earlier.
Figure 33 - Journal web site features, 2005-2021
To make Figure 33 easier to view we have excluded results from 2008 and 2015. The usefulness of Table of Contents Alerting on a publisher website has significantly and consistently decreased since 2005 when nearly 90% of respondents said it was a useful feature.

Related Articles functionality is the most useful feature of those tested, and has maintained its position fairly consistently over the period of study.

Whilst News and Editors Choice/Selected Articles type content saw an increase in popularity in 2012, this type of feature seems to have peaked in its popularity; only between 10-20% of respondents found either of these features useful – a significant drop since 2012.

**Related-articles remain the most popular feature of a publisher website. Table of Contents alerts have significantly decreased in importance, once the most popular feature it is now relegated to being one of the least.**
The interesting differential shown in Figure 34 is that people working in STE appreciate links to supporting data more so than people in medicine and HSS. People in HSS do not require images as much as people working in other fields. People in all subject areas rate related articles as the most popular feature of a publisher website.
Figure 35 shows the difference between people studying medical subjects in the academic sector and those working and studying in the medical sector. Perhaps unsurprisingly author related tools such as manuscript submission and information for authors is more popular with academics. Curated content such as news and editor’s choice is more popular with medics, although overall this these features are still only popular with between 10-20% of respondents. Medics want to download images more often than their colleagues in academia.
6. METHODOLOGY

This research carries on from, and expands upon, previous research undertaken in 2005, 2008, 2012, 2015 and 2018 (also by Simon Inger and Tracy Gardner) and attempts to follow the trends in behaviour over that period. Naturally, each time the survey is repeated, the authors have sought to keep the questions as consistent as possible with the questions in earlier surveys whilst keeping terminology current and tracking new developments. For this reason, the key question on reader behaviour in search was modified a little, some options reclassified, and additional options created. However, since those questions don’t limit how many starting points the reader acknowledges as being important, this approach should have minimal impact on the results for any option present in the survey all the way from 2005 to 2021. Some questions have been retired since the research in 2018.

One of the key limitations of the older surveys was their reach. However, the 2012 to 2021 surveys have reached very significant numbers of individuals. As a consequence, demographic breakdowns are possible, by region, by subject, by major countries, and by World Bank income classifications. Our primary goal was to give us sufficient responses within each subject category to make for meaningful comparisons. We identified the subject areas we needed for our study and created a list of publishers and intermediaries who had content in those subject areas. We approached them over a period of six months until we had sufficient organisations as supporters to give us the best chance of reaching the numbers we needed.

Of course, since the invitations to take the survey were sent out by many publishers, some individuals will have been invited to take the survey more than once. At no point did we have sight of any email addresses from any of the supporting organisations and so no de-duplication was possible. However, we attempted to mitigate the effects of individuals taking the survey more than once by careful wording in the survey invitation – the standard invitation pointed out that if the respondent had received the survey invitation more than once, it was not intended as a prompt to take the survey twice, nor an indication that any previous response had not been received. In addition, the survey was incentivised, with three prizes of $100 Amazon vouchers or equivalent, but it was made clear that duplicate prize draw entries would be ignored.

SAMPLE

For the reasons outlined above the sample used for the survey was not a random sample – surveyees were selected by our supporters who themselves were selected by their likely subject coverage. In addition, the contacts that each publisher used for the survey will be quite highly engaged with the publisher or intermediary – all of the contacts used will have opted-in to receiving emails of this type. The supporting organisations are based in the US, UK, and Canada, but their clientele is truly global, and the regional demographic breakdowns are testament to this.

SURVEY DESIGN AND RESPONSE RATE

To ensure the highest response rate the survey was limited in size. We timed the survey to take about 7 minutes and we advertised it as such. In practice the survey took on average 7 minutes and 16 seconds to complete.

15171 people embarked on the survey, and 14484 of them completed the demographics stage. At the end of the demographics, 14271 people elected to take the journals survey, 13824 elected to take the videos survey, and 13719 took the Open Access part of the survey.

