The Influence of Salience on Free Recall Accuracy with Words

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Abstract

Salience is a visual feature such as a bright color that stands out from its surroundings that attracts the human eye. It is explained by top-down visual processing according to the Feature Integration Theory (FIM) (Treisman & Gelade, 2012) and multiple factors by the guided model of attention (Wolfe & Horowitz, 2004). The purpose of this experiment was to investigate the connection between visual perception and cognitive memory of words. It was hypothesized that adult participants who were briefly flashed salient (red) words would have better recall accuracy than with non-salient (black) words in the same trial based on the theory that salience increases word remembrance. It was found that there was significantly more accurate recall for salient words than non-salient words, meaning the salient red feature of the words correlated to better free recall of words.

*Keywords: salience, cognition, free recall, visual perception, word remembrance, memory*

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Salience is an important part of the body of visual perception research, it appears in The Feature Integration Theory (FIM) by Treisman and Gelade (2012), which described salience as being defined by the “dimensions” of size, color and shape that cause features to grab our attention. According to this theory, the salience of a target from the distractors allows for an efficient search because our visual attention must address every stimulus serially, so the most salient one is often the first to be processed. Another model posed in a review article by Wolfe and Horowitz’ (2017) is the guided model of attention, which described salience similarly but with dozens of other “dimensions” categorized by their probability. Between the two models, color, motion, orientation, and size are undoubtable attributes of salience. Wolfe & Horowitz’s model of guided attention brought attention to the possible importance of semantic meanings of theoretical targets and distractors and how findings in the lab are not always true in the real world. For example, seeing a cat on a white bed; we aren’t going to focus on the most salient pattern, we probably will focus on the cat. The FIM had mostly dismissed the subconscious absorption of stimuli, but this study hopes to show that the salient attribute of color can influence word recognition even when it has nothing to do with the task.

Salience was created by presenting mostly black words and then a bright red one with no differences in size, the saturation of the color was important for the effect of salience to be observed (Qian et al., 2018). This study attempted to ensure that semantic meanings and order effects were counterbalanced appropriately, and the accuracy was calculated in a fairly simple way by dividing the number of times each word was recalled by the total number of times it was presented (# of times words were recalled/# of times words were presented). False positives/negatives and precision were not considered in this experiment, the simple remembrance of the salient word was the focus. Participants’ performance was not individually considered in this between-subjects study, partially due to data collection errors by the Pavlovia platform. The significance of this experiment is that a large mass of data was able to be collected, over 1000 words were presented and around 500 – 800 responses recorded confirming that salience can increase our memory of words in a difficult task for working memory like free recall. The informal setting of an online cognitive experiment left room for error, but the experiment was under five minutes long and fast-paced enough that participants gave feedback of enjoying the challenge of remembering words. Only four participants were able to be supervised closely while taking the experiment, one did comment that they had no idea the stimulus were red. It was hypothesized that salient words would be recognized with a better rate of accuracy than non-salient words, meaning that the ratio of times the word would be freely recalled

**Methods**

PsychoPy and Python/JavaScript were used to create the experiment and upload it to Pavlovia, the website link was then directly distributed to participants through Brightspace, email and text where participants were able to conduct the experiment anywhere on a laptop.

**Participants**

The participants were 22 male and female adults living in New York City and undergraduate students at SUNY Binghamton. The majority were between ages 19 – 22, some were > 50 years old.

**Materials and Design**

The independent variable manipulated in this between-subjects study was the salience of the word, if it was a salient (red) or non-salient (black) word. Out of 51 words presented in random order 22 times in five trials, only 11 words were chosen to be red. The first 8 participants had a set of five short words like “nap,” “lane,” or “jar” that randomly appeared as red in each trial, then a different set of 6 words like “moon” or “fork” were used for the next 14 participants. The first set of words were presented as salient 8 times and non-salient 14 times, the second set was salient 14 times and non-salient 8 times.

**Procedure**

Each participant clicked on the link to the experiment and were prompted to enter their name, major, answer if they were native English speakers, and then read the instructions, which stated that there would five trials with 10 words in each that they would be asked to recall, no mention of salience was made. When they were ready, they pressed “space” to begin and 10 words flashed in a random order for one second each, with 1 out of every 10 being a red, salient word. Then, they were asked to type any words they could remember, and press “enter” when they were ready for the next trial. The dependent variable of free recall accuracy was quantitatively measured by counting the number of times a word was recalled and the number of times the word was presented, and the variables were analyzed using RStudio, Microsoft Excel and JASP. The independent variable was counted by whether each word appeared as red or black.

