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English versus Chinese: A Cross-Lingual Study of Community Question Answering Sites

Alton Y. K. Chua and Snehasish Banerjee

***Abstract*—This paper conducts a cross-lingual study across six community question answering sites (CQAs) from two popular languages used on the internet, English and Chinese. The CQAs from the two languages are compared on the basis of three perspectives, namely, answer quality, answer responsiveness, and corpus comprehensiveness. Results indicate that there exist no statistically significant differences between the English CQAs and the Chinese CQAs in terms of answer quality. However, English CQAs appear to fare better in terms of answer responsiveness, whereas Chinese CQAs seem to perform better in terms of corpus comprehensiveness. The implications of the findings are discussed. Finally, the paper concludes with notes on limitations and future work.**

***Index Terms*—cross-lingual, community question answering, quality, responsiveness, comprehensiveness**

I. Introduction

SEARCH engines have long been recognized as gateways for online information seeking. However, they suffer from three limitations. First, they cannot parse queries formulated in natural language [1]. Second, instead of providing succinct answers to users' questions, they provide a list of URLs, browsing which can be tedious [2]. Third, their ability to find relevant information for difficult queries such as those asking for opinions or summaries is far from satisfactory [3]. These factors, coupled with the recent advancements in web technologies have led to the emergence of social media applications called community question-answering sites (CQAs), where "*any user can pose a question, and in turn other users – potentially many of them – will provide an answer*" [4, p 759].

With the growing popularity of CQAs among online users, scholarly interest in CQA research is also on the rise. Yet, two research gaps can be identified. First, most research in CQAs tends to draw data from English CQAs such as Yahoo! Answers (eg. [5], [6]). However, of late, given that Chinese CQAs such as Baidu Knows, and Korean CQAs such as Knowledge iN have also grown in popularity, confining datasets to CQAs of a single language may thwart the generalizability of findings.

Second, one of the popular themes in CQA research lies in the investigation of answer quality (eg. [7], [8]). However, other perspectives of CQAs which are research-worthy albeit not adequately explored hitherto include promptness of their answers, and scope of their corpora. An understanding of such issues has implications on the effectiveness of CQAs in meeting users' information needs, which in turn, may determine their sustenance.

To address the two above-mentioned research gaps in extant literature, this paper conducts a cross-lingual study across CQAs from two popular languages used on the internet, English and Chinese. The English CQAs selected for analysis include Yahoo! Answers, WikiAnswers and Answerbag. On the other hand, the Chinese counterparts comprise Baidu Knows, Tencent Soso Wenwen and Sina iAsk. The CQAs from the two languages are compared on the basis of three perspectives, namely, answer quality, answer responsiveness, and corpus comprehensiveness. Specifically, the following three research questions are investigated:

RQ 1: How do English CQAs differ from Chinese CQAs with respect to answer quality?

RQ 2: How do English CQAs differ from Chinese CQAs with respect to answer responsiveness?

RQ 3: How do English CQAs differ from Chinese CQAs with respect to corpus comprehensiveness?

The significance of the paper is two-fold. On the research front, a cross-lingual study of CQAs has not been done hitherto to the best of our knowledge. Behavior patterns of users in social media have been shown to be influenced by cross-lingual effects [9], [10]. This paper can thus provide insights into the behavioral differences between users of the English CQAs (henceforth, referred as English users), and those of the Chinese CQAs (henceforth, referred as Chinese users).

On the practical front, this paper sheds light on nuances in answer quality, answer responsiveness, and corpus comprehensiveness between the English CQAs and the Chinese CQAs. With the advent of translation portals such as Google Translate, English users can make sense of Chinese CQAs, and vice-versa. Hence, users may lean on the findings of this paper to choose between English CQAs and Chinese CQAs to effectively meet their information needs.

The remainder of the paper is structured as follows. The following section describes the literature which revolves around three central themes, namely, answer quality, answer responsiveness, and corpus comprehensiveness. Next, the procedures of data collection and analysis are explained. This is followed by the results and the discussion. Finally, the paper concludes with notes on limitations and future

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work.

