

"This is the peer reviewed version of the following article: Johnson, F., Scaffi, L., Rowley, J. Students' approach to the evaluation of digital information: insights from their trust judgements" *British Journal of Educational Technology* [in Press] Article first published online: 7 JUL 2015 | DOI: 10.1111/bjet.12306 **which has been published in final form at** DOI: 10.1111/bjet.12306 *This article may be used for non-commercial purposes in accordance with [Wiley Terms and Conditions for Self-Archiving](#).*"

Students' approaches to the evaluation of digital information: insights from their trust judgments

Johnson, F., Scaffi, L., Rowley, J

Manchester Metropolitan University

Abstract

This study contributes to an understanding of the role of experience in the evaluation phase of the information search process. A questionnaire-based survey collected data from first and third year undergraduate students regarding the factors that influence their judgment of the trustworthiness of online health information. Exploratory and Confirmatory Factor Analysis were conducted. First year students identified four factors: ease of use, content, recommendation, and brand. Third year students identified seven factors, in order of importance: content, credibility, recommendation, ease of use, usefulness, style, and brand. Third year students were much clearer about their evaluation processes than first year students; for third year students the factor structure was clearer, and items generally loaded onto the expected factors. The significance of these findings is discussed and recommendations for practice and further research are offered.

Keywords: trust; credibility; online health information; students; digital information; information literacy

Introduction

Young people are recognised to be one of the most active groups of Internet users. Their use of digital information sources supports their studies and various other aspects of their everyday life, such as those associated with travel, leisure, purchases, finance and health. Statistics from

the UK Office of National Statistics (www.ons.gov.uk) suggest that, in 2013, 16-24 and 25-34 year olds were the age groups with the highest levels of use of internet activities. In particular, many young people report using the Internet as one of their sources of health information (Dobransky & Hargittai, 2012; Percheski & Hargittai, 2011). However, college students and others are faced with “seemingly unending” digital resources (Fain, 2011, p. 109), such that they find it difficult to select appropriate and trustworthy sources (Gray, Klein, Noyce, Sesselberh, & Cantrill, 2005; Nettleton, Burrows, & O’Malley, 2005).

Judgments of trustworthiness are widely recognised to be a key component of the evaluation processes leading to the use of digital information in a variety of contexts, including engagement with transactions, as in online banking or retailing; interactions with other people such as in social media environments; and, most relevant to this research, the use of health information (Harris, Sillence, & Briggs, 2011; Smith, 2011; Xiao, Sharman, Rao, & Upadhyaya, 2014). Being able to formulate such trust judgments effectively can be regarded as a competence that students need to support their activities in their personal and professional lives. The importance of trust in relation to the use of digital information has prompted the development of theoretical models (e.g. Kelton, Fleischman, & Wallace, 2008; Lucassen & Schragen, 2011), as well as empirical evaluations of user behaviour (e.g. Iding, Crosby, Auerheimer, & Klemm, 2009; Rieh & Hilligoss, 2008; Lim & Simon, 2011). Some of this research relates to online health information (e.g. Dobransky & Hargittai, 2012; Fergie, Hunt, & Hilton, 2012). Other studies have noted that search behaviour changes with increased subject or domain knowledge (MaKinster, Beghetto, & Plucker, 2002; Wildemuth, 2004), which should increase as students progress through their studies. Two recent studies have examined the effect of domain knowledge on trust judgments of digital information (Braten, Stromso, & Salmeron, 2011; Lucassen & Schrageen, 2011), but there is considerable scope for further research contributions in this and related areas.

The aim of the research reported in this paper is to contribute to understanding of student evaluation of digital information resources through the lens of the factors that influence student trust judgments in the context of online health information. The research objectives are to:

1. Identify the factors that influence trust judgments in the context of online health information for cohorts of first and third year students.
2. Compare the factors used by the different cohorts, and any other differences in their evaluation behaviours, with a view to offering insights into developments over the course of their study.

Health information seeking has been chosen as the focus for this study because it is an area of everyday information seeking that has social and personal importance. As a result, of this there is a growing body of research on search and evaluation behaviours in this context. In addition, gathering data on an ‘everyday information seeking behaviour’, in contrast, for instance to behaviour in relation to learning, facilitates study of a cross-disciplinary sample of students. Research into information behaviour, including that associated with the evaluation of digital information, is an inter-disciplinary endeavour, as is evidenced by the references cited in this article. Whilst this research does offer insights into student health information behaviour, its primary objective is to use this context as a lens through which to understand how students’ approach to the evaluation of digital information evolves as they progress through their studies. This paper is structured as follows. The next section outlines the theoretical and empirical foundations for this study. Then, the methodology is outlined. This is followed by the analysis and findings section. The article concludes with a discussion section, followed by conclusions and recommendations.

Literature Review

There is a growing body of research concerning the credibility of websites and other online information sources, which has shown that students and other young people find it difficult to select appropriate and trustworthy health information sources (Gray, Klein, Noyce, Sesselberh, & Cantrill, 2005; Hansen, Derry, Resnick, & Richardson, 2003; Nettleton, Burrows, & O’Malley, 2005). More generally, they have difficulty justifying their evaluations of trustworthiness (Sanchez, Wiley, & Goldman, 2006), and often trade credibility for speed and convenience (Rieh & Hilligoss, 2008). Further, whilst there is evidence that young people seek to undertake evaluation of sources (Fergie, Hunt, & Hilton, 2012), they are not always confident in their credibility judgments (Rieh & Hilligoss, 2008) and sometimes find expertise and trustworthiness difficult to determine (Gray, Klein, Noyce, Sesselberh, & Cantrill, 2005). Research into credibility and trust judgments focuses on the factors that people use in their evaluations. For example, the early large-scale study by Fogg et al. (2003) showed that the themes most associated with credibility judgments were: design look, information design/structure, and information focus. Sillence, Briggs, Harris, and Fishwick (2007a) found that the factors contributing to patients’ selection and trust of health web sites included design factors (e.g. clear layout, good navigation aids, interactive features), and content factors (e.g. informative content, unbiased information, clear, simple language). Hargittai, Fullerton, Menchen-Trevino, and Yates Thomas (2010) found that for first year undergraduate students,

the most important factors in credibility assessment were: identifiability of information, currency, other sources for validation, whether facts or opinions are presented, authorship, and linking sites.