Each survey partner used a similar wording for their email invitations. Some used additional methods and media to reach potential surveyees and used various samples of their contact databases. As such, response rates are not always directly comparable. However, the approximate response rates were between 1% and 4%. For reasons unknown, the lowest response rate came from those in the Chemistry subject area.
BIAS AND LIMITATIONS

Of course, any survey is limited in what it can achieve. We tried not to be leading in our questioning but there are always limitations in the language used. In addition, although the audience was international, the survey was only conducted in English and so the interpretation of the language may be a factor in the accuracy of the responses. However, it should be noted that the surveyees will mostly consume journals and academic videos in English.

The survey used invitations from our supporters, which were not necessarily a completely representative sample of the world of journal readers and academic video viewers. Furthermore, due to data privacy/data protection rules, all those invited to the survey via email will be quite highly engaged with the publisher and have opted-in to receiving emails like these. This may bias their attitude to publisher web site features, or indeed their likelihood of having bookmarked a particular journal page. It may be, therefore, that external discovery platforms are even more important than portrayed in these results.

No control sample was used in this survey. With so many variables, of subject, region, job role and sector, it was decided that creating a control sample would be beyond the scope of this research project.

ANALYSIS

Analysis was performed using Excel. Many of the results were reduced to binary arrays to make further comparisons easy to calculate. A tool was developed so that a number of comparisons could be made for each survey question easily. Figure 36 shows how the tool works, creating 5 series of data, each as a result of multiple demographics.

ERROR CALCULATIONS

Throughout this document we have tried to keep demographic breakdowns of the data to quite large samples so as to minimise margins of error. All the charts include error bars calculated at a 95% confidence interval, which of course in itself brings assumptions about the nature of the distribution of answers. The reader should be aware that with average luck, one in twenty of these calculations will be insufficient and the true reading will be out of the boundaries shown in the charts. They may not be far further adrift, but as with all survey results, the reader needs to exercise caution in interpreting any certainty in the outcomes shown.
For simplicity, the error bars shown for a given data series are the same. For example, if one measurement representing 30% of the responses carried with it an error of ±5%, and another measurement of 20% of the responses carried with it an error of ±4%, the chart would be plotted with both errors at ±4.5%. Therefore, some of the error bars for “popular” results will be slightly overstated. In reality, the plots in this report generally carry much smaller error ranges than in this example, and the differences between them would therefore be much smaller still.

In some of the charts, with multiple breakdowns of the data, the error bars shown are those for the series being analysed with the fewest responses. This means that the errors for the remaining breakdowns are overstated. The reader should make a mental note of the response numbers ‘n’ clearly shown in each chart in making a judgement about the accuracy of the data. In these charts the actual error bars will be smaller than those shown for the great majority of the data points – a very cautious view of error has been used in these charts.

**Comparison with 2005 and 2008**

The survey, as conducted in 2008, was formed as similarly as possible to the original survey conducted in 2005. In both cases an invitation to take the survey was emailed to a large selection of readers of the supporters of each of those items of research. As already noted, it was imperative that the survey used language and terms as similar as possible to the prior research, that the medium of collection was the same (online survey) and the temptation to add greatly to the survey was resisted.

In 2005 and 2008, invitees to the survey were taken solely from those who had signed up for ToC alerts. It was noted in those surveys that this potentially affected the popularity of ToC alerts as a starting point in the findings. From 2012 onwards, this bias is somewhat removed (although the exact extent we cannot know), and this seems to be apparent in some of the results.

