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Finding Knowledge: What Is It to ‘Know’ When We Search?

Simon Knight

You walk into the exam room, breathe a nervous sigh, sit down, and plug your laptop in. The URL for the questions is sent out, and you are reminded that while you may search for information and browse pages as you wish, you may not communicate with any other person. You look at the first question; it gives you a poem from an author you know little about, along with some brief historical context, and another source you have studied before. You are asked to draw comparisons between the perspectives of the sources, using your knowledge of the period. ‘Right,’ you think, as you open up a popular search engine, ‘what do I need to know...’

Consider the preceding vignette; Andy Clark and David Chalmers propose that in such cases the external apparatus (the internet) fulfills the same functional role as the internal apparatus (the brain) and thus should be considered an extension of our mind.¹ For the purposes of this essay readers need not ‘buy into’ the extended mind thesis whole scale. Rather, this example is intended to illustrate a general point regarding the relationship between technology and the mind: When analyzing the functional role of technology we should consider how it shapes our activities, its implications for epistemic concepts such as ‘knowledge’, and the differences between pre- and post-technology practices.

Such an analysis has profound implications in education, for example. Under what circumstances do we accept that students ‘know’ something? How do we decide that they know something (that is, how do educators claim knowledge of their student’s knowledge states) and also that such knowledge is important? Furthermore, how we think about the future of technology and the ways that technology might change what we believe is important (for better or worse)?

Indeed, the issue of external tools is not an abstract problem. Open book exams have existed for some time, as have ‘take home’ exams and coursework. Moreover, in Denmark a three-year trial – now implemented – started in 2009 to permit the use of the internet in exams.² The inclusion of the World Wide Web in examinations (excluding sites which could be used to communicate with other students) was a natural extension of earlier Danish examinations that had included multimedia resources ranging from CD-ROMs to videos, audio, and webpages. The aim was to give students the opportunity to work with a variety of resources and to probe analysis skills and metacognitive skills, such as checking mathematical outputs using multiple methods.

I find the Danish example particularly interesting because it is so far removed from what my own assessment experience has been – both as a teacher and student. Moreover, as I and

1 Andy Clark and David Chalmers, ‘The Extended Mind’, *Analysis* 58.1 (1998): 7-19, <http://www.philosophy.ed.ac.uk/people/clark/pubs/TheExtendedMind.pdf>.

2 Simon Knight, ‘Danish Use of Internet in Exams – Epistemology, Pedagogy, Assessment...’ Finding Knowledge Blog, 23 July 2013, <http://people.kmi.open.ac.uk/knight/2013/07/danish-use-of-internet-in-exams-epistemology-pedagogy-assessment/>.

others have argued, our assessment methods implicate particular epistemological assumptions; measuring 'knowledge' of unconnected 'facts' suggests a rather different way of thinking about knowledge than those that require testing the filtering and analysis of resources towards some critical, evaluative output. The epistemological implications of our social and technical interactions with information is the subject of this essay. I will specifically look at the role of search engines as informants offering testimonial knowledge on a query, then at the question of how the receiver of testimony should be taken into account by those giving the information, and finally at how we should deal with multiplicity of perspectives, or even gaps in our knowledge.

Of course, the simple retrieval of precise information on the internet may be a challenge for many. Readers may recognize the experience of having a friend or colleague ask a question, which you respond to by turning to a search engine and finding an answer to the request with the first query. Indeed, the website www.lmgty.com – 'let me google that for you' – exists for that purpose, animating a search for any given query. The Danish example, though, shows that it is still required for students in this case to remember ('know' according to some) information, while still allowing them to engage critical literacy skills to connect pieces of information from across multiple web sources.

As mentioned above, we should examine the implications of technology concerning how we think and how our activities are shaped. However, we should not assume *prima facie* that these technological changes actually represent new epistemologies, whether positive or negative, nor new ways of thinking about what it means to 'know'. Rather, we should seek to understand the nature of 'knowledge', and how informants – including non-human informants – mediate our understanding of the world around us and have always done so. This essay considers these questions, first by discussing some issues regarding research on technological changes, then by asking what role search functions fulfill and how these functions affect our own understanding of 'knowledge'.