Although there is some consensus regarding the factors that influence judgments of the trustworthiness of online information, the discrepancy between the findings of different studies, suggests that user characteristics may be influencing information evaluation processes. Domain knowledge, in particular, has long been recognised as impacting on search behaviour [see Wildemuth (2004) for a review]. In this study, we adopt the definition of domain knowledge offered by Wildemuth (2004, p. 246) and used by others (e.g. Hembrooke, Gay, & Granka, 2005): ‘A searcher’s domain knowledge is his or her knowledge of the subject area (i.e. domain) that is the focus or topic of the search’. Poor domain knowledge in consumer health information seeking leads to use of irrelevant sites, regardless of web experience and search skills (Keselman, Browne, & Kaufman, 2008). Domain experts spend more time than novices on defining the problem, often activating their prior knowledge (Brand-Gruwel, Wopereis, & Vermetten, 2005), use more complex queries and make more use of elaborations in search reformulation (Hembrooke, Gay, & Granka, 2005). Further, in a study amongst nurses, domain and web novices carried out breadth-first searches, with little or no evaluation of the results, while domain experts evaluated information more deeply, drawing on their previous knowledge of the search topic. (Jenkins, Corritore, & Wiedenback, 2003).

Two studies that have compared the changes in students’ search behaviour over time are important precursors to this research: Wildemuth (2004) examined search behaviour of medical students at three points in a year; novices were less efficient in selecting concepts to search, and less accurate in their tactics for modifying searches. Vakkari, Pennanen, and Serola (2003) examined students at points in the development of their thesis proposal, and observed increase in students’ use of a more varied and specific vocabulary.

Whilst the studies referred to above provide evidence of the impact of domain expertise on search behaviour, this research focuses on query attributes, search strategies and tactics, and search outcomes (White, Dumais, & Teevan, 2009), with little attention paid to the evaluation stage of the search process. A handful of recent studies have started to address this gap, and use the lens of trust or credibility to understand students’ evaluation of information, in specific contexts. For example, Braten, Stromso, and Salmeron (2011) found that amongst readers of information on climate change, those with low topic knowledge were more likely to trust less trustworthy sources. Two key studies have been conducted on the evaluation of Wikipedia

articles and the role of expertise in trust judgments; they show that the accuracy of the article was more important in judgments exercised by experts Lucassen and Schrageen (2011) and that their evaluation focuses on the semantic features of the information (accuracy, completeness, scope, neutrality), whilst those who are unfamiliar with the topic pay more attention to surface features (length, references, pictures, writing style) (Lucassen & Schraagen, 2013).

Summary and contribution

The capacity to evaluate information is important. The growing body of research on the formation of trust judgments in online information behaviour offers some insights into the information evaluation process. Research has focused on those factors that affect trust judgments, but has failed to reach a consensus suggesting both contextual and user characteristics may be important influencers of evaluation processes. Yet, few studies have sought to understand how trust formation processes evolve with domain expertise, or level of education or study. This study seeks to contribute to addressing this research gap by undertaking a comparative study of the factors affecting trust formation for first and third year students, respectively. The underlying assumption is that third year students have a higher level of domain knowledge in their subject of study than first year students, which is, in turn, associated with a higher level of critical evaluation skills. It is these skills, rather than domain knowledge specific to health information, per se, that may contribute to difference in behaviour between cohorts.

Methodology

Research design

This study adopted a quantitative, survey-based research design, in order to gather sufficient data to be able to develop measurement items (Saunders, Lewis, & Thornhill, 2009). Questionnaires are also a widely used method of data collection in previous studies on health information seeking and trust judgments in digital environments (Hargittai, Fullerton, Menchen-Trevino, & Yates Thomas, 2010; Percheski & Hargittai, 2011; Smith, 2011). A four-sided, paper-based questionnaire was developed. The core of this questionnaire was a bank of 55 five-point Likert-scale statements, designed to investigate respondents' perceptions of the relative importance of various aspects of the health and medical information that they found on the internet on their evaluation of its trustworthiness. All of the Likert-scale statements were worded so that the respondents would always select from 1 (not at all important) to 5 (very

important) to keep consistency and to avoid confusion during the data analysis phase. The inclusion of specific factors was informed by previous research on trust and credibility judgments relating to both health and other types of information, and with various demographic groups. Table 1 identifies these factors, and offers construct definitions together with an indication of the previous research studies that have cited them as influencing trust and/or credibility judgments. Space considerations preclude the inclusion of the questionnaire, but examples of the Likert-style statements in the questionnaire are to be found in Tables 4 and 6.

[Table 1]

Table 1. Constructs and constructs definitions

Construct	Construct definition	Mean	s.d.	Cronbach's alpha	Measurement items informed by:
<i>Credibility</i>	The believability and impartiality of the information	3.89	0.639	0.750	Fogg et al., 2003 Hargittai, Fullerton, Menchen-Trevino and Yates Thomas, 2010 Hjørland, 2012 Kelton, Fleischman and Wallace, 2008 Lim and Simon, 2011 Menchen - Trevino and Hargittai, 2011 Metzger, 2007 Rieh and Hillgoss, 2008 Sillence, Briggs, Harris and Fishwick, 2007a,b Walraven, Brand-Gruwel and Boshuizen, 2009 Wang and Emurian, 2005
<i>Content</i>	The core characteristics of the information, such as reliability, accuracy and currency	3.76	0.692	0.724	
<i>Style</i>	The way in which the information is presented and written	3.72	0.699	0.728	
<i>Usefulness</i>	The extent to which the user is informed by and can make use of the information	3.64	0.591	0.784	
<i>Brand</i>	Brand indicators and reputation	3.59	0.821	0.753	
<i>Ease of Use</i>	The ease of locating, accessing and using the information	3.45	0.904	0.834	
<i>Recommendation</i>	Recommendations regarding the information from known person(s)	3.33	0.706	0.720	
<i>Authority</i>	The expertise and standing of the author or organisation responsible for providing the information	3.70	0.651	0.580	
<i>Triangulation</i>	The extent to which the information is consistent with other information on the same topic	3.49	0.725	0.592	

Prior to presenting the Likert-scale statements, the questionnaire asked respondents to think about a specific instance (critical incident) when they had looked for health or medical information on the internet. They were then invited to indicate whether their search on that

occasion was triggered by general interest, or because they or a member of their family had a specific complaint. Accordingly, in completing the questionnaire, each student was thinking about a scenario that had personal resonance. One of the early questions asked students whether they were answering with respect to a health issue that they or a person close to them had experienced, or had conducted the search out of general interest in a health problem. At the end of the questionnaire, respondents were asked about their disposition to trust, and their health status, before being asked to provide basic demographic data, including gender, age, course level and course subject.