Between 2005 and 2008, there was a shift in response demographic towards Life Scientists in North America, away from other demographics. In making those comparisons these shifts were taken into account. In comparing the data with the 2012, 2015, 2018 and 2021 data we have created a random sampling of the respondents to the 2012-2021 data down to the 2008 levels. This random sampling included a probability calculation which created broadly the same demographic breakdown in the 2012-2021 “down-sampled” sets as in the 2008 set. For example, in 2015, approximately 1 in 30 of the responses of those in Humanities were used, and 40% of them would be in North America. In 2018, that same sample was achieved by taking 1 in 16 of the responses in Humanities, of which about 45% are in North America. Overall the method seems to have created a set of data with similar demographics as the 2008 set, but not identical (of course).

The trend information is not available for all of the questions asked in this survey, because a number of them are new for each of 2012, 2015, 2018 and 2021 and some of the discovery platform options were introduced for the first time in each of these surveys. Also, some of the questions asked in earlier surveys are now considered redundant and have been dropped.

**Discovery Resource Characteristics**

Readers have a wide choice of where to undertake content discovery. This survey asked readers to rate the importance of a range of starting points for discovery in for several different use cases. For the time being most of these starting points are reasonably distinct, but the authors recognise that some of the boundaries between different types of discovery resource are being blurred, and will continue to be so in the future. All of the potential starting points for discovery have clear differentiating USPs for the reader, as discussed below.

**Abstracting and Indexing Services or Specialist Bibliographic Databases**

Major subject A&Is – e.g. Scopus, PubMed, Web of Science, focus on structured access to the highest quality information within a discipline. They typically cover all the key literature but not necessarily all the literature in a discipline. Their utility flows from the perceived certainty and reassurance that they offer to users in providing the
authoritative source of search results within a discipline. However, they cannot boast universal coverage of the literature – they provide good coverage of a defined subject niche, but reduce the serendipitous discovery of peripheral material. Also, many A&Is are sold at a premium, which in itself is a barrier to their use. Examples from a wide range of subjects were given in the survey questions to help surveyees understand this classification. Some of the A&Is now effectively allow for a browse function, through faceted search, narrowing results perhaps to a title and date range, somewhat similar to a journals homepage, and we have seen a rise in importance of these resources in browse presumably as a consequence.,”

**LIBRARY WEB WAGES**

Many libraries invest significantly in the development and utility of their web pages as a starting point for discovery. Library controlled web space usually has the advantage of linking only to content that has been paid for by the library and meets library selection criteria. The library’s deployment of link resolver technology has further strengthened their importance. Not only are libraries now the primary purchasers of content for their staff, researchers and students, they are also, where link resolver and associated technology has been deployed, the main determinants of how different, relevant resources are presented and offered to end users; the way in which the user navigates to a publisher site; and also what part of the site the user is delivered to. Many libraries have reduced budgets for A&Is and have cut their purchase from peripheral or under-funded subjects, driving discovery to library resource discovery tools instead.

**A JOURNAL COLLECTION, OR AGGREGATION**

This survey studies the importance of aggregators in journal discovery, though recognising that this may be a closed environment – discovery in such a database can lead only to content in that database. Aggregated databases are normally a separate incarnation of a collection of journal content licensed to an aggregator and sold and delivered independently to a publisher’s primary content incarnation.

**A SUBJECT PRE-PRINT REPOSITORY**

As Pre-print repositories grow in popularity, and especially with the rise of bioRxiv, the 2021 survey includes this resource type for the first time. Since these repositories contain the full text of the pre-print, and not just the metadata, they become both the discovery and delivery option, like the journal aggregation. Although the discovered article is not normally the version of record, it does have the considerable advantage of being free, open, and available before the version of record.

**A COMMUNITY WEB SITE, SOCIAL NETWORKING SITES**

The market for community web sites has consolidated in recent years to a few standout sites, such as Mendeley, ResearchGate, academia.edu. With millions of links, or in some cases millions of documents stored within them, they have become an important alternative to other discovery methods, with the added advantage of linking the content to individuals with profiles in the databases. In addition, Twitter, Facebook and Wikipedia are places where links are shared and citations embedded for others to follow.