Researching Search

The impact of the internet on how we think has caught popular attention in the many articles – often critical.³ However, many of these articles assume that change is a bad thing – particularly any indication of neurological change – and they often report studies of very particular circumstances. Yet neurological change is unsurprising given the human brain's high plasticity, and it is incredibly difficult to conduct solid research that tracks abilities over time given the challenges to control across multiple cohorts of ages and educational systems.

³ See for discussion and critique of these articles Simon Knight, 'Is Google Making Me [Stupid|smarter]...How About Bing?' Finding Knowledge Blog, 23 January 2013, <http://people.kmi.open.ac.uk/knight/2013/01/is-google-making-me-stupid-or-smarter-how-about-bing/>.

Much of the substance of these debates boils down to what we value. We have previously valued memory and memorization of facts, in part because they are easy to assess.⁴ However, presumably most people would agree that the purpose of education is not the speedy recall of facts – it is not to develop world-class pub quizzers, capable of reciting the dates of monarchy. Instead, the idea behind assessments is that if students can recall facts, then – by proxy – they have knowledge about those facts, meaning they can engage with critical skills of evaluation, etc. Fundamentally, these skills – understanding the connectedness of knowledge, of evaluation, of making credibility judgments – are what knowledge consists of, not the recall of individual ‘facts’ in constrained contexts. Critical skill is also what the Danish system seeks to measure; given the easy access to facts through search engines, a focus on synthesis and evaluation becomes easier. However, the question of how the tools help shape our thinking still stands. Just as books, with indexes, chapters, reference lists, and so on, present information in certain ways, so too does the internet and its tools of access, such as search engines, browsers, and social network sites.

Search Engines as Informants

An interesting aspect of the Danish example is the prohibition of communication websites in examinations. Yet the line between search engines and social networking sites is increasingly blurring. Indeed, while Google's advertising rhetoric has tended to focus on a desire to ‘know what you want, before you do’,⁵ Bing (with Facebook), at least in North America, has developed ‘Bing Social’⁶ with the headline: ‘For every search, there is someone who can help.’

Google’s strategy is to use developments in semantic web technology to identify key facts associated with any particular query; thus, a search for Florence Nightingale brings up a standard search engine results page (SERP) with key links on it. However, in addition to that SERP, there is a box on the right hand side with some key facts about Florence Nightingale populated from her Wikipedia entry. Bing Social, in contrast, uses similar developments in social network data to infer whether someone might be a good ‘informant’ for any particular query – for example, whether or not that person has qualifications in the subject of historical figures. Thus Google’s Knowledge Graph has been developing more as a direct informant – providing the information itself – while Bing Social (and Facebook Graph search) aim to provide you with good informants from your social network.

Both of these approaches have obvious uses and advantages but also potential problems. Examples of the risks of seeking informants in one’s own social network (the Bing Social and Graph Search approach) are:

4 Amongst others, Dan Russell discusses these issues: ‘Why Knowing Search Isn't the Same as Having an Education’, SearchReSearch blog, 1 August 2011, <http://searchresearch1.blogspot.co.uk/2011/08/why-knowing-search-isnt-same-as-having.html>.

5 Tim Adams, ‘Google and the Future of Search: Amit Singhal and the Knowledge Graph’, *The Guardian*, 19 January 2013, <http://www.theguardian.com/technology/2013/jan/19/google-search-knowledge-graph-singhal-interview>.

6 Derrick Connell, ‘Bing Social Updates Arrive Today: For Every Search, There is Someone Who Can Help’, Bing Blogs, 17 January 2013, http://www.bing.com/blogs/site_blogs/b/search/archive/2013/01/17/bing-social-updates-arrive-today-for-every-search-there-is-someone-who-can-help.aspx.

- If your social network mediates your information seeking, there is likely to be a confirmation bias in the returned results. If our results are influenced by our friendship groups (particularly biased in ways we might not be aware of), this raises serious concerns about the epistemic properties of the search, which we might expect will return both all relevant results (recall), and specific results that meet the criteria we have stated (precision).
- The above concern is particularly true for those who do not (or who rarely) use the internet – both in terms of an offline searcher’s access to information, and in terms of an online searcher’s access to information about those offline.
- Such data is likely to be *messy* – many people may not want all facets of their life to be searchable (indeed, there’s a Tumblr for that⁷); plenty of people post information to their social networks that might make them prominent in search results, but not necessarily good informants. For example they ‘like’ pages for signaling some attribute they don’t actually have, or to get discounts from brands, or to monitor activity (e.g. watching a political opponent’s activity).

