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The purpose of this study was to investigate the unique characteristics of tag presentation on Chinese websites and their usability for Chinese users. A visual search experiment was conducted with 36 Mainland Chinese participants, who performed search tasks using six different tag presentation styles. Results indicated that, for the Mainland Chinese population, a tag layout with sorting is more effective than a randomly sorted one; but whether the tags are arranged in a vertical or horizontal list or a tag cloud does not affect their search performance. This study also found that the overall degree of satisfaction was not significantly different when the Chinese users interacted with a tag cloud or a tag list. The results of this research could provide insight for website designers when designing culturally and linguistically adapted human-computer interfaces for Mainland Chinese users.

Headings:

Web sites/Design

Use studies/Internet

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Keyword indexing

COMPARISON OF ALTERNATIVE METHODS OF TAG PRESENTATION
ON CHINESE WEBSITES

by
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Introduction

Tagging as a new approach to metadata creation (Rivadeneira, Gruen, Muller, & Millen, 2007) was introduced by social software applications, namely social bookmarking website like Flickr (http://www.flickr.com/) and Deli.cio.us (http://del.icio.us/), and has been gaining popularity since. Typically, such sites allow users themselves to choose and apply descriptive terms, more commonly referred to as tags, to annotate and categorize an object, which could be an article, an image, a blog post or other web contents. For example, the users of Flickr, the photo sharing system, can store and tag their personal photos. Del.icio.us users are allowed to bookmark and tag web pages or online resources. Tagging provides an alternative to traditional indexing and classification, as freely chosen keywords instead of controlled vocabularies are used to describe the resources in the information system. This aspect of tagging implies that the system would have to deal with a larger and a less structured vocabulary; consequently, the presentation of the vocabulary to users would be more challenging. In addition, tags allow system users to navigate to the underlying content. They are usually hyperlinks that lead users to a collection of resources in the system to which the same tag has been applied. Hence each tag serves as an access point through which users can retrieve resources previously tagged by them, and discover additional ones tagged the same way by other people as well. Based on this observation, the usability of the tag presentation would affect users' interactions with tags and their tagging practices to a certain degree.

The display of tags, in particular the most highly used ones (popular tags), has become a familiar feature in social software sites, and several presentation techniques have emerged. Among them, tag lists and tag clouds are the most comment layouts. A tag list (Figure 1, 2) is simply the listing of a certain number of tags sorted randomly, or by alphabet or frequency. A tag cloud, on the other hand, is a novel visual presentation. It

first appeared on Flickr[1] and has been popularized by Del.icio.us and Technorati, among others. A tag cloud (Figure 3, 4) consists of a set of tags whose attributes, such as text size, location and color, are used to represent features (mainly popularity) of the associated terms. For instance, tags more frequently used are displayed in a larger font, as shown in Figure 2.

Figure 1. A Tag List in English

Figure 2. A Tag List in Chinese

Figure 3. A Tag Cloud in English

Figure 4. A Tag Cloud in Chinese

Though the use of these tag presentation techniques is growing, few formal studies have investigated their usability and effectiveness in support of users' browsing and searching of tags. Of the studies conducted, researchers have focused on Western users only. However, due to language and culture differences, the study results based on English-speaking population may not be applicable to universal interface design. Differences among users and their influences on human-computer interaction have been addressed and extensively discussed, and several variations have been documented and their implications for interface design for Chinese populations have been raised (Choong & Salvendy, 1998; Marcus, 1993; Sukaviriya & Moran, 1990).

This study attempts to understand the unique characteristics of tag presentation on Chinese websites and their usability impact on Chinese users. Specifically, it aims to discern differences in their visual search performance with different tag presentations, and compare those findings with the results from studies on Western users. It should be noted that, due to research constraints in time and budget, study participants were Mainland Chinese only because reading patterns, character systems and educational background vary in the Chinese world itself. Considering that Mainland Chinese now form the 2nd biggest Internet user group in the world (China Internet Network Information Center [CINIC], 2008), they are believed to be a population of Chinese Internet users well worth studying.

Literature Review

Over the past few years, tagging systems and tagging practices have received increasing attention from both practitioners and scholars (Ames & Naaman 2007; Golder & Huberman 2006; Marlow, Naaman, Boyd, & Davis 2006). Yet there has not been much published research, especially experimental studies, on the usability of different tag presentations. The following literature review will first examine tag layout usability studies conducted with Western participants, and then move on to related studies focusing on issues related to Chinese websites.

Empirical studies of tag list/cloud usability

Rivadeneira et al. (2007) were the first to identify the kinds of tasks tag clouds can support: searching, browsing, impression formation and recognition. In their two usability experiments, they first tested how font size (High, Medium and Low) and word location (Upper-Left, Lower-Left, Upper-Right, Lower-Right) would affect people's recall of the words displayed in a tag cloud. Thirteen participants were recruited to perform a visual search task, in which a blank screen was shown for 1 second, and then a tag cloud for 20 seconds. Afterwards, participants would have 60 seconds of free recall of the words they saw. The results showed that recall was significantly better for words with a larger font size than for words with a smaller font size, and words in the upper left quadrant than words in the other quadrants. In the subsequent experiment, Rivadeneira et al. utilized the font size (3 sizes) again, and layout (tag cloud with alphabetical sorting, tag cloud with frequency sorting, tag cloud with spatial layout, and single column tag list sorted by frequency) as the two independent variables, and gist and recognition as the dependent variables. The 11 participants started by viewing a blank screen for 1 second, then a tag cloud for 30 seconds. The participants then had to describe the principal interests of the "creator" of the tag cloud (i.e., its gist). The outcomes confirmed the previous detected effect of font size as people recognized words with larger fonts better. Quite surprisingly, there was no significant effect of layout on participants' ability to describe the gist of the creator's interests. However, among the various presentations, a tag list ordered by frequency of use resulted in more accurate impression formation, which was measured by scores given by two judges for participants' correct identification of categories in the tag cloud. Note that, since the tags in the listing layout were in a uniform font size and were not sorted alphabetically, they would appear to be in a random order to the participants. If the participants had been informed that the tags were sorted by frequency of use, they would have been more likely to focus on only the top few tags and would have been more capable of identifying the gist of the list. So it is arguable that a list ordered by frequency would provide a more accurate impression of the tagger's interests than the tag cloud layout.