To ensure initial reliability and content validity, the questionnaire was pre-tested with a panel of four expert researchers and piloted with 22 student volunteers to remove any inconsistencies and to confirm its wording, structure and design. As a result of the piloting, the wording of a few of the questions and items was changed, and some minor re-ordering of question undertaken, in order to improve clarity. The revised questionnaire was then distributed to students in class settings. Most students in the classes were willing to participate in the research. After a brief introduction, students were invited to complete the questionnaire. Completed questionnaires were collected immediately by the researchers.

Participants

Participants were first and third year undergraduate students at a large university in the UK. Since the purpose of this study was to survey students with all levels of search proficiency at different stages in their study, no prior selection was necessary or applied. Consistent with previous research studies on student and young people's health information seeking behaviour, and trust judgments in digital environment (e.g. Dobransky & Hargittai, 2012; Menchen-Trevino & Hargittai, 2011; Walraven, Brand-Gruwel, & Boshuizen, 2009), convenience sampling was employed to maximise response rate. Nevertheless, respondents were recruited from different discipline areas, including humanities, business, and sport. None of these programmes involve any specific curriculum on health-related topics. Specifically, the sports students' curriculum focussed on coaching, physical education and sport management. Working with undergraduate students enhanced the comparability of our findings to previous research (Percheski & Hargittai, 2011; Dobranski & Hargittai, 2012). 531 usable questionnaires were returned (Table 2). There was a relatively even distribution on gender (51% male, 49% female) and good representation across subject categories (Table 3).

[Table 2]

Table 2: The research sample

	Questionnaires distributed	Questionnaires rejected	Total used
1 st year students	250	11	239
3 rd year students	300	8	292

[Table 3]

Table 3: Student demographics

		1 st year		3 rd year		Total	
		No.	%	No.	%	No.	%
Gender	Males	104	43.5	165	56.5	269	50.7
	Females	135	56.5	127	43.5	262	49.3
Discipline	Business	103	43.1	136	46.6	239	45.0
	Sport	40	16.8	156	53.4	196	36.9
	Humanities	96	40.1	0	0.0	96	18.1

On the basis of the question regarding the personal critical incident that the students had in mind when they completed the questionnaire, half answered in respect of a complaint that they or a person close to them had experienced, whilst the other half were considering a search that they had conducted for general interest. In responding to the question on their health status, 75% reported that they were generally healthy, whilst 18% reported that they had recently had major health issues.

Data analysis and findings

Data were entered into IBM SPSS Statistics 22. Any spoiled questionnaires were not entered into the dataset. In order to explore differences between the factors that affected the formation of trust judgments of first year and third year students, separate Exploratory and Confirmatory Factor Analyses were conducted on each of the datasets in turn.

First year students (239 respondents)

Exploratory Factor Analysis

Exploratory factor analysis (EFA), using Principal Components Analysis (PCA), was used to determine the smallest number of factors to best represent the inter-relationships among the

items, and to identify loadings onto factors. Factor analysis is suitable for identifying correlation among variables in complex sets of data (Pallant, 2010). Prior to conducting PCA the suitability of the data for this test was established. The Cronbach’s alpha coefficient was 0.937, confirming the reliability of the scale (Bryman & Bell, 2007). Both Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity were conducted to measure sampling adequacy. The KMO value was 0.879, which is greater than the recommended value of 0.6 (Kaiser, 1974). Bartlett’s Test of Sphericity was statistically significant at the .000 level (Barlett, 1954).

A scree plot was used to identify the number of factors. This resulted in the identification of six factors, which explain a total of 48% of the variance, with factor 1 explaining 24.7 % of the total variance, factor 2, 8.2%, factor 3, 5.7%, factor 4, 3.7%, factor 5, 3.5% and factor 6, 3%. Next, the factors were rotated using Varimax with Kaiser Normalization to generate the component matrix; this showed a clear structure with meaningful strong loadings for each of the six factors.

Confirmatory Factor Analysis

EFA was followed by Confirmatory Factor Analysis (CFA) in order to test the measurement model. According to Segars and Grover (1998), the measurement model should be evaluated first and then re-specified as necessary to generate the ‘best-fit’ model. This iterative process led to a refined measurement model with four factors and eleven items. These four factors are the first four shown in Table 4; the remaining two factors from the exploratory analysis are retained in Table 4 to allow for subsequent comparison between the first and third years datasets. Item reliability (IR) ranged from 0.66 to 0.87, exceeding the acceptable value of 0.5 (Hair, Anderson, Tatham, & Black, 1992). Composite reliability (CR) for these four factors ranged from 0.74 to 0.86, above the 0.60 benchmark (Bagozzi & Yi, 1988). Finally, the average variance extracted (AVE) ranged from 0.576 to 0.624, exceeding the threshold value of 0.5 (Fornell & Larcker, 1981), showing that these items were empirically distinct. Together these indices showed that the model had an appropriate level of reliability, convergent validity, and determinant validity.