II. Literature Review

A. Answer Quality

Quality of an answer in CQAs is a measure of the value it presents to users [6]. In most CQAs, users can post answers without a peer-review process. In consequence, answer quality can fluctuate drastically from excellent to abysmal [8]. While looking for an answer to a particular question, users are thus presented with a list of answers of varying quality. Finding the appropriate answer among them is not trivial as users may not be knowledgeable enough to assess the quality of answers to questions posted by themselves [5]. This makes their task of sieving the grain from the chaff extremely arduous.

For the purpose of this paper, answer quality is operationalized based on answers' richness in three user-oriented relevance attributes, namely, content value, cognitive value and socio-emotional value [7], [11], [12]. Content value refers to the overall content quality of answers and can be explained by three factors: reasonableness, soundness and dependability. Reasonableness is the extent to which an answer is consistent and believable [12]. Soundness refers to the extent to which an answer is error free, complete and coherent. A dependable answer is one which is current, secure, and temporally coherent [13]. Cognitive value refers to an answers' ability to stimulate the cognitive cues of users' knowledge. It can be explained by two factors: understandability and novelty. Understandability is the extent to which an answer is easily comprehended [7], [11]. Novelty refers to the extent to which an answer invokes creative thinking among users [14]. Socio-emotional value refers to the social aspect of CQAs, denoting interpersonal relationships and emotions as reflected through answers. Gratitude, appreciation and empathy are some forms of emotions commonly expressed in CQAs to thank others for sharing their knowledge or providing emotional support [7], [11].

B. Answer Responsiveness

Limited scholarly attention has been trained into the responsiveness of answers in CQAs thus far. In one of the few studies, a comparative analysis was done between Yahoo! Answers and Google Answers to identify the factors for the former's success and the latter's failure [15]. The findings revealed that users could obtain answers faster from Yahoo! Answers than Google Answers. In another related study, Yahoo! Answers was found to attract fastest answers in a matter of few minutes, followed by satisfactory answers in a matter of few hours [16]. The on-going widespread support for Yahoo! Answers can be attributed to the responsiveness of its answers.

A similar study on Stack Overflow, a closed domain CQA for programmers and developers, revealed that most answering activities take place within the first hour after a question is posted [17]. In general, users seem to value responsiveness, and lack the proclivity to wait for good answers. In fact, users who cannot obtain prompt answers from CQAs turn to alternative sources of information. They never bother to return to CQAs in order to check if their questions have been answered [18]. Thus, if a CQA site does not offer responsive answers, its sustainability will be called into question. As with previous works, this paper operationalizes answer responsiveness as the time elapsed in minutes between posting a question and receiving an answer.

C. Corpus Comprehensiveness

CQAs provide an avenue to accumulate growing corpora of questions and answers [4]. Comprehensiveness of CQA corpora refers to their breadth, scope, and coverage to satisfy the information needs of users. Supported by efficient information retrieval and clustering techniques, CQA corpora consist of questions and their associated answers submitted to the sites. Besides, they also include other data items such as timestamps, ratings to answers, comments attracted by answers, and best answers selected by users [19].

When a question is posted, a list of related questions available in the CQA corpora is also presented to users. Such a list of related questions can be of utmost importance because past responses to some of those questions could also be a potential answer to the present question [20]. The relevance of the related questions with respect to the newly posted question greatly depends on the comprehensiveness of CQA corpora. Wider the corpus comprehensiveness, it would be more likely for the related questions to be relevant to the new question. Hence, for the purpose of this paper, corpus comprehensiveness is operationalized in terms of the relevance of the related questions presented by CQAs in response to a newly posted question.

III. Methodology

A. Selection of Language and CQAs

This paper draws data from six CQAs, three English and three Chinese. These two languages were chosen for being the top two languages used on the internet, supported by some 536.6 (26.8%) and 444.9 (24.2%) millions users respectively (Internet World Stats, 2012). Moreover, much scholarly attention has been trained on the investigation of both English CQAs (eg. [4], [16]) and Chinese CQAs (eg. [21], [22]).

The English CQAs selected for analysis include Yahoo! Answers, WikiAnswers and Answerbag. On the other hand, the Chinese counterparts comprise Baidu Knows, Tencent Soso Wenwen and Sina iAsk. These six CQAs were chosen given that all of them have been established for more than three years, and attract at least 20,000 unique visitors per month on average. Such longevity and popularity allows for wider scope of data collection.