In a study by Halvey and Keane (2007), tag lists were found to be more advantageous than the tag cloud in helping people to perform visual search for a specific target. In their experiment, tags were organized into six different layouts: a horizontal list, a horizontal list ordered alphabetically, a vertical list, a vertical list ordered alphabetically, a tag cloud, and a tag cloud ordered alphabetically. The details of the tag cloud design were not documented, but it was said to typically span three lines, and three font sizes were assigned randomly to the tags. Sixty-two participants completed a series of selection tasks, including four practice runs and 24 formal tasks. For each task in each of the 6 presentation types, the participants were first presented with the name of a country, and then they were to identify it on a screen with 10 country names. A new task would begin as soon as the participant had selected the correct country name, but it is not stated what would happen if the selection was incorrect. It came out that the alphabetically sorted layouts contributed to a better (shorter) average search time than the random ones, and the alphabetical horizontal listing was the fastest. Participants also made the comment that alphabetic ordering had facilitated the selection tasks. While the randomly sorted tag cloud took participants the longest time to find the target, the alphabetical tag cloud outperformed the lists without alphabetization. It should be noted that the number of appearances of the alphabetical tag cloud was more than any other layout (almost double that of the four other layouts), a learning effect for this presentation may have occurred. The effects of font size and the position of the target tag on task completion time were also investigated, and it was found that tags in larger font size and in the upper-left corner shortened the time to complete the tasks, corroborating the results from the previous study by Rivadeneira et al. (2007). Note that the statistical significance of the results of this study was not tested, so their validity is uncertain.

More positive results for tag clouds were found by Sinclair and Cardew (2007), who proposed that a tag cloud is a preferable visualization when the information-seeking task requires less specific information. In a two-part experiment, participants were first asked to tag ten articles each to create a folksonomy-like dataset. After that, they were to find answers to ten questions related to the tagged articles using either a search box, that is, writing a query, or clicking on the tags in a tag cloud. After completing all ten tasks, they

were presented with a two-question survey. The researchers then compared the usage frequency of the query methods. It was found that the tag cloud was more often used in total, suggesting that it may impose a lower mental workload than search query formation. However, the search box was favored for six of the ten questions, and it was less preferred only when the question was broad or the tag cloud had a keyword relevant to the question. This finding implies that the tag cloud better supports browsing or serendipitous discovery. Participants also made comments in the survey, saying that the search box allows for comparatively greater specificity while tags are more useful for finding general topics. The majority of participants stated a preference for the search box. Nevertheless, the positive effect of large font size was again confirmed as the tag cloud containing a relevant keyword that was larger than the surrounding text attracted more hits as participants concluded each task.

Taking a different approach from the two experimental studies described above, Hearst and Rosner (2007) examined people's subjective responses to tag clouds. They interviewed 20 people that are active in web design or information visualization research, and analyzed the contents of discussions about tag clouds on web pages. In this way, they were able to characterize the current major opinions on tag clouds. They concluded that the tag cloud as an original design is a currently-popular Web 2.0 element and is visually dynamic and more fun to look at than a list. In addition, a tag cloud is suggestive of the interests of an individual or a group and their usage trends. Conversely, they doubted that tag clouds are useful for navigation, and may create a bias toward popular ideas. Moreover, it is suspected that new users may not find the tag cloud appealing either emotionally or aesthetically.

In sum, the discussions on usability of tag presentations seem to suggest that the traditional layout of listing outperforms the tag cloud in support for browsing, searching and impression formation in general; whereas the tag cloud is considered a novel and dynamic alternative visualization of the underlying data set, and provides a visual summary that signals and reflects collaborative user behaviors rather than precisely depicting the data in the system. Even so, its usefulness is yet to be confirmed.

Tag presentation in Chinese

It is not clear whether the above reviewed empirical evidence gathered from Western users would fit the situation of tag presentation on Chinese websites. The importance of language and culture differences in the design of interfaces has been stressed by many researchers (Fernandes, 1995; Nielsen, 1990; Russo & Boor, 1993), and these two distinct aspects are likely to have a profound impact on human information interactions, including visual search performance (Nielsen, 1990; Rayner, Li, Williams, Cave, & Well, 2007; Sacher, 1998).

The major differences between the English and Chinese languages lie in their character shapes, pronunciations and text flow orientation. While English is an alphabetic language in which the graphic unit represents phonemes, Chinese uses characters whose rectangular graphical units represent a morpheme. Every Chinese character is formed by a sequence of "strokes" in a uniformly square-shaped area (Figure 5, 6), and is visually more complex and spatially denser (Fu, Dong, & Braun, 2006). Such language characteristics of Chinese imply that alphabetical sorting would be problematic, because extra mental workload would be required to perform a translation from the character to the phonetic.

Figure 5. A Simple Chinese Character   **Figure 6. A Complex Chinese Character**

A second difference is that English characters are normally presented horizontally but Chinese characters can be oriented horizontally or vertically. Most Mainland Chinese born after the 1950s are trained to read in a left-to-right and horizontal way (a "Z" type path, see Figure 7), but the older generation and people in Hong Kong and Taiwan read in the traditional right-to-left and vertical way (an "N" type path, see Figure 8). Thus it is worthwhile to investigate how text flows affect Chinese people's visual search patterns and their perception of the whole layout.
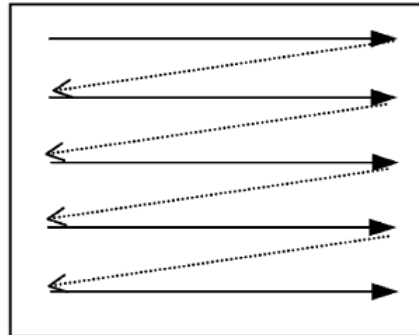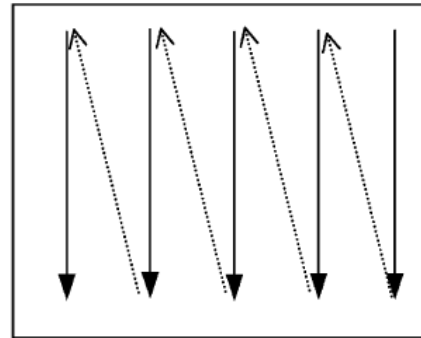
Figure 7. Z Type

Figure 8. N Type

Furthermore, speaking from the culture perspective, the differences and their implications cannot be ignored as well. Previous studies in the area of cross-culture Human-Computer Interaction have recognized the Chinese and Western people differ in patterns of thinking, feeling (Hoftstede 1997), cognitive styles, cognitive (verbal and visual) abilities and digit span (Choong & Salvendy, 1998).