Two key ideas from the work of philosopher Miranda Fricker strike me as particularly fruitful here,⁸ and to my knowledge they have not yet been explored in this context:

- The risk of *testimonial injustice* – the risk that some types of user knowledge will be marginalized by specific agents on the basis of their (demographic or personal) characteristics. Whether such a risk is greater or lesser in a particular search (or recommender) system is an interesting question (and might be thought of as a case of prejudice exercised by individuals).
- The risk of *hermeneutical injustice* – the risk that some types of user knowledge will be marginalized by the system, perhaps in such a way as to make those users unaware of their own epistemic injustice. Again, whether such a risk is greater or lesser in particular search (or recommender) systems is interesting. (This risk might be thought of as a case of marginalization, as opposed to explicitly enacted prejudice.)

These problems are arguably a part of the more general problem of the filter bubble: the concern that search engines through personalization and demographic characteristics filter SERPs to provide individuals with biased information, affirming prior beliefs. It is to this issue that I now turn.

Search as an Epistemic Tool – More of What You Want

The use of search engines to find information or sources of information is a common activity in which students must frequently engage. In a 2012 paper, Thomas Simpson suggests search engines fulfill the role of ‘surrogate experts’, and that we should be concerned about their

⁷ See, <http://actualfacebookgraphsearches.tumblr.com/>.

⁸ See for example Miranda Fricker, *Epistemic Injustice: Power and the Ethics of Knowing*, Oxford: Oxford University Press, 2009.

epistemic properties – their ability to return relevant results (precision), not exclude relevant results (recall), return results in a timely manner, and prioritize credible sources.⁹ In particular, they should be ‘objective’. By this he means that if two sides to a story exist and are equally linked to across the web, then they should be interleaved and not stacked. SERPs should not present a biased perspective on credible sources.

However, Simpson and various other authors argue that personalization of search results fails this ‘objectivity’ criterion. His claim is that presenting information that is likely to affirm a user's prior beliefs is problematic because – unless the individual is an ‘epistemic saint’¹⁰ – the search engine fails to represent the domain being searched. Simpson suggests two solutions: first, turning off personalization or querying search engines that do not use personalization, and second, legal regulation of search engines' objectivity.

While there are certainly valid concerns regarding this issue, here I want to discuss some of the motivations for personalization and personal recommendation (such as the Bing Social example discussed above) in light of testimonial knowledge. In the context of filter bubbles we should consider:

- Searchers may well search for biased information in their queries – searching for ‘Al Gore inconvenient truth’ may bring up rather different results than ‘Al Gore liar’.
- SERPs may present bias for two reasons:
 - Bias will arise from personalization of results (this is broadly *testimonial injustice*).
 - Bias will arise from an epistemically biased landscape – for example, language and gender dominance among Wikipedia articles and editors (this is broadly *hermeneutical injustice* and may be more challenging for search engines to address).
- Social search is likely to present many of the same problems, but many non-personalized search engines will too.

It is worth considering the role of the search engine in epistemic inquiry, and how search engines could foreground their assumptions about searchers to fulfill their roles as informants.

Testimonial Expertise

You're conducting a school research project on a local Spanish festival that happens to be a namesake of an English clothing brand. You ask your parents for some useful websites on the festival; they give you the details of a U.K. arts festival nearby, along with a link to a website with a primary school level English description of the clothing brand...

9 Thomas W. Simpson, ‘Evaluating Google as an Epistemic Tool’, *Metaphilosophy* 43.4 (2012): 426–445, http://people.ds.cam.ac.uk/tws21/preprints/2012_Metaphilosophy_Evaluating%20Google%20as%20an%20Epistemic%20Tool_preprint.pdf.

10 Simpson, ‘Evaluating Google as an Epistemic Tool’, p. 439.

When we seek information we are interested in different things in different contexts. One of the challenges of the ‘semantic web’ is to understand the varied meanings that any particular word can indicate – in short, to understand context. For that reason, some researchers began talking about the ‘pragmatic web’, the development of technologies to support language in action perspectives in order to understand how queries might be *used*.¹¹ Of course, in education we also want to train people to care about the right things in the right context.

