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User Perceptions of Information Quality in China: The Boomerang Decade

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Abstract

China has adopted and implemented the Internet as a vehicle for economic development during the past several decades. As this has occurred, the Chinese national government has sought to control access to information in various ways over time. As political philosophies have changed over time, so has control over the ways in which users are able to publish and access information through the Internet in China. This study examines user perceptions of information quality in China over the decade beginning in 2007 and ending in 2017. Data were collected three times at five-year intervals. The results show that user perceptions have changed in a way that is consistent with changes in control over use of the Internet in China during this ten-year period. Specifically, user perceptions of information quality along a number of dimensions are similar at the beginning and end of this decade and either significantly higher or lower in the middle of the decade in ways that are consistent with Chinese control of the Internet in the middle of this decade. Our research shows that users are sensitive to information quality issues in that the changes in Chinese Internet users' perceptions have shifted in parallel with public events and governmental practices. China is a prototypical case of tight government control of the Internet. The findings of this study shed light on user perceptions in one society of this type. In the long run, information providers should strive to provide high quality information as a strategy for mitigating the effects of fake news.

Keywords: *information quality, user perceptions, China, Internet, longitudinal research; social and technical change*

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1. Introduction

Throughout history, social changes have accompanied technological advances. The wheel changed the way that people lived and worked. The development of paper and printing brought changes to education and entertainment. Similarly, the development of the Internet has brought changes to the way people work, learn, and communicate (Leiner, et al., 1997; World Wide Web Foundation, 2020). These changes have had broad effects and have occurred relatively quickly. Although the Internet technological standards were developed primarily in the United States, the technological infrastructure of the Internet has spread around the world and has influenced societies as they have built the infrastructure needed to adopt and connect to the Internet. This is true in China as elsewhere.

As countries have implemented the technological infrastructure needed to connect their citizens to the Internet, governments have made decisions about the way in which the Internet is used and controlled within the country. In some countries, approaches to the control and use of the Internet have also shifted over time in response to factors and governmental philosophies within the country. The Internet, as it was developed in the United States and Europe, has an underlying philosophy of open-access to information and an essentially democratic nature (Berners-Lee, 2013). This is arguably inconsistent with the basic philosophy of information governance at a national level in China. The Chinese government has, therefore, had to develop a governance approach to the Internet that is somewhat different than the technical architecture of the Internet. At the national level, the adoption and use of the Internet in China has been deployed as a tool of economic development. Although this has led to improvements in the standard of living in China, Chinese citizens have faced limitations to their access to information available elsewhere through the Internet (Shao et al., 2016).

While government regulations have limited access to information available through the Internet in China, the nature of these restrictions has varied over time (Dong, 2012; Wang and Mark, 2015). The technology of the Internet makes it relatively easy for governmental authorities to quickly implement changes related to what citizens are allowed to see and communicate through the Internet. There have been periods of relatively open and freer access to information as well as periods of tighter control. Generally speaking, controls related to the Internet in China became looser during a period ending in 2012 and have become more restrictive in the years since. These changes have affected what and how information is available to users in China. Users are aware of issues related to information quality, and these changes are likely to be reflected in shifts in Chinese users' perceptions of the information available through the Internet over time.

China is an ever-important player in the world economy and international affairs. With its largest population and number of online users, we, as researchers, have a responsibility to study its users. This study examines changes in Chinese user perceptions of the information quality of Internet-based information. Yang (2014) notes that Internet use in China is inherently complex and dynamic; and the present study continues a tradition that seeks to understand the relationship between the Internet and user perceptions and behaviors in China (Kluver and Yang, 2005; Li and Kirkup, 2007; G. Yang, 2007). We believe the changing environment with its unique cultural, social, and political characteristics will affect and be affected by user behaviors and attitudes toward the Internet and the information available from it.

In this study, we look at information quality from the perspective of information consumers. Data were collected three times over ten years: first in 2007, then in 2012, and finally in 2017. In each time period, similar groups of respondents were surveyed using the same survey instrument. The central question examined in this study is whether user perceptions of the information quality of Internet-based sources of information have shifted over time as policies and control of Internet content have changed in China. China is a prototypical case of tight government control of the media. These findings of study shed light on user perceptions in one society of this type.

2. Literature Review

In order to address the question of the extent to which user perceptions of the information quality of Internet-based information have changed over time, a very brief history of the use of the Internet in China is offered. The framework of information quality used in the study is then introduced and applied to an examination of events in China during the period of the study.

2.1 A Brief History of the Internet in China

As in other parts of the world, Internet use in China began with the use of email and other forms of communication primarily to facilitate research initiatives supported by the central government and universities (Lu et al., 2002; CERNET, 2001). Over time, use of the Internet grew to include a much more diverse set of users who were drawn to

the Internet to conduct business, find information, engage in entertainment, and socialize. As elsewhere, use of the Internet grew rapidly in the late 1990s and twenty-first century (CNNIC, 1997; CNNIC, 2012; CNNIC, 2017b).

The Internet was originally designed to facilitate open communication and open access to information. As China adopted the Internet, the issue of fit between policies and priorities of the country and the architecture of the Internet became apparent. While the central Chinese government has embraced the Internet at times in order to facilitate the economic development of the country (CNNIC, 2016; Ferdinand, 2016), it has also struggled to control the publication and online discussion of information on topics that are viewed as sensitive or forbidden by the government. Efforts to block posts and users are among the tactics developed to limit the online publication of information on the Internet (Bamman, et al., 2012).

2.2 Information Quality in the Context of the Internet

In the early days of Internet use, practitioners, scholars, and teachers expressed alarm about the ease with which imperfect information could be published and distributed through the Internet. (Clausen, 1996; Keltner, 1998; Saha et al., 2012). There was wide-spread concern that Internet users, and especially students, were ill-prepared to deal with the information quality issues posed by the Internet and would accept everything they read on the Internet as being accurate, complete, unbiased, and so forth. Similar concerns are sometimes voiced today, in part, because of developments such as big data (Ge and Dohnal, 2018) and fake news (Handley, 2018).

In stark contrast to this view, empirical evidence suggests that users are aware of information quality issues associated with the Internet and recognize relative strengths and weaknesses of information published on the Internet (Klein, 2001; Klein and Callahan, 2007; Klein et al., 2011a, 2011b; Rieh and Belkin, 1998). Much of this evidence is based on Internet users in the United States, although some international efforts have been carried out in Mexico and China (Klein, 2001; Klein et al., 2011a, 2011b).

