# How Font Size and Tag Location Influence Chinese Perception of Tag Cloud?

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**Abstract.** Social tagging as a new approach for metadata creation has emerged to support browsing, searching, sharing on social network sites. Tag clouds are visual displays of social tags. In this paper we reported a user study on tag cloud perception. The goal of our evaluation is to investigate the effect of some of the different properties that can be utilized in presenting tags e.g. tag font size, tag location. Both behavior data and eye tracking data demonstrated a significant effect of font size, but effect of tag locations was mixed. Big tags were recalled better than medium and small font tags regardless of their locations in a tag cloud. Tags in the middle circle of a tag cloud received longer eye duration than outer circle, but were not recalled better.

**Keywords:** tag cloud, tagging, evaluation, visualization, user studies, Chinese.

## 1 Introduction

A tag cloud is a visual display of a set of words related to an information item such as a bookmark of a website, a blog entry, a photo. It usually has one purpose: to present a visual overview of the set of words. The size of a word is determined by the popularity to the tagged object. The larger the tag is, the more frequent the tag has appeared. In spite of their simple form, tagclouds have drawn a lot of attention from research communities [1,2, 3, 4, 5].

Several studies have done on the usage of tag clouds. Rivadeneira et al. [6] performed evaluation studies on searching and impression formation. As for goal-orientated tasks, simple alphabetical word lists are preferred over tagclouds [7]. Kaser et al. [8] proposed algorithms to create 2D tagclouds. In addition, studies concluded that the main value of tagclouds is as a signal or maker of individual or social interaction with information [5, 9].

Tags function as keywords, can be categorized with any word that defines a relationship between the online resource and a concept in the user's mind [10]. Tagging is implicitly also a social indexing process, since users share their tags and resources, constructing folksonomy, a social tag index, supporting visual information retrieval [11]. In regards to the issue of whether the tagcloud is actually useful as an aid to find information, Sinclair and Cardew-Hass's research found that where the information-seeking task was more general, participants preferred the tagcloud to

D. Harris (Ed.): Engin. Psychol. and Cog. Ergonomics, HCII 2011, LNAI 6781, pp. 273–282, 2011.

search information [12]. Often, more frequently used tags are depicted in a larger font or otherwise emphasized. In essence, the tag cloud translates the emergent vocabulary of a folksonomy into a social navigation tool [13].

Considering the role of tag cloud as visual information retrieval, it is important to attract user's attention rapidly. However, perception of tag clouds is influenced by many attributes of tags such as font size, word orientation (horizontal vs. vertical) or color that are used to represent tag frequency or semantic relationship of tags. Given the conflicting results on variables like location, it remains unclear that how tag clouds are perceived visually and which search strategies users apply when looking for tags in a tag cloud. While most previous work were based on behavior data, we report a study on the perception of tag clouds using both behavior data and eye tracking data that allows answering these questions. The goal of the study is to investigate how font size and tag location influence Chinese perception of tag cloud.

### 1.1 Tag Cloud Design

To construct a tag cloud, we divide a square into 4 quadrants: upper-left, upper-right, lower-left, and lower-right. (Fig. 1)

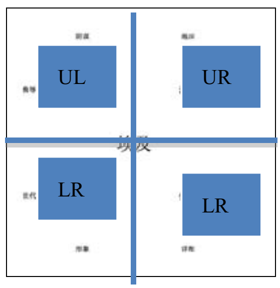


**Fig. 1.** Tag cloud Quadrants
(UL=Upper-Left; UR=Upper-Right; LL=Lower-Left; LR=Lower-Right)

Then we constructed tag clouds by varying the tag font size and tag location based on the following rules:

a) Three font sizes were chosen based on previous study [6]: big-9.83mm, medium-5.42mm, small-1.38mm;
b) 3 tag locations in a tag cloud were defined by quadrantizing a square three times. Inner location is the center of the square. Only one tag is assigned in this location. Middle location is the center of each quadrant, thus 4 tags are assigned to this location. Within each quadrant, its outer sub-quadrant (e.g. upper-left sub-quadrant of upper-left quadrant, or lower-right sub-quadrant of lower-right quadrant etc.) was divided. Outer locations are the two intersection points of the sub-quadrants. Therefore a total of 8 tags are assigned to this location in a tag cloud. In total, there are 13 tags in each tag cloud (refers to A in Fig. 2).
c) Font sizes (big, medium, small) were counter balanced cross all 3 tag locations (inner, middle, outer).