The example given above highlights how irritating such ‘help’ could be; similarly, while search engines rarely are true surrogate experts (Knowledge Graph being a counterpoint), they do strive for quality by pointing out good informants – that is, by testifying that a website is a good source in the given context. We expect informants – human and otherwise – to take into account salient factors about ourselves, although we might expect some of these to be left implicit (e.g. geolocation of information) but not others (e.g. political leanings, or perhaps facets such as literacy level).

Personalization

*A search function returns English results, and when you check quantities it defaults to metric, always using a base 10 numeric system.*¹² *When you search for your morning news, a set of left-wing blogs you like to read are returned, along with a new source and an article a friend of yours has recommended on a popular social networking site.*

While certainly in the latter case the search engines’ complicity in confirmation bias may be an issue, the real concern is the searcher’s own epistemic standpoint and his or her openness to other perspectives (which the search engine might be able to present the searcher with while still highlighting recommendations). We should pay more attention to the level of the *agent* when considering the filter bubble.

However, despite this claim, there are at least two major cases where we can imagine filter bubbles in which the searcher is not complicit:

- The ‘racist classmate’ case. In this example, we imagine a searcher who, without knowing, has a classmate who searches for white supremacist websites. In fact, we can imagine a more innocuous case in which the searcher’s classmate is particularly fond of one local café; unknown to the searcher, their searches are thus pushed towards that café as opposed to other – equally well liked, reviewed, and known – local establishments. The concern here is not that the search engine knows one’s geolocation, but that by tailoring to repeated searches – while not making this explicit in the search interface – the SERP provides a non-objective set of results (this is true even if one’s own searches have developed the bias).

11 See for example this post and references on it in Simon Knight, ‘The Pragmatic Web: More than Just Semantics Contextualized’, Finding Knowledge Blog, 4 January 2014, <http://people.kmi.open.ac.uk/knight/2013/01/the-pragmatic-web-more-than-just-semantics-contextualised/>.

12 I am grateful to Rebecca Ferguson at the Open University for these examples.

- The ‘biased community’ case. In this example, we imagine a country where the majority of searchers are more inclined towards one perspective on an issue than another. Thus, despite the presence of credible, timely, and well-linked online resources from the other perspective, searchers in that country are more likely to be directed towards the majority perspective.

In both cases the search engine mediates our access to information in ways that make understanding that information *less* transparent – they thus fail to act as objective informants.

We can see that to some extent personalization is exactly what we expect informants to deliver – I want information that understands my context. However, I also want to be able to interrogate the informant's understanding of my context, to ensure we are ‘on the same page’ as it were, and in this respect search engines often fail. I would suggest that personalization is bad not because it’s non-objective, but that, when giving an ‘objective’ judgment of testimony, we expect informants to tell us about the substantive assumptions they make in order to come to their conclusions. We expect to have some shared understanding of the assumptions informants make about our information needs. Search engines often fail to offer this kind of disclosure, except when there is good reason for them to do so (often advertising-based, for example asking searchers to clarify their postal code for the purposes of geo-located targeted advertisements). However, where these assumptions are explicit, their impacts are often not made clear. I will now discuss another example of the socio-technical mediation of our understanding of information, before presenting a final challenge to the current status quo.

When No Answer Is Answer Enough

An interesting, related problem concerning how we think about information comes in the form of the ‘testimony of silence’ – when the absence of information informs you of something.¹³

We can imagine this happening in a number of cases:

1. When a searcher queries a search engine, receives no answers, and takes that to imply positive knowledge (e.g., searching for information on traffic jams and finding nothing, leading the searcher to believe there are no current traffic problems).
2. When searchers seek information, receive no answer, and take that to mean poor community support or expertise (e.g. in the above example, assuming that no answer is due to a failure of technology, or in a scientific context thinking lack of an answer means there is no research on the topic searched).
3. When people search for information and receive irrelevant answers (e.g. in the ‘bad informant’ example above, a search is conducted to find information on a festival, but the only results returned are about another concept).

