What You See is What You Get, But Do You Get What You See? Higher Education Students' Evaluation of the Credibility of Online Information.

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Abstract

Information literacy involves the ability to find, access, evaluate, organise and store information in a variety of media, though there is as yet no consensus on a precise definition. This thesis, set in the context of higher education, explores aspects of information literacy associated with students' evaluation of information found on the World Wide Web. Two studies relating to third level students' evaluation of the credibility of online information were conducted. Study 1 examined whether the search results ranking that a website receives following a Google search query affects students' perceived credibility of that website. Study 2 presented final year psychology students with information that was either relevant or not relevant to their area of study. In order to examine the frequency of information verification behaviours and to explore the nature of information processing (either heuristic or systematic) that underlies students' interactions with online information. The results of Study 1 are consistent with the idea that state search engine rankings do not significantly impact participants' evaluation of webpage content. The results of Study 2 indicate that final year psychology students did not engage in information verification behaviours more frequently when evaluating psychology-relevant versus psychology non-relevant information, but that they did evaluate the credibility of such information differently. These results are discussed in the context of the conceptual overlap between information literacy skills and the aims of higher education.

Declaration of Originality

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~ The little people in my life, who are not so little anymore ~

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Chapter 1

Overview

The notion of literacy involves the ability to read and write - to communicate through text. Over the past few decades, developments in technology have changed the ways in which information can be accessed, transformed and explored. As a result the notion of information literacy has emerged within research and relevant professional domains. Information literacy involves the ability to find, access, evaluate, organise and store information in a variety of media, particularly digital media. Though the concept is frequently seen as an important one, and has spawned a large and complex research literature, no consensus has yet emerged as to how to define it precisely. This lack of definition has meant that the understanding of the psychological and behavioural underpinnings of information literacy is poorly advanced. At the same time, there is a strong movement in many areas of education and other professional domains (such as information and library services) to improve information literacy broadly, through the general population. The perceived importance of information literacy in modern society is such that UNESCO, in a declaration in 2005, declared information literacy to be a "basic human right".

This thesis explores some aspects of information literacy, particularly within the context of higher education. In empowering someone to be able to identify and think critically about information, judging its reliability, accuracy and relevance to a particular task, is a concept associated with high levels of information literacy that bears a significant overlap with some of the basic aims of higher education. This overlap between information literacy education and the general ambitions of higher education suggests that higher education should be a fruitful area in which to investigate this set of skills. Also, third level education should provide fertile ground for the development of this cluster of skills. Despite this apparent synergy, however, the level of information literacy amongst college and university students remains rather variable and uncertain.

This thesis seeks to add to the growing literature on information literacy and attempts to better ground the concepts of information literacy within psychological

and behavioural research. Some aspects of information literacy associated with the evaluation of information found on the World Wide Web, by students within higher education are explored. Specifically, students' ability to evaluate the quality of information is argued to be a key point of contact between information literacy and the aims of higher education. This thesis attempts to bring together specific psychological theories of information processing with information literacy skills research, in order to advance our understanding the cognitive processes associated with information evaluation.

Chapter 2 discusses information literacy within higher education. How the concept of literacy has changed over the past few decades is explored. The chapter offers a brief outline of how the notion of information literacy has grown into a significant domain of research, without cohering into a clear set of research questions or hypotheses regarding the psychological and behavioural mechanisms underlying it. It is suggested that this lack of coherence in the literature, possibly due to the fact that different disciplines (information systems, computer science, media and communications studies, psychology and other professions) have explored the area using different vocabularies and different specific outcomes in their assessments. How information literacy fits into higher education is discussed and the overlap between the apparent aims of higher education and information literacy training is highlighted. The benefits of information literacy in higher education are explored as well as the limitations of such an unstructured approach to research within the field.

Chapter 3 explores the concept of web credibility as a specific area, within the broader domain of information literacy research. In particular this thesis explores some of the underlying psychological processes involved in a person's assessment of the quality of information found online. Much information found online does not go through the same rigours of editing and publishing procedures as information found in books or other traditional media. This presents challenges to individual seekers, who may need to validate the information they find online for themselves. The role of search engines, as gateways to online information and in acting as the first indicator of the usefulness or validity of information, is discussed. In order to explore the specific psychological processes involved in such evaluations of information, two models of psychological processes of information processing are

briefly outlined, specifically the Heuristic-Systematic Processing Model and Bounded Rationality. These two models frame specific consideration of the way web-based information is evaluated by students in higher education.

Chapter 4 describes the two studies carried out as part of this thesis. The first study examines search result ranking (i.e. where a website is placed in the list after a search) and its effect on perceived credibility. Pan et al. (2007) suggest that people trust Google rankings to indicate content quality, while other research notes that information seekers do not look beyond the first few results in a search page (Bar-Ilan, Mat-Hassan & Levene, 2006; Nakamura et al., 2007; Pan et al., 2007; Spink, Ozmutlu, Ozmutlu & Jansen, 2002). The first study explores whether stated search ranking might affect a person's evaluation of the credibility of a webpage.

A second study examines the influence that experience within a domain of knowledge has on information verification behaviours (behaviours taken specifically to assess the likely reliability and accuracy of presented information). The Heuristic-Systematic Model of information processing suggests that domain-specific knowledge will affect how a person processes information within that domain. Study 2 explores whether having knowledge in the area (e.g. psychology students reading about biological psychology) changes how participants interact with a website. Of particular interest is the frequency with which participants use verification behaviours when asked to judge the credibility of online content. The expectation is that domain-relevant information will be more likely to be processed systematically, and that more systematic assessment of information will result in a greater frequency of information verification behaviours.

Chapter 5 concludes the thesis with a review of the results and a discussion of the strengths and limitations of laboratory-based data collection, in the domain of website interaction and web literacy. The cognitive information processes involved in assessing the credibility of websites are discussed in the context of the two models of information processing introduced in Chapter 3. Implications for the understanding of information literacy are elaborated on, as are the practical implications and ideas for future research.

Chapter 2

Information Literacy and Higher Education

2.1 Changing Literacies

On the face of it, the notion of literacy involves simply the ability to read and write and to communicate through text. However there is a recognition that the range of the concept of literacy is much broader. Common understanding and use of the term 'literacy' tend to go beyond that baseline level as literacy is often considered not just in terms of the capacity to pick up or put down information in textual form. A person described as "literate" is frequently considered well read, knowledgeable. In fact, simply being literate seems to involve a change in the way a person thinks (Torrance, Olson & Hildyard, 1985; Kintgen, Kroll & Rose, 1988). Literacy is seen as empowering a person to engage with information, and with the world around them, in new and interesting ways (Olson, 1994). The written word may be the medium, but it is not the whole story.

Over the past few decades, developments in technology have dramatically changed the ways in which information is accessed, transformed and explored. As a result, literacy has also changed and this in turn has effected changes in nearly all areas of society. Perhaps principal amongst these changes is that information is no longer presented simply in pure text, printed or written on a page. Rather, the variety of media that exists emphasise that literacy is not just about reading and writing but the interaction with the information in many different forms. Understanding these changes is an on-going challenge for a number of different professions and disciplines. Before people can understand the implications and the impact of these changes as a society and as scientists people need to have a clearer view of just what is involved in this new form of literacy - information literacy. This is a more challenging question than a person might expect.

2.2 Information Literacy

Information literacy was first defined (somewhat indirectly) by Paul Zurkowski in 1974, as part of a proposal to the National Commission of Libraries

and Information Science in the United States (Eisenberg, Lowe & Spitzer, 2004), "People trained in the application of information resources to their work can be called information literates" (Zurkowski, 1974, p.6).

This term caught on and was quickly developed by the incorporation of a broader sense of literacy as a change in a person's ability to engage with information in various forms, and to evaluate and consider it. By the 1980s the concept of information literacy explicitly involved the capacity to critically assess information accessed through any given medium, while the number of media in question continued to expand. Eisenberg, Lowe & Spitzer (2004) outline specific component literacies such as visual literacy, media literacy (focused on such traditional mass media as cinema, radio and television), computer, digital and network literacies.

This multifaceted nature of information literacy is both a strength and a weakness. On the one hand, the complexity of people's interactions with information in various forms is adequately recognised (Gross & Latham, 2007; Secker & Coonan, 2013) and a large multi-disciplinary effort is in place to come to some understanding of it. On the other, the various approaches, intentions and perspectives taken on information literacy has left the field broad and disjointed.

There is a general consensus around the themes and concepts associated with information literacy within the literature. Definitions abound and all have clear thematic relatedness. These revolve around the ideas of the capability to locate, evaluate and effectively use information. Surprisingly, though, at this developed stage there remains no single set of criteria, theoretical framework or intended outcomes from information literacy education that have been accepted across the board (Beetham, McGill & Littlejohn, 2008; Coonan, 2011).

This lack of consensus is a problem, making advancements in our understanding of information literacy troublesome and the various aspects of research into the area difficult to relate to one another. Information literacy seems to hold a nebulous status as something that no one quite agrees what it is, but that everyone agrees that whatever it is, it is very important (Bruce, 2004; Gross & Latham, 2007; Halttunen, 2003; Horton, 2007; Julien & Barker, 2009; Wong 2010). In 2005, UNESCO declared information literacy is essential when coping with modern life and that it was "a basic human right in a digital world". The value of

information literacy is generally widely acknowledged not only to education, but to many professions also to citizenship (Department of Education and Skills, 2011; Badke, 2011; Serenko, Detlor, Julien & Booker, 2012).

Despite this acknowledged importance of information literacy, despite nearly forty years of development of the concept and despite relevant research having been conducted within a wide range of fields, the concept itself remains disappointingly unclear. Information literacy training, a priority for staff within libraries and educational institutions in numerous countries over the past decades, appears to fall between domains. There is little integration into discipline-specific teaching or unified and agreed upon outcomes in this regard (Secker & Coonan, 2013). In the UK, for instance, Beetham et al. (2008) note that without such integration, the teaching of information literacy skills within the higher education sector is not "owned" by any particular department at an institutional level, and remains disjointed and poorly organised. Coonan (2011) argues that different interested groups - students, teachers, librarians and other information professionals and administrative leaders all have different understandings of the concept, its role and its importance.

From a research perspective, the failure of the research domain to cohere around a specific and agreed upon set of skills and outcomes associated with information literacy has meant that the various studies into these issues do not build a significant body of knowledge. Rather, the quite extensive array of studies and findings remain disparate and unfocused. There is a problematic complexity to the ideas in question, with researchers in different domains (such as information systems, computer science, media and communications studies, psychology and other professions) using different vocabularies and different specific outcomes in their assessments.

Over almost four decades of consideration, there is surprisingly little directed research that provides real insight into the structure of information literacy, its underlying psychological and cognitive functions, the behaviours associated with successful information literate activity in different media, or the ways in which information literacy skills fit into particular professional domains. Many have noted

this unsatisfactory state of affairs (e.g. Coonan, 2011; Beetham et al., 2008; Dickey & Connaway, 2010) but efforts to unify the domain remain at an early stage.

One example of such an effort, is Secker and Coonan's (2011) "new curriculum". They have drawn together a number of different research groups, and conducted an in depth review of existing literature, in order to evolve a more coherent and comprehensive approach to information literacy and information literacy training, within the context of higher education. They put forward a framework for addressing the concept, within the context of higher education, composed of ten key principles:

Table 1.1

Ten principles of A New Curriculum for Information Literacy (ANCIL). Drawn from Secker and Coonan (2013).

1. Transition from school to higher education.	6. Managing information.
2. Becoming an independent learner.	7. The ethical dimension of information.
3. Developing academic literacies.	8. Presenting and communicating knowledge.
4. Mapping and evaluating the information landscape.	9. Synthesising information and creating new knowledge.
5. Resource discovery in your discipline.	10. The social dimension of information.

These principles echo standard themes and notions of information literacy, but in this case explicitly outline a broader framework and inter-relatedness between different elements (the technical, psychological, social and institutional aspects). Secker and Coonan's (2011) framework discusses the ability to determine the appropriate technology to use for each discipline (e.g. databases, statistics or archival evidence). Further skills include developing the technical knowledge to store information in a manner whereby it can be easily found again (correctly labelling folders and files), the critical assessment of the quality of that information and the usefulness of it (a key consideration for the present thesis). In addition, the use of reference management tools to help reduce workload is considered an important information literacy competence. The framework also makes salient the social considerations of information use. Using the expertise around us within society

(peers, academic staff) as always been important in information evaluation, but has become more so as social interaction becomes a more integral part of how many technologies work. The development of social networks and related technologies has transformed the ways in which people would have traditionally sought such expert advice. This raises the further issue of being able to explore one's own online identity and how they are perceived through social networks and the World Wide Web. Finally, the broader societal and ethical frameworks play an important role in modern literacy.

For the sake of developing a model that is both practical and practicable, Secker and Coonan (2011) have constrained their focus to that of the higher education sector. The general concept of information literacy in modern society is perhaps too big a target to address comprehensively at this stage. Such a focused constraint makes sense for the sake of practicality, but also, significantly, because of the strong similarity between the general view of the information literate and that of the university graduate (Barnett, 1990).

2.3 Information Literacy and Higher Education

The information literacy literature's emphasis on independent thinking and critical mindedness shares an overlap with the purposes of higher education as it is frequently seen. "If there is a single key concept in the idea of higher education, it is 'criticism', (Barnett, 1990, p.162).

Perhaps most famously, John Henry Newman (1976) described a university education as one that was undertaken for its own sake. The ultimate aim was "nothing more or less than intellectual excellence" (p.111), but involved the student holding a critical grasp of the knowledge that they were developing. "[T]he mind never views any part of the extended subject-matter of knowledge without recollecting it is but a part" (p.123), and the student never fully accepts knowledge at face value, but cultivates a mind "which grasps what it perceives through the senses; which takes a view of things; which sees more than the senses convey; which reasons upon what it sees" (p.104).

Barnett (1990) explores a range of historical points of view with regard to higher education, beginning with Plato and ranging through to the present day.

Though the concept of what higher education is supposed to do has continually evolved, it is affected not just by the ideals of educational philosophy but by social, economic and historical factors. Barnett argues that themes of critical, independent thinking run consistently through all of the various perspectives.

The similarities between descriptions of information literacy and descriptions of the purpose of higher education are striking. It seems clear that, regardless of the particular subject or course that a person is taking, successful higher education should involve the practice, and development if necessary, of good information literacy skills.

In line with the transformation of media and information technologies over the past decades there has been a movement within certain domains of higher education to make information literacy skills more explicitly part of the education offered by colleges and universities. However, as noted, Coonan (2011) and others (Beetham et al., 2008) lament the disjointed nature of these attempts. For the main part, the actions and movements involved in this change has been within the library and technical services within colleges and universities, despite the early recognition that it is necessary to integrate information literacy skills into college/university learning more fully. As Coonan (2011) writes:

> Far from being a supplementary, optional or remedial adjunct to the academic curriculum, this paper situates information literacy as a continuum of skills, behaviours, approaches and values that is so deeply entwined with the uses of information as to be a fundamental element of learning, scholarship and research. (Coonan, 2011, pp.5-6)

This is a vital consideration that lies at the heart of Secker and Coonan's (2013) framework and one which directly informs the present work. There are everyday technology skills in use, but information literacy is not a fully separate, generic, disjoint collection of abilities. It is, in part, embedded in domain specific knowledge.

From its first articulation by Zurkowski (1974), information literacy was considered to involve the application of information resources "to their work", a domain-specific conception. Despite this, information literacy is largely considered a collection of general, non-specific "ICT skills". Many within the higher education

sector (and indeed within society more generally) assume young people today have learned these skills as part of everyday life in the digital age.

There are key differences between true information literacy skills and skills students tend to acquire growing up the digital age. Educators in colleges and universities often misjudge, and have unrealistic expectations, of students' computer savvy. Although students may be able to negotiate new technologies well in terms of their core functionality in displaying information, this does not often transfer to evaluating and searching for that information (Badke, 2011; Dickey & Connaway, 2010). It appears that students tend to exit secondary education as consumers rather than evaluators or skilled users of information. In a landmark report reviewing the state of information literacy skills amongst students in the UK it is summarised simply as follows: "Even though users may be able to use a search engine or other resource, they did not necessarily know how to get quality information from it" (Dickey & Connaway, 2010, p.3).

This rather mixed judgement on information literacy is repeated through the early and more recent literature on the information literacy capabilities of higher education students. Mittermeyer and Quirion (2003) found only 23% of a sample of 3000 First Year University students were capable of identifying elements of a webpage that might be key in evaluating its content. More recently, Salisbury and Karamanis (2011) found a similar level of capability (24%).