[Table 4]

*Table 4: Results of Confirmatory Factor Analysis - first year students (*signifies discarded factors)*

Factor	Item	IR	CR	AVE
1	EU1-How easy it was to access the information	0.73	0.850	0.587

Ease-of-use	EU3-The information is free	0.75		
	ST2-The ease with which I can read the information	0.77		
	EU2-How easy it was to find the information	0.81		
2 Content	CR1-Whether I feel I can believe the information	0.70	0.803	0.576
	AU4-The information appears to be objective (i.e. no hidden agenda)	0.73		
	CO4-The accuracy of the information (such as the absence of errors)	0.75		
3 Recommendation	RE6-My friends and family use the source	0.71	0.767	0.624
	RE1-Family and friends have recommended the source to me	0.86		
4 Brand	BR1-The information source features the logo of a respected brand	0.66	0.743	0.596
	BR2-The information source carries the logo of a well-known brand	0.87		
5 Usefulness	UF7-Whether it felt like the information was tailored to me personally	0.45	0.645*	0.390*
	UF8-The advice seemed to be offered in my best interest	0.67		
	UF9-The extent to which I felt that the site tried to help me	0.75		
6 Style	ST5-Evidence of proofreading oversights, such as spelling mistakes	0.50	0.678*	0.421*
	TR4-Extent of consistency with my prior knowledge	0.64		
	UF5-The extent to which the article adds to my previous knowledge	0.77		

IR = Item Reliability; CR = Composite Reliability; AVE = Average Variance Extracted

The fitness measures for the measurement model are shown in Table 5. This includes: GFI (goodness of fit index), AGFI (adjusted goodness of fit index), NFI (normalised fit index), CFI (an incremental fit index of improved NFI) and RMSEA (root-mean-square error of approximation). Since all of the fit measures fall into acceptable ranges, the proposed model provides a suitable fit. This model explains 42% of the total variance in trust judgments.

[Table 5]

Table 5: Confirmatory Factor Analysis Model Fit Statistics – first year students

Fit index	Results	Recommended value	Suggested by authors
TLI	0.958	>0.95	Hair, Black, Babin and Anderson (2010)
CFI	0.969	>0.95	Hu and Bentler (1999)
RMSEA	0.042	<0.06	Hu and Bentler (1999)
Chi square/d.f.	1.41	<3	Hair, Black, Babin and Anderson (2010)
NFI	0.904	>0.9	Seyal, Rahman and Rahim (2002)
GFI	0.935	>0.8	
AGFI	0.901	>0.8	

TLI = Tucker Lewis index; CFI = Comparative fit index; RMSEA = Root mean square error of approximation;

NFI = Normalised fit index; GFI = Goodness of fit index; AGFI = Adjusted goodness of fit index

Third year students (292 respondents)

Exploratory Factor Analysis

EFA, using PCA, was also conducted with the third year student dataset to determine factor structure and factor loadings. Prior to conducting PCA, the suitability of the data for this test was established. The Cronbach’s alpha coefficient was 0.933, confirming the reliability of the scale. The KMO value was 0.874, greater than the recommended value of 0.6. Bartlett’s Test of Sphericity was statistically significant at the .000 level.

A scree plot was used to identify the number of factors, resulting in the identification of seven factors, which explained 53.6% of the variance, with factor 1 explaining 25% of the total variance, factor 2, 7.7%, factor 3, 6.1%, factor 4, 4.4%, factor 5, 3.7%, factor 6, 3.5% and factor 7, 3.1%. Next, the factors were rotated using Varimax with Kaiser Normalization to generate the component matrix, which shows a clear structure with meaningful strong loadings for each of the seven components.

Confirmatory Factor Analysis

As with the first year student data, EFA was followed by CFA, in order to test the measurement model and again an iterative process was used to arrive at the ‘best-fit’ model. This process led to a refined measurement model with seven factors and 21 items (Table 6). Item reliability ranged from 0.65 to 0.97, exceeding the acceptable value of 0.5. Composite reliability for these seven factors ranged from 0.761 to 0.926, exceeding the 0.60 benchmark. Finally, the average variance extracted ranged from 0.516 to 0.805, and for all factors exceeded the threshold value of 0.5, showing that these items were empirically distinct. Together, these indices showed that the model had an appropriate level of reliability, convergent validity, and determinant validity. The fitness measures for the measurement model shown in Table 7 confirm that the proposed model provides a suitable fit.

[Table 6]

Table 6: Results of Confirmatory Factor Analysis - third year students

Factor	Item	IR	CR	AVE
1 Content	AU4-That the information appears to be objective (i.e. no hidden agendas)	0.65	0.813	0.522
	CO3-The reliability of the information	0.73		
	CO2-The comprehensiveness of the information	0.74		

	CO4-The accuracy of the information (such as the absence of errors)	0.77		
2 Credibility	CR5-The extent to which the source contains facts rather than opinions CR3-The impartiality of the information CR1-Whether I feel I can believe the information CR4-The quality of the information CR2-The objectivity of the information	0.66 0.69 0.70 0.75 0.81	0.847	0.526
3 Recommendation	RE4-I have seen recommendations from members of a social network community RE1-Family and friends have recommended the source to me RE6-My friends and family use the source	0.71 0.73 0.79	0.761	0.516
4 Ease-of-use	EU1-How easy it was to access the information EU2-How easy it was to find the information	0.89 0.97	0.813	0.522
5 Usefulness	UF1-That the information tells me most of what I need to know UF2-That the information helps me to understand the issue better	0.78 0.88	0.819	0.694
6 Style	ST3-The clarity of the structure of the information ST1-The ease with which I can understand the information ST2-The ease with which I can read the information	0.67 0.85 0.94	0.816	0.597
7 Brand	BR1-The information source features the logo of a respected brand BR2-The information source carries the logo of a well-known brand	0.90 0.90	0.892	0.805

IR = Item Reliability; CR = Composite Reliability; AVE = Average Variance Extracted

[Table 7]

Table 7: *Confirmatory Factor Analysis Model Fit Statistics – third year students*

Fit index	Results	Recommended value	Suggested by authors
TLI	0.964	>0.95	Hair, Black, Babin and Anderson (2010)
CFI	0.972	>0.95	Hu and Bentler (1999)
RMSEA	0.043	<0.06	Hu and Bentler (1999)
Chi square/d.f.	1.54	<3	Hair, Black, Babin and Anderson (2010)
NFI	0.926	>0.9	Seyal, Rahman and Rahim (2002)
GFI	0.921	>0.8	
AGFI	0.888	>0.8	