In summary, there are 6 types of tag cloud combing tag location and tag font size (Table 1 & Fig. 2).

**Table 1.** Six types of tag clouds combining font size and location

| | Tag Location | | |
|---|---|---|---|
| Example | Inner (1) | Middle (4) | Outer (8) |
| A | Big | Medium | Small |
| B | Big | Small | Medium |
| C | Medium | Big | Small |
| D | Medium | Small | Big |
| E | Small | Medium | Big |
| F | Small | Big | Medium |

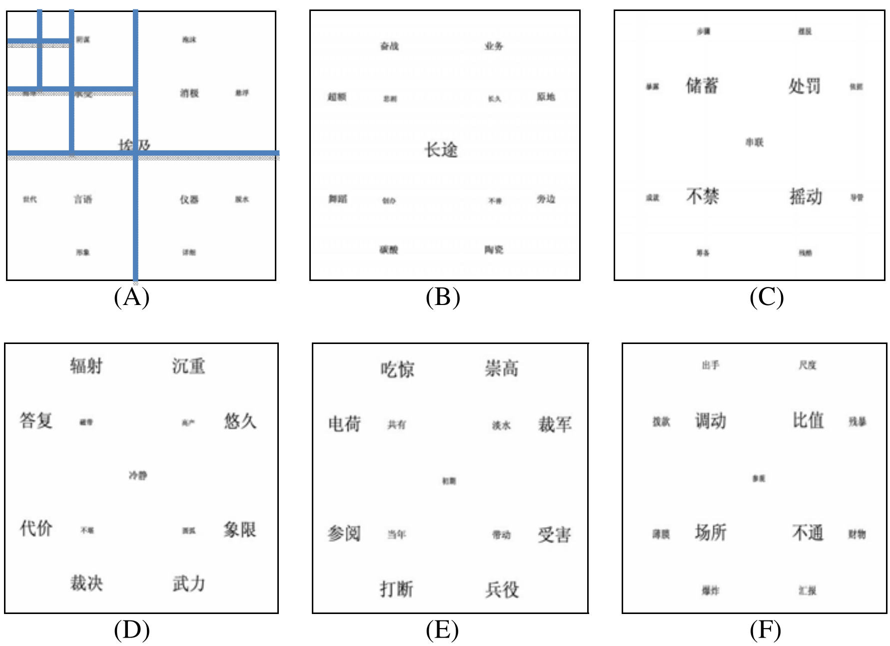


**Fig. 2.** Examples of six types of tag cloud

## 2 Method

The experimental was a 3x3 repeated measures design, with font size (Big: 9.83mm, Medium: 5.42mm and Small: 3.94mm), Locations (inner, middle and outer) as independent variables. The behavior measure (recall) and eye tracking measure (eye fixation duration, and eye fixation times) were our dependent variables.

### 2.1 Participants

Twelve students (6 female, 6 male) whose ages ranged from 21 to 31, were paid 20yuan to participate. All subjects had normal or corrected-to-normal vision.

### 2.2 Material and Apparatus

First, a set of 403 2-character Chinese words was obtained from the Chinese Words Frequency Dictionary within the written frequency from 100 to 1000 (this frequency is the mode in this dictionary). This dictionary totally contained 31187 2-character words. Second, thirteen different words were randomly sampled from the set of 403 words, and displayed in predetermined locations in order to appear as a spatial tag cloud. The layout of the tag clouds is one word inner, four words middle and eight words outer. There are 6 types of tag cloud combing tag location and tag font size (Table 1 & Fig. 2). For each type, 5 tag clouds with another 13 different words were continually sampled from the set till a total of 30 tag clouds were formulated. The tag cloud was presented to the participants by eye movement equipment, Tobii 1750.

### 2.3 Procedure

Participants performed one practice trial and 30 experimental trials. Each trial began with a blank screen for 1s, followed by a tag cloud for 20s. And then, a distract task (participants had to count backwards in threes starting from a random number) followed for 30s in order to eliminate any recency effect. The trial ended with a 60-second free recall. The presentation orders of each type of tag cloud were counterbalanced among participants.

## 3 Results and Discussions

In the following, we reported our behavior data and eye tracking data.