Numerous frameworks organizing the dimensions of information quality have been proposed and used in the field (e.g., Arazy and Kopak, 2011; Fox et al., 1993; Helfert and Foley, 2009; Huh et al., 1990; Naumann, 2002; Wang and Strong, 1996), and a variety of instruments for measuring information quality have been developed (Lee et al., 2002; Michnik and Lo, 2007; Wang and Strong, 1996). Because the study described in this paper is part of a long-standing research program in which data have been collected in several countries for several different purposes over a relatively long period of time, the framework developed by Wang and Strong (1996) is used in this paper to theorize about and measure information quality. Wang and Strong (1996) proposed a framework and measures from the perspective of information consumers. In this conceptualization of the dimensions of information quality, data quality attributes are grouped into four categories: intrinsic data quality, contextual data quality, representational data quality, and accessibility data quality. There are fifty items measuring the fifteen dimensions of information quality. The majority of the dimensions are measured by multiple items. The dimensions cover various aspects of information quality from accuracy to completeness, from style to accessibility, from timeliness to scope, and more. These dimensions as a whole express the idea that high quality data and information are of intrinsic high quality, appropriate to the task context, and clearly represented and accessible to the user.

The Wang and Strong (1996) framework are one of the most comprehensive and carefully developed frameworks in the field of information quality research. The framework has been applied in a large number of studies (e.g., Baskarada, 2010; Huang et al., 1999; Katerattanakul and Siau, 2008; Klein, 2001; Klein and Callahan, 2007; Klein et al., 2011a, 2011b, 2014; Lee et al., 2002; Michnik and Lo, 2007; Pipino et al., 2002; Strong et al., 1997). It has also been available and in use over a long period of time which has facilitated data collection for a decade in the present study and even longer in the research program in which this study is embedded.

Table 1 shows the fifteen dimensions of information quality used in the Wang and Strong (1996) framework grouped into the four categories of information quality. The last column shows the data attributes of the fifteen dimensions of information quality.

2.2.1 Intrinsic Data Quality and Perceptions of Internet-Based Information in China

The intrinsic data quality category in the Wang and Strong (1996) information quality framework includes the dimensions of believability, accuracy, objectivity, and reputation. User perceptions of believability, accuracy, objectivity, and reputation of Internet-based information in China are likely to have shifted over time as the government

Information Quality Category	Dimension of Information Quality	Data Attributes
Intrinsic Data Quality	Believability	Believable
	Accuracy	Data are certified error-free, Error free, Accurate, Correct, Flawless, Reliable, Errors can be easily identified, The integrity of the data, Precise
	Objectivity	Unbiased, Objective
	Reputation	The reputation of the data source, The reputation of the data
Contextual Data Quality	Value-added	Data give you a competitive edge, Data add value to your operations
	Relevancy	Applicable, Relevant, Interesting, Usable
	Timeliness	Age of data
	Completeness	The breadth of information, The depth of information, The scope of information
	Appropriate amount of data	The amount of data
Representational Data Quality	Interpretability	Interpretable
	Ease of understanding	Easily understood, Clear, Readable
	Representational consistency	Data are continuously presented in same format, consistently represented, consistently formatted, Data are compatible with previous data
	Concise representation	Well-presented, Concise, compactly represented, Well-organized, aesthetically pleasing, Form of presentation, Well-formatted, Format of the data
Accessibility Data Quality	Accessibility	Accessible, Retrievable, Speed of access, Available; Up-to-date
	Access security	Data cannot be accessed by competitors, Data are of a proprietary nature; Access to data can be restricted; Secure

has changed the extent and nature of its control over Internet-based information in the country. During periods of relatively restrictive government policy with respect to the Internet, users are likely to more strongly distrust Internet-based information and their views of the believability, accuracy, objectivity, and reputation of this information are likely to be lower than during times of more openness and weaker control.

During the period of time in which the Chinese Communist Party has controlled the government in China, the government has generally exercised media control and used the media for ideological purposes. The introduction of the Internet in China with its philosophy of open access to information and potential to publish user generated content was viewed by some as being likely to transform the way in which the government controls the media in China (G. Yang, 2007; Wu, 2012). While this has proven to be the case in some ways (e.g., the publication of information during the outbreak of SARS in 2002), government control over information published and disseminated through the Internet has followed traditional practices of limiting access to information in other ways (Shao et al., 2016).

The Chinese government has engaged in media control and censorship of Internet-based information throughout the history of Internet use in China, but the extent and nature of this control has varied over time in response to political objectives and concerns (MacKinnon, 2008). In some ways, the government has used the Internet to encourage openness and reform (Balla, 2014); while in other ways, technical measures and systems have been implemented to limit access to data and information, silence critical views and voices, and discourage collective and public expressions and actions (Feng and Guo, 2013; King et al., 2013, 2014).

Chinese government regulation of Internet-based information dictates that online sources of news are controlled at either the national or local level of government (Chu, 2017). Free speech is limited with respect to statements criticizing the government or national policies and practices (Shao et al., 2016). The nuances of the specific practices, enforcement, and penalties associated with these regulations vary over time in response to government concerns. Because penalties can be severe, knowledge of these nuances spreads widely among the user population in China; and Internet users tend to understand how to conform to these regulations and how to avoid incurring penalties for violating the regulations. This awareness of shifts in government regulations suggests that user perceptions of the intrinsic data quality of Internet-based information are likely to also vary in response to user knowledge and reactions to these changes over time in government regulation of Internet-based information.

At times, heightened awareness of issues associated with intrinsic data quality emerges among the user population in China. For example, a national protest centered on the issue of the accuracy of Internet-based information occurred following the death of a Chinese college student in 2016 who was believed to have died, at least in part, because of inaccurate information disseminated through the Internet on appropriate medical treatments for his condition (Li, 2016). Internet users are likely to have been aware of this event, and their perceptions of the intrinsic data quality of Internet-based information generally are likely to have shifted because of this awareness.

Evidence of Chinese Internet users' sensitivity to issues associated with intrinsic data quality are also found in surveys of Internet users who report that they trust media sources in the west more than they trust Chinese sources of information (Weber and Fan, 2016) and trust news published by official news agencies more than they trust commercial news sites (Xie and Zhao, 2014).

As detailed later in the manuscript, we expect changes in government regulation and control of Internet-based information over time to affect Chinese users' perceptions of intrinsic data quality. We expect these changes to be particularly evident among urban, college students in China who are frequent and well-educated users of the Internet. Specifically, we expect perceptions of the believability, accuracy, objectivity, and reputation of Internet-based sources of information to shift during the decade beginning in 2007.

2.2.2 Contextual Data Quality and Perceptions of Internet-Based Information in China

The contextual data quality category in the Wang and Strong (1996) information quality framework includes the dimensions of value-added, relevancy, timeliness, completeness, and appropriate amount of data.