TLI = Tucker Lewis index; CFI = Comparative fit index; RMSEA = Root mean square error of approximation; NFI = Normalised fit index; GFI = Goodness of fit index; AGFI = Adjusted goodness of fit index

Labelling and discussing factors

After identifying the CFA model for both data sets, the labelling of the factors was considered. With regard to the third year data set, the loading of items on to factors gave clear licence to retain the original construct labels. For consistency and to enhance comparability, when labelling the first year factors alignment was sought between this model and the third year model. Brand is measured using the same items in both models. Recommendation has the same items, except that the third year model includes an additional item for “Recommendations from members of a social network community”. In respect of other factors, whilst it was deemed appropriate to allocate the same labels, there are differences in the items. So, for content there is only one item in common, with the first year model being a mix of items originally identified as content, credibility, and authority. Our view is that these items typify what the first year students see as content. Similarly, the difference between the versions of the usefulness factors is interesting. The third year version adopts more of a cognitive turn (“The information tells me most of what I need to know”, and “The information helps me to understand the issue better”), whilst the first year version rests more on the information being generally helpful (e.g. “The extent to which I felt that the site/document tried to help me”). Also, ease of use in the first year model is a wider construct, incorporating four items compared with the two in the third year model. The additional items in the first year model are “The information is easy to read”, and “The information is free”. Style for the third year model includes three items, originally coded as belonging to style, whereas in the first year model this factor includes items originally associated with style, triangulation, and usefulness, with the latter two items making reference to prior knowledge. Again, the third year version takes a more cognitive turn, focussing on the aspects that influence the understandability of the information. Credibility only exists as a distinct factor in the third year model. Finally, although included in the questionnaire, neither authority nor triangulation emerge in either model, although one item from authority (“That the information appears to be objective”) does load onto the content factor in both models.

Discussion

The findings of this study offer clear evidence that student trust judgments in relation to digital health information change as they progress through their undergraduate studies. We believe this to be the first study that has undertaken a quantitative study explicitly comparing trust judgments between students at different points in their university studies. Accordingly, it offers a number of unique insights in relation to the development of trust formation processes, which

will be discussed later. However, in general terms, the findings from this research align with previous research on information behaviour and information literacies. Firstly, several previous researchers have demonstrated that there is a link between domain knowledge and information behaviour, both in general (MaKinster, Beghetto, & Plucker 2002; Wildemuth, 2004; Hembrooke, Gay, & Granka, 2005), and more specifically, in relation to online health information. For example, Keselman, Browne, and Kaufman (2008), found that imprecise domain knowledge led consumers to search for information on irrelevant sites, regardless of their web experience and general search skills, whilst Jenkins, Corritore, and Wiedenback (2003) found that experts could be distinguished from novices by their greater focus on conducting in-depth searches, and performing evaluation of the retrieved sources. Two prior studies that explore the impact of student domain expertise by studying students at different stages in their study more specifically confirm that a step-change in information behaviour can take place during the course of undergraduate studies (Vakkari, Pennanen, & Serola, 2003; Wildemuth, 2004). However, these studies on the role of domain expertise on search behaviour focus on query attributes, search strategies and tactics, and search outcomes (White, Dumais, & Teevan, 2009), rather than evaluation of sources. In addition, in previous research, students are conducting searches in the domain of their study; this is not the case in our research.

There is some limited evidence from previous studies in contexts such as climate change (Braten, Stromso, & Salmeron, 2011) and Wikipedia (Lucassen & Schrageen, 2011; 2013) that expertise affects trust judgments. This research goes further and, through the lens of trust judgments, offers specific insights into the evaluation processes in regard of digital information, adopted by students at different stages in their studies. In particular, comparison of the factors that influence student trust judgments shows that as they progress through their studies:

1. ***Students exercise enhanced sophistication in evaluation*** – This is evidenced both by the greater number of factors, and the greater number of items surfacing in the CFA for third year students. Third year students take into account seven factors, which subsume 21 items, compared with the four factors and eleven items in the first year model, suggesting third years make use of a wider range of cues and indicators. In addition, all except one of the items in the third year student model load onto the anticipated factors, whereas the loading in the first year model is more mixed. On this basis, third year students appear to be clearer about the information evaluation process, and to exhibit a higher level of consensus as to what is important.

2. ***Different factors come into play in their trust judgments*** – Most striking in comparing the two models is the presence of a significant multi-item factor for credibility in the third year student model. Only one credibility item “Whether I can believe the content” appears in the first year student model, and this loads onto the content factor. This suggests that third year students are more alert to the importance of credibility. Prior research and theory has suggested strong links between credibility and trustworthiness (Kelton, Fleischman, & Wallace, 2008; Hargittai, Fullerton, Menchen-Trevino, & Yates Thomas, 2010) and elsewhere we have argued the case for viewing credibility as a precedent of trust (Rowley & Johnson, 2013). The evidence here suggests that for third year students this is the case, but for first year students it is not. In other words, there the relationship between trustworthiness and credibility may be context dependent, where the context may include both information and user characteristics, as suggested by Lucassen and Schragen (2011).

3. ***The relative significance of factors changes*** – The relative importance of the factors in trust judgments varies. In the first year model the order is: ease of use, content, recommendation, and brand. In the third year model, the order is: content, credibility, recommendation, ease of use, usefulness, style and brand. First years seek convenience and ease. Although they acknowledge the importance of content, they have a specific and surface notion of the essence of content, and look for endorsement either from peers or from brand communication. Third years, on the other hand, place content in pride of place, and follow this up with credibility, before looking to recommendations, and taking into account ease of use, usefulness, and style.

