First Look: Examining the Horizontal Grid Layout using Eye-tracking

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Previous research has shown that users scan traditional text-based web pages using an "F-shaped" pattern. Evidence of this pattern exists because of the hierarchical structure of search engine result pages (SERP). With the recent implementation of Windows 8, search results are presented as a horizontal grid rather than a list. Due to the structural differences between the list and grid layouts, it is reasonable to postulate that users would exhibit dissimilar scanning patterns between layouts. This study compared the eye-tracking data of two SERP layouts (grid vs. list) with two types of tasks (informational vs. navigational) to observe differences in gaze patterns. Results indicated that users viewed the top left quadrants of the grid layout the most. However, there was little consensus as to how the results were ordered in the grid, unlike the list layout.

INTRODUCTION

Search results are traditionally displayed as a list in which the most relevant results are located at the top of the page. The hierarchically ranked results structure guides users to view traditional search engine result page (SERP) layouts linearly. This visual hierarchy creates a presentation bias, in which users are more likely to attend to search results that are collectively organized at the top (Bar-Ilan, Kennoy, Levene, & Yaari, 2009). Past eye-tracking research has shown that users follow an "F-shaped" pattern of scanning within the traditional list layouts (Nielson, 2006, Shrestha et al., 2007; 2008). This pattern forms when users browse a text-based layout. These web pages typically show dense gaze fixations in the upper left portions of the web page. Evidence of this pattern is inevitable within traditional SERP due to the linear organization and heavy emphasis on textual content.

Multiple studies have shown evidence of users' susceptibility to presentation bias even when the order of SERP results are manipulated, thus providing more implications of this "F-shaped" pattern of scanning (Keane, O'Brien & Symth, 2008; Guan & Cutrell, 2007). Others have indicated that SERPs organized with a list layout can influence how often users attend to the higher positioned search links (Granka, Joachims, & Gay, 2004; Guan & Cutrell, 2007; Pan et al., 2007).

The hierarchical structure of list layouts biases users to rank higher positioned results as more important than results listed at the bottom of the page. As a result of this bias, users typically spend less time attending to the bottom of the page. There is also evidence of list layouts influencing the number of search result clicks, as users are more likely to click on search results that are at the top of the list (Pan et al., 2007). While reliance on search order is influenced by users' confidence in the search engine's capability of displaying trustworthy sources (Pan et al., 2007), users' browsing behavior may be affected by the way the content is organized on a page.

Implications of the "F-shaped" gaze pattern are less prominent in alternative SERP layouts. Shrestha (2012) investigated users' interaction with a traditional SERP list layout against two alternative SERP layouts (tabular and grid). The search results within the tabular layout were segregated into three columns (title, URL and text snippet). On the other hand, the search results (unsegregated) within the grid layout were divided into two columns. Results showed that the way users viewed a layout varied by condition. In comparison to the list and tabular layout, the hierarchical scanning pattern was less noticeable within the grid layout. However, Shrestha (2012) noticed users treated the two columns as individual lists. That is, users vertically scanned down the left column before moving onto the right column.

Similarly, Kammerer and Gerjets (2014) found differences in gaze patterns between the grid and list layouts when trustworthiness of the search results were manipulated in descending (most to least) and ascending (least to most) order. Consistent with much of the SERP literature, users viewed the two manipulated SERP conditions on the list layouts hierarchically, but the grid layout showed a less structured viewing pattern. Specifically, users viewed grid pages line-by-line or column-by-column pattern. Similar to previous findings, they also found that a majority of users spent a longer duration on the top of the list interface. However, when users viewed the grid layout, fixation duration was consistent across all search results, suggesting that the grid layout allowed users to evaluate each search hit more carefully than the list layout.

Compared to list and alternative counterparts, the recent adaption of Windows 8 may reveal unique differences in how users view a different SERP layout. Unlike the list interface which naturally guides users to search in a top-down manner, Windows 8 incorporates a grid tiled layout that may display unclear ranking positions and require users to navigate horizontally.

While Shrestha (2012) and Krammerer and Gerjets (2014) found differences in scanning patterns for a grid layout, the stimuli that were used were not fully representative of the grid layout presently implemented in the new Windows 8 interface. Although a large body of literature has already addressed how users approach web pages, there are few empirical studies that examined alternative SERP interfaces

that are similar to those used in the latest Windows 8 operating system.

Purpose

The goal of this study is to understand how users view the grid SERP layout currently implemented in Windows 8. This study compared two SERP layouts (grid vs. list) and two types of tasks (informational vs. navigational). Eye-tracking data was gathered to see if differences in gaze patterns existed when users perform two types of search tasks on the two SERP presentations.