Chinese governmental control of the publication and dissemination of Internet based data may affect user perceptions of the dimensions of data quality associated with contextual data quality. Users understand that censorship is blocking their access to information on certain topics and on information related to points of view opposed by the government. This leaves users with an understanding that the information they access for any particular task may be incomplete for that task. They also may realize that relevant information is missing and that issues of timeliness affect the data they can access in the sense that the most up-to-date information may be blocked. Finally, users' assessments of the appropriate amount of data may be affected by their awareness that some data may be blocked when they search for information on a topic or information they need for a task.

User perceptions of value-added, relevancy, timeliness, completeness, and appropriate amount of data may have been affected in the time period following President Xi's 2015 call for tightened control over the media and heightened monitoring of social media in China (Creemers, 2015; The Washington Post, 2016; Wong, 2016a, 2016b). Following this call, a law was implemented in 2017 imposing additional Internet restrictions including expanded authority of a department charged with monitoring and controlling the Internet.

Chinese government regulation and censorship of Internet-based information is well documented and well understood by Chinese users of the Internet. This regulation and censorship affect user perceptions of the value-added, relevancy, timeliness, completeness, and appropriate amount of data because people are aware of these controls. Since users know that some information is blocked, they understand that information is incomplete and lacking in some ways with respect to the value-added, timeliness, and appropriate amount of data dimensions of data quality. As regulations and the extent and nature of censorship change over time, user perceptions of these dimensions of data quality will also shift over time. A key element of regulation and censorship of the Internet is that policies and practices are not kept secret from Internet users. Rather, the policies work, at least in part, because they are well understood and users are quite knowledgeable about what is and is not allowed on the Internet. As changes occur in Internet regulation, users are informed and communicate with one another about these changes.

Consequently, user perceptions will reflect this and will shift as the nature and extent of regulations and censorship shift over time.

2.2.3 Representational Data Quality and Perceptions of Internet-Based Information in China

The representational data quality category in the Wang and Strong (1996) information quality framework includes the dimensions of interpretability, ease of understanding, representational consistency, and concise representation.

Chinese regulation and censorship of the Internet is concerned with information content rather than with the presentation or format of information. If content is allowed, it can be published and disseminated in any format with any degree of interpretability and ease of understanding. These are simply not concerning of Chinese government policy or practice. Because of an absence of regulation related to representational data quality, we do not expect to see shifts in user perceptions of interpretability, ease of understanding, representational consistency, and concise representation.

2.2.4 Accessibility Data Quality and Perceptions of Internet-Based Information in China

The accessibility data quality category in the Wang and Strong (1996) information quality framework includes the dimensions of accessibility and access security.

A key aim of censorship is the limiting of access to information and ideas. As regulations and censorship strategies have changed over time in China, access to information has changed and user perceptions of accessibility and access security have in turn shifted.

Accessibility issues related to the Internet in China are twofold. First, the Great Fire Wall of China (Zhong et al., 2017) blocks access to a wide array of websites by Chinese users. The exact websites blocked vary over time, and users are well aware of these changes. The existence of the fire wall is known by Chinese users of the Internet and the ways in which it operates are understood. Users employ tactics such as Virtual Private Networks to thwart censorship but face a dynamic environment as these tactics are themselves shut down over time (Yang and Liu, 2014). Second, in order to avoid governmental sanctions, commercial websites engage in regulation and censorship of their own. Posts and texts related to sensitive topics and those containing a government-issued list of forbidden words and topics are simply not published. User awareness of these restrictions is evidenced by the use of text manipulation tactics designed to avoid the detection of forbidden words (Kou et al., 2017). Search engines available in China do not return results related to forbidden topics. These practices have become a normal part of Internet use for Chinese users; and, in general, users are knowledgeable about these restrictions.

Knowledge of these practices affect users' perception of data accessibility and security. As practices related to censorship change over time, users' perceptions of accessibility and access security are also expected to shift. Since an understanding of what is and is not permitted on the Internet is vital to avoiding sanctions in China, we expect that user perceptions of these two dimensions of data quality will be especially responsive to changes in governmental policy.

3. Research Questions and Hypotheses

This study addresses the question of whether users' perceptions of the information quality of Internet-based information have changed over time in China.

The set of fifteen hypotheses given below are tested to answer the research question using data collected in 2007, 2012 and 2017. The fifteen hypotheses are organized according to the four categories of data quality in the Wang and Strong framework (1996).

3.1 Shifting Patterns in Intrinsic Data Quality

Intrinsic data quality includes the innate attributes of information, such as accuracy, objectivity, believability, and reputation. The truthfulness of information is the focus. In the past decade, online content has experienced explosive growth in volume. Compared to the traditionally controlled state media, online content has enjoyed a period of openness. We propose that user perceptions are influenced by these changes so user perceptions of intrinsic data quality will also change, which is embodied in its believability, accuracy, objectivity, and resulting reputation.

- Hypothesis H1:** A shifting pattern will be observed in perceptions of the **believability** of Internet-based sources of information in 2007, 2012, and 2017 among urban, Chinese college students.
- Hypothesis H2:** A shifting pattern will be observed in perceptions of the **accuracy** of Internet-based sources of information in 2007, 2012, and 2017 among urban, Chinese college students.
- Hypothesis H3:** A shifting pattern will be observed in perceptions of the **objectivity** of Internet-based sources of information in 2007, 2012, and 2017 among urban, Chinese college students.
- Hypothesis H4:** A shifting pattern will be observed in perceptions of the **reputation** of Internet-based sources of information in 2007, 2012, and 2017 among urban, Chinese college students.

3.2 Shifting Patterns in Contextual Data Quality

Contextual category of data quality examines the characteristics related to external use of data and information. Chinese Internet users, both data consumers and content providers, understand the constraints within which they are operating. Biased information may present an incomplete picture since it does not present arguments from all sides, although the absolute amount of information available has increased. Thus, we posit there are changes in user perceptions in contextual data quality dimensions.

- Hypothesis H5:** A shifting pattern will be observed in perceptions of the **value-added** of Internet-based sources of information in 2007, 2012, and 2017 among urban, Chinese college students.
- Hypothesis H6:** A shifting pattern will be observed in perceptions of the **relevancy** of Internet-based sources of information in 2007, 2012, and 2017 among urban, Chinese college students.
- Hypothesis H7:** A shifting pattern will be observed in perceptions of the **timeliness** of Internet-based sources of information in 2007, 2012, and 2017 among urban, Chinese college students.
- Hypothesis H8:** A shifting pattern will be observed in perceptions of the **completeness** of Internet-based sources of information in 2007, 2012, and 2017 among urban, Chinese college students.
- Hypothesis H9:** A shifting pattern will be observed in perceptions of the **appropriate amount of data** of Internet-based sources of information in 2007, 2012, and 2017 among urban, Chinese college students.