4. ***The third year model is more consistent with prior research into trust formation with respect to digital information*** – Most of the original antecedents to trust included in this research were retained in the third year model. We comment briefly on each of the factors in turn. Starting with *content* (which includes objectivity, reliability, comprehensiveness, and accuracy), several authors have commented on the importance of content, or the related construct, information quality as an antecedent to credibility or trust (e.g. Harris, Sillence, & Briggs, 2011; Shen, Cheung, & Lee, 2012; Yaari, Baruchson-Arbib, & Bar-Ilan, 2011). More specifically, Fergie, Hunt and Hilton (2012) report that young people seek to assess reliability and information quality in health information seeking. Next, as discussed above, various authors acknowledge the

relationship between *credibility* and trust. *Recommendation* has been less widely studied as a precursor to trust, but its inclusion in both models in this study is consistent with other studies that suggest that young adults look to their teachers and networks for advice in information seeking and evaluation (Hargittai, Fullerton, Menchen-Trevino, & Yates Thomas, 2010; Rieh & Hilligoss, 2008). *Ease of use* is well-established as a precedent to technology adoption (e.g. Davis, 1989) and, more specifically, several authors identify this as an antecedent to trust, although ease of use is often measured with items that privilege website design (Fogg et al., 2003; Robins, Holmes, & Stansbury, 2010). Our items relate to the information, specifically, how easy it is to find and access. Similarly, *usefulness* is often identified as a precedent to trust, but not always as a distinct factor, but rather represented by relevance (e.g. Iding, Crosby, Auerheimer, & Klemm, 2009), focus (Fogg et al., 2003) or personalisation (Sillence, Briggs, Harris, & Fishwick, 2007b). *Style* has been widely implicated in trust judgments (e.g. Wang & Emurian, 2005; Rowley & Johnson, 2013). Finally, the role of *brand* in trust formation has received very little attention, but Fergie, Hunt, and Hilton (2012) and Hargittai, Fullerton, Menchen-Trevino, and Yates Thomas (2010) suggest that young people notice brand logos and associate them with information quality.

Conclusions and recommendations

This research has compared the factors associated with the trust judgments made by two distinct student cohorts in one university in the UK. Using a questionnaire-based survey approach, the study has gathered data on the factors that influence judgments of trustworthiness. The data has been subjected to Exploratory and Confirmatory Factor Analysis to create two separate measurement scales relating to trust judgments, one for each of the student cohorts. On this basis, the research offers clear evidence that student trust judgments in relation to digital health information change as they progress through their undergraduate studies. Such development is consistent with prior literature regarding the importance of domain knowledge on search behaviour, but deviates from this prior literature on two critical counts. First, the students participating in this study were not studying ‘health’, and hence there is no reason to believe that their domain knowledge in health has been developed during the course of their studies, but, it is likely that they have developed transferable information evaluation skills during the process of study specific to their discipline. Secondly, with its focus on evaluation, and more specifically trust judgments, this research offers new insights into information behaviour. These can be summarised under four themes:

1. As their studies progress, students exercise enhanced sophistication in the formulation of trust judgments, with both a larger number of factors and a larger number of items, being taken into account.
2. Credibility is only present as a distinct factor in the third year model, suggesting that student learn about the importance of credibility and how to assess it as they progress through their studies. From the perspective of theory, such a shift may be contributing to the ongoing debate regarding the relationship between judgments of credibility, and those of trustworthiness, and we suggest that this relationship may be mediated by both information and user characteristics.
3. Not only does the number of factors change between the two cohorts, but the relative contribution of factors also changes. This offers insights into the nature of the changes in information behaviour. For first year students, the most important factor is ease of use, whereas for third years it is content, or the quality of the information. An alternative perspective is that first years substitute ease of use for credibility as one of their top three influencing factors.
4. The third year model is more consistent with prior research into trust formation with respect to digital information. This suggests that much of theory and research into trust formation, and possibly information behaviour, more generally, tends to be normative, and grounded in the practice of domain and search experts. As such, it may not be entirely representative of actual information behaviour in many segments of the population.

Whilst our study offers valuable and interesting insights into students' trust judgments in relation to online information, it has a number of limitations. First, in common with other related studies, this research uses a convenience sample in the interests of generating a sufficient dataset. An option for further research would be to use a panel survey in which some of the variables are controlled. Next, there is scope for further analysis of our dataset; specifically, we are interested in whether there are differences in trust judgments between male and female students, and whether the motivation for the search (involvement) influences trust behaviours. Another obvious limitation is the scope of the present study, in terms of geographical location, topic (health), and sample population (undergraduate students). Further

investigations should be conducted in different contexts, including everyday information seeking, associated with, for example, consumer decision making and travel, and information seeking for study and work. In addition, our study does not explore differences between disciplines; student in some disciplines, such as health and sport science, may have more health related expertise than those in other disciplines. Hence, the evaluation practices of different user groups, say in different disciplines, might also be explored further, and specifically, whether year groups of students (e.g. first years) are homogeneous in terms of the speed of development of the sophistication of their evaluation skills. Further, it would be valuable to understand the extent to which students' information evaluation skills match those of professional groups in the general population.

Another key limitation of this research is that it does not relate student trust judgments to their Internet experience, or information literacy proficiency. It would be worthwhile to gather insights into how specific training in the development of information skills impacts on trust judgments, and other aspects of information evaluation.

One very important theoretical issue is the dynamic between trust and credibility. This study adopts a pragmatic stance, treating credibility as an antecedent to trust, but, in general, there is no consensus on the directionality of the relationship between these two key variables. Further empirical exploration could offer greater clarification as to the quite possibly dynamic and contextual relationships between judgments of trust and of credibility.

Both this study and any further research in all of the above areas has the potential to inform programmes and practices targeted towards the development of information literacy, and in some disciplines, evidence-based practice. Both librarians and academics have a key role to play in developing students' information skills. Both groups need to appreciate that as students progress through their studies their enhanced ability to exercise critical evaluation extends to the evaluation of digital information sources, irrespective of their specific domain knowledge. Librarians are typically responsible for formal information literacy programmes. Often, such programmes focus either on introducing sources and/or developing searching skills. Greater attention needs to be directed towards a structured and progressive programme of information literacy activities that matches stage of study. Arguably, one of the most important differentiators of this approach must be a greater focus on the evaluation processes and the way in which they should be integrated into the search process. As subject experts and teachers, academics also have an important role to play in developing the information evaluation skills of their students. Their role focusses on direction in relation to judging authority, information

quality, and credibility in their specific disciplinary context. This can be achieved through learning and assessment activities that require students to engage with and evaluate information sources. Learning approaches such as problem-based learning and assessments that involve literature review or analysis of specific research and other sources can be valuable in this context. Whilst they may perceive themselves to be developing students in the context of study in specific disciplines, it is important that both librarians and academics recognise that students develop transferrable information evaluation skills under their guidance, and give students the opportunity to evidence this, and gain confidence in the transferability of their skills.

