

Spatial Presentation and Compatibility of Horizontally and Vertically Associated Words

Jeffrey Gilleland

Cognitive Science Program, Indiana University Bloomington

1. Introduction

When many people read books, analyze images, or interpret graphs, they do so from left to right and top to bottom. This is the way that most English books are written, the way the English language is written, and the way the English language is read. If this is true, then why has research shown that words in the right visual field have a higher recall and accuracy rate than words presented in the left visual field? This finding is very interesting and is further explored in the following research. The following experiment manipulates and explores the aspects of existing publications to further dissect and understand this bizarre phenomenon and produce more “fitting” results.

Previous work by Timothy R. Jordan and Geoffrey R. Patching shows words presented in the right visual field (RVF) yield a higher accuracy rate of recall than words presented in the left visual field (LVF). How might this come about? Words viewed in the RVF are done so with the left sides of each retina and words in the LVF are seen with the right sides of each retina. The information from the RVF is first sent to the left hemisphere of the brain and information from the LVF is first sent to the right hemisphere of the brain. The left hemisphere is responsible for language processing in 93% of all people (96% in those that are right handed). Words from the RVF thus have a direct pathway to the language processing part whereas words from the LVF must first go to the right hemisphere to be processed and then sent across where it can be further processed as language. This pathway is much noisier and so the message can be delayed, disrupted or forgotten, significantly reducing reaction time and/or accuracy for words presented in the LVF.

In the experiment by Jordan and Patching, a word was shown in either the RVF or in the LVF followed by the presentation of this word along with a distracter (in this case a different word than the previous). Subjects were instructed to select the correct word that had been shown. They found that words presented in the RVF had a higher accuracy rate than those presented in the LVF. In the following experiment words are presented in each of four equally divided quadrants to test for effects of positioning such as seen in the previously mentioned experiment. The following experiment not only explores the right and left visual fields, but also the upper and lower visual fields. This was not taken into consideration in their experiment. One aspect of this previously conducted experiment is that the words were only presented for a brief portion of a second. Here, six words will be presented for about 2 seconds, allowing for some search patterns to develop. This will not only test visual fields, but also the biases that may have been previously instilled through years of exposure to the

English language.

This experiment also explores the effects of presenting words vertically against horizontally. In doing so, the effects of word compatibility will be tested through the spatial presentation of the word. Most words have an implied direction or motion associated with them, either horizontal or vertical. For example, the word lift would be associated with a vertical connotation and the word push would have a horizontal motion associated with it. A word would be considered compatible if it was presented with the same spatial orientation as its implied associated direction. So the word lift presented vertically would be considered compatible, while the word push presented vertically would be considered incompatible. The hypothesis for this experiment is that words presented in a compatible manner will produce higher accuracy rates and recall than those presented in an incompatible way. Furthermore, this will be true for both the horizontally associated words and the vertically associated words.

Several other visual field biases are discussed in the previously described experiment as well as others, such a complimenting study conducted by Iain T. Darker and Timothy R. Jordan. Subjects in this experiment were shown a blinking focal point that they were told to focus on. After the point blinked rapidly for a short time, either a four-letter word or a four-letter non-word was presented to either side of the focal point. This was presented momentarily and the subject was asked to identify which word they had seen. This experiment not only tested for differences in the RVF and the LVF but also for differences in the upper and lower visual fields. Results from this experiment as well as others produce, at best, variable results for the upper and lower visual fields. However, with the layout of the following experiment, differences between these visual fields are expected. An upper visual field bias is expected for search patterns that will lead to higher accuracy rates and recall for words presented in the upper visual field. This bias again would be the result of schooling and reading techniques developed earlier on.

The Darker and Jordan experiment brings up yet another factor that must be considered when presenting words. Most words have what are referred to as “in-word” cues that can be used to identify a word at a glance. For example, the word “heat” has the word “eat” within it that would give someone glancing at the word an added clue for future recognition of the word. A paradigm that tries to eliminate these in-word cues is known as the Reicher-Wheeler task, which takes words that are very similar and differ only by one letter. This paradigm can be seen by using the words “heat” and “neat”. The in-word cues for both of these words are exactly the same, varying only by the first letter, which is known as the critical letter. Without knowing the critical letter of each word, there is no way to determine which word had actually been seen.

When given a chance to scan a list of words, people will tend to start in the upper left quadrant and then scan the rest of the list based on the way Americans have been taught to read. Therefore, a further prediction of this experiment is that words in the upper left quadrant will have the highest accuracy rates and recall, and the words in the lower right quadrant will have the lowest accuracy rates and recall. Additionally, words presented in a compatible manner will have higher accuracy rates and recall than words presented in an incompatible way. These predictions are based on the way reading and writing are taught, and given enough time to scan and analyze a word list, these engrained processes will come through in the form of search biases.