**A PUBLISHER’S WEB SITE**

Publisher web sites, of course, contain only a fraction of the available literature in a given subject area, unless that publisher has almost complete dominance of the subject area under consideration. Despite this clear limitation when searching for new content, the size of these publisher collections and the often superior interface design make these sites appealing to users, even though information specialists would advise against using them in lieu of larger search collections. There may well be a degree of brand familiarity, and hence trust, that helps drive their importance.
EMAIL BASED ALERTS

Email based alerts, whether table of contents alerts, or saved search alerts have an advantage because they are under user control, and most likely are set up for content that the user knows he has access rights to use. By definition, the resource has already gained the user’s trust. However, as content is increasingly published ahead of the issue publication date (‘online first’) table of contents alerts by definition provide a rather late alert for much of the content, whereas subject or search based alerts will be more current.

THE JOURNAL’S HOMEPAGE

In many ways, the journal’s home page is not dissimilar in characteristics to email based alerts. A user has bookmarked a journal home page presumably because he has experience of the journal, has access to it (a subscriber) and has respect and trust for it.

GENERAL WEB SEARCH ENGINES

The main strengths of search engines such as Google are their simplicity, broad coverage and the fact they are free to use. Their speed allows for search to be refined and retried quickly and is a frequently cited reason for their popularity. Google appears only to include pay-walled articles when it has good reason to suspect that the reader has permission to access it. As such it is not as comprehensive as Google Scholar for most readers. Having said that, the authors of this study are aware of anecdotal evidence that in some subject areas Google has the added benefit of searching other content types, such as laboratory web pages and government resources which gives a broader search than simply searching for academic articles.

ACADEMIC SEARCH ENGINES

In the earliest studies we did not separate out the use of academic search engines, such as Google Scholar, from general ones, like Google. But over the years a clear division has emerged in the use cases for each resource, and the academic search engines provide more consistent results from reader to reader, whereas engines like Google learn an individual’s interests and tailor the results to them. This may be good for some, and bad for others.

A SCHOLARLY SOCIETY WEB PAGE

Society web pages have much the same appeal as a journal homepage. Society members usually have access privileges to the society journals through the site. One presumes, though, that the brand affinity for members with the society is even stronger than with the journal.

DELIVERY SITES

One of the survey questions tackles the question of content delivery. We asked ‘What proportion of the journal articles that you read do you access from each of the following resources?’ Surveyees were given a range of delivery site types and asked to simply say whether they used those sites more than 70% of the time, between 30% and 70% of the time, less than 30% of the time, or not at all. Naturally, some people voted for more than one item as more than 70%, or more than 4 items between 30% and 70%. To mitigate against this effect, we took the following approach.

For each response we assigned an approximate figure, of 75%, 35%, 15% and 0% to each of the four answers, added up the total of the percentages and created a correction factor for each person. For example, if a person’s answers added up to 200%, we divided all their responses by 2, i.e. the correction factor. We calculated a standard deviation figure for the correction factors. Through an iterative method we altered the assumed percentages above to reduce the standard deviation of correction factors to its minimum value, and so created a best fit of how to interpret the range of percentages given. These are given below:
<table>
<thead>
<tr>
<th>Survey Response</th>
<th>Used Figure</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 70%</td>
<td>69.8%</td>
</tr>
<tr>
<td>Between 30% and 70%</td>
<td>37.2%</td>
</tr>
<tr>
<td>Less than 30%</td>
<td>9.9%</td>
</tr>
<tr>
<td>Not at all</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

With each response given the percentage above, a correction factor was reapplied to each respondent’s answers so that no-one could account for more than 100% of their time.

Answers from this question provide valuable insight into readers’ delivery options and so we wanted to test the effect of different derivations of these figures on the final published results. We found that any reasonable combination of numbers in the above table consistently produced the headline results reported in this work, and although changing the sizes of each result in absolute terms, never affected the relative ranking of results, and critically, never placed the use of free resources at less than the publisher-controlled resources.
7. DEMOGRAPHICS

Figure 37 – Respondents by region, 2021

 Respondents to the survey come from an excellent regional spread and this allows for significant regional (and in some cases country) breakdowns.