Head and Eisenberg (2010) provide more positive findings. In a large scale survey across six US colleges and a number of disciplinary areas. They indicate that significant proportions of students (though still far short of all of them) researching for course work reported checking external sources (66%), checking webpage bibliographies (59%) and generally "took little at face value" (Head & Eisenberg, 2010, p.3). While certainly welcome, this runs against the majority of such research, as already noted.

The JISC report by Dickey and Connaway (2010) which explicitly examined expectations concerning the "Google Generation", warns that mere access to and experience with the technologies in question are not sufficient to foster the kinds of critical thinking and evaluative mind-set required for real information literacy. Technical skills do not necessarily transfer to literacy skills in their broader sense

(Badke, 2011; Pask & Saunders, 2004). Julien, Detlor, Serenko, Willson and Lavallee (2009) note a major obstacle in the development of these skills is the motivation of students and their understanding of the process of information usage. They discuss the point that students are typically concerned with learning how to find information, but that few are concerned in gaining the skills to evaluate the quality of that information, or the general information resources with which they are engaged. Insofar as information literacy instruction has been introduced to higher level education, it is viewed by students primarily as a time saving technique rather than as a set of skills enabling greater efficiency in the search for, evaluation and manipulation of, and deployment of that information.

Information literacy may, perhaps because of the ubiquity and familiarity of information technologies, be subject to a significant "Dunning-Kruger effect" (Kruger & Dunning, 1999). That is those with poor skills may not be aware of just how bad their skills are. Gross and Latham (2007) investigated the capabilities of students entering Florida State University and noted that those with low levels of ability typically over-estimated their skills. Harrington (2009) found some evidence for a similar (though weaker) effect amongst psychology graduate students.

While this research has been conducted on groups in North America, similar findings seem likely amongst students in Ireland. Secondary schools in Ireland rarely have the resources to provide information systems professionals, such as dedicated librarians (Connolly, Curran, Lynch, & O'Shea, 2013). Few secondary school teachers are (specifically) qualified to offer explicit information literacy instruction. These new literacies are only beginning to find their way onto the Irish curriculum, which means, that students are receiving little, if any, direct training and the standard method of the formalised education system remains rooted in what is fast becoming an out-dated conception of literacy.

A new action plan has been proposed by the Department of Education and Skills to improve literacy and numeracy generally by 2020 (Department of Education and Skills, 2011). This plan makes explicit reference to the broader framework of skills associated with literacy (questioning, inferring, synthesising and evaluating knowledge) and may well begin to address the issue somewhat. However, the link with new technologies and the specific skills set required for engaging

successfully with these new technologies, of identifying behaviours appropriate to synthesising and evaluating knowledge within particular technological contexts, has yet to be made. Within the UK, Coonan (2011) notes that information literacy is not often considered outside of "ICT skills", and is generally circumscribed as a set of basic or functional computer use skills. Yet it should be considered a core aspect of domain-specific knowledge. Coonan argues that this misconception should be resisted and the crucial and core role of information literacy in higher education be recognised.

2.4 Benefits of Information Literacy in Higher Education

Given the overlap (in fact, the near identity) between the conceptions of the information literate and the university graduate as an autonomous, critical, independent thinker, it would seem obvious that good information literacy skills would benefit higher level education.

Much of the research on information literacy skill levels and instruction has been conducted by library and information professionals to date. Research conducted with students from other disciplines has focussed on students' attitudes and confidence with the technologies to which they have been introduced (Streatfield & Markless, 2008; Julien et al., 2009).

Dedicated information literacy instruction does show benefits in terms of technology-specific skill development (Detlor, Julien, Willson, Serenko & Lavallee, 2011; Marupova, 2006). The broader impacts on the students' academic life are more difficult to evaluate, but Detlor et al. (2011) note that, along with an increased confidence with technology, were increases in both reported effectiveness and efficiency at finding information. Students reported less effort and time required to find library materials. Changes in attitude and improvements in the time taken to get hold of necessary materials would be expected to have spill-over benefits in terms of the rest of the students' academic activities. But while students appear to appreciate this time-saving outcome to information literacy instruction (Secker & Coonan, 2013) this appreciation occurs within an unfortunate failure to understand the broader conception of information literacy. Serenko et al. (2012) and Julian et al. (2009) note that students report improvements in grades and that the instruction had positive impact on their coursework. Keating, O'Siochrú and Watt (2009) found that

such instruction also made students more aware of their study techniques and learning strategies. Keating et al.'s study provides the first vital step to enable students to improve their information literacy techniques, essential to the deliberate and critical mode of thought that is higher education's ambition. This suggests that improved information literacy skills will also help students avoid the Dunning-Kruger effect. They may become aware of their own limitations and be made more capable of overcoming those limitations with regard to information literacy.

2.5 Still in Search of the Foundations of Information Literacy

While these results give some indication of the existing information literacy skills of third level students, there are clear limitations to much research in this domain. Most significantly, the vast majority of this research was conducted using self-report questionnaires (Gross & Latham, 2007; Harrington, 2009; Flanagin & Metzger, 2007). While these allow for fast and inexpensive surveying of large numbers of students, they provide weak information regarding the actual behaviours and capabilities of participating students. Such survey-based methods provide a framework within which to construct more detailed research questions, but offer little insight into the specifics of students' interactions with technology and their use of information in various areas of life and work.

Studies drawing on more objective data collection methods may provide more focused results. Studies which employ logs of computer use can provide some indication of patterns in people's search and viewing behaviours (Ke, Kwakkelaar, Tai & Chen, 2002; Hunter, 1996). While such data are clearly useful for some research questions with regard to aggregate patterns of use (how many times particular resources were accessed, what times or durations of access of different resources tended to be), the kinds of data collected make analysis of individual behaviour difficult or impossible. More recently developed "deep log" analysis (e.g. Nicholas, Huntington & Jamali, 2008) do provide (through IP address matching) the ability to identify individual users and track their behaviour within a particular web resource (in the Nicholas et al., 2008, case, within the very large, multidisciplinary, database ScienceDirect). The development of these techniques are exciting because of their promise in offering individual-level analysis of web browsing patterns, but are limited by the technical demands involved. The web is too large to track the

behaviour of many people over its entire range (at least without the resources of a major government, for instance). In addition, specific intentions, responses or interactions with a given page or document is not generally available. Deep log analysis is therefore suited to particular kinds of in-context behaviour tracking and is likely to prove very useful in the future with regard to such questions. Other methods are needed if interactions with technology and information directly are to be examined.

Where researchers may be interested in specific content or user effects more focused behavioural studies are required. For example, the dynamics of students' search and evaluation behaviours where, for instance, facial expressions are used to assess disappointment and concentration, (Wirth, Bocking, Karnowski & von Pape, 2007), or, as outlined in more detail in the next chapter, the effects of rank ordering in search engine results (e.g. Spink et al., 2002; Pan et al., 2007).

Such behavioural work has, to date, often been of a very descriptive nature. That is the identification of general patterns in people's information search, retrieval and usage. Also, information literacy skills are typically seen as generic or general, rather than contextualised within domain-specific practice. This work suffers from the lack of theoretical consensus regarding information literacy and the absence of a framework for asking pointed psychological questions - questions regarding the cognitive and behavioural aspects of interaction with information sources.

If proper, evidence-based, advances in the integration and improvement of information literacy skills are to be made within higher education generally, a number of factors must be considered. Firstly, the various capacities associated with information literacy will each need to be contextualised within psychological theory. The different facets or domains of information literacy interact with a wide range of cognitive and social psychological research domains such as persuasion and social influence, reasoning, decision making, memory, attention and more.

These developed theoretical frameworks will then need to be tested and supported by empirical methods that involve more critical data gathering techniques than self-report surveys. Such surveys are certainly useful, and provide an initial picture of the state of things as they stand, but do not allow for controlled, precise observations needed.

To address all of the complex, multifaceted aspects of information literacy is a large undertaking and far beyond the scope of this thesis. The specific focus of the current work concerns one aspect of information literacy, that Barnett (1990, 1997) has identified as being the defining characteristic of higher education - critical thinking. This is specifically with regard to the evaluation of information found on the World Wide Web, the first port of call for most students of higher education (Salisbury & Karasmanis, 2011). This issue concerns what is sometimes called "web credibility" within the domain of information technologies and in particular within the domain of online information gathering. In the following chapter issues associated with credibility are outlined. These are the psychology of message processing and information literacy within higher education. The specific research questions and objectives of the current work are also outlined in more detail.

Chapter 3

Web Credibility Information Quality and the Psychology of Information Processing

3.1 The World Wide Web

"[T]he internet represents the real information revolution…one that removes the governmental and corporate filters that have so long been in place with traditional mass media" (Beacham, 1995, p.6).

The internet[1] allows for the publication of anything without permission from editors, governments or other "gatekeepers". While this is in many ways empowering and liberating (to the extent that access to the internet is considered by some to be a human right (UNESCO, 2005) and closely associated with the right to free speech), it brings with it certain costs and demands for the user. The accessibility of all this information imposes a greater need for a form of literacy that enables users to evaluate the credibility, accuracy and usefulness of websites. Quantity of information does not ensure quality. Editorial functions that were previously undertaken by publishers now fall on information retrievers (Glister, 1997). In the past when users looked at published books, editors and publishers acted as guardians of credibility and accuracy. Now the responsibility falls on the users themselves to take appropriate steps to evaluate the websites information presented to them (Glister, 1997).

Brandt (1996) identifies three filters of quality present in more traditional media that do not exist for many forms of web content. Firstly, effort and cost; the ease and cheapness of website production makes being certain of the source difficult. Credible sources such as governments, or other organisations, stand on an even

[1] The terms internet and World Wide Web are used interchangeably throughout this thesis, the two are different. The internet refers to the structure of networks, the hardware and software infrastructure that makes up the global network, while the World Wide Web allows for information access over that infrastructure

playing field with less reputable ones. Secondly, the peer review standard across much of the publishing world (particularly for academic content) is not necessary for web publishing. Finally, specialist or expert endorsement, such as by a librarian or teacher, is surrendered in favour of automated search and retrieval processes.

Flanagin and Metzger (2000) similarly maintain that many pre-existing methods of information evaluation such as established reputations, genres, or personal experiences are not as effective when applied to the evaluation of online content. These points argue for the necessity of strong information literacy skills.

The availability of quality information online is not in question as the internet can be clearly and increasingly, a source of excellent and extraordinarily high quality information. The difference is that the role of quality assurance can no longer be delegated so reliably to others.

3.2 Quality of Information on the World Wide Web

Introducing the research domain of "persuasive technology", Fogg (2003) notes that "if someone didn't want to influence others in some way, he or she would not take the time or energy to set up a Web site" (p.147). Fogg makes the point that whether they are trying to provide information (and convince people of its accuracy), persuade people to purchase something or simply encourage them to use their own services as compared with other online competitors, one fundamental issue that websites face is credibility.

Credibility can be defined as judgements made by a perceiver relating to the believability of a communicator (O'Keefe, 2002). That is, what the viewer thinks of the information being portrayed, and of the person or company who portrays that information. Building on the basic foundation of the Hovland-Yale model of persuasion (Aronson, Wilson & Akert, 2010; Hovland & Weiss, 1951), Fogg (2003) maintains that credibility is a perceived quality of an information source, made up of that source's perceived trustworthiness and expertise. Trustworthiness refers to the users' belief as to whether the source is honest and whether information is presented without manipulation or deception. Expertise relates to the communicators and their competency with regard to the knowledge or information they impart (Ohanian,

1991). Fogg et al. (2002) note that these two aspects of credibility are simultaneously perceived through the multiple dimensions of a website.

Credibility is not an objective property of a website. It cannot be determined by counting how many hyperlinks the website has, or, how many words there are on a page. Because credibility is a perceived characteristic its evaluation is one of the facets of information literacy. In essence credibility involves a user's ability to make judgements regarding the trustworthiness and expertise of the website's author, and through that the accuracy, the quality, of the information provided.

The internet often lacks editors and other traditional gatekeepers and guardians of information quality (Danielson, 2005), but it has some significant advantages over traditional media when it comes to allowing for the assessment of credibility or accuracy. In traditional print media, if an information retriever were to take extra steps to evaluate the quality of the information presented the time and effort required might be quite substantial. Either an expert (e.g. a teacher or specialist) or an information professional (e.g. a librarian) might be consulted. Alternatively, further sources of supporting knowledge could be sought from another book, magazine or journal. In each case there is a notable cost in terms of time, effort and possibly money, to the information retriever.

The behaviours engaged in, to assess the value or check validity of information presented are termed "verification behaviours", or "information verification behaviours" (Flanagin & Metzger, 2000). Different media offers different kinds of potential verification behaviours and the knowledge of when and how to engage in them forms one of core aspects of information literacy. This is what Secker and Coonan (2013, p.41) term as "mapping and evaluating the information landscape".

The massive interconnectedness of the World Wide Web enables near-instant reference to supporting citations and other materials. The Knowledge of how to make use of that inter-connectedness, which links to follow and which supports to examine are essential components of web literacy, itself a component of information literacy. While some evaluation must be specific to a given discipline, some general points can be outlined.

Dragulanescu (2002) identifies a number of points of consideration is the evaluation of information found online. These include whether source references for the information are provided, whether details on the expertise and background of the author are provided, whether the information is up-to-date, whether the author can be contacted or otherwise interacted with, and what the clear goals of the website are.

Verification behaviours associated with these considerations involve searching for and viewing information about the author (frequently included in an "About Us" or "About the Author" section), following hyperlinks to sources for specific claims, checking the dates and details of key references or citations, and potentially contacting the author regarding the information presented.

Verification behaviours are of particular interest to the present work because they represent potential behavioural indicators of systematic (deliberate, effortful) information processing, a mode of interaction with presented information that predict the provision of an improved evaluation of the quality of that information.

3.3 Evaluating Information Quality: Models of Information Processing

Psychological theory provides a number of models that make predictions about the engagement with and evaluation of presented information. When information presented on the World Wide Web is considered, the evaluation of it, and the prediction of information verification behaviours, two theories in particular provide relevant guidance. The first is the Heuristic-Systematic Theory of Information Processing (developed first as a model of evaluating credibility in the context of persuasion but has since expanded to consider the evaluation of information more generally) and the second is the theory of Bounded Rationality.

Chaiken's (1980) earlier work on the heuristic-systematic processing model investigated if the number of persuasive messages from a likable or unlikable communicator could affect participants' opinions. She found that those who were deemed more involved (expecting to discuss the topic at a later stage) had greater opinion change when a greater number (six) of arguments were given, but the likeability of the communicator did not have an effect. While for those who were less involved (expecting to discuss an unrelated topic at a later stage) they were more influenced by the communicator rather than the number of arguments (two or six).

Chaiken reports that participants who are invested or "highly involved" in the content of a message, would be more inclined to employ systematic information processing. This could be replicated for modern information retrieval processes by utilising verification behaviours such as using the number of hyperlinks (arguments) and examining the expertise of the author as a means of determining if systematic processing is used.

The second theory that can predict how information is engaged with and evaluated is Bounded Rationality (Simon, 1955). This is a view of the standard modes of operation of the cognitive system in interaction with information in the environment. The theory places emphasis on heuristics – rules of thumb used to reach ends that might not be optimal, but suffice given the context in which they are deployed. While not guaranteeing optimised behaviour, heuristics nevertheless manage higher cognitive functions to be carried out by a system with limited resources, often without any conscious deliberation. Walking is a prime example. A destination can be decided and a route but people will not go through the cognitive processes of getting the body to walk (which leg to start with, how much it should be extended and so forth). Walking is generally an unconscious effort, however it is a very conscious effort for toddlers taking their first steps. Similarly interaction with the World Wide Web would be an unconscious deliberation for many. The theory expects the person to have a certain level of familiarity.

Though other theories exist, particularly within the field of persuasion within social psychology (e.g. the Elaboration Likelihood model; Petty & Cacioppo, 1990) the Heuristic-Systematic Theory and Bounded Rationality explicitly claim to be general models of information processing. While, as Fogg (2003) notes, all websites are persuasive endeavours, there is less interest with the specifics of that persuasion than with the manner in which users interact with the information itself. Applying the logic of these two more general models is therefore seen as a good "first step" in grounding the psychological processes involved in information literacy, and the evaluation of web-based information in particular. As a more refined picture of phenomena relevant to web usage and information literacy in different circumstances is developed, more focused and domain-specific theories may become relevant. That is beyond the scope of the current work.