METHOD

Participants

A total of 45 participants (16 Males and 29 Females) aged 18 to 46 (M = 23.05, SD = 6.71) were recruited from a Midwestern University for this study. A majority of participants (69%) reportedly use their laptop as their primary source of computing. At least 26 participants used Windows 7 as their primary operating system. The remaining users used Windows 8 (n = 9), Mac OS X (n = 8), or other (n = 2).

Design

Participants completed a total of 12 search tasks (6 informational; 6 navigational) on two SERP layouts (grid vs. list). The layouts were mocked up on Adobe Dreamweaver to mimic the SERP list layout on Google and horizontal grid layout on Windows 8 Bing. These layouts were stripped of branding to control for potential bias.

Materials

Hardware. A Tobii X120 eye-tracking system was used to capture eye-tracking measures including first fixations, fixation count, visit count, and total fixation durations on specified Areas of Interests (AOIs) on the list and grid layouts. Eye-tracking data was used to generate gaze plots to show scan paths and heatmaps to present scan patterns through aggregated data.

Measurements. A modified version of the System Usability Scale (SUS) was administered to collect user satisfaction after use of each layout (Brooke, 1996).

Stimuli. Two different layouts were used in this study. The grid layout was designed to mirror the SERP interface of Windows 8 (see Figure 1) and the list layout was designed to reflect the traditional SERP interface of Google (see Figure 2). Results presented on each layout were for either an informational or navigational search task.

Tasks. There were 12 tasks total (6 informational; 6 navigational). The informational search task (represented as *info task*) was an exploratory search task and participants were able to choose an answer from multiple sources (e.g., "You had heard that Facebook was once sued by twin brothers. What are their names?"). The navigational search task (represented as *nav task*) specified a particular result on the SERP layout (e.g., "Why should you love the Skinny Caramel Macchiato according to the Starbucks website?").

Figure 1. Example of an info (left) and nav task (right) on the grid layout.

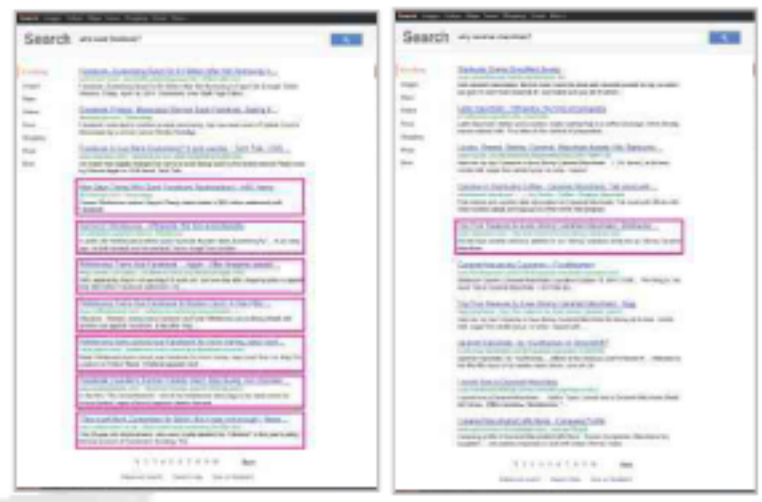

Figure 2. Example of an info (left) and nav task (right) on the list layout.

Procedure

The experiment lasted approximately 60-75 minutes. Prior to the experiment, participants were asked to complete a consent form and a background questionnaire. Participants were calibrated using Tobii X120 to accurately capture their eye movement. Participants completed 6 *info tasks* and 6 *nav tasks* (12 tasks total) on two SERP layouts (*grid* and *list*). Task type and layout were counterbalanced for each participant. Tasks within each layout were randomized.

The 12 search tasks were presented on the computer screen. Participants were asked to read aloud the search tasks (e.g., "You had heard that Facebook was once sued by twin brothers. What are their names?"). Once read aloud, they were permitted to start the search task. Each participant was given a practice trial for the *grid* and *list* layout. They were allotted 5 minutes to complete the search task. If the task was not completed within the given time interval or if a participant quit the task, it counted as a failure. Upon completion of each layout, participants were also asked to complete a satisfaction survey and were asked to give a layout preference and answer a few open-ended questions on search strategies post-experiment.

RESULTS

Viewing Patterns of Task Type and Layout Type

Areas of Interest (AOIs) were specified on each search hit for the two layouts. Based on the official ordering of the search results found on the *grid* and *list* layouts, three areas of the *grid* and *list* layouts were grouped into these three sections. Figure 3 provides a visualization of how these AOIs were divided.