3.3 No Shifting Patterns in Representational Data Quality

Although presentation of information plays a role in understanding information and the interface of Web has evolved, in essence it is still text-based and linked pages with images and videos. Overall the design of information presentation has not change significantly. More critically, in China, the presentation of the information is not the concern of censorship and access restriction. Therefore, we posit that there are no changes in user perceptions in the dimensions of interpretability, ease of understanding, representational consistency, and concise representation.

- Hypothesis H10:** No shifting pattern will be observed in perceptions of the **interpretability** of Internet-based sources of information in 2007, 2012, and 2017 among urban, Chinese college students.
- Hypothesis H11:** No shifting pattern will be observed in perceptions of the **ease of understanding** of Internet-based sources of information in 2007, 2012, and 2017 among urban, Chinese college students.
- Hypothesis H12:** No shifting pattern will be observed in perceptions of the **representational consistency** of Internet-based sources of information in 2007, 2012, and 2017 among urban, Chinese college students.
- Hypothesis H13:** No shifting pattern will be observed in perceptions of the **concise**

representation of Internet-based sources of information in 2007, 2012, and 2017 among urban, Chinese college students.

3.4 Shifting Patterns in Accessibility Data Quality

In the Wang and Strong (1996) framework, accessibility data quality includes both accessibility and access security. Data consumers using computers to access information view accessibility data quality as an important dimension of data quality (Wang and Strong, 1996). This study examines whether Chinese users' perception of accessibility and security have changed over time. Restriction to access of information is fundamentally at the heart of the control over the Internet by the Chinese government. At times, the Chinese government has loosened its control of the Internet, and we posit that user perceptions have been affected by these shifts.

Hypothesis H14: A shifting pattern will be observed in perceptions of the **accessibility** of Internet-based sources of information in 2007, 2012, and 2017 among urban, Chinese college students.

Hypothesis H15: A shifting pattern will be observed in perceptions of the **access security** of Internet-based sources of information in 2007, 2012, and 2017 among urban, Chinese college students.

4. Methodology

The purpose of the current study is to examine user perceptions of information quality in China from 2007 to 2017. Survey data were collected three times: first in 2007, then in 2012, and finally in 2017. The same survey was used in a similar research setting in all three rounds of data collection. Data were collected from undergraduate students in a major, national university in Beijing, China. The student population of the university has been stable over the years in terms of educational and socioeconomic background and therefore provides a good setting for the examination of changes in perceptions over time.

The information quality framework developed by Wang and Strong (1996) provides the foundation of the survey used in the current study. The survey has been used in prior studies of information quality (e.g., Klein, 2001; Klein and Callahan, 2007; Klein et al., 2011a, 2011b). The survey used in the current study includes a set of fifty questions that measure users' perceptions of the information quality of Internet-based information along fifteen dimensions (Wang and Strong, 1996). The questions in the survey were written in both Chinese and English as shown in Appendix A.

Characteristics of the survey respondents are summarized in Table 2. The respondent profiles are similar across the three time periods. However, the 2007 cohort had fewer years of experience with computers and the Internet because young children did not start using computers and the Internet as early in this cohort compared to later cohorts. Male students made up more than half of the survey respondents due to the nature of their course enrollments, and consistent with the finding that there are more male Internet users than female users in China (CNNIC, 2017b). For ease of reference, we will refer to the data sets from 2007, 2012, and 2017 as T1, T2, and T3 respectively.

5. Empirical Results

The results of the data analysis are reported here, first for the reliability of the measures and then for tests of the research hypotheses.

5.1 Reliability of the Measures

The measures used in data collection for the study have been previously validated and used in past studies (e.g., Klein, 2001; Klein and Callahan, 2007; Klein et al., 2011a, 2011b). The survey includes questions measuring the fifteen dimensions of information quality. We first examined the reliability of the dimensions that are measured with more than one item. Table 3 presents Cronbach's alpha for these dimensions for the three rounds of data collection. The objectivity dimension has poor reliability and was therefore excluded from the remaining analysis.

	2007 (T1)	2012 (T2)	2017 (T3)
Number of valid responses	253	200	265
Average age	21	21	20
Gender	Male: 185 Female: 68	Male: 112 Female: 88	Male: 187 Female: 63
Most common level	Junior	Junior: 144 Freshman: 16	Junior: 157 Freshman: 79
Most common major	Telecommunications	Telecommunications: 116 Computer: 32	Signal and control: 140 Telecommunications: 65
Years of computer experience	5.7	8.1	6.8
Years of Internet experience	4.8	6.9	6.7

Dimension of Information Quality	Cronbach's Alpha		
	2007 (T1)	2012 (T2)	2017 (T3)
Accuracy	.861	.902	.868
Objectivity	.539	.636	.580
Completeness	.771	.742	.726
Reputation	.754	.728	.766
Value-added	.762	.705	.724
Relevancy	.691	.796	.707
Ease of Understanding	.738	.756	.755
Representational Consistency	.563	.753	.663
Concise Representation	.805	.822	.873
Accessibility	.808	.853	.828
Access Security	.729	.776	.714

5.2 User Perceptions of Information Quality of Internet-Based Sources

Next, we conducted mean comparisons of the fifteen dimensions across the three time periods included in the study. For dimensions in intrinsic data quality (H1, H2, and H4, H3 is dropped because of the low reliability of objectivity dimension), contextual data quality (H5-H9), and accessibility data quality (H14 and H15), we hypothesized shifts over time. Thus, a supported hypothesis means a significant shift was detected. The results show one dimension of intrinsic data quality (accuracy), two dimensions of contextual data quality (completeness and appropriate amount), and both dimensions of accessibility data quality supported with a statistically significant difference. For the representational data quality category, we hypothesized no shift in user perceptions of information quality. Thus, a hypothesis is supported when no significant difference is found. The results show no differences. Thus, all four hypotheses for the representational data quality category are supported.

Tests were conducted to determine whether gender has an effect on respondents' perceptions of information quality. Gender was not significant for 2007 and 2017. In the 2012 data, females rated believability, objectivity, timeliness, representational consistency, and concise representation significantly higher than male participants. There is no statistically significant difference in the other dimensions of information quality.

Tests were conducted to determine whether experience with computers has an effect on respondents' perceptions of information quality. The number of years of computer use is not statistically significant for 2007, 2012, and 2017.

Tests were conducted to determine whether experience with the Internet has an effect on respondents' perceptions of information quality. The number of years of Internet use is not statistically significant for 2007, 2012, and 2017.