3.3.1 The Heuristic-Systematic Theory of Information Processing

The Heuristic-Systematic Theory was originally proposed as a model of persuasion and the interpretation of persuasive messages (Chaiken, 1980, 1987; Chaiken & Ledgerwood, 2012). It offered an explanation of how the interaction between a person and a perceived message results in attitude changes. Coming under the general framework of "dual-process theories", the model suggests two modes of information processing, two ways in which a person might interact with information presented to them.

The heuristic mode is one in which the person uses salient, often peripheral cues regarding the message to evaluate its credibility. In an online context this might involve the design or look of the website, the names of institutions or other organisations associated with the site (and their reputations) or other details (Fogg, 2003). These cues do not technically provide direct information concerning the validity of the website's content. Further peripheral details might include the number of hyperlinks visible on the page, or the number of references or citations included. Heuristic information processing, as the name suggests, is quick and simple, and is cognitively undemanding.

The second mode of information processing is much more effortful. It involves a more deliberate or conscious scrutiny of the information presented (Chaiken & Ledgerwood, 2012; Trumbo, 1999) and requires significant cognitive resources. This second mode of thought is closely associated with critical thinking about the content presented. The mode of processing selected in a given situation depends on a number of internal (receiver or user) and external (message or site) factors. Internal factors include the individual's cognitive abilities, for example their prior knowledge or expertise in the area and their motivation to invest time and cognitive effort. External factors include how the information is presented, whether it is complex or simple, as well as other inherent and situational characteristics (Chaiken, Liberman & Eagly, 1989; Petty & Cacioppo, 1990).

3.3.2 Bounded Rationality

A second model of general information processing present in the literature is that of bounded rationality. Originating with Simon (1955) and developed more

significantly recently by Gigerenzer and colleagues (Gigerenzer & Brighton, 2009; Todd & Gigerenzer, 2012), the bounded rationality model focuses on the fact that people have very limited cognitive resources, and tend to make use of the least effortful form of processing available to them at any time, in order to achieve their goals. More significantly, as people engage with their environment they expect certain structures and reliabilities that act as supporting assumptions to heuristic computation. In fact they make heuristic computation more efficient and successful than complex thinking in the right kinds of situations (what Gigenzer and Brighton, 2009, term the "less-can-be-more" effect).

Bounded rationality theory makes somewhat different predictions to the Heuristic-Systematic Theory, insofar as it suggests that deliberate, systematic assessment of presented information is even less likely. We use heuristics both because they demand fewer resources and also because in many situations they are actually more effective (Simon, 1955). This places less emphasis on the capabilities of the individual person than was the case with the heuristic-systematic model.

3.4 Evaluating the Credibility of Web-Based Information

3.4.1 Search Engines and Credibility

Before information can be evaluated it must first be accessed. In the case of the World Wide Web, finding the information potentially provides the first hints at its credibility.

Search engines are the most common ways of gathering information from the internet. Google is currently the search engine used for the largest percentage of queries (StatCounter, 2012). Search engines use automated computer bots to gather data about webpages available on the internet. These data are then stored in a database and indices are created from the various possible keywords which are used within the content of the webpages themselves. When a user types in a search query it is the index that is searched rather than the web directly. Because each search engines index is organised differently, search results and their rankings (order of websites e.g. first, second etc.) vary between engines. The algorithms behind these different engines form the basis for competition between the various search companies (Rethlefsen, Rothman & Mojon, 2009). Companies keep at least some of

their search algorithm secret in order to continue competing. What this means is that an unknowable algorithm makes the first proxy judgement regarding the quality of information relevant to a person's problem when it comes to using the internet.

The role that search engine results pages might play, or the influence search ranking carries, in the evaluation of the information presented on a given webpage is not easy to specify, and has seen surprisingly little research. The majority of research on web search has focused specifically on interaction with the search results page only, where the consensus is clearly that only the top few results (between top three and top five) are given any real consideration (Bar-Ilan et al., 2006; Nakamura et al., 2007; Pan et al., 2007; Spink et al., 2002). The relationship between search results pages and the content for which they act as gateway, is not well understood.

Kammerer and Gerjets (2012) note that the form of presentation of results from a search engine can affect the likelihood of a person being distracted by, and clicking on, commercial links (i.e. hyperlinks produced as advertisements relevant to the query rather than as query-specific results). They found that results presented in a tabular, as opposed to a standard list formatting, also produced longer eye fixations and better search outcomes when participants were confident that there was good information to be found. This implies a potentially strong influence of search engine result presentations, though participants interactions with the specific content of the web pages themselves was not the researchers' primary concern. Similarly, Lau, Coiera, Zrimec and Compton (2010) noted that different search engine designs (task-based vs. resource-based organisation of searches) produces quite different patterns of use. This indicates that search engine operation affects the way a person interacts with their available information resources, but again, the credibility and evaluation of those resources for users were not key to the researchers' aims.

Wirth, Bocking, Karnowski and von Pape (2007) examined whether people used heuristic or systematic processing while using a search engine. Using verbal protocols they (perhaps unsurprisingly) found a mixture of both, though the conditions under which participants switched between these modes were not clear. Participants were asked to do three search tasks with different levels of difficulty: low, intermediate and high. Experience with internet use was the best predictor of mode of processing, with less experienced users relying more on heuristics, such as

working entirely with the first page of results. For all participants the cognitive effort invested seemed greatest when dealing with results presented on the first page of search engine results. Effort in evaluation tended to reduce when participants went past the first page, and participants demonstrated heuristic processing only (as identified using verbal indicators) for later pages of results.

Wirth et al. (2007) found tracking browsing actions (such as using the 'back' button on the web browser) to be ambiguous, but define all of their indicators of elaborative or systematic thinking in terms of think aloud protocols. Verbal protocols are certainly useful (Ericsson & Simon, 1993), but for example Walraven, Brand-Gruwel and Boshuizen (2009) found the method rather unreliable, with participants sometimes failing to describe the reasons for their actions when leaving and entering webpages (Wirth et al., did not describe levels of non-compliance with the procedure).

Wirth et al. found higher levels of systematic processing in first-results-page sites; this runs somewhat counter to those of Pan et al. (2007). Pan et al. investigated the influence that result rankings have on users' perceptions of credibility. They had judges evaluate the results pages from four different search queries using Google. The judges were asked to rank the pages on how relevant they thought the information the titles and page abstracts were. Participants were then presented with the Google results pages either in the rank order according to the judges, or in a reversed order. A third group were shown the Google results page unaltered. Pan et al. found that participants were more influenced by the order in which pages were presented, their rankings, than by the content of the results page abstracts. In essence, participants trusted Google to have got it right, rather than evaluating the content of the information presented to them, for themselves.

Work by Pan et al. suggests that by the time a person actually views a webpage they have already been primed to consider it as credible or otherwise according to the ranking of search results. This possibility is given some support by the work of Feufel and Stahl (2012). They found that there was concern about information quality during the search phase amongst a number of different groups of users, but that these concerns about quality disappeared when pages were actually accessed. This occurred in particular, once content was accessed that fitted

participants' search intentions, regardless of other considerations. However, Pan et al's participants saw only result page abstracts, they never saw the page content. The impact of search ranking of the credibility of the actual page content therefore remains unclear. Most research on search engine interactions pay little attention to perceived credibility. The research is more interested in whether or not a person will actually view the page in question.

The open manner in which Wirth et al's (2007) study was conducted (participants move back and forth through results and content pages) means that it is not clear whether, on viewing the actual content of a page, a person's judgement of it can be affected or not by knowing its ranking within search results. Before examining the possible psychological processes involved in evaluating a webpage, it is worth knowing whether such processes are made immaterial by the fact that few pages are viewed without first having to survive the gauntlet of search engine ranking. In the first study of the present work webpage content was presented, along with an indication of that page's ranking in the search results. The aim was to assess whether there is a difference between perceived credibility based on indicated search ranking alone.

If page rank significantly affects how a page is perceived, it would appear to be evidence of heuristic-based processing of information, regardless of the possibility of further, more careful or systematic evaluation. In the case that indicated ranking has a weak or no effect, then the possibility exists that the content of a page might be assessed more deliberately, or at the least on the basis of information presented on the page itself rather than its ordering on a separate results listing.

3.4.2 Evaluating Information on Individual Webpages

Once web users get past search engine results and reach the content of a webpage there are a number of potential indicators of quality. While the ideal assessment of such information involves the careful checking of a range of sources, both online and offline, the inter-connectedness of the internet provides the possibility for near-instantaneous double-checking in a manner that no other source of information has. Within the eco-system of the web itself, the suggestions of Dragulanescu (2002) provide some good practices. Research over the past decade

has found that even experienced web users frequently do not use these potential indicators.

Flanagin and Metzger (2000) argue that many methods of evaluating information relevant to traditional media are not as effective when applied to evaluating online content. These methods include established reputations, genres or the personal experiences of the user. More recently Flanagin and Metzger, (2007) investigated how often participants deliberately interact with criteria such as accuracy, authority, objectivity, currency and coverage, when evaluating the credibility of online information. They found that participants were typically poor at actively determining credibility, and only occasionally making explicit attempts to determine these criteria. Though they do not analyse their findings explicitly in these terms, they found heuristic processing more likely, with participants using less effortful or peripheral criteria to make assessments. These criteria include the evaluation of website design, the presence of branding or logos, and layout. This emphasis on appearance and surface characteristics is well supported in the literature (Dochterman & Stamp, 2010; Flanagin & Metzger, 2007; Rains & Karmikel, 2009; Reinhard & Sporer, 2010). Additional research has indicated the use of other peripheral cues such as the length of the article being reviewed (Lim & Simon, 2011) or the number of references associated with it (Lucassen, Noordzij & Schragen, 2011; Lim, 2013). Ahmad, Komlodi, Wang and Hercegfi (2010) found that the number of hyperlinks to external websites can affect users' perceptions, as well as any indications as to whether the site was being kept up-to-date. Ahmad et al's findings fit some of the basic suggestions regarding some of the standing possibilities when it comes to evaluating webpages. They report people's awareness of the value of these indicators but they fail to report whether users actually engage with such signals regarding information quality. This is despite the fact that they collected eye-tracking and online behavioural data.

Metzger, Flanagin and Medders (2010), using focus groups rather than the standard self-report questionnaires, note the rise of social referencing for credibility assessment. They note the importance of peer endorsement of points of view or particular webpages. They also raise the issue of social networking technologies which are now a part and parcel of how information on the web is frequently encountered. Social networks are beyond the scope of the present work, as the

emphasis here is on the information literacy of higher education students and the psychological and behavioural aspects underlying their judgements of the credibility of information presented to them via webpages.

The existing literature on the issue of evaluating the credibility of information found online has tended to tackle it in a broad approach, treating all information presented online as more or less equivalent to the users. The research mainly exists within the field of computer science and library and information studies, and as such the emphasis is on the generic use of tools in question rather than specific interaction between user and content. Secker and Coonan's (2013) ANCIL model explicitly notes that information literacy is not an adjunct or generic set of information and computing technology skills; the content matters, the particular task and the participant's relationship to the information also matters. Where generic information search tasks are provided it is hard to see how the participants in such research can contextualise their actions. More specifically, from the perspective of the two theoretical approaches introduced in sections 3.3.1 and 3.3.2, there seem to be two aspects missing from such generically conducted research.

Heuristic-Systematic Theory suggests that people will systematically process information where they have the skills to do so. In support Secker and Coonan (2013) argue, that critical thinking that makes good information literacy skills is domain-specific and where people are motivated to engage with the material. Where people engage in systematic information processing of material more information verification behaviours and more critical assessments of the information presented is expected.

Bounded rationality is less clear in its predictions on this issue. This perspective holds that people take advantage of reliable relationships and structures in the information available to them in their environments. The internet, has a less identifiable structure than the physical world, though the model might suggest that while people engage in more heuristic evaluation behaviours more frequently than within the Heuristic-Systematic Theory the pattern of those heuristic evaluations will be different in domains with which we are familiar.

The processes of information evaluation that underlay web credibility assessment as a component of information literacy (within Secker and Coonan's fourth principle, regarding the evaluation of the information landscape), is not yet fully understood. Both Secker and Coonan's approach to information literacy and the Heuristic-Systematic Theory of information processing suggest that strong domain-specific effects in information verification behaviours may be found. This more theoretically grounded take on the evaluation of website credibility has only recently begun to develop in the literature. The most explicit and carefully considered example of this work is the recent case of Lim's (2013) examination of heuristic processing of higher education students of Wikipedia. The present research is strongly influenced by Lim's work. Her study is outlined in some detail in the following section.

3.4.3 Lim's (2013) Evaluation of Heuristic Processing of a Wikipedia Entry

This study provides a clear theoretical rationale and attempts to gain insight into the kinds of psychological processes involved in information literacy activities. Lim examined the question of whether credibility and content assessment owes more to a heuristic-systematic model of information processing or to a bounded rationality model.

Lim (2013) attempted to ascertain whether students' assessments of credibility are affected by what she terms a "peripheral cue". She investigated whether something about an informative webpage that is technically irrelevant to its content would affect students' perceptions of its believability. Two versions of the same page were created, one with a single reference in support of its content, and one with 22 references in support of its content. Lim was interested to discern whether the number of references alone was enough to affect the credibility of the piece - and she found that it was.

In a move that supports the ecological validity of the study Lim allowed participants to complete the experimental task in their own time and using their own computers. This ensured that at least some of the context of the web use was similar to the normal state of affairs for her participants. Participants followed a link provided to them in an email to one of two version of the same Wikipedia article. One contained a single supporting citation and one contained 22 citations.

Participants were asked to complete an online survey concerning their knowledge of the material presented and their behaviour in interacting with it.

While the context of the task is potentially a strength for Lim's study, the lack of control over the environment and the technical difficulties in collecting behavioural data in such an unstructured task meant there are important limitations to the task. The length of time spent viewing a page is available through activity logs for Lim. She sacrificed certainty over whether or not the participant actually read the page for that entire period of time (she did ensure the page was read as she asked a few short questions on the content). By taking the task into the field the opportunity to observe particular kinds of interaction with the webpage in question was lost. Specifically, any behaviours that might indicate differences in the kinds of information processing engaged in by participants were not available. The effect of heuristic or systematic processing is left to outcomes on participant's self-report evaluations of the page.

This thesis seeks to build on Lim's initial study by providing a task that should, according to the heuristic-systematic model, provoke differences in heuristic and systematic thinking and thereby differences in the presence of information verification behaviours.

Additionally, working within the domain of information systems research, Lim does not endorse a specific model of information literacy. As such, while her work is a significant advance on others' due to its strong theoretical framework, it maintains the point of view of information literacy skills (and web credibility evaluation in particular) as generic, more or less independent of the content presented. This reduces the impact of her study, as it neglects the key triggers of systematic thinking according to heuristic-systematic information processing theory (Chaiken & Ledgerwood, 2012). That is the capacity to evaluate the information present and the motivation to do so. Study 2 of the present work takes the first steps in attempting to address this weakness.

3.5 The Present Work

This thesis presents two studies examining higher education students' evaluation of the quality of information available online. Given the amount of

research which strongly supports a heuristic, minimal-effort approach to webpage evaluation (including one study previously discussed, which suggested that once participants get as far as actual web-content their concerns about information quality disappear (Feufel & Stahl, 2012). It is important to tease out the role of the search result ranking of a webpage on the evaluation of the webpage itself and not just whether it is viewed. Study 1 attempts to do this using study skills information that is relevant to and useful to higher education students.

Study 2 expands on Lim's (2013) experiment by directly measuring information verification behaviours, as opposed to the reliance on self-report for assessment of levels of processing. Study 2 also attempts to within the constraints of lab-based experimentation, activate systematic processing of the information according to the heuristic-systematic processing theory.

Chapter 4

Experiments

4.1 Study 1: Search Result Ranking and its Effect on Perceived Credibility

Search engines are the effective gatekeepers of much of the information on the World Wide Web. This is unlike the gatekeepers in more traditional media such as editors, reviewers and publishers. Search engines are automatic and algorithmic. They use cues other than the actual semantic content of the information on a webpage itself to determine whether to include that page in the results for a given search query. Given their commercial nature, the particular workings of a search engine is always partially withheld. This means users cannot be fully aware of the criteria by which results are matched to their queries. Research indicates that users generally do not know, or understand, the criteria by which a search engine produces results (Nakamura et al., 2007).

Despite its relative obscurity, the search engine's gatekeeping role is a powerful one. As noted in the previous chapter, its potential impact on users' perception of the credibility of websites has neither been well studied nor well understood.