Figure 38 – Respondents by country of origin, 2021

For the purposes of being able to apply demographic breakdowns by country for all of the survey questions, we separately identified all countries with more than 300 respondents and then further clustered all other respondents within a region as one. In Europe this means we can analyse the behaviour of individuals from UK, Germany, Italy, and Spain and all of the other European respondents are grouped together as “All Other European Countries”. The same approach was taken with all other Continents.
Although dominated by the academic sector, there were enough respondents in Corporate, Government, and Medical sectors to allow for further breakdowns by subject, region, and income.

The numbers of respondents by job role allows for meaningful comparisons to be made for almost all roles, and for some there are sufficient numbers to permit meaningful analyses in combination with other demographics such as region or country.
When embarking on this project, our aim was to get around 600 responses in each subject area, so that detailed demographic analysis would be possible within subjects with minimal error-bars. This was achieved for eight of the subject areas. Computer Science, Earth Science, Religion and Law are the least well-represented in the data, although in absolute terms there are enough individuals in the first two of these areas to allow for a useful subject-based analysis, even if not when combined with a further demographic.
The individuals’ countries were mapped onto World Bank income categories which are themselves calculated as GNI per capita: low income, $1,025 or less; lower middle income, $1,026 - $4,035; upper middle income, $4,036 - $12,475; and high income, $12,476 or more, as measured in 2011. We used the 2011 classification rather than the updated ones to allow for comparisons across time – our current data structure does not allow for changes in income classification of countries in our longitudinal analyses.
8. CONCLUSIONS

There continues to be very significant regional and sectoral differences in how readers discover academic content.

There have been some interesting changes in the way people discover academic content over the last 3 years. We can see that the major discovery resources such as Google Scholar, Google, A&Is (predominantly in life sciences and medicine) and the library are still of crucial importance, but there are differences in quite how important depending on subject areas, sector, and region. Google Scholar now dominates in the academic sector at least.

We can see that people, particularly those in poorer countries, do actively search for open access content and so publishers and technology providers need to take this into account when designing their websites and managing the distribution of metadata to third parties. People are finding the version of record, even when they are using repositories such as PMC, institutional repositories or scientific social networks such as ResearchGate in their initial article discovery process.

PrePrint servers are not as important as other discovery methods, apart from in Physics where the highly establish arXiv is still a crucial source of discovery of academic content. Social media is growing in significance, but not in all sectors and all countries. Around half of all articles are discovered as a result of a search, as opposed to chancing upon the article another way – e.g. via a recommendation from a colleague or social media. Recommendations from people and machines are important, as we see that the Related Articles feature on a journals website remains the most popular of those listed.

The key take home is that there is still not a single dominant player in content discovery and that differences in region, sector and subject area will impact how content is discovered. Publishers needing to maximise their global visibility need to work with the discovery options that dominate from region to region, sector by sector.
9. ABOUT THE AUTHORS

SIMON INGER

Simon has worked in journals for 34 years, and as a consultant for the last 20 of those, where the work has mostly been with societies and the organisations that serve them. Simon was originally an Oxford electrochemist, before turning his hand to technology, product development, and then launching his first company, CatchWord, in 1994.

Simon has worked extensively with learned and professional societies throughout his career and has been involved in a number of successful start-ups whose focus is to work with those societies. In addition, as a product developer, he has assisted in the invention of a number of product ideas that societies have launched and taken to market.

TRACY GARDNER

Tracy has been consulting since 2004, working with societies, publishers and intermediaries on a wide range of projects including product development, strategic marketing and business development. She is a researcher and co-author for the How Readers Discover Content reports which have been published every 3 years since 2005. She has worked in scholarly communications since 1997, when she joined CatchWord as Marketing Manager, and later worked at CABI as head of marketing and product development.