Dimension of Information Quality	2007 (T1)	2012 (T2)	2017 (T3)	Mean comparison p-value	Hypothesis	Supported?
Intrinsic Data Quality						
Believability	3.57	3.67	3.63	.777	H1	Not supported
Accuracy	3.46	3.72	3.43	.015	H2	Supported
Reputation	3.60	3.65	3.53	.653	H4	Not Supported
Contextual Data Quality						
Value-added	4.25	4.04	4.18	.280	H5	Not supported
Relevancy	4.27	4.24	4.25	.942	H6	Not supported
Timeliness	4.48	4.43	4.49	.914	H7	Not supported
Completeness	4.57	4.18	4.41	.007	H8	Supported
Appropriate Amount	5.02	4.54	5.01	.003	H9	Supported
Representational Data Quality						
Interpretability	4.07	4.00	4.15	.524	H10	Supported
Ease of Understanding	4.41	4.17	4.28	.128	H11	Supported
Representational Consistency	3.72	3.83	3.64	.158	H12	Supported
Concise Representation	3.81	3.85	3.85	.823	H13	Supported
Accessibility Data Quality						
Accessibility	4.64	4.28	4.66	.003	H14	Supported
Access Security	3.40	3.77	3.25	.000	H15	Supported

The first category of dimensions deals with the intrinsic information quality. Among the three remaining dimensions, only the accuracy dimension had a significant change in user perception over time. With 2012 data as the highest, it shows that users perceived the accuracy of information online better than that in 2007 and 2017. Although no significant changes are observed in believability and objectivity they were rated consistently low compared to other dimensions of data.

If the first category of information quality is the internal, the second category addresses external aspects. Among the five dimensions, only two dimensions of user perceptions have changed significantly over time. They are completeness and appropriate amount. The low points occurred in 2012. As hypothesized, there were no shifts in user perception of dimensions of representational data quality. These dimensions of information quality are the interpretability, ease of understanding, representational consistency, and concise representation of information. Compared to dimensions in other categories that related to the content of the information, these dimensions measure the presentational aspects of information display. If the content of and access to information is the core motive and focus of governmental control, presentational aspects have not experienced the same changes in regulation and practices. This is reflected in the stability of user perceptions of these dimensions of information quality. Both dimensions in accessibility category show change over time. The pattern of change shows that accessibility is similar to completeness and appropriate amount.

Table 5 presents the results of a post hoc analysis using Tukey tests to determine which time periods are significantly different for each dimension of information quality. For comparisons with statistically significant differences, the homogeneous subsets are given. The sparklines in the last column trace the mean values of a dimension over the three time periods, visually showing the trends and changes. For dimensions that are not different, the sparklines look like a straight line with little slope. For those dimensions that are different over the time, sparklines show a change of direction. The patterns are either Boomerang or the reverse. This observation is a way of visualizing change over time.

In summary, among the dimensions, there were significant changes in user perceptions of five dimensions. These dimensions are related to the availability of information, such as completeness, appropriate amount, accessibility, and accessibility security.

Table 5. Perceptions of Internet-based Sources 2007, 2012, and 2017 – Tukey Tests

Dimension of Information Quality	2007 (T1)	2012 (T2)	2017 (T3)	different ?	Tukey Tests	Homogenous Subsets	Sparkline
Believability	3.57	3.67	3.63	No		(T1, T2, T3)	
Accuracy	3.46	3.72	3.43	Yes	T1 vs. T2 (p=.040) T2 vs. T3 (p=.019)	(T1, T3) (T2)	
Reputation	3.6	3.65	3.53	No		(T1, T2, T3)	
Value-added	4.25	4.04	4.18	No		(T1, T2, T3)	
Relevancy	4.27	4.24	4.25	No		(T1, T2, T3)	
Timeliness	4.48	4.43	4.49	No		(T1, T2, T3)	
Completeness	4.57	4.18	4.41	Yes	T1 vs. T2 (p=.005)	(T1, T3) (T2, T3)	
Appropriate Amount	5.02	4.54	5.01	Yes	T1 vs. T2 (p=.008) T2 vs. T3 (p=.009)	(T1, T3) (T2)	
Interpretability	4.07	4	4.15	No		(T1, T2, T3)	
Ease of Understanding	4.41	4.17	4.28	No		(T1, T2, T3)	
Representational Consistency	3.72	3.83	3.64	No		(T1, T2, T3)	
Concise Representation	3.81	3.85	3.85	No		(T1, T2, T3)	
Accessibility	4.64	4.28	4.66	Yes	T1 vs. T2. (p=.011) T2 vs. T3 (p=.006)	(T1, T3) (T2)	
Access Security	3.4	3.77	3.25	Yes	T1 vs. T2 (p=.006) T2 vs. T3 (p=.000)	(T1, T3) (T2)	

6. Discussion, Implications, and Future Research

The decade from 2007 to 2017 was characterized by a pattern of continuing but slowed economic growth in China (Trading Economics, 2018). However, the general public continued to have little access to most western social media and news organization websites. After a short period of openness, in recent years, more regulation and “self-regulation” of free speech were put into place (Wong, 2016a; The Washington Post, 2016). The most striking observations of our findings reflect the changes that occurred in the larger societal and political environment in that changes in user perceptions of information quality displayed a boomerang pattern over this time period.

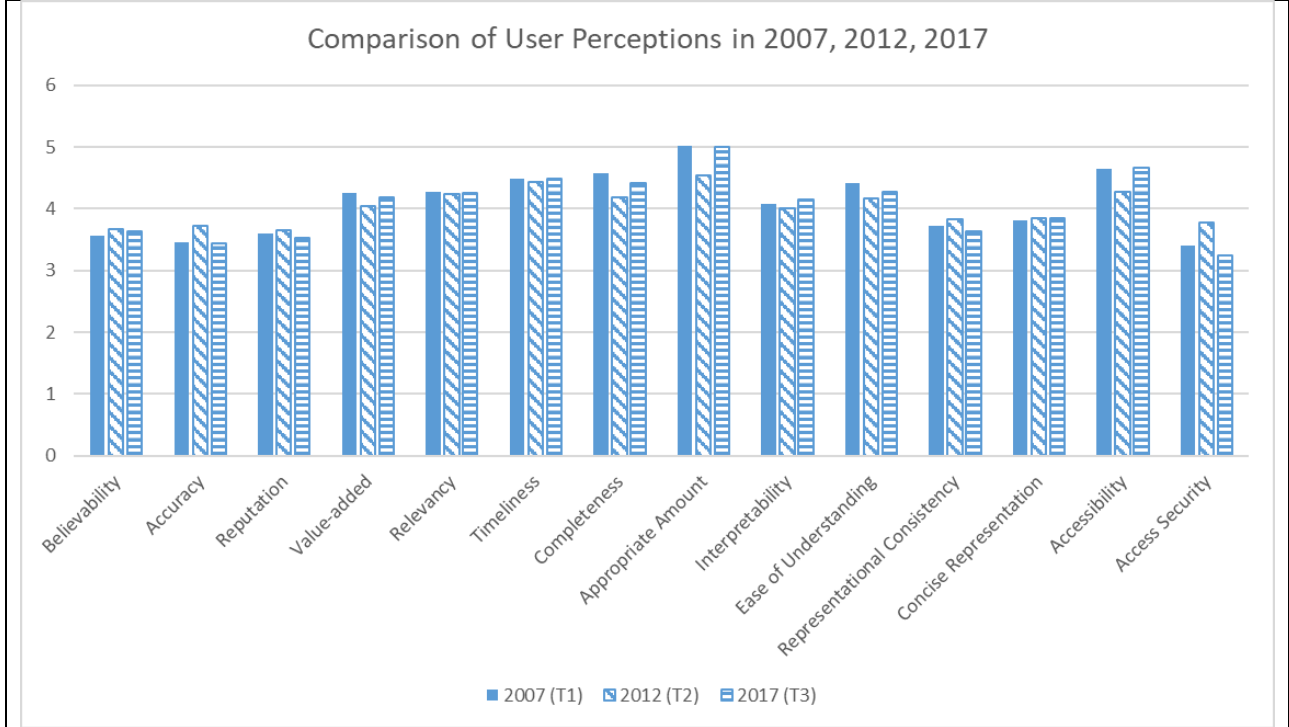
6.1 User Perceptions of Information Quality from 2007 to 2017