In attempting to understand the processes by which third level students evaluate information presented to them on the internet it is important to try to identify whether such judgements of a website's credibility are effectively foreclosed by the page's ranking in a listing of search results. Pan et al. (2007) suggest "In Google We Trust…", with the standard finding that users do not tend to look beyond just the first few results in a search page. This indicates that there is an expectation the answer to the search query is presented in those top results.

Pan et al's. (2007) study does not answer the question of what a result ranking's effect has on how information is perceived, as the particular pages themselves (rather than their abstracts) were not viewed. It may affect whether

information is seen in the first place. Study 1 presents higher education students with relevant information (i.e. information with which students might be expected to engage) and identifies that information as being either first ranked, or tenth ranked on a listing of search results on Google (the internet's most-used search engine) (StatCounter, 2012). How participants evaluate that information given this contextual cue will give some insight into the impact search rankings have on a website's credibility.

In addition, and although it is not the primary aim of the present study, following Secker and Coonan's (2013; see also Coonan, 2011) argument that information literacy skills are embedded within domain specific expertise, the possibility will be explored that that the point of progression through their studies will affect the manner in which the students view the information presented.

4.1.1 Study 1: Method

4.1.1.1 Design

The experiment used a between participants design. The independent variable was the Google rank output assigned to a website presented to the participants, Rank 1 group were told the webpages came first in a Google search and Rank 10 group were told the webpages came tenth in a Google search. Dependent variables were their judgements as to the usefulness of the information and their likelihood of following the advice (Appendix A) on the presented webpages. These dependent variables are used as indirect assessments of the page's perceived credibility by the participants (given that information evaluated as not credible would not likely be deemed useful, nor would a person choose to follow such advice).

4.1.1.2 Participants

A convenience sample of college students (n = 60) 43 females and 17 males, took part in this experiment. The majority of participants were aged between "18 to 22" (n = 35, 58%), while the rest of the participants were aged, "23 to 30" (n = 12, 20%), "31 to 40" (n = 4, 7%) and "41 and over" (n = 9, 15%).

4.1.1.3 Apparatus and Materials

The experiment was designed and conducted on SuperLab 4.0.8 using desktop computers. Three webpages were chosen from the website www.how-to-study.com. These pages had information on studying, note taking and taking tests and were edited to remove the website address. The content on the page was cropped in order to fit to the computer screen. The navigation bars at the top were removed to make room for the body of text on the webpage (Appendix B). Participants were asked a number of questions at the end that required them to use the keyboard and input an answer using one to five as appropriate (Appendix A).

4.1.1.4 Procedure

All participants were required to read an information sheet on the study and sign a consent form prior to partaking in the experiment (Appendix C). Participants were informed that they could withdraw at any stage without consequence. Participants were randomly assigned into one of two groups. One group was informed that the webpages were taken from a website that was ranked first in a Google search for study skills for college. Those in the second group were informed the webpages were ranked tenth. All participants viewed instructions on the computer monitor (Appendix D). They were informed that they would be presented with a series of webpages discussing study skills at college and that when they were finished reading the webpages, they would be asked a few short questions on what they had read. This was so participants would be more likely to read the webpages in enough detail to answer the questions towards the end of the experiment. Participants were asked to read the instructions and webpages at their own pace and asked to press the spacebar when they were ready to proceed to the next page.

All participants viewed three webpages, one page on studying, the second on note taking and the third on taking tests (Appendix B). After reading the webpages participants were presented with some demographic questions. Participants then provided judgements on how accurate and how believable they considered the webpages to be. These judgements followed the model of credibility used by Fogg (2003), in that credibility can be measured as a perceived quality of trustworthiness and expertise. Judgements were made using a five-point likert scale ranging from, strongly disagree to strongly agree. When finished participants were given a

debriefing sheet that informed them of what the study had investigated (Appendix E).

4.1.2 Study 1: Results

4.1.2.1 Google Rank differences

As the experiment was set up in such a way that it required an answer from each participant for every question, missing data were not an issue.

Participants' evaluations of the usefulness of the presented information violated assumptions of normality, assessed with the Shapiro-Wilk test(S-W = .619, df=60, p < 0.001). A Mann Whitney *U* showed no significant difference between those who saw webpages which they were ranked first in a Google search (*md* = 4, n = 30), compared to those who were told the webpage ranked tenth in the search (*md* = 4, n = 30), on whether they thought the webpages provided useful information to them, *U* = 386, z = -1.315, *p* = 0.188.

Participants' indicated willingness to follow the advice presented also violated assumptions of normality, assessed with the Shapiro-Wilk test(S-W = .739, df=60, p < 0.001) There was also no significant difference between viewing webpages which were indicated as ranked first (*md* = 4, n = 30) or as ranked tenth (*md* = 4, n = 30) from a Google search, on how likely participants were to follow the advice, *U* = 406, z = -.806, *p* = 0.421.

As shown in Figure 4-1, 54 (90% of all participants) were in agreement that the webpages provided useful information, 3 (5%) disagreed and 3 (5%) were undecided. For those who were told the webpages came first in a Google rank, 26 (87%) agreed or strongly agreed that the information was useful, 1 (3%) disagreed and 3 (10%) were undecided. While those who viewed the webpages believing they came tenth in a Google rank, 28 (93%) were in agreement and 2 (7%) disagreed.

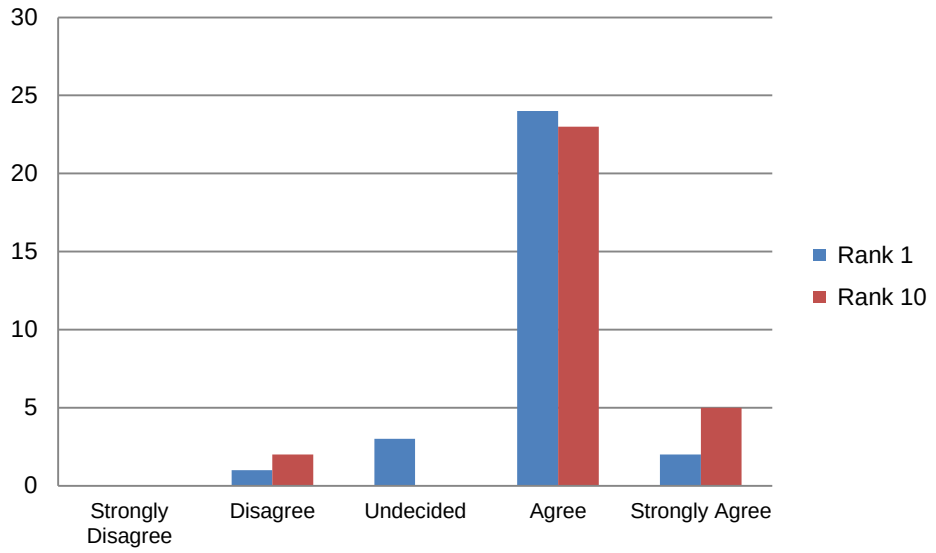

Figure 4-1: Frequencies for the question "Do you think the webpages provide useful information?"

When asked whether participants would follow the advice given on the webpages 49 (82% of all participants) agreed or strongly agreed, 2 (3%) disagreed and 9 (15%) were undecided. Of those who were told the webpages came first in a Google rank 24 (80%) were in agreement and 6 (20%) were undecided. While for those who were told the webpages came tenth in a Google search 25 (83%) were in agreement, 2 (7%) disagreed and 3 (10%) were undecided. As shown in Figure 4-2, while there was a tendency for those who saw the webpages believing they came tenth in a Google rank, to report being more unfavourable towards whether they would follow the advice, with disagree being the lowest response, this tendency did not reach significance, (U = 386, z = -1.315, p = 0.188).

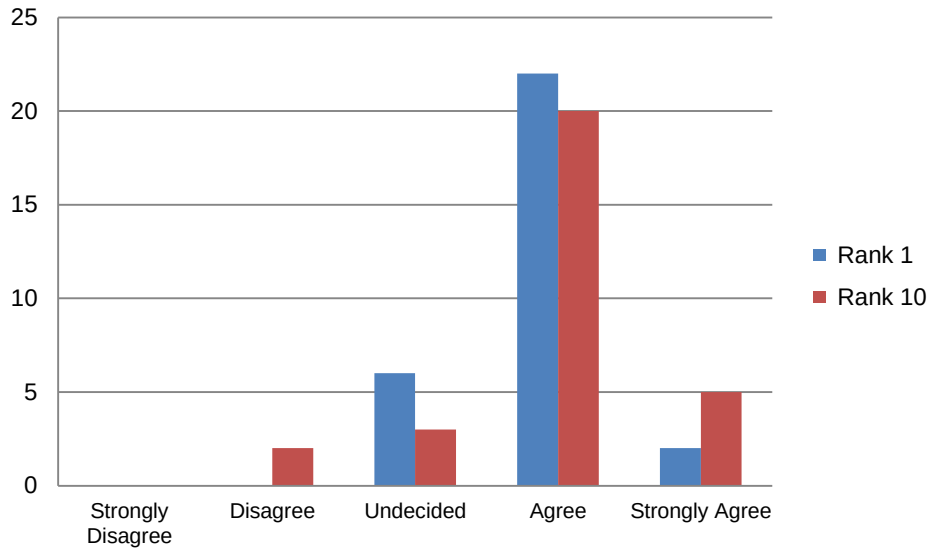

Figure 4-2: Frequency of different responses to the question "I would follow the advice given"

4.1.2.2 Exploratory Analysis: Influence of Academic Level

To examine whether experience at third level education affected information evaluation several further tests were conducted. Participants ranged from first year students to postgraduate students within the college, 5 groups in total. The highest proportion of participants 24 (40%) were from first year, the second highest was postgraduates with 18 (30%) participants, the other 18 (30%) came from second, third and fourth years. A nonparametric statistic was chosen to investigate if differences existed between the five different academic years on what they thought of the webpages. As the data collected were ordinal, a Kruskal-Wallis Test provided the ability to test between the five groups, to investigate if differences exist between students as they progress through their degree on whether the webpages provide useful information and whether they would follow the advice.

Students' academic year was investigated as previous research maintained that checking for credibility was more of an issues for novices (Flanagin & Metzger, 2000). Therefor it was expected that 1st year students would perform poorer than students who were further into their degree. The Kruskal-Wallis Test revealed no significant difference in how useful participants thought the information from the webpages were dependent on what year they were in, 1st Year (*md* = 4, n = 24), 2nd Year (*md* = 4, n = 6), 3rd Year (*md* = 4, n = 7), 4th Year *(md* = 4, n = 5) or postgraduate (*md* = 4, n = 18), χ^2 (4 *n* = 60) = 1.529, *p* = .821. Results also revealed

no significant difference between academic year in college on whether participants would follow the advice from the webpages, 1st Year (*md* = 4, n = 24), 2nd Year (*md* = 4, n = 6), 3rd Year (*md* = 4, n = 7), 4th Year *(md* = 4, n = 5) or postgraduate (*md* = 4, n = 18), χ^2 (4 *n* = 60) = 2.964, *p* = .564.

4.1.3 Study 1: Discussion

The principal outcomes from Study 1 suggest that a nine-rankings difference between similar content on a Google search results page does not have a negative effect on the evaluation of the lower ranked page.

Regardless of which group participants were randomly assigned to, a high proportion of them either agreed or strongly agreed that the webpages provided useful information and that they would follow the advice given. This indicates that participants do not equate the content on webpages to the Google rank it received, or at least that should ranking matter then the difference in ranks must be greater than the nine ranks used in the present study. Students appear to have judged that the content on the webpages did come from a valid source and would independently warrant believability. In this study stated search ranking did not appear to have an overall effect on a person's perception of the page's credibility. While only the top three or five results from a search might be viewed, perceived accuracy and perceived usefulness presented on pages lower ranked is not directly impacted. Ranking affects whether a website will be visited at all, but once the page is viewed, it may be viewed on its own merits. Previous research suggests that those merits are more likely to do with layout and presentation than the details of content (Dochterman & Stamp, 2010; Flanagin & Metzger, 2007; Rains & Karmikel, 2009; Reinhard & Sporer, 2010).

The exploratory analysis that examined whether experience at third level education affected evaluation of information also showed no significant differences across the various levels of study. Patterns of evaluation of the accuracy and usefulness of the information were similar across groups. This suggests that the modes of analysis and interaction with the material was not significantly different across levels of experience.

While results from Study 1 are interesting they warrant further investigation. Attempts at replication, and any conclusions draw at this early stage must be carefully qualified.

The material presented to participants was relevant to their role as students. This perhaps avoids the worst assumptions of information evaluation as a generic skill. The advice in question was still rather general. Participants might be expected to have some understanding and interest in the information presented to them but their true level of motivation is difficult to gauge. It is also uncertain whether the fact that the material was presented as part of a psychological experiment had, or had not, an impact on responses. Such laboratory and experimenter effects are a perennial concern for psychological science, and will need to be addressed in future work with as much care as any other area of research. In the present work participants were not directly engaged in a search task itself, and so did not actually see a search results page. This may be a weakness, but not necessarily a damaging one for the suggested conclusions here, as the ranking of the website was very clearly stated to participants.

Study 1 suggests that users do not necessarily anticipate credibility judgements on the basis of search result ranking, at least over the range of ranks presented, of which one was outside typical clicking habits. However, the generic nature of the task and the information presented does not allow us to examine the potential for systematic over heuristic information processing, or whether experience relevant to the particular content might affect credibility judgements or patterns of evaluation. This was the purpose of Study 2.

4.2 Study 2: Experience within a Domain of Knowledge and Information Verification Behaviours.

As noted in the previous chapter, the majority of research strongly suggests that web users routinely use salient but peripheral cues such as branding and layout, (Dochterman & Stamp, 2010; Rains & Karmikel, 2009; Reinhard & Sporer, 2010) to evaluate the credibility of a webpage. More systematic or effortful processing seems much less likely (Flanagin & Metzger, 2007; Ahmad et al., 2010). Two problems with much of the existing literature were also noted. The first is that in many cases the search or evaluation tasks presented to participants concerned information with little personal relevance to them, and did not necessarily take into account participants' existing knowledge. In situations such as that, practically all models of information processing predict heuristic evaluation of the presented material (Wirth, et al., 2007). It is necessary for researchers to ensure to directly compare situations of familiarity and competency when participants' engage with the content of the information presented (though of course the content itself must still be novel to some extent). This fits with the model of information literacy in use in the present work (that of Secker and Coonan, 2013), which sees information literacy as embedded within more specific skills-base, and the heuristic-systematic information processing theory. Providing situations in which participants should be more likely to engage in some systematic evaluation will provide a better means to examine the theory and its usefulness in understanding information literacy more generally.

The second principal concern intended to be addressed by Study 2 is that the over reliance on self-report, or indirect assessments, of behaviours during the participants' interaction with the to-be-assessed information. While both self-report (including questionnaires and verbal protocols) and indirect behaviour tracking (through computer event recording) are valuable and useful tools, direct observation of behaviour also promises important insights. In particular, where there is engagement in systematic, conscious and deliberate assessment of information found online, increases in the frequency of information verification behaviours should be seen, such as more hyperlinks clicked and the "about the author" tab clicked.

Study 2 employed final year undergraduate psychology students. They were presented with information that was either relevant or irrelevant, to psychology and

behaviour. Participants read one of two "blog posts", one relating to the brain and behaviour, the other to the environmental impact of meat production. Heuristic-Systematic Theory suggests that if there is a specific capacity and motivation for evaluation, a more systematic evaluation becomes more probable. Participants were explicitly instructed to evaluate the credibility of the presented blog post. It was expected that these final year psychology undergraduates would be more likely to engage in systematic processing and thus show higher frequencies of information verification behaviours.

The inclusion of measurement of specific information verification behaviours and the presentation of different domain-specific information are the principal ways in which this study builds on that of Lim (2013). Lim's work was conducted entirely online, away from the laboratory, and depended on just a short self-report questionnaire for assessment of what extent the information presented was processed heuristically. Lim provided only one article (i.e. the environment impact of meat production), but provided differing numbers of references. The number of references used was the cue assessed for its impact on credibility. Lim's measure of credibility, more extensive than that used in Study 1 of the present work, is used here. The present study also adapts some of Lim's materials, but adds domain-specific knowledge as a key variable likely to demonstrate more systematic thinking. Systematic thinking is identified as involving higher frequencies of information verification behaviours.

Three key verification behaviours were identified. These were associated with the consensus model of credibility as comprised of trustworthiness and expertise (Fogg, 2003) and the general practice in web use and the discipline of psychology.