So far, no formal evaluation study on Chinese tag presentation has been done, but there have been several studies on Chinese users' visual search performance when they interact with a computer interface. Dong and Salvendy (1999) compared the effectiveness of orientation of menus in Chinese and English, respectively. Menu designs are highly related if not similar to tag display designs, since they both involve the visual search process for a displaying item among distractors. The researchers had 80 Mainland Chinese as participants in the first of the two experiments and 20 Americans in the second. Both experiments had the same design and procedure, differing only in the language version of the stimuli. The participants from the two countries were asked to find a target item in the menu system. Chinese participants were tested on an English menu with an English target, an English menu with a Chinese target, a Chinese menu with an English target, and a Chinese menu with a Chinese target; while American participants only interacted with an English menu with an English target. Neither selection error rates nor satisfaction level were found to be significantly different between country groups. Significant menu layout effects were found only when the search target was in Chinese. When using a menu in their native language, Chinese and American participants showed reversed trends. The Chinese participants performed faster with

vertical menus than with horizontal menus, but Americans performed faster with horizontal menus. A horizontal menu also worked better for Chinese participants when the menus were in English. Dong and Salvendy concluded that menu layouts have a language-sensitive effect, and that a vertical layout may be more suitable for the Chinese population when they use a Chinese interface.

In their evaluation of the efficiency of different object orientations in an eye-movement based interface, Feng and Shen (2006) found that, for Mainland Chinese users, the selection time for a target among horizontally arranged objects was shorter than that of vertically arranged objects. During the experiment, the 12 participants were eye-tracked when they carried out a total of 240 trials. A digit as the stimulus was first shown to them on the screen, which also contained a cue to search. They were to fixate on the target digit until the stimuli series with 7 digits (arranged horizontally or vertically) appeared, and then to search for the target digit and again fixate on it. The eye-tracker would provide feedback for correct selections so as to end a trial. While neither the arrangement of objects nor the target location had an effect on selection errors, the layouts had a significant effect on search time; a horizontal orientation was more efficient in support of searching.

Note that the stimuli used in this study were digits randomly chosen from 1 to 9, which are far less complex than the Chinese characters used as stimuli in Dong and Salvendy's study. So it is possible that the target complexity affected participants' performance. Additionally, both studies were limited to a single row/column search field and may not be valid in the case of a fuller search field. These two factors were taken into account by Lau, Shih, and Goonetilleke (2002) as they examined the visual search strategies and eye movements of Hong Kong Chinese, Mainland Chinese and non-native Chinese readers when they searched for a target Chinese character among a screen filled with characters. Six participants were recruited for each of the three groups (18 in total). In the experiment, three layouts, the row (horizontal), the column (vertical) and uniform (square) and two word-complexities (number of strokes in a character) were presented. An eye-tracking device was used to detect the scanning patterns. Lau et al. found that word

complexity had little or no effect on accuracy or search time. Search time, error rate and eye-tracking data suggested that Mainland Chinese have an adaptive search pattern dependent on the screen layout; that is, they may employ different search strategies when presented with different search screens, thus tending to be more flexible with search structure. Such flexibility with a full-screen search field was corroborated with another more recent visual search study on Mainland Chinese. Ding, Li, Hu and Yan (2007) eye-tracked 33 college students when they performed a search task for an image of a bell among a full-screen of object images. Neither a horizontal nor a vertical scanning pattern dominated, as 18 participants adopted the former and 15 the latter. In addition, the search time and error rate were not significantly affected by the search strategies used.

Conclusion

Based on the aforementioned literature, there does not seem to be a consistent conclusion on the visual search patterns of Mainland Chinese and hence the proper design of tag presentations for this user group. It is hoped that the current study could contribute to this research area with an empirical approach. The research questions to be addressed in the study are as follows:

1. Does a tag cloud or a tag list result in faster search time and lower error rate for Chinese users when they search or browse tags?

2. Does a tag cloud or a tag list result in higher satisfaction of Chinese users when they search or browse tags?

3. Does sorting of the tags affect the above-three aspects?

Study Methods

Thirty-six Mainland Chinese participants were tested with a standard visual search experiment, in which they were to find a tag among a set of tags. The set of tags was presented in search screens with two sorting methods (alphabetical and random) and three layouts (horizontal tag list, vertical tag list and tag cloud). Performance data (i.e., accuracy of target identification and time required to find the target tag) and subjective

perceptions toward the layouts were recorded. The study methods are described in more detail below.

Participants

Thirty-six Mainland Chinese, 21 male and 15 female, were recruited through the Friendship Association of Chinese Students & Scholars listserv of UNC-Chapel Hill and campus advertisements. Participants were 3 undergraduate, 26 graduate and 7 PhD students from UNC-Chapel Hill. They were 26 years of age on average, and all had normal or corrected-to-normal vision. While all the participants were well acquainted with web browsing and searching (with an average of 10.5 hours Internet usage per week), 20 of them didn't know what a tag or tagging is, nine interact with tags daily, and seven interact with tags about 1-5 times/week.

Experimental Procedures

Each participant took part in the experiment individually. Prior to the actual experiment, the participant was informed that the objective of the study was to evaluate the tag presentation effectiveness and that s/he should perform both as quickly and as accurately as possible. The participant was then asked to sign the informed consent form and complete a demographic questionnaire (Appendix A). A standard visual search experiment was used. The objective of the task was to find a tag (target tag) among a set of tags. Each tag was a Chinese term. Each participant was given three practice trials. After that, each participant carried out 60 experimental trials (10 trials each for 6 experiment conditions). In all trials, the target screen was shown first for 10 seconds. Next the search screen was shown, with the mouse positioned at the center of the screen. The participant had to find the target term as fast as possible. Once the participant found the target term, s/he was asked to click on it. Afterwards the next trial was presented automatically. Immediately after the participant finished all the search tasks in an experimental condition, s/he was presented with a questionnaire (Appendix B). This questionnaire used items selected from the Questionnaire for User Interaction Satisfaction (QUIS™, Shneiderman & Plaisant, 2005) and a questionnaire developed by Douglas et al. (1999). Then another group of 10 search tasks was begun. When the participant has

finished all the 60 tasks, s/he was asked to rank the most preferred layouts and to respond to some follow-up questions (Appendix C).

The experiment was programmed using Visual Basic 6.0 and was run on a Fujitsu laptop in the Microsoft Chinese Windows XP environment.

Experimental Design

The experimental design was a 2 (Sorting) X 3 (Layout) factorial design. Each participant completed three practice trials (one on each of the three different layouts) and a total of 60 experimental trials (10 trials each for the six conditions: two kinds of sorting by three layouts). The trials were "blocked" by these six experimental conditions and each block consisted of 10 trials. The testing order was balanced across participants by using the six conditions to form a Latin square-like design.

The two independent variables were:

1) Sorting: alphabetical, random.