In this section, we examine changes in user perceptions of information quality of Internet-based information from 2007 to 2017. We explore this issue from two angles: (1) whether there were significant changes and (2) whether there is a salient pattern of change.

6.1.1 Trends

Significant differences were found in mean values of user perceptions of four dimensions (i. e., completeness, appropriate amount, accessibility, access security) at .01 level and another (accuracy) at .05 level over the three time points. Figure 1 shows a column chart with all of the dimensions of information quality with the three time periods next to each other. As shown in the figure, the greatest changes occur in appropriate amount, access security, accessibility and completeness.

Figure 1. Comparison of User Perceptions in 2007, 2012, and 2017

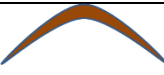
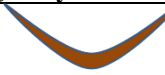


6.1.2 Return to the Past

Compared to the significance of the differences, the pattern of changes may be more telling. In 2017, all of the dimensions return toward the level of 2007, which is very evidently shown in Figure 1 by the sparklines. This can be visualized in the shape of a boomerang. Table 6 shows a summary of these patterns. The dimensions with significant differences at a level of .01 are indicated with two asterisks, while the dimension with a significant difference at a level of .05 is indicated with one asterisk.

All of the dimensions with statistically significant differences in the mean comparisons display a boomerang pattern. Access security and accuracy show this pattern with mean values in 2012 the highest among the three giving a boomerang shape when the pattern is visualized. Completeness, appropriate amount, and accessibility decreased in the 2012 data set and increased in 2017, showing the opposite pattern which can be visualized as a reserved boomerang. A return to the ratings of 2007 in 2017 is a salient pattern in the user perceptions of Internet-based data. For example, for the accuracy dimension, paired comparison Tukey tests show that the mean ratings from 2007 and 2012 are different and that the mean ratings of 2012 and 2017 are different. User perceptions of accuracy reach their peak in 2012 and then return to the level seen in 2007 in 2017.

As shown in Table 6, in addition to the completeness, appropriate amount, and accessibility dimensions which have statistically significant differences for mean comparisons, another five dimensions display a dip in the ratings for 2012.

Table 6. Patterns of Changes in Information Quality Dimensions	
 Boomerang	 Reversed Boomerang
Access security ** Accuracy * Believability Reputation Representational consistency	Completeness** Appropriate amount** Accessibility** Value-added Relevancy Timeliness Interpretability Ease of understanding

** significant at .01 level
 * significant at .05 level

This turning point in 2012 coincides with the scandals of low-quality commercial information and the changes in leadership and government policies in China. This supports the idea that users are sensitive to changes that affect information quality. Access security has been a concern among users in China throughout the years. The dip in ratings after improvement may be the effect of online surveillance, public opinion control projects, and big data initiatives that made users feel vulnerable. When Google left China in 2010, a great loss was felt since it was a sharp reminder of how much information was out of reach for typical Internet users in China. This is consistent with the dip in ratings of accessibility, completeness, and appropriate amount in 2012. Homegrown Internet services in China such as Baidu and Sina Weibo quickly occupied the space left by Western search engines and social media. Subsequently, ratings of these dimensions improved with perceptions of the accuracy of Internet-based sources showing a peak in 2012. Arguably, after several public crises and promising results, public confidence improved in the years leading up to 2012. Subsequently, ratings of these dimensions dropped in an environment characterized by lower quality commercial information and increased censorship and propaganda.

6.2 Contributions and Implications

6.2.1 Contributions

The contributions of this research are threefold. First, the study uses a research method involving a cross-sectional approach with observations over time to study a phenomenon in the MIS field. With three data collections using an identical survey instrument and targeting similar respondents, the research revealed chronological changes in Chinese users' perceptions of Internet-based sources from 2007 to 2017. These findings reflect changes in the larger technical and political environment in which Chinese users operate. We are able to see how technologies and society intertwine and affect one another. One observation of interest is the boomerang shape in most changes, in which user ratings in 2007 and 2017 were closer to each other than to ratings in 2012. Without data from 2012, we would not have seen this pattern. Figure 1 shows that there is not much difference in ratings if we only look at 2007 and 2017. This provides evidence of the power of this type of research design to discern changes over time and strong support for more research in IS research with this approach, especially if we want to discover how information systems and users interact over time. Many effects develop over relatively long periods of time which motivates the need for studies that reexamine phenomena over time.

With the strength of the research in mind, we do realize many challenges it presents. In addition to the difficulty of finding suitable data collection sites, determining the appropriate repeating cycle is difficult. Although the results show a boomerang pattern, we do not know if this is a hiccup on a long term upward or downward trend or a normal fluctuation in data. To find out, we plan to continue data collection in the future. Another question would be whether a five-year cycle is too long. It is possible that changes have been missed even within the five-year time span between the administrations of the survey in this study.

A second contribution of the study is the use of a validated and previously used instrument for data collection. The same survey instrument has been used in prior research to measure user perceptions of information quality in a variety of settings (Klein, 2001; Klein and Callahan, 2007; Klein et al., 2011b). The instrument performs at an acceptable level of reliability and is sensitive enough to reflect differences in various contexts. Results from the present study contribute to this cumulative body of research. We believe that continuing this research tradition in both time and scope will be beneficial to information quality research in particular and information systems research at large.