The first behaviour observed were whether a person clicked a link to find out more about the author (by clicking an "About the Author" link). This indicated they were interested in assessing the author's expertise. The second behaviour was following hyperlinks associated with specific claims and citations within the text. This is general web practice and is associated with evaluating the trustworthiness of the information and author. The final information verification behaviour was the amount of time spent looking at the reference section presented at the end of the

article. Psychology students (as in many disciplines) are repeatedly encouraged to both include reference sections in their own work as well as use reference sections to follow up on information while reading. The reference section provided no explicit back-up of available information, the type of sources indicated, their number, how up-to-date those sources are, or (perhaps in some cases) the reputability of those sources can provide information. Longer time spent looking at the reference section is taken to indicate a greater interest in evaluating the information according to these possibilities and therefore is also deemed one indicator of more systematic processing.

As a secondary objective of the present study, a general information literacy skills questionnaire was included. Secker and Coonan (2013) argue that information literacy is more likely to be embedded in subject-specific activities. However, more information verification behaviours may be seen regardless of the subject matter if participants have generally good information literacy skills. There are a number of questionnaires that purport to measure information literacy in this manner. The CAUL Information Skills Survey (which is based on the Australian and New Zealand Information Literacy Framework) has seen relatively wide use and is cited in previous research (Williamson & Asla, 2009; Clark, 2009; Hodgens, Sendall & Evans, 2012) this was the measure used in the present study to measure information literacy in this more general way.

4.2.1 Study 2: Method

4.2.1.1 Design

The experiment used a between participants design. The independent variable was the web blog post to which students were assigned: biological psychology blog or the environmental impact of meat production blog (Appendix F). Each blog entry had five hyperlinks leading to supporting sources. Participants' information literacy skills were assessed using the CAUL Information Skills Survey (Catts, 2003) (Appendix G). The independent variable of information literacy skills was divided into two categories (low or high ISS knowledge), based on the median value of the total score from the questions in the Information Skills Survey. Dependent variables included students judgements on the credibility of the blog (7 questions from Lim, 2013), their information verification behaviours 1) whether they clicked on

hyperlinks, 2) whether they clicked on the "about the author" tab, and 3) whether they gave the time, or not, to read the reference section. The dependant variable heuristic processing was measured and divided into two categories (low or high heuristics), based on the median value of the total score of the measurements of heuristic processing.

4.2.1.2 Participants

A convenience sample of final year psychology students (n = 26) 18 females and 8 males, took part in this experiment. The mean age of participants was 25 (SD = 8.275).

4.2.1.3 Apparatus and Materials

The experiment was conducted using SMI RED 250 eye tracker and was run at 250 Hz, degree of visual angle <0.5, with iView X software. The experiment was designed using SMI Experiment Centre, the computer system was also connected to the internet. Supplementary software recorded the mouse clicks of the participants. Two blog posts were constructed with free HTML editing software. One of the blog posts used information from various websites and articles on the topic of whether yawning could be related to cooling down the brain, the other blog post was a Wikipedia article on the environmental impact of meat production (Appendix F). This was an adaptation of what Lim (2013) presented to students. The content in each blog post was of similar word length. The tone and style of the writing was similar (typically neutral and journalistic) and typical of that used in many academic blogs. Each blog post had five hyperlinks and two tabs at the top of the webpage, one "home" tab and the second an "about the author" tab. An adapted version of Lim's (2013) survey was used to measure credibility, knowledge and heuristic processing (Appendix H). The seven items regarding credibility, seven items on heuristic processing and one question on knowledge were all modified by Lim (2013) from the measurements of previous studies.

The CAUL Information Skills Survey (Catts, 2003) was administered to assess students' information literacy skills. Answers to these questions were provided using a four point likert scale labelled never, sometimes, often or always. The rationale behind this four point scale was to force participants to identify

between their common and their less frequent practices. This avoided the risk of participants opting for the central position (Catts, 2003). The surveys have demonstrated statistical coherence sufficient to benchmark group achievement of overall Information Literacy outcomes specified in the Information Literacy Framework second edition, with the exception of Standard One (Catts, 2005) which was not tested for in the CAUL Information Skills Survey. The minimum score participants could achieve was 20 and the maximum was 80.

The potential influence of the experimental setting was measured with two likert scale items. One asked participants to agree or disagree with the statement "The fact that the webpage was presented as part of an experiment affects how likely I think it is to be accurate". The other asked participants to agree or disagree with the statement "The fact that the webpage was presented as part of an experiment make me more inclined to think it is accurate."

4.2.1.4 Procedure

All participants were required to read an information sheet on the study and sign a consent form (Appendix I) prior to partaking in the experiment. Participants were informed that they could withdraw at any stage without having to give any reason. Participants were randomly assigned to one of two groups: viewing a blog post on the relationship between the brain and behaviour or a blog post on the environmental impact of meat production. Participants were first presented with instructions on the calibration of the eye tracker. When they were ready they pressed the spacebar to begin the calibration process (Appendix J). After calibration participants were then presented with instructions about the experiment, and that they would be asked to judge the credibility of the information after reading the blog post (Appendix K). Once they understood the instructions and pressed the spacebar they were presented with one of the blog posts depending on which group they had been assigned to (Appendix F).

On exiting the blog post, participants were presented with a number of demographic questions. These were followed by a series of questions pertaining to the information they had just read (Appendix H). These questions were taken from Lim's (2013) study and measured credibility, heuristic processing and general ISS knowledge. Credibility was defined as an individuals' assessment of whether

information is believable based on their previous knowledge, experience and situation. Heuristic processing was measured through the use of a variety of cues in the form of a survey while the participants' read the blog post. Seven of the items regarding credibility were based on Lim's (2013) study. Answers to these questions were provided using a five point likert scale ranging from strongly agree to strongly disagree. Following these questions participants were asked about their general use of the internet and information resources using the CAUL Information Skills Survey (Appendix G).

Key information verification behaviours were recorded; whether participants clicked on the hyperlinks or the "about the author" tab and the length of time spent viewing the hyperlinks and reference section. On completion participants were given a debriefing sheet informing them of what the study had investigated (Appendix L).

4.2.2 Study 2: Results

Data gathered concerned three information verification behaviours - the number of times a participant clicked a hyperlink supporting a claim made in the article, whether participants clicked the "about the author" link to seek information regarding the author's expertise, and the amount of time participants looked at the reference section of the articles. These resulting data are outlined here.

Measurements for perceived credibility of the page, heuristic processing and knowledge were taken from Lim (2013). All variables were rated on a 5 point likert scale ranging from "strongly agree" to "strongly disagree".

4.2.2.1 Subject Content and Perceived Credibility

The Sharpiro-Wilk test of normality (S-W =.973, df = 26, p = .712) indicated data were normally distributed. An independent samples t-test was conducted to compare the credibility judgements scores for the psychology blog post and the meat blog post group. There was a significant difference between scores for the biological psychology blog post (M = 24.54, SD = 5.517) and the environmental impact of meat production blog post M = 19.77, SD = 5.294; $t(24) = 2.249$, $p = .034$. The differences indicated that students determined the meat blog post to be more credible than the psychology blog post.

4.2.2.2 Information Verification Behaviours

In this study, participants are deemed to have engaged in more systematic processing of the information if they show more information verification behaviours. Three information verification behaviours were identified as likely: whether participants clicked the hyperlinks to investigate if the content on the blog post is supported by other reputable sources; whether the "about the author" tab was clicked to investigate the background of the author and see if they were a reliable source; and dwell times on the reference section were used to help identify systematic processing, as spending a longer dwell time looking at the reference section could signify effortful scrutiny.

4.2.2.3 Following Hyperlinks

Given the participants' greater relevant knowledge and presumed motivation in assessing the blog post in an area familiar to them, it was expected that those in the psychology blog post group would demonstrate more systematic information processing and click on more hyperlinks (Figure 4-3). A Mann-Whitney *U* test revealed no significant difference between the total number of hyperlinks clicked into for the psychology blog post (*Md* = .00, *n* = 13) and meat blog post (*Md* = .00, *n* = 13), *U* = 69.500, z = -.942, *p* = .346.

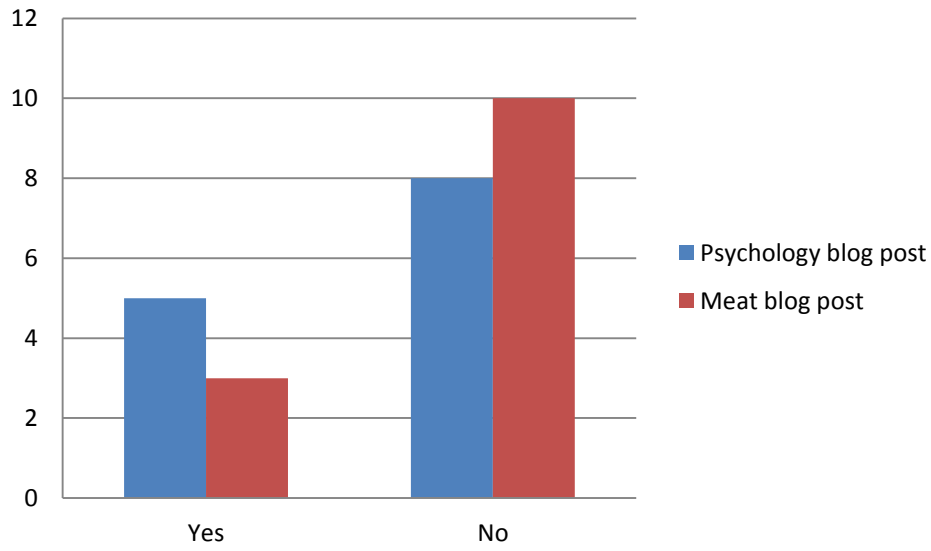

Figure 4-3: Frequencies for both groups on whether participants clicked on any of the hyperlinks.

4.2.2.4 Time Spent Looking at the Reference Section

Given that information regarding the reputability of information sources is often available in a reference section, it was expected that the group viewing the psychology post would spend more time and effort reading this. A Mann-Whitney *U* test revealed no significant difference between the time students spent looking at the reference section for the psychology blog post (*Md* = .00, *n* = 13) and looking at the meat blog post (*Md* = 364.100, *n* = 13), *U* = 58.500, z = -1.404, *p* = .160.

4.2.2.5 Follow-Up: Did Participants Look at the Reference Section?

A Chi-square test for independence (with Yates Continuity Correction) was used to determine if there was an association between looking at the reference section and whether students viewed the psychology or meat blog post. Results indicated no significant difference, χ^2 (1, n = 26) = .619, *p* = .431. Figure 4-4 shows the frequencies of participants who looked at the reference section for both groups.

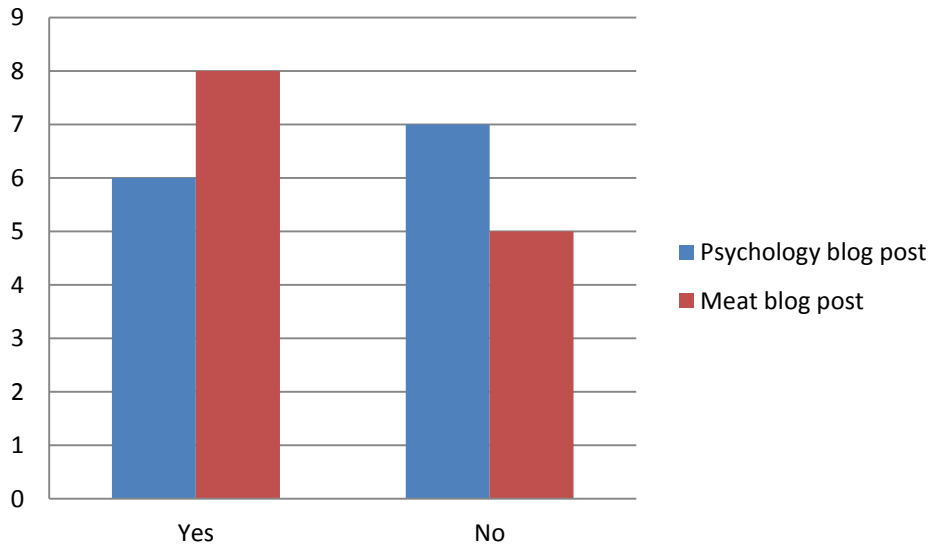

Figure 4-4: Frequencies for both groups on whether participants looked at the reference section.

4.2.2.6 Clicking "About the Author"

Information about the author can help a reader assess the credibility of the information presented on a webpage. It was expected that those who viewed the psychology blog post would demonstrate more systematic processing and click on the tab more often than those who viewed the meat blog post. A Chi-square test for independence (with yates Continuity Correction) indicated no significant difference

between clicking on the "about the author" tab and whether students viewed the psychology or meat blog post, χ^2 (1, n = 26) = 1.00, p = .656. The proportion of students who clicked on the "about the author" tab was the same for both groups, 5 students clicked on it and 8 did not (Figure 4-5).

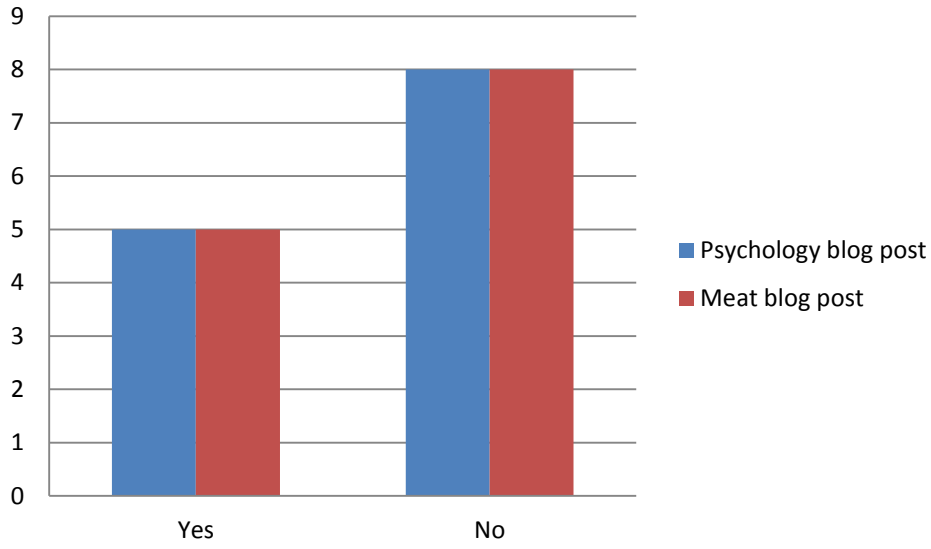

Figure 4-5: Frequencies for both groups on whether participants clicked on the "about the author" tab.

4.2.2.7 Information Literacy Skills and Information Verification Behaviour

General information literacy skills were measured using the CAUL Information Skills Survey. A median split was used to divide participants into high and low information skills to assess whether general information literacy as measured by such a survey was associated with any differences in information verification behaviour regardless of topic content (in what follows participants who read the psychology blog post and those who read the meat blog post are collapsed into a single group).

The total score for the twenty questions in the Information Skills Survey ranged from 47 to 75. The average score for all participants (n=26) was 61.04, the median split was 61.50.

4.2.2.8 Information Literacy Skills and Clicking "About the Author"

An independent samples t-test was conducted to investigate if the total students scored on the information skills survey had an effect on clicking on the "about the author" tab. There was no significant difference in scores between those

who clicked on the "about the author" tab (M = 64.30, SD 2.211) and those who did not click on the "about the author" tab M = 59.00, SD = 1.860; $t(24) = 1.807$, p = .083. Figure 4-6 shows whether or not participants clicked on the "about the author" tab and their ISS score.

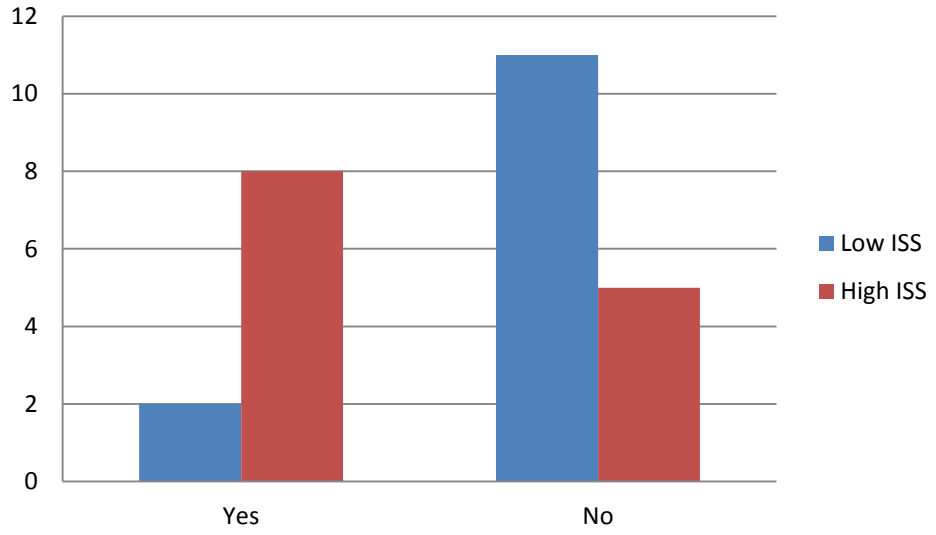

Figure 4-6: Frequencies for low and high information skills and whether participants clicked on the "about the author" tab.