Alphabetical sorting is based on Pinyin, the official romanization system adopted by People's Republic of China, which uses the Latin alphabet to represent sounds in Standard Mandarin. For example, the Pinyin for "音乐" (music) is "yin yue" and "电影" (movie) "dian ying", so that the tag "电影" will come before "音乐" in the sorting; and for "文学" (literature) whose Pinyin is "wen xue" and "文化" (culture) "wen hua", "文化" comes before "文学".

Within each random sorting condition, the search screen was different among trials.

2) Layout: tag cloud, horizontal tag list, vertical tag list

The tag cloud layout (Figure 9) spans 7 rows, with 7 or 8 tags located in each sequential line. 3 different font sizes: small (9-point), medium (11-point) and large (13-point) were used. The occurrence of the three font sizes for both the target tags and the tags in the cloud was balanced. The remaining one target tag of the 10 tags was in 11-point font.

红娘	高跟鞋	陈楚生	鲧夫	印度	盐巴	怀孕	后
卫	敖包	柳条	曹禺	那英	洗碗	厦门	平头
咖啡	幼儿园	关岛	谢霆锋	考官	防晒	偷渡	安
理会	纸巾	土壤	天空	熊猫	董事	钟楼	信物
羽毛	火车站	魂魄	救生员	织女	四合院	户外	
金陵	黄包车	废铁	青海	朝霞	龙舟	旱鸭子	吵
架	减肥茶	赤壁	太空站	宁波	吐鲁番	屈原	柿子

Figure 9. A Random Tag Cloud Search Screen

The tag list layouts (Figure 10, 11) were constructed by varying the separation between rows and columns. The font size of each character in each tag was equal to the small size font (9-point) in the tag cloud, which is the normal font size in most Chinese websites. Each of the cells in these two layouts was of the same height and width. The horizontal layout had six rows and nine columns of tags (that is, a total of 54 tags). Tags were left-aligned by column. The vertical layout had nine rows and six columns (i.e., 54 tags). Tags were also left-aligned by column.

歌曲	末日	内衣	人材	桌面	红塔山	合同	紧线器	蜡烛
优酷	忧伤	猜拳	任贤齐	粤菜	超载	花生	办证	神探
章节	制片	啤酒花	玉米	绵绵	投资	闷骚	管理	芒果网
海贼	许哲佩	齐秦	英超	申请书	评语	感悟	对话	华山
五粮液	原创	高地	聊天	翅膀	赵无极	门徒	大道理	大巴
芭比	视觉	左传	射击	济公	凯恩斯	羊毛衫	休闲	危机

Figure 10. A Random Horizontal Tag List Search Screen

闷骚	人材	雪梨	白药	光标	纯净水
感悟	猜拳	海贼	许哲佩	齐秦	照明
休闲	啤酒花	评语	太阳	玉兰	饼干
申请书	对话	国画	涂鸦	赵无极	厨具
翅膀	大道理	李时珍	波普	红茶	橡皮擦
济公	粤菜	超载	花生	办证	神探
桌面	歌曲	末日	内衣	泡沫	日记
门徒	优酷	忧伤	猜拳	禽流感	博客
羊毛衫	章节	制片	啤酒花	尾牙	分流

Figure 11. A Random Vertical Tag List Search Screen

The differences in the size of the search field for the three layouts had to be minimized in order to eliminate any bias created by this factor (Scott and Findlay, 1993). The variation between the total area sizes of the three search screens did not exceed 2%.

In order to balance the positions of the target tags among all the trials and the three layouts, the search area was divided into nine equal areas. For every condition, the target in each of the ten trials was randomized among one of the nine areas with one of the areas having the target tag presented twice, and that repeated area was randomized among conditions. The exact position of the target word within an area was also randomized.

The target tag was a Chinese term. The concept of a term in Chinese is quite different from that in English because Chinese is a character-based language, so a term consists of one or more characters. In this experiment, the target tag and tags in the search screen had two or three characters. There hasn't been any research on the average number of characters per Chinese tag. The number used here was based on two pieces of evidence:
1) A character-per-Chinese tag count of the top five (ranked by Alexa) Chinese web portals' "popular tags" page, which revealed an average of 2.36 characters/tag.
2) Pu, Chuang, & Yang (2002) and Chau, Fang, & Yang (2007)'s respective studies on Hong Kong and Taiwan search engine logs, suggesting that the mean number of characters used in the pure Chinese queries is 3.28.
One-third of the target tags and the tags in the search screen were 3-character tags, and the other two-thirds were 2-character tags.

The terms were obtained from the "Popular Internet Term Corpus" of the third largest Chinese search engine, Sogou [2]. The target terms and the tags on the search screen were randomly chosen from the corpus. Terms co-occurring on one search screen did not form any meaningful context. Each target tag was unique; each distractor tag appeared once for each condition and one or two times for all conditions.

The dependent variables of the study were:

1) Search time: the average time to locate the target in each trial. Counting started when the search screen was shown and ended when the participant clicked on the screen.

2) Accuracy percentage: the percentage of trials having correct selection of the target item within each experimental condition.

3) Satisfaction: the score obtained through a satisfaction questionnaire (Appendix B).

Data Analysis

The performance data (accuracy and selection time) were analyzed using repeated measures MANOVA with Sorting and Layout (2X3) as the within-subjects variables to examine the differences among the presentation types. All the rating pairs (each on a 7-point scale) in the questionnaire were treated with an overall multivariate analysis and post-hoc Tukey HSD-adjusted comparisons. Participants' rankings of the layouts were subjected to a chi-square analysis.

Results

Accuracy & Selection Time

Accuracy was measured by the percentage of trials in which the target items were correctly selected. It not only represents whether the target item was found but if there was any slip in hitting the target as well. The Accuracy Percentage for all conditions was above 93% (Figure 12). Accuracy Percentage was not significantly different among Sorting [F (1, 35) =0.299, p>0.5] and Layout [F (2, 34) =1.607, p>0.2].