2. Method

2.1 Participants

Ten participants were used in this experiment. Five were females and five were males, all college students at Indiana University Bloomington. All but one of the participants was right-handed, although this should not affect the results in any way.

2.2 Materials and Design

There were different types of words used in this experiment, including vertically associated (VA) words, horizontally associated (HA) as well as some relatively neutral words. Some of the VA words included lift, fall, jump, and rise. Some of the HA words included roll, path, road, and kick. Some neutral words would be moth, drug, and cake. All the words used in the experiment were four letters in length and had a familiarity and concreteness rating of at least 350, as defined by the MRC Psycholinguistic Database. This means the words used in the experiment were relatively common words and recognizable by the subjects.

Six words were presented either horizontally or vertically on a slide in one of four quadrants. The words were presented either in a compatible way or in their incompatible way, according to the detailed description mentioned earlier. The words on the slide had a font size of 24 and were presented in all caps so they were easily noticeable and easy to read.

The subject was instructed that the slide was going to be shown for a brief amount of time and to remember as many of the words as they could. The slide was then presented to the subject for two seconds and then a blank white screen was shown. The subject was then instructed to recall and write down as many of the words as they could remember. The next slide was then shown with the next six words and the same process was repeated. The subject was shown one practice slide to demonstrate what the slide might look like, in order to give them adequate preparation to achieve accurate results. The subject was shown four slides containing vertical words and four slides containing horizontal words. This gave a total of 24 vertical words and 24 horizontal words, all presented in different quadrants and with different compatibilities.

The subject was judged based on the accuracy of the words they could recall. Accuracy was determined based on different levels of analyzation. Their scores were analyzed based on percent correct for each quadrant and percent correct based on the compatibility of the word.

3. Results and Discussion

Table 1 shows the amount of correct responses for all of the slides combined. It is divided by quadrant and also by compatibility. There were a total of 16 words displayed in the upper left quadrant, 15 in the upper right, 13 in the lower left, and 12 in the lower right. There were a total of 15 compatible words and 14 incompatible words displayed. These numbers were also converted into percentages as seen in Figure 1.

Table 1.
Number of correct responses by compatibility and quadrant

Subject #	Quadrant				Compatibility	
	Upper Left	Upper Right	Lower Left	Lower Right	Comp.	Incomp.
1	15	2	10	3	11	6
2	14	9	9	5	13	7
3	15	2	6	4	9	7
4	11	6	6	3	6	7
5	16	9	7	1	13	8
6	14	9	4	4	11	8
7	13	6	8	4	12	8
8	11	8	5	8	10	6
9	15	9	11	0	12	8
10	14	9	7	4	11	9
Totals	138	69	73	36	108	74
Tot Possible	160	150	130	120	150	140
% Correct	86.25%	46.00%	56.15%	30.00%	72.00%	52.86%

Figure 1 depicts percent correct data for the different quadrants. Words located in the upper left quadrant were correctly recalled 86.25% of the time, words in the upper right 46% of the time, words in the lower left 56.15% of the time, and words in the lower right 30% of the time. The standard error for this examination was 5.0, which means the percent recalled in each quadrant were significantly different from each other. The overwhelming percentage here is 86.25% for the upper left quadrant. This is followed by the next highest percentage, the lower left quadrant. This means the subjects tended to start on the left side of the screen (particularly in the upper left) and then worked their way down and across the screen in search for words. With only 2 seconds available for search and store, it was very difficult for any of the subjects to recall more than 4 of the words from any one slide. There were a few subjects that recalled 5 words on a given slide but no one subject was able to recall all six words from any given slide.

This was done intentionally in order to test for search patterns. With inadequate time for the subject to scan the entire screen, search patterns were developed and biases were seen. The first place that almost all the subjects looked was to the upper left and then either down or across. When recalling the words, the first word subjects recalled would often times be the word from the upper left quadrant.

The next area that was tested was the compatibility of the word. Subjects recalled words presented compatibly 72% with a SEM of 4.32, while only recalling the incompatible words 53% of the time with a SEM of 2.31. This indicates words that were presented in their compatible fashion yielded a significantly higher rate of recall than words presented in an incompatible manner. This can be seen in Figure 2. This figure is the visual representation of the percentage correctly recalled for each type of word.