Acknowledgements

The researchers are grateful for the internal research grant from the Institute of Humanities and Social Science Research, Manchester Metropolitan University that facilitated this research.

Data access: Data collected in this research is available from the authors (j.rowley@mmu.ac.uk) or through Manchester Metropolitan University's Institutional Repository.

Ethical considerations: Respondents were given the opportunity to decline to complete the questionnaire. No sensitive or invasive questions were asked. No personal identifying data was collected.

Conflict of interests: There are no conflicts of interest associated with this research.

References

- Bagozzi, R.P. & Yi, Y. (1988). On the evaluation of Structural Equation Models. *Journal of the Academy of Marketing Science*, 16(Spring), 74-94.
- Bartlett, M.S. (1954). A note on the multiplying factors for various chi-square approximations. *Journal of the Royal Statistical Society*, 16, SeriesB, 296-308.
- Brand-Gruwel, S., Wopereis, I., & Vermetten, Y. (2005). Information problem solving by experts and novices: analysis of a complex cognitive skill. *Computers in Human Behaviour*, 21, 487-508.
- Brand-Gruwel, S, Wopereis, I., & Walraven, A. (2009). A descriptive model of information problem solving while using the internet. *Computers & Education*, 53, 4, 1207-1217.
- Braten, I., Stromso, H.I., & Salmeron, L. (2011). Trust and mistrust when students read multiple information sources about climate change. *Learning and Instruction*, 21, 2, 180-192.

- Davis, F.D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *Management Information Systems Quarterly*, 13, 3, 319-340.
- Dobransky, K., & Hargittai, E. (2012). Inquiring minds acquiring wellness: Uses of online and offline sources for health information. *Health Communication*, 27, 4, 331-343.
- Fain, M. (2011). Assessing Information Literacy Skills Development in First Year Students: A Multi-Year Study. *Journal of Academic Librarianship*, 37, 2, 109-119.
- Fergie, G., Hunt, K., & Hilton, S. (2012). What young people want from health-related online resources: A focus groups study. *Journal of Youth Studies*, 16, 5, 579-596.
- Fogg, B.J., Soohoo, C., Danielson, D.R., Marable, L., Stanford, J., & Tauber, E.R. (2003). How do users evaluate the credibility of web sites? A study with over 2,500 participants. Proceedings of DUX2003, Designing for User Experiences Conference.
- Fornell, C., & Larcker, D.F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18, 1, 39-50.
- Gray, N.J., Klein, J.D., Noyce, P.R., Sesselberh, T.S., & Cantrill, J.A. (2005). Health information-seeking behaviour in adolescence: The place of the Internet. *Social Science & Medicine*, 60, 7, 1467-1678.
- Hair, J.F, Anderson, R.E., Tatham, R.L., & Black, W.C. (1992). Multiple Discriminant Analysis. In: *Multivariate Data Analysis with Readings* (pp. 87-152). New York: Macmillan Publishing Company.
- Hair, J.F., Black, W.C., Babin, B.J., & Anderson, R.E. (2010). *Multivariate Data Analysis* (7th edn.). Prentice Hall, Upper Saddle River, New Jersey.
- Hansen, D.L., Derry, H.A., Resnick, P.J., & Richardson, C.R. (2003). Adolescents search for health information on the internet: An observational study. *Journal of Medical Internet Research*, 5(4), e25; doi:[10.2196/jmir.5.4.e25](https://doi.org/10.2196/jmir.5.4.e25)
- Hargittai, E., Fullerton, L., Menchen-Trevino, E., & Yates Thomas, K. (2010). Trust online: Young adults' evaluation of web content. *International Journal of Communication*, 4, 1, 468-494.
- Harris, P.R., Sillence, E., & Briggs, P. (2011). Perceived threat and corroboration: Key factors that improve a predictive model of trust in Internet-based health information and advice. *Journal of Medical Internet Research*, 13, 3, e51; doi:[10.2196/jmir.1821](https://doi.org/10.2196/jmir.1821)
- Hembrooke, H.A., Gay, G.K., & Granka, L.A. (2005). The effects of expertise and feedback on search term selection and subsequent learning. *Journal of the American Society for Information Science*, 56, 8, 861-871.

- Hu, L., & Bentler, P.M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Structural Equation Modeling*, 6, 1, 1-55.
- Iding, M.K., Crosby, M.E., Auerheimer, B., & Klemm, E.B. (2009). Web site credibility: Why do people believe what they believe? *Instructional Science*, 37, 1, 43-63.
- Jenkins, C., Corritore, C.L., & Wiedenback, S. (2003). Patterns of information seeking on the web: a qualitative study of domain expertise and web expertise. *IT&Society*, 1(3), 64-89.
- Kaiser, H. (1974). An index of factorial simplicity. *Psychometrika*, 39, 31-36.
- Kelton, K., Fleischman, K.R., & Wallace, W.A. (2008). Trust in digital information. *Journal of the American Society for Information Science and Technology*, 59, 3, 363-374.
- Keselman, A., Browne, A.C., & Kaufman, D.R. (2008). Consumer health information seeking as hypothesis testing. *Journal of the American Medical Informatics Association*, 15, 4, 484-495.
- Lucassen, T., & Schraagen, J.M. (2011). Factual accuracy and trust in information: The role of expertise. *Journal of the American Society for Information Science and Technology*, 62, 7, 1232-1242.
- Lucassen, T., & Schraagen, J.M. (2013). Topic familiarity and information skills in online credibility evaluation. *Journal of the American Society for Information Science and Technology*, 64, 254-264.
- MaKinster, J.G., Beghetto, R.A., & Plucker, J.A. (2002). Why can't I find Newton's Third Law? Case studies of students use of the web as a science resource. *Journal of Science Education and Technology*, 11, 2, 155-172.
- Menchen-Trevino, E., & Hargittai, E. (2011). Young adults' credibility assessment of Wikipedia. *Information, Communication & Society*, 14, 1, 24-51.
- Metzger, M.J. (2007). Making sense of credibility on the Web: Models for evaluating online information and recommendations for future research. *Journal of the American Society for Information Science and Technology*, 58, 13, 2078-2091.
- Nettleton, S., Burrows, R., & O'Malley, L. (2005). The mundane realities of the everyday lay use of the internet for health, and their consequences for media convergence. *Sociology of Health and Illness*, 27, 7, 972-992.
- Pallant, J. (2010). *SPSS Survival Manual* (4th edn). Open University Press.
- Rieh, S.Y., & Hilligoss, B. (2008). College students' credibility judgments in the information seeking process. In: M.J. Metzger (Ed.), *Digital Media, Youth and Credibility* (pp. 49-71). Cambridge, MA: MIT Press.