Figure 3. Sections of AOIs for grid and list layouts: Blue represents search results 1-3(Left; Top), yellow represents search results 4-6 (Center; Center); red represents search results 7-10 (Right; Bottom).

Order of Fixations. **Results revealed that fixation patterns within the *grid* were not as systematic as fixation patterns the traditional *list* layout. Overall, regardless of the type of tasks, the order of fixations for the search results on the traditional *list* layout remained relatively similar. The order of fixations on the *grid* was also relatively similar regardless of the type of task.**

Users fixated first on the results located on upper left quadrants of the grid layout for the *info task* condition. Search results located on the bottom row and right column of the *grid* were attended to last. The *nav task* had the target location of the search task appeared on the 2nd, 4th, 5th, 6th, 7th, and 9th search results of the *grid* layout. Results indicated noticeable similarities to the *info task*. When performing a *nav task*, users fixated first on the upper left quadrants of the *grid* layout. Figure 4 shows the gaze orders and Figure 5 shows an example of a heatmap generated from the gaze data.

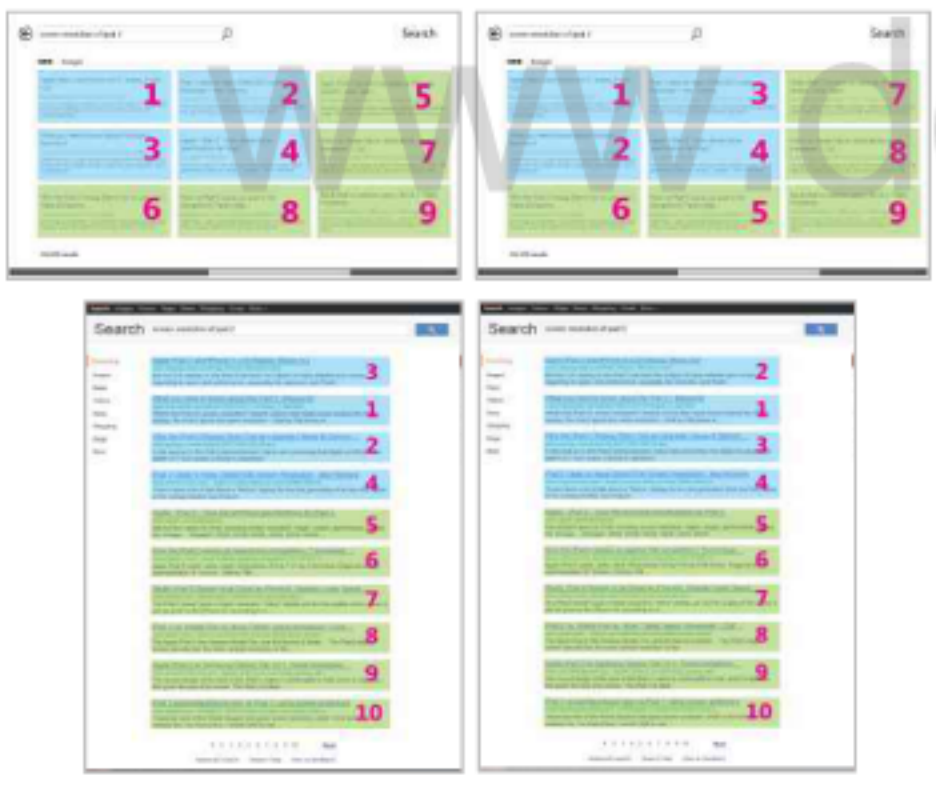

Figure 4. Order of fixations of the info and nav tasks for both layouts represented numerically.

Figure 5. Example of heatmaps generated from gaze patterns from individual participants performing an info task on both layouts.

Comparisons of the grid and list Layout by Task Type

A series of one-way ANOVAs were conducted to look at the number of fixations, visit count, and total fixation duration for the AOIs on *grid* & *info task*, *grid* & *nav task*, *list* & *info task*, and *list* & *nav task*. Table 1 displays the means and standard deviations.

Fixation Count. **Overall, results showed significance for the *info task* within the layouts, $F(1, 43) = 101.92$, $p < .001$, *partial* $\eta^2 = .70$. Users fixated more on the *grid* layout than the *list* layout when performing an *info task*. There were no differences for the *nav task* across the layouts, $F(1, 43) = .01$, $p > .05$, *partial* $\eta^2 < .001$.**

Significant differences were found for the *grid* layout for the tasks, $F(1, 43) = 122.23$, $p < .05$, *partial* $\eta^2 = .74$. Users fixated more when performing an *info task* than a *nav task* on the *grid* layout. A significant difference was also found for the *list* layout for the tasks, $F(1, 43) = 6.65$, $p <. 05$, *partial* $\eta^2 = .13$. Users fixated more when performing an *info task* than a *nav task* in the *list* layout.