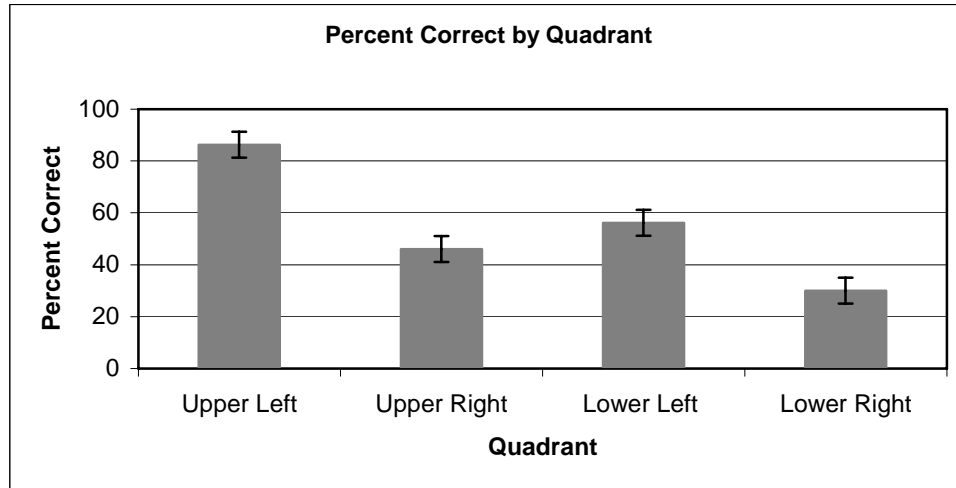


Figure 1. Percent correct responses by quadrant

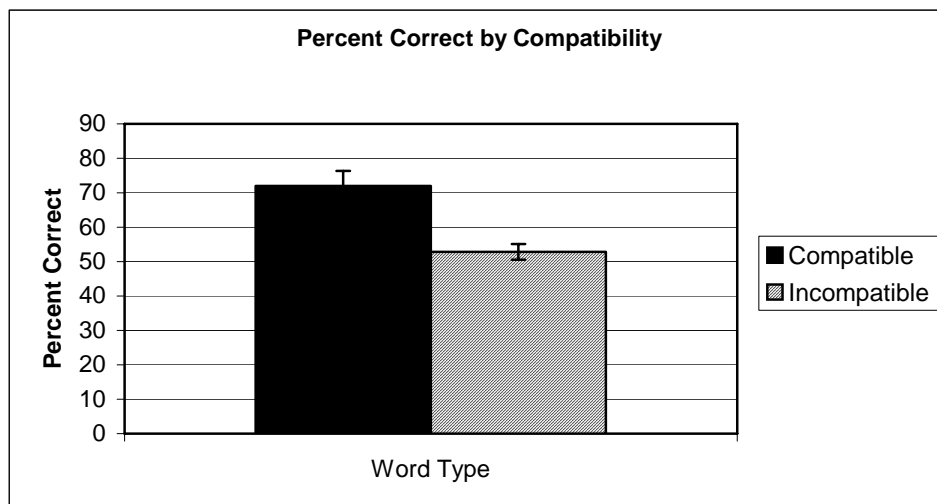


Figure 2. Percent correct responses by compatibility

This data supports the hypothesis that the upper left quadrant would have the highest rates of recall and the lower right quadrant would have the lowest rates of recall. The data also shows us that the lower left quadrant had significantly higher recall than the upper right quadrant, which means the overall search pattern was from left to right.

Furthermore, the data provides support to the hypothesis that the compatibility of a word will play a difference in storing and recalling. The compatible words, whether they were presented horizontally or vertically, had significantly higher rates of recall than did incompatible words.

4. Conclusion

This experiment was able to show that when given enough time to develop any type of search pattern, when analyzing words for recall, the upper left quadrant will produce the highest rates of recall. This is most likely due to the way people have been taught to read and analyze problems. Given time to search and analyze, the visual field biases that were seen in the previous experiments were essentially eliminated by the search patterns of the subjects.

In addition, the compatibility of the word played a significant role in recalling task for the words. This may have been due to people associating the words with their implied movement. It was easier for people to associate words when they were in their compatible state. Words presented in a normal way (horizontally) will still be the most familiar presentation of a word, but when only comparing compatibility and not taking this aspect into consideration, it is clear that compatibility also plays a role.

References

- Darker, Iain T., Timothy R. Jordan. (2004) Perception of words and non-words in the upper and lower visual fields. *Brain and Language*. 593-600.
- Jordan, Timothy R., Geoffrey R. Patching. (2002) Assessing effects of stimulus orientation and perception of lateralized words and non-words. *Neuropsychologia*. 1693 – 1702.