4.2.2.9 Information Literacy Skills and Following Hyperlinks

A Chi-square test for independence (with yates Continuity Correction) indicated no significant difference between clicking on any of the hyperlinks and students information skills level, χ^2 (1, n = 26) = .722, p = .395. The proportion of students identified as having a high level of information skills and who clicked on any of the hyperlinks was not significantly different from the proportion of students with a low level of information skills. It was expected that those who scored high on the information skills scale would interact more with hyperlinks as they should have learned that an important element when considering credibility is to investigate if the content as supported by other trustworthy sources (see Figure 4-7).

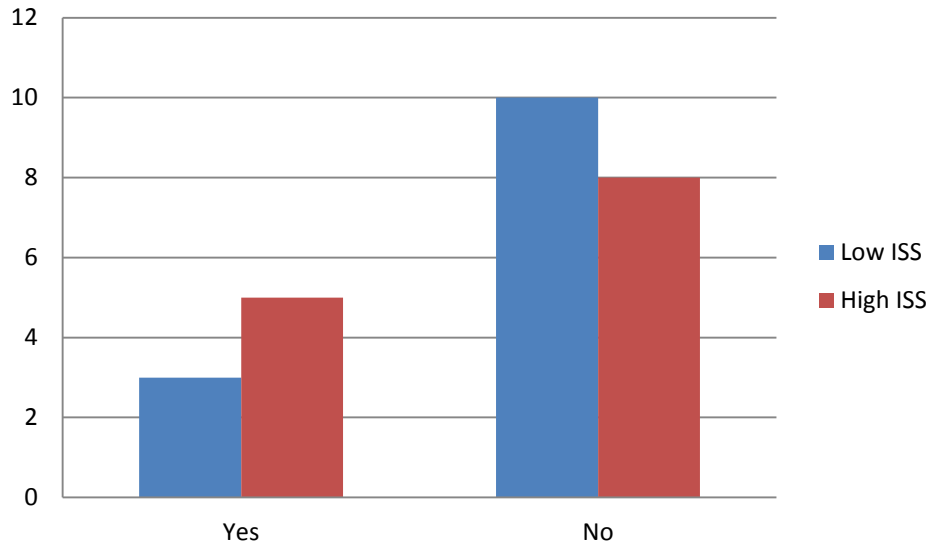

Figure 4-7: Frequencies for low and high information skills and whether participants clicked on any of the hyperlinks.

4.2.2.10 Information Literacy Skills and Examination of the Reference Section

A Mann-Whitney *U* test revealed no significant difference between the dwell time on the reference section for those who scored high, (*Md* = 364.100, *n* = 13) and those who scored low, (*Md* = .000, *n* = 13) on the information skills survey, *U* = 75.000, z = -.513, *p* = .608. Seven of the students who scored low and five of those who scored high on the information skills survey did not look at the reference section.

4.2.2.11 Influence of the Experimental Setting

Influence of the experimental setting was a factor, with 12 (46.2%) participants agreed with the statement "the fact that the webpage was presented as part of an experiment affects how likely I think it is to be accurate". On examination of the direction of the influence, 11 (42.3%) agreed that "the fact that the webpages was presented as part of an experiment makes me more inclined to think it is accurate". Five (19.2%) were undecided and 10 (38.4%) were in disagreement.

On examination of experimental influence between the two groups, those who read the psychology blog post, seven (54%) were in agreement that the fact the blog post was presented as part of an experiment affected how likely they thought it to be accurate, three (23%) each were undecided and disagreed. Results from those who read the meat blog post showed five (39%) agreed, six (46%) were undecided

and two (15%) disagreed. More students in the meat blog post agreed that "the fact that the blog post was presented as part of an experiment makes me more inclined to think it is accurate" with seven (54%) in agreement. This compared to the psychology blog post where four (31%) agreed.

4.2.3 Study 2: Discussion

The results of Study 2 indicate that final year psychology students did not engage in information verification behaviours any more frequently when evaluating psychology-relevant information than non-psychology information. However results did show that they evaluated the credibility of such information differently.

It was expected that final year psychology students would be capable of evaluating the information (Chaiken & Ledgerwood's, 2012, *capacity* condition), and that the content of the psychology-relevant information would be enough to demonstrate *some* motivation (the *motivation* condition). The Heuristic-Systematic Theory suggests that where there is capacity and motivation information will be assessed more systematically. Evidence for this in the present study is mixed. While psychology students appeared to be more critical toward psychology-relevant information (rating it as less credible) they did not show clear behavioural signs of more careful information evaluation on any of the measures included in the study.

There are several possible reasons for this. The first is that participants were not sufficiently motivated as noted. The second is that bounded rationality theory, which predicts heuristic evaluation in the vast majority of cases, is a more accurate reflection of patterns of information processing behaviour. This being the case participants may have evaluated the information more critically but did so according to characteristics within the general content of the articles rather than making use of the available extra actions (such as following hyperlinks to assess claims made). In essence, participants may have felt that they had enough information, without any further assessment to make their judgement. What Chaiken et al., 1989, or Eagly and Chaiken, 1993, might call having a low *sufficiency threshold*. This would have implications as to how information literacy (and critical thinking more generally) might be taught in higher education (these implications are addressed in the following chapter). As appearance, layout, number of references, and writing style were similar across the two articles, some of the typical signals used in more

heuristic assessment of content could not be what caused the effect. It would appear to be something more engrained in the students psychological knowledge.

A third possibility is that participants *wished* to engage in a more systematic assessment of the information but did not have the skills, to do so, in this case the particular information and computing technology skills. This third possibility seems unlikely given the ubiquity of people's ability to follow a hyperlink (the most basic of web use skills) and the fact that nearly half of the participants did not view the reference section of the articles. This is a basic skill appropriate to offline text media just as much as online. Further implications of these results for the understanding of information literacy in higher education more generally are addressed in the following chapter.

The implications of the information literacy questionnaire are also difficult to assess clearly given the range of null results. Given that subject-specific knowledge failed to produce real differences in verification behaviours, that information literacy measurements also failed to enable any such distinctions does not tell us much. It seems clear that level of general information literacy does not correlate with real differences in patterns of evaluation (whether information is heuristically or systematically assessed) as might be expected, as measured by the Information Skills Survey. This raises questions about what is being measured by the CAUL questionnaire. The relatively high overall scores by participants, combined with very limited evidence of critical verification behaviours, suggests that participants' perceptions of their own capacity might not be reliable, and may be subject to a problematic Dunning-Kruger effect. It must be noted that the results of the present study cannot support any strong conclusion. However, they do suggest that a more systematic evaluation of the possibility should be undertaken. If information literacy skills questionnaires in general have poor predictive validity when it comes to the critical interaction with information found, then the scope of use of such questionnaires should be carefully assessed.

Chapter 5

General Discussion

5.1 Review of Results

This thesis has attempted to examine some of the behaviours and processes associated with the evaluation of information presented on webpages in higher education students. It is situated within the field of research on information literacy, and specifically within the attempt by Secker and Coonan (2013) to bring order to the domain and provide a means by which the varied facets of information literacy in higher education might be integrated. The capacity to evaluate the credibility of information encountered is a core aspect of information literacy, as well as the intention of higher education more generally (Barnett, 1990; 1997).

It appears from existing research that web users typically use very weak strategies for the assessment of information on websites (usually to do with layout, presentation, branding and so forth) (Dochterman & Stamp, 2010; Flanagin & Metzger, 2007; Rains & Karmikel, 2009; Reinhard & Sporer, 2010). They also access a very limited range of sites, deeming only the first few results in a search engine results listing to be worthy of attention. Study 1 explicitly examined whether that dependence on those very top rankings spilled over into evaluation of the webpages themselves, and while null results are difficult to interpret. Results suggest that a lower stated ranking does not in itself lead participants to write-off, or negatively evaluate the credibility of webpage content.

The consistency with which the existing research seems to identify salient but surface characteristics of a page as the basis for evaluation of its credibility, strongly suggests that participants default to a heuristic mode of processing for the task. Study 2, driven partly by the Heuristic-Systematic Theory of information processing, attempted to prompt more systematic evaluations from final year psychology students by providing them with information specific to their domain of study. This was to examine whether systematic information processing of online material could be prompted, and whether different patterns of information verifications behaviours

might be seen between different forms of information (those forms being relevant or irrelevant to a final year student's domain of study). It was found that subject domain had no effect on information verification behaviour frequency. This infers that participants used heuristic assessment of a website's credibility regardless of the subject matter of the page presented, at least within a laboratory-based task. Furthermore, general information literacy skills did not predict differences in information verification behaviours (regardless of subject matter).

5.2. Methodological Considerations

Web browsing is a dynamic and complex behaviour, and the processes involved in the evaluation of the credibility of a webpage are not easy to assess (Metzger et al., 2010). While much of the existing work in this area has primarily used self-report measures, the two studies presented here used laboratory based computer tasks in order to directly measure specific behaviours. The direct observation of behaviours involved in interaction with the web (particularly information verification behaviours) is a strength of the methods used. These methods indicate that there are alternatives to the current over-reliance on surveys and questionnaires. Nonetheless, the artificiality of the laboratory setting is a potentially significant confound. The conclusions to be drawn as regards the understanding of web credibility and information literacy are therefore limited, and must be qualified. As with all studies, attempts at replication will be essential.

Impact of the experimental setting, one of the more significant problems with laboratory-based tasks, is difficult to assess. In Study 2, participants were asked about the potential impact of the fact that information was presented as part of a psychological experiment, but responses were not consistent among participants. While half the participants indicated that the experimental context affected their evaluations, half did not. When the direction of the effect was checked nearly half agreed that it made them more likely to believe the information, a slightly smaller proportion disagreed, while a few were undecided. This suggests that influence of the setting and experimenter is something of a nuisance variable, that will have to be acknowledged and worked out over replications. Laboratory-based tasks will be essential, if measurements of specific behaviours are to be collected, given the exorbitant cost of trying to observe such behaviours in normal everyday web

browsing. This will no doubt change as technology develops, and computer interfaces include eye-trackers and movement trackers as standard in addition to webcams and other equipment that might provide the necessary data.

Currently, a combination of laboratory-based and naturalistic studies will provide the most accurate and comprehensive reflection of participants' behaviours. While there must be caution in the drawing of conclusions (and all such conclusions that follow are offered strongly subject to this qualification), the collection and interpretation of data must be continued.

5.3 Cognitive Information Processing and Web Credibility

The evaluation of the credibility of web-presented information involves more than just the look of the website in question. It is unsurprising, but worth emphasising, that a person's existing knowledge base in a domain can affect their view of the web (Secker & Coonan, 2013). While the majority of existing research has emphasised how users are distracted by, and depend upon, salient perceptual details of a site, the interaction with the users' existing knowledge, which will vary considerably between people and between domains, is vital to understanding how credibility is judged. Precisely how prior knowledge has its effects, and how that prior knowledge interacts with a person's technical skills on using a computer to access information, remain unclear.

Of the two models of information processing outlined in Chapter 2, the findings of the present study provide more support for Bounded Rationality Theory (Gigerenzer & Brighton, 2009; Simon, 1955; Todd & Gigerenzer, 2012) than the Heuristic-Systematic Theory. While Study 1 suggests that higher education students do not use the simplest available signal of credibility (search result ranking) to pre-judge the credibility of the content of a webpage, Study 2 suggests that even when dealing with content relevant to their studies, information verification behaviours remain relatively rare. Though participants' motivation levels are a significant methodological problem, which must temper conclusions here, where there was capacity and opportunity to engage in more careful, systematic, evaluation of information presented, few did so. This would seem to indicate that the Heuristic-Systematic Theory (Chaiken, 1980, 1987; Chaiken & Ledgerwood, 2012) provides a less accurate description of the patterns of information processing in this context. If

Heuristic-Systematic Theory is to be upheld the behavioural indicators that will reveal the difference between mode of processing will have to be identified.

Given the limited nature of the evidence presented here, it is not possible to draw firm conclusions on the matter. However, some points regarding these theoretical approaches are worth noting as future research may be developed to tease these ideas apart further. While Heuristic-Systematic Theory does provide some indication of how a person might switch between the two modes of information processing, it is essential in examining the theory to make predictions as to how this change in mode of operation is expressed in behaviour. An increase in frequency of information verification behaviours was identified as the most likely candidate and three such behaviours were observed in Study 2. The kinds of behaviours that are possible will depend on the context and the medium in question. Metzger et al. (2010) note the importance of social referencing. This was not addressed in the present study. If the theory is to be evaluated effectively, and web credibility to be adequately embedded into more general psychological theory then clear predictions will need to be made. Aside from perhaps time spent on task, it is not clear what such predictions might be.

Bounded Rationality Theory, can take slightly more support from the findings of the present work. This theory claims that people routinely use reliable structures in the information in the environment to make quick but effective decisions about the world around them. Previous literature highlights presentation and layout of webpages but these could not be the features underlying the different evaluations in the present work as webpage presentation and layout were the same in both articles presented in Study 2. The students' experience with psychological knowledge made them less believing across the board, or the students used some indicator(s) within the content itself that has not yet been identified. The development of heuristic means of evaluating generally (not just for credibility) has long been associated with the development of expertise (Kahneman, 2011). It is expected with experience that people might come to note some reliable characteristics of well-supported facts that do not actually require direct assessment of support through information verification behaviours to evaluate. Martignon, Katsikopoulos and Woike (2012), describe "fast, frugal" decision trees that enable the classification of material in various ways with minimal use of cognitive

resources. The credibility, or likely accuracy, of information presented within a domain of prior knowledge might be classified as credible or non-credible in this way. The family of heuristics that Martignon et al. (2008, 2012) outline could provide a means to explore the patterns of judgements in web credibility research more specifically. They could act as a more refined, more specific hypothesis regarding information processing within the bounded rationality framework.

The present work provides more hints than clear indications of how students of higher education evaluate the credibility of websites. The differences in judgements on the basis of content, makes it clear that though there is a long way to go yet, web credibility evaluation is a complex task that involves domain-specific knowledge in subtle ways. It would appear that Secker and Coonan's (2013) claim that information literacy must be grounded within practices and activities of domain-specific, professional-specific actions finds support here.

What this means for the understanding of information literacy more generally is discussed in more detail in the following section. The integrative approach that Secker and Coonan recommend for understanding information literacy means that even when examining just the narrowly focused area of web credibility in the context of higher education, the broader framework within which that evaluation is taking place needs to be considered. Subject-specific skills, ICT skills as well as social skills and more general study and learning skills all play a role. To try and identify just one aspect of this complex phenomenon and isolate it entirely might be a naïve exercise.

5.4 Implications for the Understanding of Information Literacy

Previous research showed the narrow focus of people's views of search engine results (Bar-Ilan et al., 2006; Nakamura et al., 2007; Pan et al. 2007; Spink et al., 2002). The literature suggests that participants consider higher ranked pages to be more credible (Pan et al., 2007). Study 1 suggested that despite the apparently strong impression of ranking influence, a page's ranking did not significantly affect the evaluation of its perceived accuracy or usefulness. That search ranking affects behaviour but not, apparently, evaluation, attests to the complexity and context-sensitivity of information processing and information literacy. Information

evaluation is conducted within the context of the kind of page that the information is presented in, that is a content full page or a search engine results page.

This suggests that content really does matter when it comes to evaluating information along with the differences in credibility judgements between topics in Study 2. While this would support Secker and Coonan's (2013) view that information literacy is intertwined with domain specific knowledge, the fact that interactions with search engines might separate skills (or at least different criteria) means that there is likely to be important generic web credibility, and information literacy skills, too. Web search engines operate similarly regardless of the content of the query. Content matters, but clearly technology matters also. While learning to use technology might be best done in domain specific settings (perhaps where motivation to do it properly will be highest), it is likely that properly organised generic instruction would also be beneficial.