- Robins, D., Holmes, J., & Stansbury, M. (2010). Consumer health information on the web: The relationship of visual design and perceptions of credibility. *Journal of the American Society of Information Science and Technology*, *61*, 1, 13-29.
- Rowley, J., & Johnson, F. (2013). Understanding trust formation in digital information sources: The case of Wikipedia. *Journal of Information Science*, *39*, 4, 494-508.
- Sanchez, C.A., Wiley, J., & Goldman, S.R. (2006). Teaching students to evaluate source reliability during Internet search tasks. In: S.A. Barab, K.E. Hay, & D.T. Hickey (Eds.), *Proceedings of the seventh international conference on the learning sciences* (pp. 662-666). Bloomington, IN: International Society of Learning Sciences.
- Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research Methods for Business Students*. (5th edn.), Harlow: Pearson Education.
- Segars, A.H., & Grover, V. (1998). Strategic Information Systems Planning Success: An Investigation of the Construct and Its Measurement. *MIS Quarterly*, *22*, 2, 139-163.
- Seyal, A.H., Rahman, M.N.A., & Rahim, M.M. (2002). Determinants of academic use of the Internet: a structural equation model. *Behaviour & Information Technology*, *21*, 1, 71-86.
- Shen, X.-L., Cheung, C.M., & Lee, M.K.O. (2012). What leads students to adopt information from Wikipedia? An empirical investigation into the role of trust and information usefulness. *British Journal of Educational Technology*, *44*, 3, 502-517.
- Sillence, E., Briggs, P., Harris, P., & Fishwick, L. (2007a). Going online for health advice: Changes in usage and trust practices over the last five years. *Interacting with Computers*, *19*, 3, 397-406.
- Sillence, E., Briggs, P., Harris, P., & Fishwick, L. (2007b). How do patients evaluate and make use of online health information? *Social Science & Medicine*, *64*, 9, 1853-1862.
- Smith, D. (2011). Health care consumer's use and trust of health information sources. *Journal of Communication in Healthcare*, *4*, 3, 200-210.
- Vakkari, P., Pennanen, M., & Serola, S. (2003). Changes in search terms and tactics while writing a research proposal: a longitudinal case study. *Information Processing & Management*, *39*, 3, 445-463.
- Walraven, A., Brand-Gruwel, S., & Boshuizen, H.P.A. (2009). How students evaluate information and sources when searching the World Wide Web for information. *Computers & Education*, *52*, 1, 234-246.
- Wang, Y.D., & Emurian, H.H. (2005). An overview of online trust: Concepts, elements, and implications. *Computers in Human Behaviour*, *21*, 1, 105-125.

- White, R.W., Dumais, S.T., & Teevan, J. (2009). Characterizing the influence of domain expertise on web search behaviour (pp. 132-141). Proceedings of *WSDM, February 9-12, Barcelona, Spain*.
- Wildemuth, B.M. (2004). The effects of domain knowledge on search tactic formulation. *Journal of the American Society for Information Science and Technology*, 55, 3, 246-258.
- Xiao, N., Sharman, R., Rao, H.R., & Upadhyaya, S. (2014). Factors influencing online health information search: An empirical analysis of a national cancer-related survey. *Decision Support Systems*, 57, 417-427.
- Yaari, E., Baruchson-Arbib, S., & Bar-Ilan, J. (2011). Information quality assessment of community-generated content – A user study of Wikipedia. *Journal of Information Science*, 37, 5, 487-498.

Table 1. Constructs and constructs definitions

Construct	Construct definition	Mean	s.d.	Cronbach's alpha	Measurement items informed by:
<i>Credibility</i>	The believability and impartiality of the information	3.89	0.639	0.750	Fogg et al., 2003 Hargittai, Fullerton, Menchen-Trevino and Yates Thomas, 2010 Hjørland, 2012 Kelton, Fleischman and Wallace, 2008 Lim and Simon, 2011 Menchen - Trevino and Hargittai, 2011 Metzger, 2007 Rieh and Hillgoss, 2008 Sillence, Briggs, Harris and Fishwick, 2007a,b Walraven, Brand-Gruwel and Boshuizen, 2009 Wang and Emurian, 2005
<i>Content</i>	The core characteristics of the information, such as reliability, accuracy and currency	3.76	0.692	0.724	
<i>Style</i>	The way in which the information is presented and written	3.72	0.699	0.728	
<i>Usefulness</i>	The extent to which the user is informed by and can make use of the information	3.64	0.591	0.784	
<i>Brand</i>	Brand indicators and reputation	3.59	0.821	0.753	
<i>Ease of Use</i>	The ease of locating, accessing and using the information	3.45	0.904	0.834	
<i>Recommendation</i>	Recommendations regarding the information from known person(s)	3.33	0.706	0.720	
<i>Authority</i>	The expertise and standing of the author or organisation responsible for providing the information	3.70	0.651	0.580	
<i>Triangulation</i>	The extent to which the information is consistent with other information on the same topic	3.49	0.725	0.592	