Third, China is an important player in the world economy and international affairs. With its large population and number of online users, we, as researchers, have a responsibility to study its users whose perceptions of information quality are a critical aspect of understanding how information technologies affect people, unfortunately, this is an area that rarely receives sufficient research attention. The uniqueness of Chinese society provides a rich environment for such studies. The insights gained will be valuable for understanding the interplay of technologies, societies, and people.

6.2.2 Implications

Our research shows that users are sensitive to information quality issues in that changes in Chinese users' perceptions shifted along with public events and governmental practices. The dimensions to which end users paid special attention are those related to integrity and validity, that is intrinsic data quality. The lesson here is that, in the long run,

information providers should strive to provide high quality information. To deal with the challenges presented by widespread fake news, the best strategy may be to continue providing high quality information that are free of bias and objective.

In this study, all of the respondents are college students. For educators, the results of the study provide valuable insights into college students' skills in judging information quality. In contrast to the long-held belief that young people are gullible and lacking in the skills needed to distinguish valid and reliable information sources from less valid information sources, the results suggest that college students in China are experienced Internet users who can critically evaluate information. Encouragingly, the results suggest that at least some college students are sophisticated information consumers whose perceptions are affected by changes in the environment in which information is produced, disseminated, and consumed.

As with many technological innovations, societies have experienced both benefits and drawbacks as they have adapted to the Internet. For example, in 2000 one reporter noted that "in this Internet-driven Information Age, with markets moving on rumors (or the mere whiff of one), code names have gotten more common and creative and become the stuff of street lore." (Tan, 2000; Lazer et al, 2018). With the prevalence of fake news in the past several years, the issue of information quality continues to be a serious concern. Our study builds on research addressing user perceptions of information quality and has the potential to inform the development of skills needed to access Internet-based information.

6.2.3 Future Research

This study was designed to observe changes in user perceptions of information quality over time in a dynamic and sometimes turbulent society. Chinese society has experienced significant political, economic, and social changes in the recent past. As has been the case throughout the history of modern China, these changes have occurred in a global context in which innovations have been shared with and adopted from the rest of the world and in which the degree to which China has been open to and influenced by the rest of the world has varied over time. The most recent period of change has been characterized by the introduction and development of the Internet which has transformed how users access and understand information. These technological advances have been coupled with and affected by shifts in the political climate in China, and the findings of this study demonstrate that user perceptions of information quality reflect these political shifts. In the future, Chinese users' perceptions of information quality are likely to continue to evolve with the political, economic, and social environment. Future research initiatives are planned to extend the documentation and insight into these changes through additional periodic administration of the survey used in this study.

Another area for future study is to build on previous information quality studies by examining user perceptions in different societies. One society of particular interest is Taiwan. While Mainland China and Taiwan share a cultural heritage and language tradition, they have developed different political and economic systems during the past seven decades. As part of this, the two societies have implemented different types of Internet regulations (K. Yang, 2007). Because Taiwan and Mainland China were separated for forty years and then experienced increasing levels of commercial and cultural exchange, a comparison of user perceptions of information quality in these two societies is likely to be both interesting and of significant importance in understanding how societies evolve in the context of technological change and political separation.

In the current research, the targeted user group is college students who have been the major body of Internet users in China. However, recently there has been an increase in the number of older Internet users in China (CNNIC, 2017a, 2017b). These users experienced state media control and events during the pre-Internet era and grew up in a very different socioeconomic environment. In addition, users in rural areas and users with less education in China have been studied less than urban users in China. The views they possess may be different from those of users with access to higher education in urban environments. Research involving more diverse user groups will broaden and test the generalizability of the findings of the current study.

This study focuses on the information quality of Internet-based sources of information. Although the publication of purely traditional sources of information such as print newspapers and magazines has decreased recently, many media outlets have adopted an Internet-based publication platform. Future research addressing the distinction between Internet-based information and traditional sources of information may increase our understanding of this potentially blurry line and the related user perceptions.

7. Conclusion

In the last several decades, Chinese society has experienced a great deal of economic, political, social, and cultural change. The introduction of the Internet has affected all aspects of public and private life. The population of Chinese Internet users grew into the largest in the world in 2008 and is currently larger than the population of Europe (CNNIC, 2017b). Meanwhile, the Chinese government has extended its control of media and the press into the realm of the Internet. The power struggle between state regulations and Internet-emboldened Chinese users has been the focus of many research studies. We took the perspective of Internet users as information consumers and studied changes in user perceptions of information quality from 2007 to 2017.

Changes in key information quality dimensions reflect users' points of concern in the surrounding political and socioeconomic environment. The boomerang pattern in our data shows that users are sensitive to changes in the political and social environment. A research approach with a decade-long time span was necessary to observe shifts over time. Future extensions will extend this project in order to further our understanding of changes in user perception of information quality over time.

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Appendix A:

Your age (年龄): _____

If younger than 18, please stop. Thank. 如果你小于 18 岁, 请停止。谢谢。

Internet Sources of Data. You may have used the Internet for school assignments, work assignments, or personal projects. The following is a list of questions about data from Internet sources (e.g., World Wide Web) that you may have used. Please note that the terms data and information are used interchangeably in this survey.

互联网数据

你也许在完成学校作业, 工作任务, 或个人项目中使用过互联网。以下是一系列有关互联网和万维网数据和信息的问题。在这份问卷调查中, “信息”和“数据”可以交替使用。

Although the questions may seem repetitive, your response to each question is critical to the success of the study. Please answer each question to the best of your ability.

即使有些问题看上去有重复, 请对每个问题一一作答。回答时, 圈中你的第一反应, 并尽量使用全部刻度。请尽你所能回答问题。

	Strongly Disagree 非常不同意			Neutral 中立				Strongly Agree 非常同意
Data from Internet sources are accurate. 互联网数据是准确的。	1	2	3	4	5	6	7	
Data from Internet sources are believable. 互联网数据是可信的。	1	2	3	4	5	6	7	
Data from Internet sources are concise. 互联网数据是简明的。	1	2	3	4	5	6	7	
Data from Internet sources are objective. 互联网数据是客观的。	1	2	3	4	5	6	7	
Data from Internet sources are well-presented. 互联网数据表达得好。	1	2	3	4	5	6	7	
Data from Internet sources are up-to-date. 互联网数据是最新的。	1	2	3	4	5	6	7	
Data from Internet sources are aesthetically pleasing. 互联网数据赏心悦目。	1	2	3	4	5	6	7	
Data from Internet sources are accessible. 互联网数据是可获得的。	1	2	3	4	5	6	7	
Data from Internet sources are compactly represented. 互联网数据表达紧凑。	1	2	3	4	5	6	7	
Data from Internet sources are consistently formatted. 互联网数据格式一致。	1	2	3	4	5	6	7	
Data from Internet sources are retrievable. 互联网数据是可获取的。	1	2	3	4	5	6	7	
Data from Internet sources are usable. 互联网数据是可以使用的。	1	2	3	4	5	6	7	
Data from Internet sources are well-organized. 互联网数据组织得好。	1	2	3	4	5	6	7	
Data from Internet sources are correct. 互联网数据是正确的。	1	2	3	4	5	6	7	
Data from Internet sources are relevant. 互联网数据是有关的。	1	2	3	4	5	6	7	
Data from Internet sources are flawless. 互联网数据是无误的。	1	2	3	4	5	6	7	
Data from Internet sources are consistently represented. 互联网数据是表达一致的。	1	2	3	4	5	6	7	
Data from Internet sources are interesting. 互联网数据是有趣的。	1	2	3	4	5	6	7	
Data from Internet sources are unbiased. 互联网数据是无偏见的。	1	2	3	4	5	6	7	