It is important to keep track of the various relationships between the different skills and cognitive processes at the base of information literacy, and to examine their interactions, as Secker and Coonan's (2013) ambitious project begins to develop. This is another reason to develop a range of research methods within the area.

That Secker and Coonan's framework is so recently developed means that tools measuring the different aspects of information literacy that the framework identifies, and tools that might also attempt to situate information literate behaviours, within specific disciplines within higher education, have yet to be merged. Current information literacy assessment tools are represented in the present work by the CAUL questionnaire. This general purpose information literacy questionnaire is indicative of the type of instrument frequently used in the literature (the literature itself, as has been noted, often depending entirely on such self-report tools). High or low scores on this scale showed no association with any of the dependent variables recorded (behavioural or self-report) in the present study. the differences in score has no predictive value within the specific context of web credibility evaluation and thereby suggests that such general purpose tests may simply be too broad - a consideration enforced by Secker and Coonan's (2013) approach generally. The evaluation of the CAUL was not an intention of the present work, however. Rather,

it might have been expected that higher information literacy skills would be associated with more frequent information verification behaviours. In this single instance, however, this was clearly not the case. Coonan's (2011) review and Secker and Coonan's (2013) framework, along with the results of both studies in the current research suggests that while information literacy skills have some generic components there is an important interaction between these generic component skills and more focused domain-specific intent. Broad self-report measures of information literacy are not likely to be able to capture the important and potentially intricate dynamics between these elements, and will not aid in the identification of particular cognitive processes which underpin them.

The low numbers of participants who engaged in various information verification behaviours in the sample in Study 2 seems to run counter to their relatively high scores of the CAUL scale.

5.5 Practical Implications

Secker and Coonan's (2013) "new curriculum" for information literacy (ANCIL) identifies the concept as a wide set of inter-related elements that must be approached in an integrative manner. Studies 1 and 2 of the present work, as discussed above, suggest some support for this view, that is information literacy as a mixture of domain specific and more general technological skills. This suggests that instruction in information literacy, and the kind of critical, evaluative interaction with information by autonomous individuals (that is the objective of higher education (Barnett, 1990, 1997)), then new media and new technologies must be integrated into the workings of education in colleges and universities.

Where such information literacy programmes currently do exist the tendency is to provide them in short intense bursts early in the students' higher level education. This fits the more traditional "information literacy as adjunct" idea but does not fit either the ANCIL model or the findings of the present work. Instead, the present work would support Secker and Coonan's call to integrate web credibility evaluative skills training (and by extension most likely other kinds of information literacy training) into subject-specific activities. These technologies should be viewed not as something separate to the content of the student's degree programme, but as vital as reading and writing (traditional literacy). This suggests integrated

information literacy training might also mitigate the kinds of assumptions of competence that are frequently made about the "Google generation" (Badke, 2011; Dickey & Connaway, 2010).

Training and education relevant to web credibility assessment should take into account the strong tendency to use heuristic information processing when dealing with online content. While the proper psychological theorising about these processes is still in its earliest stages, having developed only the past few years, the present work seems to support the consistent finding in previous literature that systematic or effortful engagement with a website is unlikely. Information literacy training should be specifically organised to be sensitive to this fact and to mitigate the potential drawbacks of it though as Gigerenzer and Brighton, 2009, note, there are often benefits to such heuristic thinking too. More research is needed on this issue before more specific and targeted suggestions can be made.

Information verification behaviours are potentially very powerful. They allow the avoidance of being caught out by misinformation or miss otherwise valid information. All claims made in the article in Study 2 were in fact supported by hyperlinks to the research. Where generic verification behaviours exist, technology could be adapted to make them less effortful. The behaviours could be turned into the kind of salient perceptual task that people are eager to perform (Dochterman & Stamp, 2010; Flanagin & Metzger, 2007; Rains & Karmikel, 2009; Reinhard & Sporer, 2010). The last edit date of a webpage retrieved, the author of the page, the number of links or number of references are all pieces of information that are relatively easy to identify and are highlighted in various ways by browsing software. For example there are already browser plug-ins that help fact-check news sites and political speeches such as http://truthgoggl.es. This would enable technology to maximise the gain from people's default heuristic habits.

5.6 Future Research

Future work in this area will be led both by theoretical development, with properly disciplined psychological bases for specific component skills and behaviours of information literacy, and also by technological development as supports for those different skills and behaviour changes. Information literacy will be forever changing as technology advances.

Nevertheless, information literacy has characteristic structures that might still be used to identify useful and productive research questions. For instance, web users appear to have a strong tendency to use heuristic information processing in their evaluations of information. Various media will no doubt have different signals or cues that guide that heuristic processing. Though they may change over prolonged periods of time, it will be essential to identify and keep track of them both to understand how people are dealing with information and to adapt education programmes to suit.

Specific research might use a more naturalistic version of tasks such as that presented in Study 2 in this thesis. The task would still (for practical, equipment-based reasons) need to be conducted in a laboratory but it might be possible for the task to be set during term time, associated with actual assignment work for students. Their normal web searching and computer reading could be conducted in a properly prepared laboratory. This is one way students as participants might, be more motivated to fully engage with the information they find. This would maximise the likelihood of systematic thinking and allow for a stronger assessment of the different predictions of Heuristic-Systematic Theory and Bounded Rationality Theory.

The social component of web credibility assessment (endorsement or criticism by peers and authority figures) was not addressed in the present work, but is explicitly part of Secker and Coonan's ANCIL framework. It was also identified as important by recent qualitative work from Metzger et al. (2010). Social networking tools may provide a fruitful new line of inquiry into both the skills students use when evaluating web content, as well as the conditions under which they are likely to engage in either heuristic or (if ever) systematic information processing.

5.7 Conclusion.

Despite nearly forty years of work on the topic, the understanding of information literacy is still at a surprisingly early stage. The cognitive and social processes that underlie information literacy remain ill-understood and are only now being full investigated. Research methods in the domain are of mixed value and are still developing. The various facets of the complex phenomenon of information literacy are still being integrated with one another to enable more effective progress

to be made across the various disciplines and sub-disciplines engaged in research. The present work is a small part of that collective endeavour, intended to show some of the potential value of more focused, theory-driven behavioural study.

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Appendices

Appendix A Study 1 questions for participants

How old are you?

18-22	23-30	31-40	41+
1	2	3	4

Type in your answer using a scale of 1 to 4

Please specify your Gender?

Female	Male
1	2

Type in your answer using a scale of 1 to 2

What year are you in?

1st	2nd	3rd	4th	PG
1	2	3	4	5

Type in your answer using a scale of 1 to 5

Did you think the webpages provided useful information?

Strongly disagree	Disagree	Undecided	Agree	Strongly agree
1	2	3	4	5

Type in your answer using a scale of 1 to 5

I would follow the advice given

Strongly disagree	Disagree	Undecided	Agree	Strongly agree
1	2	3	4	5

Type in your response on a scale of 1 to 5

Have you previously used either the Internet or read books to learn about study skills?

Always	Very Often	Sometimes	Rarely	Never
1	2	3	4	5

Type in your answer using a scale of 1 to 5

How many hours do you study outside of class a week?

Less than 5	6 - 10	11 -15	16-20	More than 20
1	2	3	4	5

Type in your answer using a scale of 1 to 5

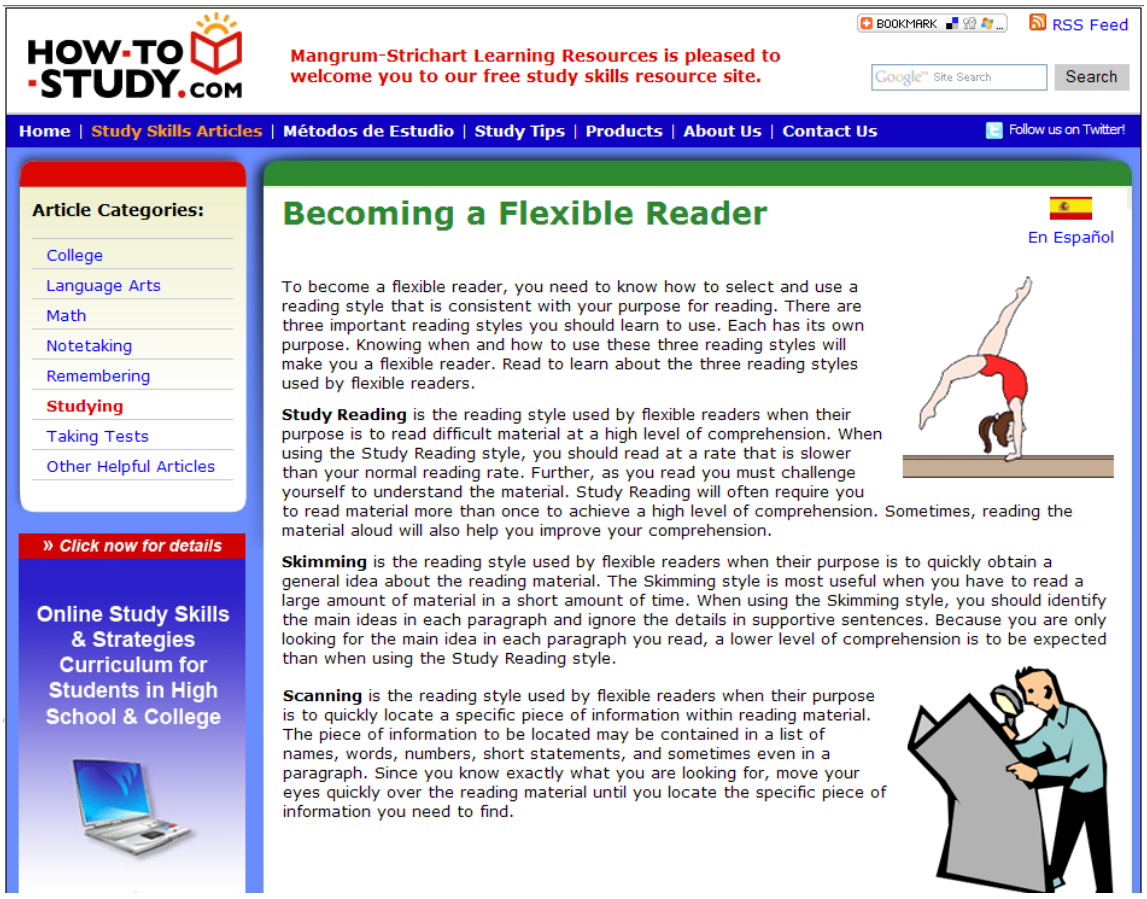
I attend lectures

Always	Very Often	Sometimes	Rarely	Never
1	2	3	4	5

Type in your answer using a scale of 1 to 5

Thank you for participating in this study.

Appendix B Study 1 webpages viewed by participants



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Article Categories:

- College
- Language Arts
- Math
- **Notetaking**
- Remembering
- Studying
- Taking Tests
- Other Helpful Articles

Good Listening in Class

En Español

It is important for you to be a good listener in class. Much of what you will have to learn will be presented verbally by your teachers. Just hearing what your teachers say is not the same as listening to what they say. Listening is a cognitive act that requires you to pay attention and think about and mentally process what you hear.

Here are some things you should do to be a good listener in class.

- **Be Cognitively Ready to Listen When You Come to Class**. Make sure you complete all assigned work and readings. Review your notes from previous class sessions. Think about what you know about the topic that will be covered in class that day.
- **Be Emotionally Ready to Listen When You Come to Class**. Your attitude is important. Make a conscious choice to find the topic useful and interesting. Be committed to learning all that you can.
- **Listen with a Purpose**. Identify what you expect and hope to learn from the class session. Listen for these things as your teacher talks.
- **Listen with an Open Mind**. Be receptive to what your teacher says. It is good to question what is said as long as you remain open to points of view other than your own.
- **Be Attentive**. Focus on what your teacher is saying. Try not to daydream and let your mind wander to other things. It helps to sit in the front and center of the class, and to maintain eye contact with your teacher.
- **Be an Active Listener**. You can think faster than your teacher can speak. Use this to your advantage by evaluating what is being said and trying to anticipate what will be said next. Take good written notes about what your teacher says. While you can think faster than your teacher can speak, you cannot write faster than your teacher can speak. Taking notes requires you to make decisions about what to write, and you have to be an active listener to do this.

Article Categories:

- College
- Language Arts
- Math
- Notetaking
- Remembering
- Studying
- **Taking Tests**
- Other Helpful Articles

Test Taking Tips

En Español

General Tips

- Answer the questions you find easiest first. Come back to the others later.
- Don't spend more than a minute or two on any question.
- As you work on a section, keep track of how much time remains. (It's a good idea to bring a reliable watch.)
- Answer every question. There is no penalty for guessing.
- Be careful to mark only one answer choice per question.
- Write in the test book in any way that will help you.
- Consider all answer choices before you choose one. Use the process of elimination to narrow your choices.

English Section Tips

- Consider the writing style used for each section. The correct answer choice will be the one that works best with the writing style used.
- When asked a question about something that is underlined, consider how the underlined portion fits with the rest of the section.
- Examine each answer choice to see how it differs from the others.
- For items that include "No Change" as an answer choice, choose this as your answer only if you are sure none of the other answer choices are correct.
- Reread the underlined portion with your answer choice to be sure it is correct.

Appendix C Study 1 information sheet and consent form.

Post graduate research
Department of Psychology
Mary Immaculate College

Participant Information Sheet

Thank you for your interest in the study.

You will be asked to view some information retrieved from the Web on the topic of study tips. You will be asked some questions at the end.

Your participation is voluntary. **You may withdraw from participation at any time without consequence.** You do not have to give any reasons for withdrawing.

All data is collected anonymously you are only required to give your name for consent. Data will be collected and stored in compliance with the Freedom of Information Act and the Data Protection Act.

This research complies with the Mary Immaculate Research Ethics Committee and the ethical guidelines of the Psychology Society of Ireland.

Thank you very much for your time.

If you have concerns about this study and wish to contact someone independent, you may contact: MIREC Administrator, Mary Immaculate College, South Circular Road, Limerick
061-204515, mirec@mic.ul.ie

Post Graduate Research
Department of Psychology
Mary Immaculate College

Coláiste Mhuire gan Smál
Mary Immaculate College

Consent Form

I have read and understood the Participant Information Sheet.

I understand what the project is about.

I know that my participation is voluntary and that I can withdraw from the project at any stage without giving any reason.

I am aware that my results will be kept confidential.

I have read this form completely, I am 18 years of age or older and am happy to take part in the study on on-line shopping.

Signed: _____ Date: _____

Appendix D Study 1 groups and instructions

Rank 1 Group

You will be presented with a series of webpages taken from a website about study skills at college.

The webpages are taken from a website that is ranked 1st in a Google search for "study skills for college".

Press the spacebar to continue

Rank 10 Group

You will be presented with a series of webpages taken from a website about study skills at college.

The webpages are taken from a website that is ranked 10th in a Google search for "study skills for college".

Press the spacebar to continue

Read the content in the following pages.

When you are finished you will be asked a few short questions on what you read.

Press the spacebar to continue

Appendix E Study 1 debriefing sheet.

Post Graduate Research

Department of Psychology

Mary Immaculate College

Coláiste Mhuire gan Smál
Mary Immaculate College

Debriefing

This study is investigating whether PageRank (what number a website comes up at after a search has been performed in Google) affects credibility. Do users think more highly of websites which return in the top 3 of a Google search? The information you viewed will be the same for all participants but some will be told the PageRank is 1 while other will be told it's 10.

I will be looking to see if there's a difference between the two groups (those told the website was ranked 1 or 10) towards the questions you answered at the end as to whether you would follow the advice given.

Appendix F Study 2 Blog post presented with two groups

Psychology blog post

Could yawning be all about cooling down the brain?

Err, don't people yawn because they're bored and/or tired?

Yes, it's true people do yawn more at bedtime or after they've woken up and they do yawn when they're bored (people even yawn in their sleep).

But yawning isn't that simple. If it was, how could you explain that some paratroopers yawn before their first jump, as do some violinists before they go on stage and Olympic athletes before their event (Provine, 2005). These are hardly situations in which people are likely to be bored.

Many people believe that yawning gets more oxygen into the body or expels more carbon dioxide. But this is not true. The theory is now thought to be seriously flawed, if not plain wrong.

The truth is no one really knows the real root cause of a yawn. Some good guesses have been made, though, and it's likely that some combination of them is true.

Cadaverous Clues

In 2002 Gary Hack and his team were dissecting a cadaver when they discovered that the back wall of the maxillary sinus was much thinner-and therefore more flexible-than described in many medical textbooks. The researchers postulated that, when the jaw moves, the sinus wall flexes, ventilating the sinuses.