A=Alphabetic; R=Random; C=Cloud; H=Horizontal; V=Vertical
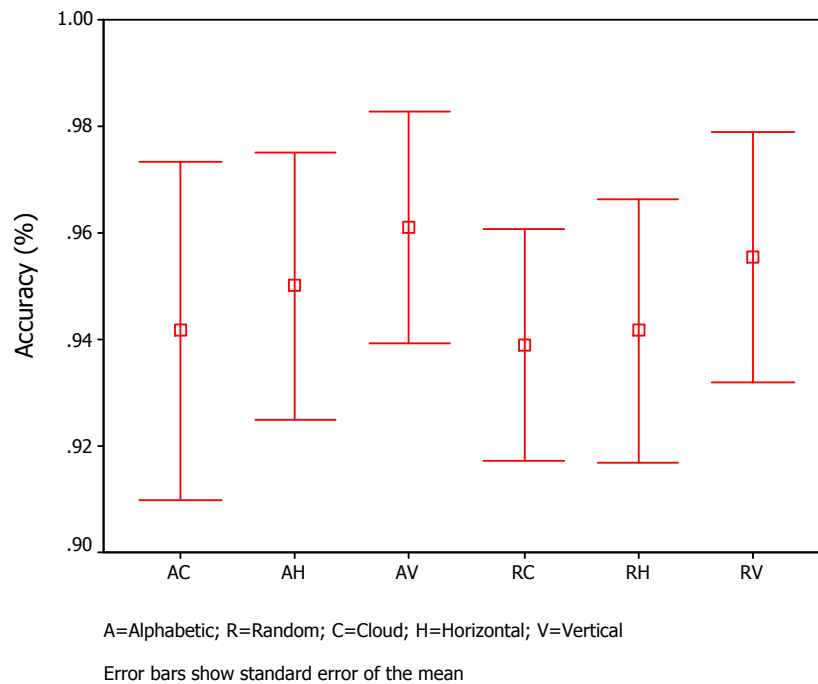
Error bars show standard error of the mean

Figure 12. Accuracy for the six tag presentations.

Table 1 shows the mean selection times for the different presentations. The alphabetical order (mean=6.95 seconds, S.D.=2.66) resulted in a faster mean selection time than the random order (mean=8.12 seconds, S.D.=4.39) (Figure 13), and this difference was statistically significant [$F_{(1,\ 35)}$ =4.383, p=0.044)]. The average search time using alphabetical ordering was 17% faster than using random ordering. The differences between the three layouts (horizontal list, vertical list, and tag cloud) were not statistically significant [$F_{(2,\ 34)}$ =2.521, p>0.09].

Presentation Type	Mean (in seconds)
Alphabetic Horizontal List	6.82
Alphabetic Vertical List	6.85
Alphabetic Cloud	7.16
Random Vertical List	7.57
Random Cloud	8.37
Random Horizontal List	8.42

Table 1. Average Selection Time (seconds) for the six tag presentations.

The tag cloud layout was individually investigated for the effect of the three font sizes on Selection Time. There was no statistically significant effect of font size on Selection Time [$F_{(2, 34)} = 0.463$, $p > 0.6$].
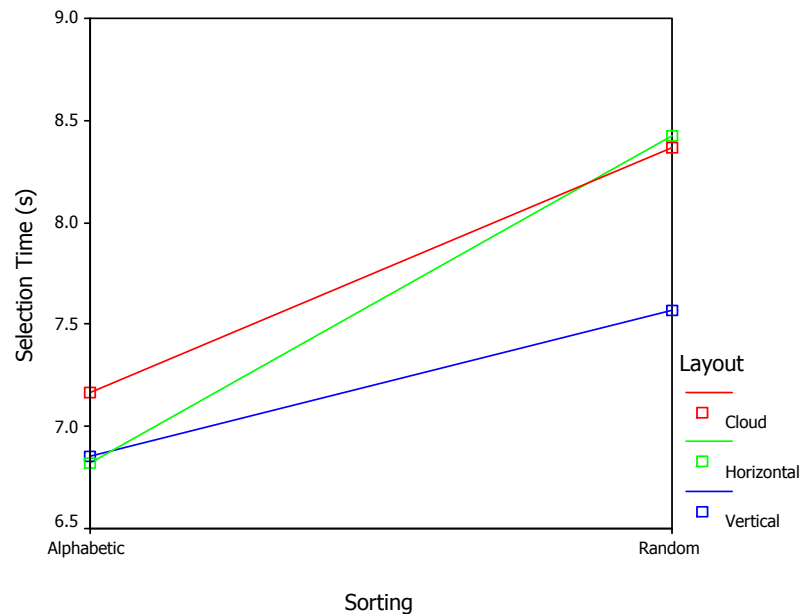

Figure 13. Average Selection Time (seconds) for the 2 kinds of Sorting.

Subjective Satisfaction and Ranking

Table 2 and Figure 14 summarize participants' responses to the six tag presentations. An overall multivariate analysis on all the rating pairs (1 to 7 on each end) suggests no significant differences between alphabetical and randomly-sorted layouts [$F_{(6, 205)} = 701.698$, $p > 0.3$], but the effect of Layout is marginally significant [$F_{(12, 410)} = 2.35$, $p = 0.06$], and significantly different for the question of required mental effort ($p = 0.028$). Tukey HSD-adjusted comparisons showed significant differences between the tag cloud and the horizontal tag list for ratings of terrible/wonderful, and whether the mental effort was too low/high. The horizontal tag list was considered significantly more wonderful (mean=4.01, S.D=1.42) than the tag cloud (mean=3.44, S.D=1.46), and the mental effort required for selection from the horizontal tag list (mean=3.15, S.D=1.43) was rated significantly lower than the tag cloud (mean=3.78, S.D=1.38). The differences in ratings were not statistically significant for the remaining rating scales.

Presentation Type	Terrible | Wonderful	Frustrating | Stimulating	Dull | Satisfying	Mental Effort Low--High	Accurate Pointing Easy--Difficult	Uncomfortable | Comfortable
Alphabetic Horizontal List	3.25	3.47	3.67	3.94	3.72	3.94
Alphabetic Vertical List	4.08	4.28	3.50	3.00	3.00	4.31
Alphabetic Cloud	3.89	4.22	3.50	3.14	3.28	4.08
Random Vertical List	3.64	3.72	3.83	3.61	3.89	3.81
Random Cloud	3.94	3.94	3.47	3.31	3.50	3.94
Random Horizontal List	3.78	3.89	3.53	3.50	3.36	3.86