¹³ Interestingly Garfield discussed this in Eugene Garfield, *When Is a Negative Search Result Positive? Essays of an Information Scientist* vol. 1, 12 August 1970, pp. 117–118, <http://www.garfield.library.upenn.edu/essays/V1p117y1962-73.pdf>. According to Google Scholar (September 2013) that paper has been cited six times since then, most prominently by Marchionini discussing exploratory search – readers might be entertained to consider whether this is a positive negative result...Certainly it suggests an interesting lack of exploration of this area.

4. When people search for information but do not see the response (e.g. where search results are weighted against the answer they are looking for, as in some filter bubble cases above).

Again, in this context search engines, searchers, and the epistemic environment all play a part in the state of knowledge. To give an example of a complex case, I conducted a study in which I asked 11-year-old children in a classroom to find the answer to the question, 'How many women have won The Nobel Prize?'¹⁴ This query is relatively simple in many respects, and in fact simply entering the query into most search engines will bring up a relevant result with the correct answer. However, slightly to my surprise, some of the children visited 'answer'-style websites and took the user-submitted claims made there without checking the date of the answer given, thereby reflecting a lack of attention to the nature of change in such knowledge claims. For other questions some children decided there was no answer when they could not find one, failing to adjust their search terms or to think about how other information might be relevant to their problem. Educational contexts are further complicated by the presence of content filters that can prevent students from seeing highly relevant results.

In each of these instances, search results' presentation and user interaction have an impact. Users may be more likely to see information that confirms their prior beliefs; this bias relates to their queries, the results they click, and the information they take away from chosen results. For example, recent evidence from Microsoft Research indicates that in the health domain, searchers favor positive over negative information *as do search engines* – thus creating a filter bubble based on a 'testimony of silence' around negative results.¹⁵ Importantly, this bias leads to the uptake of incorrect health information in many cases.¹⁶

Diversity Aware Search

In the preceding sections I have noted some concerns over how we look for information and why understanding the socio-technical factors involved might be interesting. There are a number of suggested solutions to these problems, but many have issues. For example:

- One solution to the filter bubble is not to personalize results. However, this is problematic because, as discussed above, we expect a degree of personalization from good informants. We expect information to be in accord with our prior understandings, our context (geographic if nothing else), etc. However, search engines such as DuckDuckGo follow exactly this approach.
- Another solution is to use friends and other social contacts as informants. Our friends understand our common knowledge and can address this and be interrogated as to their reasons more directly; of course, there are still important biases here, and my friends

14 Simon Knight and Neil Mercer, 'The Role of Exploratory Talk in Classroom Search Engine Tasks', in *Technology, Pedagogy and Education*, forthcoming, 2014.

15 Ryan W. White, 'Beliefs and Biases in Web Search', *SIGIR'13*, Dublin, Ireland, 28 July-1 August, 2013, <http://research.microsoft.com/e>

16 See also Martin Feuz in this volume.....

may not be able to inform me about a rather large range of topics. Moreover, often we don't want our social contacts to know about our information needs in the first place.

- Another solution is to show results deliberately that are beyond the area of enquiry, either topic-wise, socially, or in terms of perspective taken.

This last approach is interesting as it attempts to diversify perspectives and contexts; it has been described as 'Diversity Aware Search'.¹⁷ As has been noted, 'diverse exposure' may be a means to burst your filter bubble, with methods ranging from clustering results, depictions of the 'balance' of articles searchers have actually viewed, and asking readers to engage in discourse based on considering multiple perspectives.¹⁸ The 'liquid publications'¹⁹ project for example developed a diversity-aware scholar search that can be used to avoid homophily in one's academic network by down-ranking papers by authors with whom the searcher has co-authored in the past.²⁰

Other solutions could be to look for diverse ways of clustering the same set of documents or present searchers with clusterings from different users;²¹ this could particularly work in cases where the user is 'exploring' the information landscape and has no well-defined information need at initial stages.²² In this case, searchers may be unaware of alternative groupings and of various ways their information need could be defined. Such approaches may foreground facets of personalization that usually remain hidden.