### 3.1 Behavioral Data

A 3x3 repeated measure of ANOVA was conducted on the recall data. Not only the main effects of font size ($F(2, 22) = 46.57$, $p<.001$), and location ($F(2, 22) = 6.46$, $p < .05$) were significant, the interaction effect was significant ($F(4, 44) = 6.22$, $p < .001$) as well.

Table 2 and Fig. 3 showed the mean and standard errors of recall data.

**Table 2.** Recall of tags by font size and location (mean, standard error)

| | Tag Location | | | |
|---|---|---|---|---|
| Font Size | Inner | Middle | Outer | Mean |
| Big | .66 (.05) | .39 (.03) | .35 (.03) | 0.47 |
| Medium | .29 (.06) | .22 (.03) | .27 (.03) | 0.26 |
| Small | .29 (.06) | .21 (.03) | .23(.03) | 0.24 |
| Mean | 0.41 | 0.27 | 0.28 | |

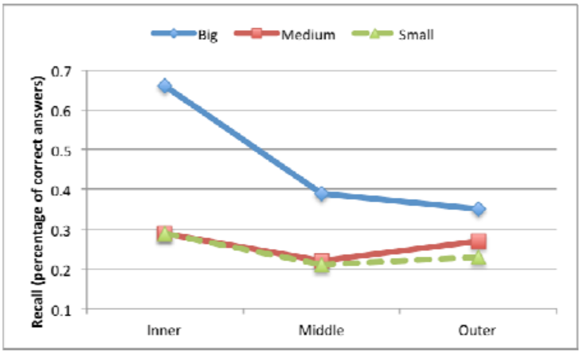


**Fig. 3.** Recall by font size and location

Recall for tags with a larger font size is significantly bigger than for tags with a smaller font size crossing all three locations. Pairwise comparisons revealed that when the location is inner or middle, the differences between big-medium, and big-small font size were significant, while the difference between medium and small font was not significant; when the location is outer, the differences among all pairs big-medium, big-small, medium-small were significant. This suggests that the advantage of medium font size vs. small font size on recall only occurs in the outer tag cloud. One possible explanation is that recall of tags in the middle tag cloud was interfered by tags from both inner and outer tag clouds, thus even out the font size advantage. A future study with different medium font size might further our understanding on this.

Recall for tags in different locations (inner, middle, outer) depends on the tag font size. When the font size is big, the effect of location is significant, $F$ (2, 22) = 20.42, $p < .001$. Pairwise comparisons revealed that the differences between inner and middle (.66 vs. .39), and inner and outer (.66 vs. .35) were significant, while the difference between middle and outer was not significant. However, when the font size were medium and small, the effects of location were not significant. This result implies that font size seems a stronger factor than tag location in tag recall. This is an important finding, suggesting that designers should use the feature of tag font size rather than tag location to improve the recall and perception of tags in a tag cloud.

To further our understanding of effect of location on recall, one-way ANOVA of quadrant on recall was conducted. Main effect of quadrant was significant ($F$ (3, 47) = 3.668, $p < .05$). As shown in Table 3 and Fig. 4, Recalls of tags in the upper quadrant (UL) were significantly better than the lower quadrants (LL, LR), but the difference between Upper-Left and Upper-Right (.34 vs. .33) was not significant. This confirmed our prediction that participants would pay more attention to upper quadrant than lower quadrant in a tag cloud given our reading habit is scanning from upper-down and left-right. In addition, our data suggested that better recalls of tags in a tag cloud only along the direction of upper-down, but not along left-right direction.

**Table 3.** Recall of tags by quadrant (mean, standard errors)

| *Quadrant* | | *Mean* | *SE* |
|---|---|---|---|
| Upper-Left | (UL) | .34 | .042 |
| Upper-Right | (UR) | .33 | .042 |
| Lower-Left | (LL) | .21 | .021 |
| Lower-Right | (LR) | .24 | .015 |


**Fig. 4.** Recall of tags by quadrant

### 3.2 Eye Movement Data

Similar to the behavior data, a 3x3 repeated measure of ANOVA with two within-subjects factors of three font sizes (big, medium, small) and three locations (inner, middle and outer) was conducted on the eye movement data.

First, the analysis of average fixation durations (seconds) revealed significant main effects of font size ($F(2, 18) = 14.92$, $p < .001$), and of location ($F(2, 18) = 3.71$, $p < .05$) as shown in Table 4 and Fig. 5.