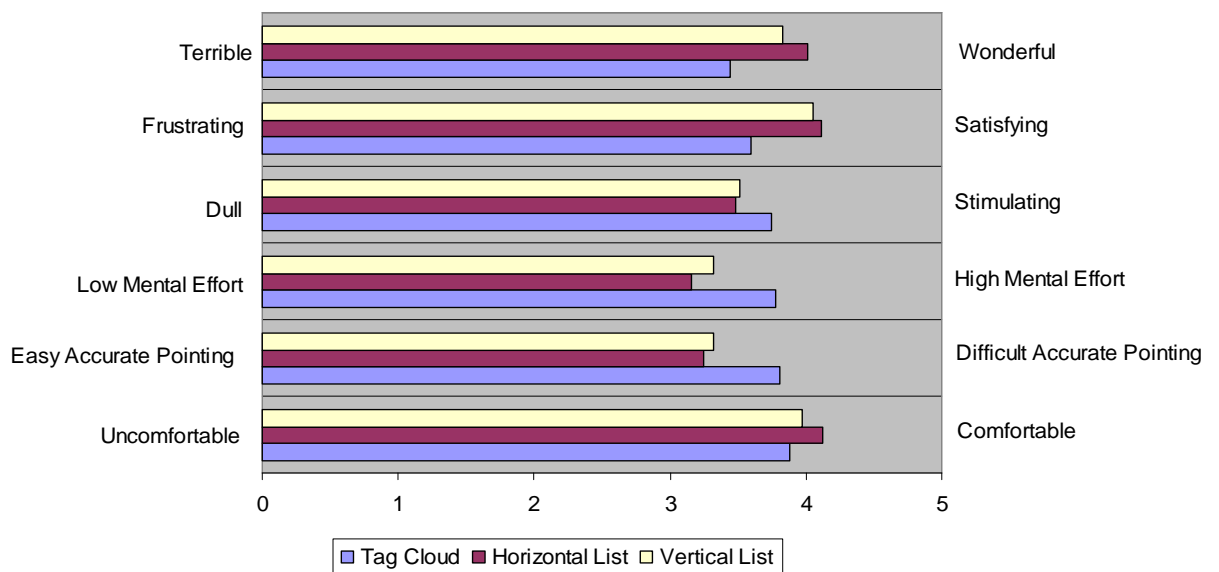**Table 2. Subjective Satisfaction.**

Figure 14. Subjective Satisfaction.

A chi-square analysis of the participants' preferences ranked on the final questionnaire showed that there were not significant differences for the rankings of the six presentations [x^2(2, N= 108) = 3.243, p >0.6]. Any of the six presentations had at least

two participants that ranked it as the most favored one (i.e., rank 1), with the alphabetic horizontal layout being ranked 1 the most (by 12 participants).

Participant Comments

Participants had varied responses to the different presentations, so only the most frequently-recurring comments on the three layouts (mentioned by more than six people) were coded and tabulated as shown in Table 3.

Times Mentioned	
Tag Cloud	
12	Font variation makes searching difficult, especially for terms in smaller font
11	Font variation helps with searching
10	Font variation makes the layout chaotic and messy
6	Fun, less boring
Horizontal Tag List	
11	Looks more comfortable because it is in accordance with reading pattern
6	Looks orderly
3	Dull
Vertical Tag List	
10	Looks more compact, making searching more efficient
6	Looks orderly

Table 3. Participants' Comments.

Of the two kinds of Sorting, 22 of the 36 participants clearly stated that they didn't realize that items in some layouts were in alphabetic order, but they all considered that this sorting would be helpful if they had known it beforehand. For the remaining 14 people who did notice the alphabetization, all confirmed its help with their selection.

When interacting with the listing layouts, 17 participants said they searched by columns, 11 by rows and 8 said they randomly changed from time to time.

Discussion

Search Performance

The search performance discussed here was measured by Accuracy Percentage and Search Time. The dependent variable Accuracy Percentage was not found to be affected by either Sorting or Layout, so it is not significantly different among the layouts. This result is not surprising if we consider the relative simplicity of the task, and the fact that participants were allowed to take as much time as they wanted to find the target item. The occurrence of errors is more likely to be attributed to slips of the mouse rather than a wrong selection.

Selection time, however, was significantly affected by Sorting. Using a layout sorted alphabetically, participants performed 1.17 seconds faster, on average, than using a layout in random order. This result indicates that, despite the fact that such an ordering is less evident in the Chinese language and requires a mental translation process from the character to its phonetic, it serves as a useful cue that contributes to more efficient searching for the users. Hence, it can be concluded that a layout with an alphabetical ordering will be beneficial for Chinese users' interaction with tag presentation.

Layout (horizontal list vs. vertical list vs. tag cloud) was not found to have a significant effect on selection time. There could be several explanations for this result. On one hand, search time could be affected by many factors, such as the participant's preferred starting position for the search (thus, the distance travelled from that position to the target), scanning habits, experience with the layout, the searching strategies used, and the layout itself. Each factor alone, as well as their combinations, could result in a high degree of variation in search time. In particular, differences in scanning patterns and search strategies might mask the effect of Layout. As previous studies by Lau et al. (2002) and

Ding et al. (2007) have suggested, Mainland Chinese exhibited rather flexible scanning patterns. They may not scan in the same way as they read, that is, following the horizontal Z path they were trained to adopt; and they may change the scanning direction from horizontal to vertical according to the layout. The present study's results are consistent with their findings. In addition, though no eye-tracking data was available as objective evidence, participants did mention different preferences for scanning direction, and searching strategies as well. Some participants said they would "glance over" the whole layout before searching by row or column, in which case the tag cloud with terms that were bigger in font may soon catch the participant's attention. Some said they would do a transposition when they were presented with the listing layouts in order to shorten the distance the eye had to travel in each scanning session. To be exact, they would scan by column with a horizontal list that has more columns but fewer tags in each column; and by row with a vertical list that has more rows but fewer tags in each row. Such strategies would obviously be inapplicable in the tag cloud situation, and some suggested they had used a "skewed" pattern, jumping from row to row. Besides the above-mentioned factors, even the participant's familiarity with a certain target term might play a part. Six participants had mentioned that they searched faster for a term with which they were familiar. Unfortunately, this factor is difficult to balance in the experimental design because of the great variations of familiarity for different participants.

For the tag cloud layout, the effect of font size on search time, previously found in Halvey and Keane's (2007) study, was not shown for the Chinese participants in the current study. There may be two reasons. First, the interaction between font size and the location of the target term were not controlled in the current experiment, since it was beyond the research questions of this study. In Halvey and Keane's (2007) study, they didn't specify whether these two factors were controlled in their design of the tag cloud. In this regard, we cannot be certain whether the advantage of bigger font size they found was influenced by the target locations. In addition, no statistical significance was reported for their results. Another possible reason for the discrepancies between the two studies could be that the font size gradation used in this study was not great enough to create an

obvious contrast among the terms; that is, terms in 9-point font didn't appear much different from terms in 11-point, and 11-point from 13-point. Future studies will need to incorporate a greater degree of gradation to further investigate this feature of tag clouds.

In summary, the selection time and error rate for Chinese users when they search or browse tags with a tag cloud or a tag list are not significantly different, but they search significantly faster when the tags are in an alphabetic order than when the tags are randomly arranged.