B. Data Collection

The data collection period, which lasted from July to December, 2011, involved three steps: gathering questions from the CQAs, cross-posting the gathered questions across the CQAs, and harvesting answers attracted by the cross-

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posted questions. The first step involved gathering some 100 questions from each of the six CQAs from four categories, namely, entertainment, sports, computer/internet, and science/mathematics. These categories were chosen as they are commonly available and allow for comparison across all CQAs. Questions that were culturally-specific in tone, nature and context were omitted as they were not suitable for cross-posting across the CQAs of the two languages. A few iterations were made to the question gathering process to produce six sets of 100 questions, each set comprising 25 questions from each of the four categories.

The second step involved cross-posting of the gathered questions across the six CQAs. Specifically, 500 questions extracted from the other five CQAs were posted into each CQA. This meant that questions extracted from the English CQAs had to be translated to Chinese, whereas those drawn from the Chinese counterparts had to be translated to English. Translations were done by three research associates (henceforth, known as coders) who were effectively bilingual, possessed graduate degrees in Information Science with minimum two years of professional experience, and were knowledgeable about the four chosen categories. When needed, the coders conferred among themselves to ensure their correctness and consistency of the translated questions. Questions were posted throughout the day, seven days a week with randomized timings as much as possible to minimize any confounding effects of different time zones, time of the day, and day of the week on attracting answers from users across the globe.

The third step involved harvesting answers attracted by the cross-posted questions from the six CQAs. A window of four days was given to each question to solicit answers. In response to the 3,000 questions (1500 questions for each language, 500 questions per CQA site), a total of 5,356 answers were harvested. Along with the questions and their respective answers, related data items such as time-stamp and URLs were also archived.

C. Coding and Analysis

For measuring answer quality, content analysis was used to identify characteristics within answer text [23]. The coders evaluated answers based on a five-point Likert scale (1=strongly disagree, 5=strongly agree) to denote the extent to which content value, cognitive value, and socio-emotional value could be observed. The mean pair-wise Cohen's kappa for inter-coder reliability among the three coders was found to be 0.83, indicating non-chance level of agreement in quality scores [24]. Finally, the answer quality score for each answer was computed as the arithmetic mean of its scores on the three quality attributes.

For measuring answer responsiveness, system timestamps were used. The timestamp of posting a question to a particular CQA was recorded. Thereafter, the timestamps of receiving all answers within the window of four days were also recorded. Finally, the responsiveness of each answer was calculated as the difference in minutes between the timestamp of receiving the answer and that of posting the question.

When questions are posted in CQAs, a list of four or five related questions available in their corpora is presented to users. For measuring corpus comprehensiveness, the relevance of such related questions in response to a newly posted question was considered. For each question, the individual related questions were assigned a relevance score ranging from 1 to 5. For instance, if a related question was assigned a score of 1 (5), it was deemed completely irrelevant to the parent question (highly relevant to the parent question). Scores were assigned by the three coders and the mean pair-wise Cohen's kappa was found to be 0.81, indicating non-chance level of agreement in relevance scores [24]. Finally, the corpus comprehensiveness score for each question was calculated as the arithmetic mean of relevance scores of all related questions presented by the CQAs.

To address RQ 1 and RQ 2, the 5,356 harvested answers were the units of analysis. On the other hand, the 3,000 cross-posted questions were the units of analysis for addressing RQ 3. All the three RQs were first addressed using independent samples t-test. To delve deeper, hierarchical analysis of variance (HANOVA) was also used. HANOVA is suitable when multiple categorical levels are nested hierarchically within some parent independent variables [25], [26]. In this case, language is the parent independent variable with three CQAs nested within English, and three nested within Chinese.

IV. Results

A. Descriptive Statistics

Of the 3,000 cross-posted questions across the CQAs from the two languages (1,500 questions per language, 500 questions per CQA site), 2,065 were answered resulting in a collection of 5,356 answers. The three English CQAs attracted 2,231 answers in response to 894 questions (2.50 answers per question). On the other hand, the three Chinese CQAs received 3,125 answers in response to 1,171 questions (2.67 answers per question). The general descriptive statistics of the CQAs from the two languages are shown in Table I.