Total Fixation Duration. **Overall, no differences were found for the *info task*, $F(1, 43) = .47$, $p > .05$, *partial* $\eta^2 = .01$ and *nav task*, $F(1, 43) = .01$, $p > .05$, *partial* $\eta^2 < .001$ within the layouts.**

There were also no differences found for the *grid* layout for the tasks, $F(1, 43) = 2.84$, $p > .05$, *partial* $\eta^2 = .06$. However, there was significance for the *list* layout for the tasks, $F(1, 43) = 6.13$, $p <. 05$, *partial* $\eta^2 = .13$. Users fixated longer when performing an *info task* than a *nav task* on the *list* layout.

Table 1. Mean (*SD*) of Eye-Tracking Measures for Task Type (Info/Nav) and Layout Type (Grid/List).

Layout by Info Task	Fixation Count M (*SD*)	Total Fixation Duration M (*SD*)
Grid Layout	7.59 (2.61)**	1.63 (0.65)
List Layout	1.76 (0.72)**	1.76 (0.72)
Layout by Nav Task		
Grid Layout	1.30 (0.54)	1.30 (0.54)
List Layout	1.29 (0.51)	1.29 (0.50)
Task by Grid Layout		
Info Task	7.59 (2.61)*	1.61 (0.65)
Nav Task	1.30 (0.54)*	1.30 (0.54)
Task by List Layout		
Info Task	1.76 (0.72)*	1.74 (0.71)*
Nav Task	1.29 (0.50)*	1.28 (0.51)*

*p < .05; **p < .001

Comparisons of Specific AOIs on the grid layout

Results from the eye tracking data indicated that users view the *grid* layout differently than the *list* layout. Unlike the *list* layout, users were not consistent in reporting the location of the 'top three' results**. When users were prompted (post-**experiment) to indicate where they believed the 'top three' **results were located, 57% of the participants reported that the 'top three' search results would be located in the top row and 32% indicated they would be in the left column (see Figure 6). 11% of the participants were unsure or thought there was no pattern.**

Figure 6. Users' perception of 'top three results' **location on grid layout.**

Overall AOIs Comparisons of Left column & Top row

To better understand where users viewed the top results on the *grid* layout when performing an *info task* or *nav task*, multiple dependent *t*-tests were conducted to compare the number of fixations, visit count, and total fixation duration between the results located on the *top row* and *left column* of the *grid* layout. AOIs for these two sectioned areas were created and represented in Figure 7. Table 2 displays the means and standard deviations. A Bonferroni correction was implemented to control for family-wise type I error (p = .013).

Figure 7. 'Top three results' as represented by the left column (Blue AOIs) and the top row (Red AOIs).

Fixation Count. **Results indicated no differences in fixations for the *info task* between the *Left – Top*, $t(22) = -2.04$, $p > .05$, $d = .29$. There was no significant differences for the *nav task* between *Left – Top*, $t(21) = -2.33$, $p > .01$, $d = .33$.**

Visit Count. **No significant differences were found in revisits for the *info task* between *Left – Top*, $t(22) = -.83$, $p > .05$, $d = .10$, and *nav task* between *Left – Top*, $t(21) = -1.27$, $p > .05$, $d = .10$.**

Total Fixation Duration. **Results indicated significant differences in total fixation duration for *Left – Top* when performing an *info task*, $t(22) = -2.75$, $p < .013$, $d = .33$, and *nav task*, $t(21) = -3.14$, $p < .01$, $d = .35$. Users fixated longer on the *top row* than the *left column* when performing an *info task* and *nav task*.**

Table 2. Means (SD) of Eye-Tracking Measures for Left Column and Top Row for Task Type (Info/Nav) on the Grid Layout.

Grid Layout		Fixation Count M (*SD*)	Visit Count M (*SD*)	Total Fixation Duration M (*SD*)
Pair 1	Info Left	8.88 (*2.64*)	3.60 (*1.58*)	1.88 (0.72)*
	Info Top	9.82 (*3.94*)	3.77 (*1.80*)	2.16 (0.99)*
Pair 2	Nav Left	5.82 (*2.10*)	1.86 (*.61*)	1.39 (0.65)*
	Nav Top	6.58 (*2.55*)	1.93 (*.68*)	1.65 (0.82)*