User Satisfaction

Participants' subjective perceptions of the layouts were not significantly affected by Sorting. When answering the final questionnaire, 61% of the participants actually stated that, during the experiment, they had not recognized whether there was an ordering for the tags, so didn't consider it helpful for their search or a reason for a higher/lower rating of the layout. Thus, it appears that the comparative superiority of alphabetical layouts in selection time might be attributed to another factor, possibly a more orderly visual effect created by sorting and list alignment. When constructing the search screens, each of the 30 alphabetical ones was designed with 8 to 9 pairs of terms that have the same first characters to serve as a cue (Figure 15), since the alphabetic sorting is less evident in Chinese than English. With this term grouping, the search screen may look better arranged to the participants than a random one, therefore facilitating their selection. However, since the current study didn't intend to investigate the effect of such groupings, only the number of occurrences of these term pairs (but not their positions) was balanced in the experiment, so future examination is needed to confirm its influence. Nevertheless, what these results imply for design is twofold. First, while sorting has a significant impact on search time, we cannot claim that alphabetical sorting is the most useful solution, since Chinese terms could also be sorted by total character stroke count, shape of successive strokes and radicals. Such sorting methods will also group terms together, so further investigation is worthwhile. Second, it is better to inform the Chinese users of the presence of sorting in order to increase their searching efficiency. Some participants who didn't realize the sorting during the experiment acknowledged that alphabetization would be useful for them if they had known about it beforehand.
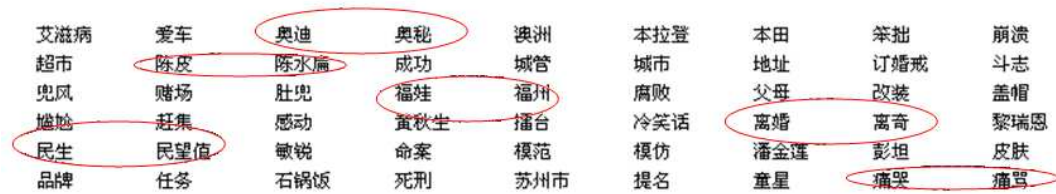
Figure 15. The Grouping of Terms in a Layout

艾滋病	爱车	奥迪	奥秘	澳洲	本拉登	本田	笨拙	崩溃
超市	陈皮	陈水扁	成功	城管	城市	地址	订婚戒	斗志
兜风	赌场	肚兜	福娃	福州	腐败	父母	改装	盖帽
尴尬	赶集	感动	黄秋生	播台	冷笑话	离婚	离奇	黎瑞恩
民生	民望值	敏锐	命案	模范	模仿	潘金莲	彭坦	皮肤
品牌	任务	石锅饭	死刑	苏州市	提名	童星	痛哭	痛骂

Participants didn't rate any of the three layouts significantly more terrible/wonderful, frustrating/satisfying, and dull/stimulating than the other two, and they didn't consider accurate pointing and the general comfortableness with the layouts significantly different. However, the mental effort needed to perform the search task was significantly different between the tag cloud and the horizontal tag list, and post-hoc analysis suggests that participants also felt the former significantly more terrible than the latter. This can be attributed to the fact that the horizontal list is in accordance with Chinese participants' left-to-right reading pattern, and thus appears more familiar to them. From participants' comments on the three layouts, we can argue that their attitudes toward the tag cloud were obviously more extreme, whereas their impressions on the lists tended to be neutral. The listing layouts were visually less provocative. They looked more orderly, and had a clear orientation (horizontal or vertical). The unconventional tag cloud, with a somewhat irregular look, may have required more effort to search. Specifically, the variations of font size may evoke negative feelings. In the current user group, this design feature induced completely different reactions and was the main controversy. For some, this variation made the layout look chaotic and badly-arranged; for others, it looked fun and interesting. Participants who didn't like it found it "terrible" or "bizarre", and it even made them feel dizzy; more importantly, they considered it a hindrance to their search, distracting their attention. But participants who favored this design said the terms in big font size rapidly caught their attention, helping them to locate the target term or eliminate the distracting terms. These divided opinions have two implications. First, though the font size variations did not significantly affect search time, tags in bigger font would appear more attractive to the eyes, which corroborates what Rivadeneira et al. (2007) and Sinclair and Cardew (2007) found in their studies. Second, the visual advantages may

create bias towards popular ideas, as Hearst and Rostener (2007) have noticed, because tags in small fonts would be less visible and would more often be ignored.

Another factor that seemed to influence satisfaction with tag clouds was participants' previous experience with the layout. Hearst and Rostener (2007) noted the discussion on whether new users react well to tag clouds. The current study did not find a significant difference in layout satisfaction between people who didn't know about tags and those who had previous experience with tags, but comments made by participants who had not previously encountered the tag cloud suggested that they had more often formed a negative impression of it. Some even expressed extreme dislike. During the experiment, six participants had uttered, "Oh, so horrible!", when they were first shown the tag cloud selection screen. What this means for designers is that they should expect an initial repulsion when introducing the tag cloud to their websites and it may be more appropriate for them to provide alternative view modes such as the traditional listing for users to choose. That being said, it cannot be concluded that participants' impressions of tag clouds would not improve when they gain more experience with this form of tag presentation.

To sum up, overall user satisfaction with these six tag presentations did not differ significantly. However, participants rated the tag cloud layout significantly more terrible and requiring more mental effort than the horizontal tag list.

Conclusion

The current study has attempted to address whether a tag cloud or a tag list results in faster search time, lower error rate and higher satisfaction for Chinese users when they search or browse tags; and whether sorting of the tags affects the above three aspects. From the data gathered, it was found that the selection time, error rate and the overall degree of satisfaction were not significantly different when Chinese users interacted with a tag cloud or a tag list. However, an alphabetically sorted tag presentation would significantly shorten the time they needed to search for an item. It was also found that

users regarded the horizontal tag list as more wonderful than the tag cloud, and considered the required mental effort lower for the former.

From an application standpoint, some guidelines could be proposed in light of these results, so as to optimize Chinese users' performance and experience with the tag presentation design on a Chinese website:

(1) Sort the tags alphabetically, whether arranging them in a tag cloud or a tag list layout, and indicate the presence of such sorting, so that users will be able to locate a certain tag much faster.

(2) For tag cloud design, attention should be paid to the font size gradation if this feature is to be utilized to a greater extent. Otherwise font sizes may not help distinguish the tags.

(3) Investigate the possible reactions of the target users before the introduction of the tag cloud; consider providing alternative presentation styles. A tag cloud may leave a negative impression for users, especially those who are new to this design, thus decreasing their willingness to interact with the interface.