Table I
General Descriptive Statistics

CQA/ language	Questions answered # (%)	Answers received (#)	Answers/ question
Yahoo Answers	442 (88.4)	1,357	3.07
Wiki-Answers	137 (27.4)	140	1.02
Answer-bag	315 (63.0)	734	2.33
Baidu Knows	408 (81.6)	1,227	3.01
Tencent Soso Wenwen	383 (76.6)	1,132	2.96
Sina iAsk	380 (76.0)	766	2.02
English	**894 (59.6)**	**2,231**	**2.50**
Chinese	**1,171 (78.1)**	**3,125**	**2.67**

The descriptive statistics of the CQAs from the two languages based on the three evaluation perspectives:

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answer quality, answer responsiveness, and corpus comprehensiveness are shown in Table II. It appears that there is hardly anything to choose between the two languages in terms of answer quality. However, the English CQAs appear to fare better in terms of answer responsiveness, whereas the Chinese CQAs seem to perform better in terms of corpus comprehensiveness.

Table II
Descriptive Statistics based on the three Evaluation Perspectives

CQA/ language	Answer Quality (1-5)	Answer Responsive-ness (minutes)	Corpus Comprehensive-ness (1-5)
Yahoo Answers	4.03 ± 0.69	351.11 ± 1013.59	1.37 ± 0.77
Wiki-Answers	4.07 ± 0.92	721.90 ± 1200.57	2.08 ± 1.44
Answer-bag	3.91 ± 0.66	464.33 ± 850.57	1.88 ± 1.50
Baidu Knows	3.84 ± 1.04	550.88 ± 1009.75	2.59 ± 1.73
Tencent Soso Wenwen	4.02 ± 0.72	451.00 ± 1044.69	2.34 ± 1.74
Sina iAsk	4.09 ± 0.59	975.57 ± 1303.18	1.52 ± 1.08
English	**3.99 ± 0.70**	**411.62 ± 980.58**	**1.78 ± 1.32**
Chinese	**3.97 ± 0.84**	**618.80 ± 1119.98**	**2.15 ± 1.61**

B. Inferential Statistics

The results of the t-test for RQ 1 suggest that there exists no statistically significant difference in answer quality between the English CQAs and the Chinese CQAs. However, the results of HANOVA indicate a statistically significant nested effect of the CQAs within the two languages [$F(4, 5350) = 16.92$, $p < 0.001$]. Among the English CQAs, WikiAnswers (4.07 ± 0.92) attracts answers of the highest quality. On the other hand, among the Chinese CQAs, Sina iAsk (4.09 ± 0.59) receives the best quality answers.

The results of the t-test for RQ 2 reveal a significant difference in answer responsiveness between the English CQAs (411.62 ± 980.58) and the Chinese CQAs (618.80 ± 1119.98) [$t (5137.223) = -7.18$, $p < 0.001$]. The English CQAs appear to fare better than the Chinese CQAs in terms of answer responsiveness. The results of HANOVA indicate a statistically significant nested effect of the CQAs within the two languages [$F(4, 5350) = 35.21$, $p < 0.001$]. Among the English CQAs, Yahoo! Answers (351.11 ± 1013.59) attracts answers with the highest responsiveness. On the other hand, among the Chinese CQAs, Tencent Soso Wenwen (451.00 ± 1044.69) receives the most responsive answers.

The results of the t-test for RQ 3 reveal a significant difference in corpus comprehensiveness between the English CQAs (1.78 ± 1.32) and the Chinese CQAs (2.15 ± 1.61) [$t(2883.064) = -6.935$, $p < 0.001$]. The Chinese CQAs seem to perform better than the English CQAs in terms of corpus comprehensiveness. The results of HANOVA indicate a statistically significant nested effect of the CQAs within the two languages [$F(4, 2994) = 52.56$, $p < 0.001$]. Among the English CQAs, WikiAnswers (2.08 ± 1.44) offers the highest corpus comprehensiveness. On the other hand, among the Chinese CQAs, Baidu Knows (2.59 ± 1.73) possesses the most comprehensive corpus. The results of the inferential statistics are summarized in Table III.