"I'd always kept that in the back of my mind, because yawning was an exaggerated

jaw movement that would have an impact on this previously described pump in humans," Hack said. Later, he came across the postdoctoral research of Princeton's Gallup, (2007) who had become the first to suggest the brain-cooling theory for yawning.

Since 2007, Gallup had tested the idea in both animals-many of which also yawn-and people. For instance, Gallup and his team had implanted probes into rats' brains and recorded brain-temperature changes before, during, and after the rats yawned. The team discovered that brain temperature spikes in the run-up to a yawn, then starts to decline, and finally falls rapidly to pre-yawn temperature. This suggests yawns are triggered by an increase in brain temperature and "actually promote brain cooling," Gallup said.

Gallup had also studied two women who suffer from chronic bouts of excessive yawning. He had asked one of the patients-who could predict her "yawning attacks"-to take her own temperature before and after the episode, he said. The results showed her body temperature rose before the yawn and fell afterward-"directly mirroring results of the rat-brain temperature study," Gallup said. However, "we do have to be cautious that there are only two subjects in [that] study." Indeed, co-author Hack expects the brain-cooling yawning theory to be "very controversial-we're delving into an area that's not well understood."

The Seasons Influence our Yawning

A study led by Andrew Gallup, a postdoctoral research associate in Princeton University's Department of Ecology and Evolutionary Biology, is the first involving humans to show that yawning frequency varies with the season and that people are less likely to yawn when the heat outdoors exceeds body temperature.

Their study accordingly showed a higher incidence of yawning across seasons when ambient temperatures were lower, even after statistically controlling for other features such as humidity, time spent outside and the amount of sleep the night before. Nearly half of the people in the winter session yawned, as opposed to less than a quarter of summer participants (Gallup & Eldakar, 2012).

Furthermore, when analysing data for each season separately, they observed that yawning was related to the length of time a person spent outside exposed to the climate conditions. This was particularly true during the summer when the proportion of individuals yawning dropped significantly as the length of time spent outside increased prior to testing. Nearly 40 percent of participants yawned within the first five minutes outside, but the percentage of summertime yawners dropped to less than 10 percent thereafter. An inverse effect was observed in the winter, but the proportion of people who yawned increased only slightly for those who spent more than five minutes outdoors.

This is the first report to show that yawning frequency varies from season to season. The applications of this research are intriguing, not only in terms of basic physiological knowledge, but also for better understanding diseases and conditions, such as multiple sclerosis or epilepsy, that are accompanied by frequent yawning and thermoregulatory dysfunction. These results provide additional support for the view that excessive yawning may be used as a diagnostic tool for identifying instances of diminished thermoregulation.

The findings might hold some hope for sufferers of insomnia, migraines, and even epilepsy.

Though scientists have put forth various theories for yawning-from fatigue to lack of oxygen-none have held up to scrutiny.

"We can put a man on the moon, but we do not understand what the function of yawning is," said Hack, of the University of Maryland School of Dentistry in Baltimore.

Now, Hack and co-author Andrew Gallup, of Princeton University, propose that yawning causes the walls of the maxillary sinus to expand and contract like a bellows, pumping air onto the brain, which lowers its temperature. Located in our cheekbones, the maxillary are the largest of four pairs of sinus cavities in the human head.

Like a computer, the human brain is "exquisitely" sensitive to temperature and must stay cool to work efficiently, said Hack, whose previously collected data was combined with Gallup's in the new study, recently published in the journal Medical Hypotheses.

How to stop an attack of the yawns

Finally, how might you combat a monster attack of the yawns? A couple of clues come from a case study of two patients suffering from chronic attacks of yawning (Gallup & Gallup, 2010). Neither patients were regularly tired or were having problems with their sleep. They both found that applying a cold cloth to their foreheads or nasal breathing stopped their symptoms. They both had problems regulating their body temperature so the hot brain theory of yawning might have something to it...

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About the Author page

About me

Ellen Weintraub

Industry: Science

Occupation: Post-doctoral research fellow, University of Manchester

Location: Manchester, United Kingdom

Introduction: I have been research and teaching in this area for more than ten years, and bloggin about it for three. I am currently working on a European funded project extending my doctoral work.

Interests: biology, statistics, systems thinking, science communication

Meat blog post

Environmental impact of meat production

Home About the Author

Does the meat you eat affect the environment? It looks like it can, but it's not clear whether the overall effect is for better or worse.

Livestock are typically fed corn, soybean meal and other grains which have to first be grown using large amounts of fertiliser, fuel, pesticides, water and land. The American Environmental Working Group (EWG) estimates that growing livestock feed in the U.S. alone requires 167 million pounds of pesticides and 17 billion pounds of nitrogen fertiliser each year across some 149 million acres of cropland. The process generates copious amounts of nitrous oxide, a greenhouse gas 300 times more potent than carbon dioxide, while the output of methane-another potent greenhouse gas-from cattle is estimated to generate some 20 percent of overall U.S. methane emissions.

Consequences for the environment can result from changes in the amount of production in order to meet changes in demand for consumption. It has been estimated that global meat consumption may double from 2000 to 2050. This is mostly as a consequence of increasing world population, but is also partly because of increased per capita meat consumption with much of the per capita consumption increase occurring in the developing world. Global production and consumption of poultry meat have recently been growing at more than 5 percent annually. Trends vary among livestock sectors. For example, global per capita consumption of pork has increased recently (almost entirely due to changes in consumption within China), but global per capita consumption of ruminant meats has been declining (FAO, 2006)

Grazing and land use

In comparison with grazing, intensive livestock production requires large quantities of harvested feed. The growing of cereals for feed in turn requires substantial areas

of land, but grain-fed livestock need less food overall. A pound of beef (live weight) requires about seven pounds of feed, compared to more than three pound for a pound of pork and less than two pounds for a pound of chicken (Adler & Lawler, 2012). We have to be careful, however, assumptions about feed quality are implicit in such generalisations. For example, production of a pound of beef cattle live weight may require between 4 and 5 pounds of feed high in protein and metabolizable energy content, or more than 20 pounds of feed of much lower quality (National Research Council, 2000).

"If all the grain currently fed to livestock in the United States were consumed directly by people, the number of people who could be fed would be nearly 800 million," reports ecologist David Pimentel of Cornell University's College of Agriculture and Life Sciences. He adds that the seven billion livestock in the U.S. consume five times as much grain as is consumed directly by the entire U.S. population.

Free-range animal production requires land for grazing, which in some places has led to land use change. According to the Food and Agriculture Organization (FAO), "Ranching-induced deforestation is one of the main causes of loss of some unique plant and animal species in the tropical rainforests of Central and South America as well as carbon release in the atmosphere." This for example has implications for meat consumption in Europe, which imports significant amounts of feed from Brazil.

Raising animals for human consumption accounts for approximately 40 percent of the total amount of agricultural output in industrialised countries. Grazing occupies 26 percent of the earth's ice-free terrestrial surface, and feed crop production uses about one third of all arable land.

The Good with the Bad: Effects on wildlife

Grazing (especially, overgrazing) may detrimentally affect certain wildlife species, e.g. by altering cover and food supplies. However, habitat modification by livestock grazing can also benefit some wildlife species. For example, in North America, various studies have found that grazing sometimes improves habitat for elk,

blacktailed prairie dogs, sage grouse, mule deer and numerous other species. A survey of refuge managers on 123 National Wildlife Refuges in the US tallied 86 species of wildlife considered positively affected and 82 considered negatively affected by refuge cattle grazing or haying (Strassman, 1987). Such mixed effects suggest that wildlife diversity may be enhanced and maintained by grazing livestock in some places while excluding livestock in some places. The kind of grazing system employed (e.g. rest-rotation, deferred grazing, HILF grazing) is often important in achieving grazing benefits for particular wildlife species.

Other Beneficial environmental effects

Among environmental benefits of meat production is conversion of materials that might otherwise be wasted, to produce high-protein food. For example, Elferink et al., (2008) state that "Currently, 70 percent of the feedstock used in the Dutch feed industry originates from the food processing industry." US examples of "waste" conversion with regard to grain include feeding livestock the distillers grains (with solubles) remaining from ethanol production. For the marketing year 2009/2010, dried distillers grains used as livestock feed (and residual) in the US amounted to 25.0 million metric tons. Much of the soy meal used as livestock feed is produced from material left after extraction of the soybean oil used in foods and in production of biodiesel, soaps and industrial fatty acids. Similarly, canola meal for livestock feed is produced from material left after oil extraction (for food and biodiesel) from canola seed. Examples with regard to roughages include straw from barley and wheat crops (feedable especially to large-ruminant breeding stock when on maintenance diets), and corn stover. Also, small-ruminant flocks in North America (and elsewhere) are sometimes used on fields for removal of various crop residues inedible by humans, converting them to food.

There are environmental benefits of meat-producing small ruminants for control of specific invasive or noxious weeds (such as spotted knapweed, tansy ragwort, leafy spurge, yellow starthistle, tall larkspur, etc.) on rangeland. Small ruminants are also useful for vegetation management in forest plantations, and for clearing brush on rights-of-way. These represent food-producing alternatives to herbicide use.

It looks like assessing and balancing the environmental impact of our increasingly meat-laden diet might be a complicated problem for both policy makers and consumers in the twenty-first century.

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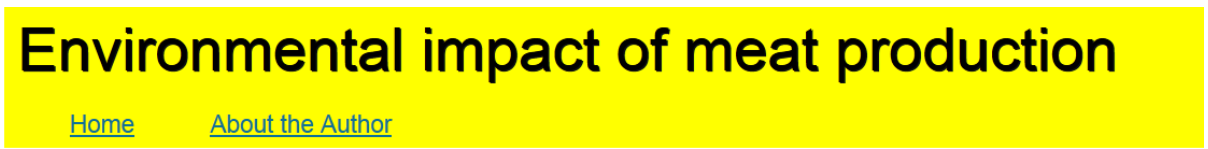
About the Author page



About me

Ellen Weintraub

Industry: Science

Occupation: Post-doctoral research fellow, University of Manchester

Location: Manchester, United Kingdom

Introduction: I have been research and teaching in this area for more than ten years, and bloggin about it for three. I am currently working on a European funded project extending my doctoral work.

Interests: biology, statistics, systems thinking, science communication

Appendix G Study 2 CAUL Information Skills Survey

Please respond to the following statements, which refer to your

general use of the internet and information resources.

I have a system that helps me organise the information I need.

never, sometimes, often or always

I keep accurate details of everything I read.

never, sometimes, often or always

I use a combination of search tools including library catalogues and web search engines.

never, sometimes, often or always

When I get a new idea, I work out how to explain it effectively.

never, sometimes, often or always

I critically evaluate each information source I use.

never, sometimes, often or always

When I make notes about the information I am reading, I include the author and title.

never, sometimes, often or always

I reference websites that I have used in my assignment.

never, sometimes, often or always

I evaluate information I read for criteria including accuracy and relevance.

never, sometimes, often or always

I develop a system to keep track of the information I find and its sources.

never, sometimes, often or always

I apply my institution's policies regarding plagiarism.

never, sometimes, often or always

In selecting information, I evaluate the quality of the information.

never, sometimes, often or always

I have a system for searching for information on a subject.

never, sometimes, often or always

I need to keep relearning because life is constantly changing.

never, sometimes, often or always

I revise my research plan and strategy if I need to gather more information or data.

never, sometimes, often or always

I present the information in a medium that suits the audience.

never, sometimes, often or always

If my searching returns too much irrelevant information, I change my keywords.

never, sometimes, often or always

When I consider information I have found, I state the key ideas in my own words.

never, sometimes, often or always

I compare information as I'm reading with what I already know.

never, sometimes, often or always

I decide how best to find the information I require for a particular task.

never, sometimes, often or always

I comply with stated restrictions on the use of intellectual property.

never, sometimes, often or always

I feel confident about my ability to evaluate the validity of information on the Web.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

I go to more than one online source (website) when looking for information.

Always, Often, Sometimes, Seldom or Never

The fact that these webpages were presented as part of an experiment affects how likely I think there are to be accurate.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

The fact that the webpages was presented as part of an experiment makes me more inclined to think they are accurate.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

Are there any other steps you'd take to decide whether to believe information presented on a website? If so please describe them briefly.

Appendix H Study 2 questions for participants

What is your Age?

Gender

Female/Male

I would describe my level of expertise in the use of the internet as:

Excellent, Above Average, Average, Below Average or Poor

The following questions refer to the content on the website you have just read:

(Credibility measure Lim, 2013)

This article is accurate.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

The information in this article is verifiable elsewhere.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

This article is reliable.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

This article includes major facts of the topic.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

This article presents views fairly and without bias.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

This article is trustworthy.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

This article is believable.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

I think the author of the webpage has expertise in the subject area.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

(Cognitive workload measure Lim, 2013)

This article was difficult to follow.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

I felt stressed while I was reading this article.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

I felt distracted while I was reading this article.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

My mind wandered while I was reading this article.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

I paid attention to this article.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

(Involvement measure Lim, 2013)

This topic is relevant to me.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

This topic has been on my mind lately.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

This article made me think about this issue.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

I am motivated to learn more about the environmental issues of meat production.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

or

I am motivated to learn more about the relationship between the brain and behaviour

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

(Knowledge measure Lim, 2013)

I am knowledgeable about the environmental impact of meat production.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

or

I am knowledgeable about the relationship between the brain and behaviour

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

(Heuristic processing measure Lim, 2013)

I looked at the headings of the article.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

I scanned the length of the article.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

I scanned the references of the article.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

I scanned the quantity of citations of the article.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

I scanned whether notable sources were cited.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

I checked if there were any external links.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

I scanned the content of the article.

Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree

Appendix I Study 2 information sheet and consent form.

Information Sheet

You are invited to take part in a research study as part of my masters research. Before you decide, it is important that you understand why the research is being done and what it will involve.

Researcher's Details

Name: Michelle Glasheen

Email: michelle.glasheen@mic.ul.ie

Supervisor's Details

Name: Dr. Marek McGann

Email: marek.mcgann@mic.ul.ie

Purpose of the Study: The purpose of this experiment is to examine people's use of the web and their behaviour in reading information online.

Who is undertaking it and why: This project is being undertaken by Michelle Glasheen (michelle.glasheen@mic.ul.ie), as part of a postgraduate research project in the Department of Psychology, Mary Immaculate College. The project is being completed to examine skills and behaviours associated with internet usage. The supervisor of this research is Dr. Marek McGann (marek.mcgann@mic.ul.ie).

What will happen to me if I take part? You will be asked to read a blog post, after reading the webpage you will be asked to judge the credibility of the information presented. Your eye movements and computer use will be recorded during this time. You will be asked to answer some short questions on your use of the internet and information generally after viewing the website.

Summary

Participation in this study is voluntary and you are free to withdraw from the experiment at any time, without giving any reason. Your anonymity is assured and all data collected is only accessible to the researcher, the supervisor, and the examiners. All information gathered will remain confidential and will not be released to any third party. Mary Immaculate College is subject to the Freedom Information Act. The research procedures will adhere to the Data Protection Act (2003).

Post graduate research

Department of Psychology
Mary Immaculate College

Consent Form

I have read and understood the Participant Information Sheet.

I understand what the project is about.

I know that my participation is voluntary and that I can withdraw from the project at any stage without giving any reason.

I am aware that my results will be kept confidential.

I have read this form completely, I am 18 years of age or older and am happy to take part in the study.

Signed: _____ Date: _____

Appendix J Study 2 eye tracker calibration

Welcome

Thank You for participating in this experiment

You will see a black circle in the middle of the screen keeping your

head still and just moving your eyes follow the black circle around

the monitor.

Press the space bar to continue

Appendix K Study 2 instructions

You will be asked to read a blog post on the topic of environmental impact of meat production after reading the webpage you will be asked to judge the credibility of the information presented.

Or

You will be asked to read a blog post on the topic of the relationship between the brain and behaviour after reading the webpage you will be asked to judge the credibility of the information presented.

Press the spacebar to continue

Appendix L Study 2 debriefing sheet

Post graduate research

Department of Psychology

Mary Immaculate College

Debriefing

This study is investigating behaviours used when deciding if a website is credible.

Participants viewed one of two blog posts, after being asked to judge the credibility of the information presented prior to reading the blog, I'm interested to investigate people's behaviours while reading the information. For instance are hyperlinks clicked on to see if the information was accurate? Whether the "about us" tab was clicked to get more information about the author, or whether the reference section was viewed.

Participants' information literacy skills were also assessed to compare peoples self-report of their behaviours, and their behaviours while reading the information.