An additional benefit of such diversity-aware search tools is that they offer the opportunity to address 'content holes' in a searcher's knowledge.²³ Indeed, such an approach may assist in addressing some of the issues of 'silence' raised above. To give an example taken from Nadamoto et al., we might imagine a Mexican community in which swine flu in Mexico is widely discussed and known.²⁴ However, if that community does not also relate to the wider global risk

17 See for example, Elena Simperl et al., 'DiversiWeb 2011', In *ACM SIGIR Forum*, 45 (2011): 49–53, <http://dl.acm.org/citation.cfm?id=1988861>.

18 Paul Resnick et al., 'Bursting Your (Filter) Bubble: Strategies for Promoting Diverse Exposure', In *Proceedings of the 2013 Conference on Computer Supported Cooperative Work Companion*, 95–100, 2013, <http://dl.acm.org/citation.cfm?id=2441981>.

19 See, <http://project.liquidpub.org/tools>.

20 For another example of diversity aware search see the Narcissus search engine described in the contribution by Phil Jones and Aharon Amir in this Reader.

21 Mathias Verbeke, Bettina Berendt, and Siegfried Nijssen, 'Data Mining, Interactive Semantic Structuring, and Collaboration: A Diversity-aware Method for Sense-making in Search', In *Proceedings of First International Workshop on Living Web, Collocated with the 8th International Semantic Web Conference (ISWC-2009)*. CEUR Workshop Proceedings, Washington, DC, USA. Vol. 515, 2009, <http://www.liacs.nl/home/snijssen/publications/iswc2009.pdf>.

22 Rahul Singh, Ya-Wen Hsu, and Naureen Moon, 'Multiple Perspective Interactive Search: a Paradigm for Exploratory Search and Information Retrieval on the Web', *Multimedia Tools and Applications* 62.2 (2013): 507–543.

23 Akiyo Nadamoto et al., 'Content Hole Search in Community-type Content Using Wikipedia', In *Proceedings of the 11th International Conference on Information Integration and Web-based Applications & Services*, 25-32, 2009, <http://dl.acm.org/citation.cfm?id=1806353>.

24 Nadamoto et al., 'Content Hole Search'.

of swine flu, it has a content hole; such gaps might be identified in community discussions across blogs through comparisons with content on related Wikipedia pages.

It is interesting to note that such an approach might also lead to unintended consequences, for example insofar as some research indicates that exposure to opposing perspectives can reinforce one's own viewpoint (and prepare one for arguing against opposition). Furthermore, technical approaches that increase diversity by reducing redundancy (repetition of information) may lead a person to question an important credibility cue, given that repetition may be highly salient in the context of seeking to corroborate sources. Therefore diversity-aware search is not a definitive solution to the problems presented above, but rather an indication of a design feature that might present interesting alternatives and lead to different interactions with search users. A big problem of search engines that are not diversity-aware is that the user will almost never learn how biased the retrieved information is. It would help if search engines would state what kind of filtering and interpretative steps they perform.

Conclusions

You are asked to draw a comparison among the perspectives in the sources, using your knowledge of the time. 'Right', you think, as you open up a popular search engine, 'what do I need to know...'

Access to external resources prompts us to consider what it means to 'know' something and what types of knowledge are important. Asking you what a 'clepsydra' is has a different connotation in a closed book or an open (or internet-enabled) examination. That is not to say that memorizing 'facts' has no value; it is sometimes rather important, for example in the case of remembering road sign meanings. However, facts aren't disconnected from meaning, and exploring how people *use* information gives insight into their knowledge states.

On the internet, the tools at hand provide paths to information, offer particular routes, and often obfuscate alternative paths to the same or other destinations. Designing search engines is a hard challenge; many searches are 'precision' searches aimed at the recall of an individual token, but many others, such as holiday planning or weighing scientific literature, involve 'exploratory' activities and credibility judgments of sources. Thinking about how best to represent results for these multiple purposes is complex (and indeed, Google is currently soliciting feedback on how it might improve in this respect²⁵). Even with technological improvements, we should raise awareness about the ways in which technology mediates our access to information, and education should reflect the importance of this awareness while also training our associated critical evaluation and credibility judgment skills.

25 Patrick Thomas, 'Give Us Your Feedback on Search Policies', Inside Search blog, 23 August 2013, <http://insidesearch.blogspot.co.uk/2013/08/give-us-your-feedback-on-search-policies.html>.

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