Eye fixation duration for tags with a larger font size is significantly longer than for tags with a smaller font size as shown in the significant pairwise comparisons of all three pairs big-medium, big-small, medium-small ($p<.05$). Consistent with our behavior data, effect of font size is robust. This eye tracking data supported our behavior data that tags in bigger font size than in smaller font were scanned longer, processed deeper, and therefore recalled better.

In terms of effect of location on eye fixation duration, participants spent less time on tags in the outer tag cloud than in inner or middle tag cloud ($p<.05$), but the difference between inner and middle (353.79 ms vs. 346.76 ms) was not significant. This result supported our explanation to the behavior data that tags in the middle circle of a tag cloud received the interferences from tags in both inner circle and outer circles. Here participants spent similar amount of time on tags in the middle circle as those in the inner circle, implying that participants developed their own scanning strategy to the tags in the middle circle to reduce the interferences to them.

**Table 4.** Eye fixation duration (milliseconds) by font size and location (mean, standard error)

| | Tag Location | | | |
|---|---|---|---|---|
| Font Size | Inner | Middle | Outer | Mean |
| Big | 456.93 (70.75) | 494.34 (67.47) | 422.85 (63.66) | **458.04** |
| Medium | 385.76 (81.54) | 292.03 (49.31) | 219.76 (46.72) | **299.18** |
| Small | 218.68 (62.96) | 253.90 (63.35) | 178.39 (40.46) | **216.99** |
| Mean | **353.79** | **346.76** | **273.67** | |

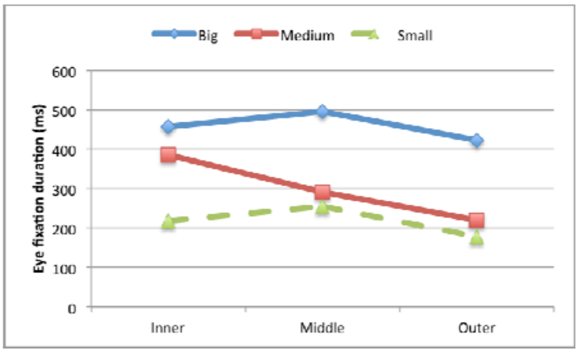


**Fig. 5.** Eye fixation duration (ms) by font size and location

Second, the analysis of average fixation times revealed a significant main effect of font size ($F(2, 18) = 29.43$, $p < .001$), a marginally significant main effect of location ($F(2, 18) = 3.54$, $p = .051$), and a marginally significant interaction effect ($F(4, 36) = 2.26$, $p = .081$) as shown in Table 5 and Fig. 6.

Similar to the result with eye fixation duration, eye fixation times for tags with a larger font size is significantly more frequent than for tags with a smaller font size as shown in the significant pairwise comparisons of all three pairs big-medium, big-small, medium-small ($p$<.05).

Different from eye fixation duration result, pairwise comparisons of locations revealed that only the difference between middle and outer was significant (1.29 vs. 1.00), while the differences between inner and middle, inner and outer were not significant. This further supported our explanation that participants developed corresponding visual scanning strategy on processing the tags in the middle circle of a tag cloud, that is scanning tags in the middle location longer and more frequently.

**Table 5.** Eye fixation times by font size and location (mean, standard error)

| | Tag Location | | | |
|---|---|---|---|---|
| Font Size | Inner | Middle | Outer | Mean |
| Big | 1.73 (.24) | 1.97 (.23) | 1.65 (.21) | **1.78** |
| Medium | 1.22 (.20) | 1.06 (.16) | .75 (.12) | **1.01** |
| Small | .59 (.13) | .86 (.16) | .59 (.09) | **.68** |
| Mean | **1.18** | **1.29** | **1.00** | |

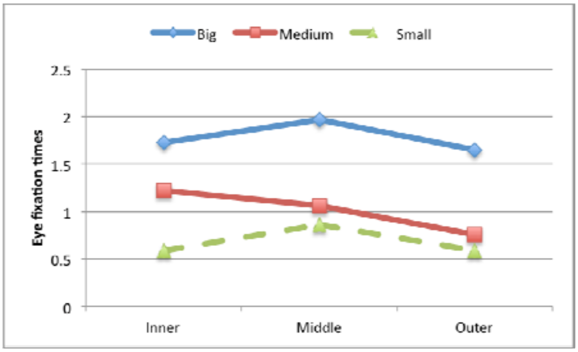


**Fig. 6.** Eye fixation times by font size and location

Finally, One-way ANOVA of effect of quadrant on eye movement data was conducted. It revealed a non-significant of quadrant on eye fixation duration ($F$ (3, 39) = 1.817, $p$ = .161), and a marginally significant effect on eye fixation times ($F$ (3, 39) = 2.551, $p$ = .071), as shown in Table 6 and Fig. 7.