Data from Internet sources are interpretable. 互联网数据是可解释的。	1	2	3	4	5	6	7
Data from Internet sources are applicable. 互联网数据是适用的。	1	2	3	4	5	6	7
Data from Internet sources are available. 互联网数据是可用到的。	1	2	3	4	5	6	7
Data from Internet sources are error-free. 互联网数据是没有错误的。	1	2	3	4	5	6	7
Data from Internet sources are well-formatted. 互联网数据格式设计得好。	1	2	3	4	5	6	7
Data from Internet sources were reliable. 互联网数据是可靠的。	1	2	3	4	5	6	7
Data from Internet sources are clear. 互联网数据是清楚的。	1	2	3	4	5	6	7
Data from Internet sources are precise. 互联网数据是精确的。	1	2	3	4	5	6	7
Data from Internet sources are readable. 互联网数据是可读的。	1	2	3	4	5	6	7
Data from Internet sources are easily understood. 互联网数据是容易被理解的。	1	2	3	4	5	6	7
Data from Internet sources are certified error-free. 互联网数据被鉴定没有错误。	1	2	3	4	5	6	7
Data from Internet sources give you competitive edge. 互联网数据给你竞争优势。	1	2	3	4	5	6	7
Data from Internet sources cannot be accessed by competitors. 竞争对手无法获得互联网数据。	1	2	3	4	5	6	7
Data from Internet sources are compatible with previous data. 互联网数据和以前的数据兼容。	1	2	3	4	5	6	7
Data from Internet sources add value to your assignments. 互联网数据让你的作业更有价值。	1	2	3	4	5	6	7
Data from Internet sources are of a proprietary nature. 互联网数据是私有（非公开）性质。	1	2	3	4	5	6	7
Data from Internet sources are continuously presented in the same format. 互联网数据连续使用同种格式。	1	2	3	4	5	6	7
Data from Internet sources are secure. 互联网数据是安全（不易被破坏）的。	1	2	3	4	5	6	7
Errors in data from Internet sources can be easily identified. 互联网数据的错误很容易被发现。	1	2	3	4	5	6	7
The form of presentation of data from Internet sources is adequate. 互联网数据的表达形式适当。	1	2	3	4	5	6	7
The scope of information from Internet sources is adequate. 互联网信息有足够的范围。	1	2	3	4	5	6	7
The format of the data from Internet sources is adequate. 互联网数据的格式适当。	1	2	3	4	5	6	7
The depth of information from Internet sources is adequate. 互联网信息有足够的深度。	1	2	3	4	5	6	7
The reputation of the source of data from Internet sources is adequate. 互联网数据源有足够的信誉。	1	2	3	4	5	6	7
The breadth of information from Internet sources is adequate. 互联网信息有足够的广度。	1	2	3	4	5	6	7
The age of the data from Internet sources is adequate. . . 互联网信息有足够的数据的年限。	1	2	3	4	5	6	7
The reputation of the data from Internet sources is adequate. 互联网数据有足够的可信度。	1	2	3	4	5	6	7

The amount of data available from Internet sources is adequate. 互联网数据有足够的数量。	1	2	3	4	5	6	7
The speed of access to data from Internet sources is adequate. 获取互联网数据的速度足够快。	1	2	3	4	5	6	7
The integrity of the data from Internet sources is adequate. 互联网数据有足够的完整性。	1	2	3	4	5	6	7
Access to data from Internet sources can be restricted. 可以限制对互联网数据的获取。	1	2	3	4	5	6	7

Background Questions. Please answer the following questions about your background.

个人背景

I. Work Experience 工作经历

1. How many years of full-time work experience have you had?
有几年全职工作经历?
2. How many years of part-time work experience have you had?
有几年兼职/半职工作经历?

II. Computer and Internet Experience 计算机和互联网使用经验

1. How many years of experience using computers have you had?
有几年使用计算机的经验?
2. How many years of experience using the Internet have you had?
有几年使用互联网的经验?
3. Which of the following best characterizes your experience with the Internet?
以下哪一项最切合你的互联网使用经验?
 Very experienced 非常有经验
 Experienced 有经验
 Somewhat experienced 有一点儿经验
 inexperienced 没经验
 Very inexperienced 非常没经验

III. Demographic Information 个人信息

1. What is your age? 年龄 _____
2. What is your gender? 性别 Female 女 Male 男
3. Which grade you are? 年级
 Freshman 大一
 Sophomore 大二
 Junior 大三
 Senior 大四
 Graduate 研究生
 other, 其它 please identify 请指明 _____

Your Major 专业: _____

Author Biographies



Yi Maggie Guo is an Associate Professor of Management Information Systems at University of Michigan – Dearborn. She received her Ph.D. from Texas A&M University and her MS from the University of Nebraska at Omaha. Her research interests include user behavior and new technologies, information quality, flow theory, online shopping experience, and business education. Her work has appeared in *Decision Support Systems*, *Communications of AIS*, *Decision Sciences Journal of Innovative Education*, *Information Resources Management Journal*, *Information Systems Journal*, *International Journal of Information Management*, *International Journal of Information Quality*, *Journal of Organizational and End User Computing*, *Service Industries Journal*, and other journals.



Barbara D. Klein is a Professor of MIS at the University of Michigan-Dearborn. She received her PhD in Information and Decision Sciences from the University of Minnesota, her MBA from the State University of New York at Albany, and her BA from the University of Iowa. She has published in the *MIS Quarterly*, *International Journal of Information Quality*, *Omega*, *Database, Information & Management*, *Information Resources Management Journal*, and other journals. Her research interests include information quality, user error behavior, and information systems pedagogy. Professor Klein has worked in the information systems field at IBM, Exxon, and AMP.