It should be noted that this study is an initial investigation of tag presentations on Chinese websites, and it would be more desirable to have eye-tracking data to suggest possible interaction patterns. Also, tag clouds may be useful for other tasks besides searching, such as impression formation and recognition/matching (Rivadeneira et al., 2007), but these aspects were not investigated here. Nonetheless, the current results do provide a basis for preliminary design decisions and for future studies, and at the same time contribute to cross-cultural human-computer interaction design.

Notes

[1] http://en.wikipedia.org/wiki/Tag_cloud

[2] http://www.sogou.com/labs/dl/t.html

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Appendices

Appendix A
Demographic Questionnaire Administered Before All Trials

1. You are:

__Male   __Female

__Undergraduate Student   ___Master's Degree Student   ___PhD Student

___ Other: _____

2. Your Major/Department: _____

3. Your age: ___

4. Your eyesight is:

___Normal   __Short/long sighted, wear glasses   __ Short/long sighted, wear contacts lens

5. How many hours do you use the Internet every week?

(   ) None   (   ) 1-5 Hours   (   ) 6-15 Hours   (   ) More than 15 Hours

6. How often do you interact with tags on websites?

(   ) Don't know what a tag is   (   ) Once a week   (   ) 2-5 times a week   (   ) Daily

Appendix B

Questionnaire Administered After Trials in Each Condition

1. Do you have previous experience with this tag layout?
No___   Yes___

2. Please circle the number that is most appropriate as an answer to the following questions.

- The selecting screen is:

terrible	1	2	3	4	5	6	7	wonderful
frustrating	1	2	3	4	5	6	7	satisfying
dull	1	2	3	4	5	6	7	stimulating

- The mental effort required for operation was

too low	1	2	3	4	5	6	7	too high

- Accurate pointing was

easy	1	2	3	4	5	6	7	difficult

- General comfort

very uncomfortable	1	2	3	4	5	6	7	very comfortable

Satisfaction measured by QUIS 70 [Shneiderman and Plaisant 2005], section2 part 1; and by a questionnaire from Douglas et al. [1999], section 2 part2.

Appendix C

Questionnaire Administered After All Trials

Please rank the top 3 (1= most preferable) tag layouts. You may put down your comments on each layout at the right side.

(   ) Tag cloud sorted randomly

写真 淘宝 性感 帅哥 服饰 收藏 十字绣 酒 人物 外贸服饰批发 明星 饰品 唐诗韵 美景 休闲 经典 代理 服装批发 风景 希望大家喜欢 ★品牌专卖★ 娱乐 生活 原创 美女 花 高跟美女 我 艺术 风光 宝宝 自然 自拍 韩国 流行饰品 手工书籍 鑫海地鞋业 美图 真丝 服装 衣服 爱 新疆 流行银饰 养眼 摄影 动漫 可爱 彩金三件套 时尚 照片 零 售 我的 托斯卡的橱窗 壁纸 好 旅游 卡通 甜甜 哈哈 朋友 精品批发 韩剧 女装批发零售 春 宝 贝 批发 外贸女装批发 宠物 女装 包包 风间召唤 北京 外贸服装 罗伯特巴乔

Comments:

_____

_____

_____

(   ) Tag cloud sorted alphabetically

爱心 澳门 八百里 笔架山 穿越 春游 纯净水 大别山 地名 东北 服装 发布会 赣州 高交会 鼓架 古镇 国庆 哈尔滨 欢乐谷 惠东 火山 机器猫 纪晓岚 奖 金 论语 吕秀才 老友记 刘丹 民居 南澳 纽约 女儿 盆景 漂流 齐达内 秦川 擎天柱 染料 瑞金 杉菜 手鼓 双城 腾冲 汪东城 我猜 王晶 乡巴佬 湘西 宵夜 新娘 异形 英格兰 月野兔 朱孝天 纸牌 珠宝

Comments:

_____

_____

_____

(   ) Horizontal tag list sorted randomly

80后 幾米 爱情 安妮宝贝 传记 唐诗韵 美女 旅游 卡通 女友 理财 村上春树 曝光 记录片 性交易 刘亦菲 校花 婚礼 时尚 性感 休闲 桌面 红楼梦 聚焦 电影 外星人 经典 足球 减肥 创意 暴力 奥运 插画 电影 英语 风景 韩剧 校花 婚礼 动漫 内幕 日本文学 料理 哈利波特 同志 恶搞 动漫 名著 王小波 八卦 越狱 葛菲 黑社会 内蒙古

Comments:

_____

_____

_____

(   ) Horizontal tag list sorted alphabetically

八仙桌 表情 猜拳 炒面 炒鱿鱼 大奔 地雷阵 董卿 峨嵋派 犯罪 橄榄球 钢管舞 高手 歌词 冠军 合同 花泽类 花痴 火锅 火棘 江姐 胶水 近视 近卫军 经脉 竞技 聚焦 聚焦 骏马 李安 李英爱 轮椅 论坛 麦当劳 门徒 纽约 女足 啤酒 皮皮鲁 忍冬 三门峡 探戈 西安 西甲 校徽 许哲佩 印刷 印小天 优酷 章节 制片 中关村 直肠子 置业

Comments:

_____

_____

_____

(   ) Vertical tag list sorted randomly

幾米 爱情 聚焦 安妮宝贝 80后 传记 电影 英语 电影 风景 村上春树 越狱 美女 旅游 外星人 卡通 唐诗韵 恶搞 校花 婚礼 经典 动漫 韩剧 内幕 女友 理财 八卦 插画 生活 曝光 性感 休闲 王小波 桌面 时尚 红楼梦 减肥 创意 武侠 暴力 足球 奥运 美食 传奇 外国文学 车祸 饮食 余秋雨 音乐 记录片 名著 性交易 健康 刘亦菲

Comments:

_____

_____

_____

(   ) Vertical tag list sorted alphabetically

安徽 丁字裤 格瓦拉 捷运 老外 母亲节 安全套 钉子户 葛优 姐弟恋 老徐 木原 按摩 顶级 葛莱美 金城武 乐队 内地 案发现场 订婚 个性 金刚 乐器 内心 报复 东北 宫崎骏 梁咏琪 勒索 沈昌文 报告 东京 巩俐 两生花 擂台 生活 鲍威尔 二奶 红色 林一峰 冷笑话 生意人 暴打 儿化音 洪洞 另类 离婚 诗歌 爆扣 儿子 孝然 刘德华 夏立蔚 十字绣

Comments:

_____

_____

_____

Follow-up Question:
1. Have you recognized the alphabetical sorting in some search screens?
   If yes: Do you think it has been helpful for your search?
   If no: Do you think it will be helpful if you have known it beforehand?
2. What were your scanning patterns when you search for the term in the tag cloud/list?