Table III
Summary of Inferential Statistics

Evaluation Perspectives	Cross-lingual Effects	English – best CQA	Chinese - best CQA
Answer Quality	$p = 0.23$	Wiki-Answers	Sina iAsk
Answer Responsiveness	$p < 0.001$*	Yahoo! Answers	Tencent Soso Wenwen
Corpus Compr-ehensiveness	$p < 0.001$*	Wiki-Answers	Baidu Knows

* Statistically significant ($p < 0.05$)

V. Discussion

Three main findings could be culled from this cross-lingual study across CQAs from the two languages. First, contrary to prior research [9], [27], [28], no statistically significant difference in answer quality between the English CQAs and the Chinese CQAs suggest a lack of language divide on the Internet. Though it was once conceived that "*if you want to take full advantage of the Internet there is only one real way to do it: learn English*" [27, p 226], this paper paints a paradoxical picture. Both English users and Chinese users appear equally proficient in providing high quality answers in CQAs of their respective languages. Hence, obtaining high quality answers from Chinese CQAs may not be challenging for Chinese users, even if they are not experts in English. This could be vestige of the gradual trends of globalization in web usage and ICT across the globe.

Second, despite attracting more answers per question (as indicated in Table I), Chinese CQAs lag behind in terms of answer responsiveness compared to the English CQAs. Perhaps, Chinese users are more reliant on cues from initial answers compared to English users, who tend to be more matured, independent, and hence, responsive [29], [30]. Nonetheless, once the first answer to a given question is submitted in Chinese CQAs, it seems to lead to a domino effect that piques the interests of others to contribute more answers. This reflects the collectivist social orientations among Chinese users, who are highly motivated by expectations of social reciprocity [30]. Consistent with prior research, the findings thus reveal that cross-lingual differences influence users' asking and answering patterns in CQAs [9], [10].

Third, irrespective of language, all CQAs indicate a scope for improvement with respect to corpus comprehensiveness. With the growing popularity of CQAs [4], [5], their corpora are expected to become more comprehensive over time. At the same time, it is feasible to rank all past questions and answers based on relevance through inter-question, inter-answer, and question-answer similarity [3], [31], [32]. Yet, dearth of relevant related questions in response to newly posted questions from all CQAs suggests that most CQA corpora are perhaps not well equipped with efficient

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information retrieval and clustering techniques. Given that innumerable questions posted in CQAs are recurrent [20], users' dependency on the goodwill of answerers can be reduced considerably if CQA corpora are supported with better retrieval and clustering techniques.

VI. Conclusion

This paper conducts a cross-lingual study across CQAs from two popular languages used on the internet, English and Chinese. The English CQAs selected for analysis include Yahoo! Answers, WikiAnswers and Answerbag. On the other hand, the Chinese counterparts comprise Baidu Knows, Tencent Soso Wenwen and Sina iAsk. The CQAs from the two languages are compared on the basis of three perspectives, namely, answer quality, answer responsiveness, and corpus comprehensiveness. Results indicate that there exist no statistically significant differences between the English CQAs and the Chinese CQAs in terms of answer quality. However, the English CQAs appear to fare better in terms of answer responsiveness, whereas the Chinese CQAs seem to perform better in terms of corpus comprehensiveness.

The findings of the paper should be interpreted in light of two constraints. First, selection of the six CQAs from the two languages was governed by the longevity and popularity of the sites. Uniformity in system features and efficacies across the CQAs was not taken into account. For example, Answerbag is the only CQA among the six that allows images to be posted as answer content. Second, the relevance of the related questions is constrained by the period of data collection. Given the ever-growing corpora of CQAs, the related questions presented by CQAs in response to a newly posted question may keep changing over time. Hence, comprehensiveness scores for a newly posted question are likely to vary over time.

This study opens a few potential directions for future CQA research. One possible area of investigation could be to evaluate CQAs in terms of their system features that promote users' engagement. After all, an actively engaged community is essential for CQAs to thrive. A second area of research could center on examining whether answer quality, answer responsiveness, and corpus comprehensiveness vary with question categories such as entertainment, sports, computer/internet, and science/mathematics. Such an investigation could offer insights into the extent to which the performance of CQAs vary across question categories.

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