*p < .013; **p < .001

Usability Measures

Overall Satisfaction and Preference. **An adapted version of SUS scale was used to gather an overall satisfaction rating for the two layouts. The SUS score ranges from 0 to 100 with a higher score indicating higher satisfaction. A dependent *t*-test revealed that were no differences in satisfaction between the *grid* and *list* layout, $t(44) = -1.76$, $p > .05$ (see Figure 8). When asked which layout they preferred, 47% of participants chose the *grid* over the *list* layout.**

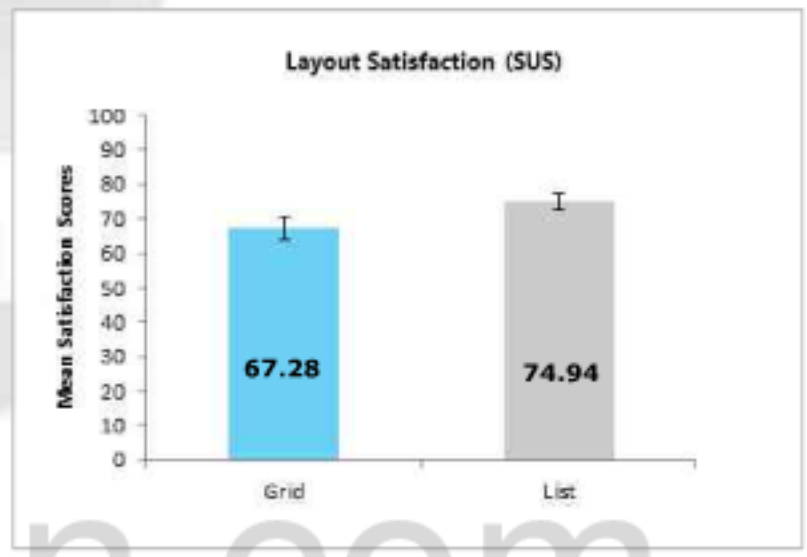

Figure 8. Mean satisfaction scores of the grid and list layouts.

DISCUSSION

This study provides some insight as to how users view a grid layout in comparison to a traditional list layout when performing two types of tasks with search results. Similar to Kammerer & Gerjets (2014), results from this study showed that users viewed the grid layout differently from the list layout. The "F-shaped" pattern was less prominent on the **grid in comparison to the list layout. Dense gaze fixations were found on the upper left quadrants of the grid. Overall, users also fixated on all the results when presented in a grid format.**

Unlike the list layout, which is designed in a way that users can view the search results in a hierarchical manner, users reported two different hierarchies (column-by-column vs. row-by-row) on the grid layout. However, it is important to note that users had a tendency to fixate on the upper left four quadrants earlier and for a greater length of time. The results located on the bottom row and right column were typically scanned last.

The list layout allowed users to scroll down the page beyond the fold for additional information. The grid layout displayed the results all at once without scrolling. Nielsen (2010) found users spent 80% of their time viewing

information above the page fold. Therefore, this could explain why users fixated more search results when viewing a grid layout. Users also fixated more on search results when performing informational tasks in comparison to navigational tasks possibly. This was probably due to the fact that the informational task was less directive and users had to scan more of the page to determine their answer.

The lack of a formal structure in the grid layout may have confused the users' perception of search result order. When users were asked where they thought the 'top three' results were located most indicated that it was either the left column or the top row.

Users tended to look at the top row more and for a longer length of time than the left column regardless of task type. This seems to imply that users abided to a top-to-bottom rather than left-to-right scanning pattern. Had users known of the correct ordering of the results, it could be argued that differences would have been found and users would have fixated more on either result hit based on this prior knowledge of the search results order.

Designers should consider these results to optimize the horizontal grid layout. Due to the ambiguous ordering of the search results on the grid layout, designers cannot assume that all users will view the results in a similar manner. If the upper left quadrants are where users tend to focus first, it would be important to place the most relevant information on that specific area. Otherwise, the potential important information may be ignored similarly to the bottom results on the list layout. On the other hand, Kammerer & Gerjets (2014) postulate that perhaps there are some benefits to the confusion. If users do not realize the true ordering on the grid interface, the nontraditional viewing patterns may be good for information processing. Instead of relying on the search engine's ranking algorithm, users would have to actively evaluate the sources in accordance to trustworthiness. It is possible that as users become more familiar with the layout, a bias on the upper left portion of the grid may cause users to ignore other areas on the layout.

Windows 8 is currently adapted and used by millions (Warren, 2014). This study provided relevant information to better understand how users may be approaching this new horizontal grid-based interface. While this study only allowed users to look at a static image of the grid layout, a follow up study should allow users to scroll horizontally to see if changes in gaze patterns would occur on subsequent pages.

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