**Table 6.** Eye fixation duration (seconds) and fixation times by quadrant

| *Quadrant* | | *Fixation duration* | *Fixation times* |
|---|---|---|---|
| Upper-Left | (UL) | 94.45 (10.02) | 365.80 (29.84) |
| Upper-Right | (UR) | 87.70 (9.04) | 335.60 (24.75) |
| Lower-Left | (LL) | 72.17 (9.50) | 288.60 (35.68) |
| Lower-Right | (LR) | 66.92 (.49) | 257.20 (29.73) |

While participants did not spend longer time on upper quadrants than lower quadrants, they did focus their eyes more frequently on upper quadrants than lower quadrants. Post Hoc Tests revealed significant difference of eye fixation times between UL and LR (365.8 vs. 257.2) was significant, and UL and LL (365.8 vs.288.6), UR and LR (335.6 vs. 257.2) were marginally significant. Again, this results suggested participants focused their eyes more frequently in the upper than lower quadrants, and more in the left than in the right quadrants.

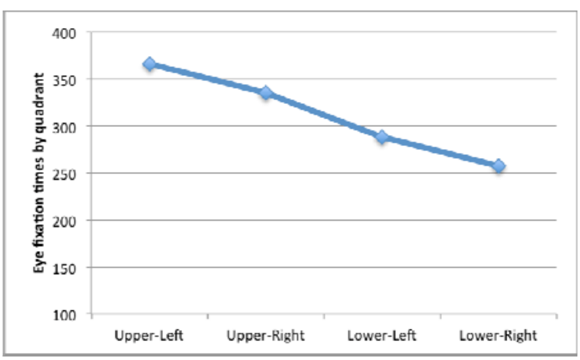


**Fig. 7.** Eye fixation times by quadrant

## 4 Conclusion and Implications

Overall, both our behavior data and eye tracking data demonstrated a robust effect of font size. Participants scanned and recalled more tags with larger fonts. They recalled more big tags than medium and small tags, while no more medium tags than small tags, except when the location is outer. However, we found a significant difference between medium tags and small tags in eye movement. Participants spent longer time and switched their eyes more frequently to medium tags than small tags, but they didn't encode or retrieve more medium tags. Therefore, eye movement is a more sensitive index to indicate what kind of tags can attract people's attention. People browse and search the tag clouds, click the tags that they are interested in, and needn't to memorize the tags.

The effect of location is not as robust as that of font size, and the behavioral data and the eye movement data are not so consistent. Only when the tags are big, participants recalled more tags inner than middle and outer. Interestingly, participants seemed developed their own visual scanning strategy to the tags in middle of a tag cloud. They spent similar amount of time, on tags in the middle as in the inner location, but significantly more time than in the outer location. The eye fixation frequency showed similar findings. These findings suggested while participants tried to move their eyes to tags in the middle location to reduce the interferences from tags from outer and inner locations, the recall of tags in the middle location was not compensated.

The effect of quadrant showed that participants recalled more tags in upper-left and upper-right than lower-left and lower-right and scanned more in upper-left than lower-right. Designers may consider upper quadrant especially upper-left as a focal point within a tag cloud. This area can either locate smaller font tags to compensate for font size, while locating bigger font tags to other quadrants, or locate tags that need to be emphasized.

In the future, other features of tag clouds such as tag colors, tag orientation, tag cloud size/density, number of characters/tag, semantic relationship of tags, need to be investigated so that we will have a better understanding of both cognitive and social process of tags in a tag cloud in order to design a better retrieval system to support tag creation, presentation and sharing.

**Acknowledgements.** This material is based upon work supported by the National Science Foundation under Grant No. IIS-0803225. We thank Dr. Kan Zhang and Dr. Xianghong Sun for their assistance in this project.

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