**Results**

The participants had better than expected overall accuracy (*M = 0.419, SD = 0.208).* There was better mean accuracy for salient words than non-salient words (*M = 0.655, SD = 0.129*) and non-salient words had lower mean accuracy (*M = 0.360, SD = 0.181).* An independent samples t-test was used to compare the variables with an alpha level of 0.05, (*t(*48) = -4.819, *p* < 0.001), finding a significant main effect of salience on accuracy. A paired samples t-test compared accuracy to the salience variable, (*t*(49) = 4.660, *p* < 0.001) and attempted to compare the number of times words were presented saliently/non-saliently compared to accuracy, (*t*(49) = 2.776, *p* =.008, *t*(49) = 28.769, *p* <.001), which did have significant effects, both salient and non-salient presentation increased accuracy significantly showing the study had reliable effects. A Pearson’s Correlation test was done, showing a strong positive correlation for salience (*r* = - 0.571*, p* < 0.001)*.*

**Discussion**

The hypothesis was supported by the results of the data, salient words were remembered at a significantly more accurate rate than non-salient words. Some considerations of the experiment are that the data was not able to be as thoroughly analyzed as it could have been, which can be attributed to faults with Pavlovia and errors in data collection/analysis coding. In the future, the experiment should be set to automatically score participants and record the exact words they were presented with as the experiment progresses. RStudio was a very helpful tool and the only reason this data was able to be analyzed at all due to the sheer amount of data collected, 1013 words were presented, the improper data collection on Pavlovia did not allow the recalled words to be separated by participant. Further analysis of this data is important, statistical analysis of large amounts of data can give believable but misleading results.

The experiment had a wide variety of populations that had little bias towards this experiment (almost all were not psychology majors and several reported that they found it very difficult and tried hard). One participant was observed reading the words aloud to remember them. The samples given of participants are interesting in their variance, some participants remembered every single red word in all five of their trials while others only remembered one or two of them in all five trials and overall doing better than expected according to the capacities of working memory. One possible explanation by Gaspelin et al. (2015) is that the red words were distractors from the non-salient words and reduced their accuracy for the other words by activating suppression rather than increasing memory for salient words. Some fixated on random non-salient words and re-wrote them two or three times in the same trial, possibly due to specific emotional responses to words increasing the participant’s attention to semantic meaning (Kissler et al., 2007) (the word “death” was the most recalled word). Another factor considered was the serial position effect, which is when the first and last few words are better remembered.

Overall, however, the volume of data and counterbalancing by changing the order of words at random allowed us to be confident in the validity of the results. Most participants were able to remember words at an average rate of around 65% salient words (including repeats), they were not significantly more accurate with salient words but were higher than the overall rate, 42% and the non-salient words (36%) (*Figure 1)*. It appears that salient words were remembered much better, even when participants were not at all directed to pay attention to color and were completely focused on the task of remembering words by their own personal learning methods.

It would be recommended for future research to reduce the time of display of each word to reduce the recall rate. This study was not intentionally replicating any others aside from basic word recall, it should be taken further to investigate salience, which appears in so many parts of cognitive and perceptual psychology. Additionally, comparing the effects of semantic and emotional meanings of words to salience would be a good next step, it was noticed that words with stronger action meanings like “shout” or “pivot” had more recalls as well as emotional words like “death or “laugh,” although these were not statistically significant differences, they have been previously researched (Kissler et al. 2007). In real life, this can help us study and learn how people visually search for items and words, assisting with public infrastructure like public transportation signs, car signals and warning labels.

References

Gaspelin, N., Leonard, C. J., & Luck, S. J. (2015). Direct evidence for active suppression of salient- but-irrelevant sensory inputs. Psychological Science, 26(11), 1740–1750. <https://doi-> org.proxy.binghamton.edu/10.1177/0956797615597913

Treisman, A., & Gelade, G. (2012). A feature-integration theory of attention. In J. Wolfe & L. Robertson (Eds.), *From perception to consciousness: Searching with Anne Treisman* (pp. 77–96). Oxford University Press. [https://doi.org/10.1093/acprof:osobl/9780199734337.003.0011](https://psycnet.apa.org/doi/10.1093/acprof:osobl/9780199734337.003.0011)

Kissler, J., Herbert, C., Peyk, P., & Junghofer, M. (2007). Buzzwords: Early cortical responses to emotional words during reading. *Psychological Science*, *18*(6), 475–480. <https://doi-> org.proxy.binghamton.edu/10.1111/j.1467-9280.2007.01924.x

Qian, J., Zhang, K., Wang, K., Li, J., & Lei, Q. (2018). Saturation and brightness modulate the effect of depth on visual working memory. *Journal of Vision*, *18*(9). <https://doi-> org.proxy.binghamton.edu/10.1167/18.9.16

Wolfe, J., Horowitz, T. (2017). Five factors that guide attention in visual search. *Nat Hum Behavior 1*,0058. <https://doi.org/10.1038/s41562-017-0058>

*Figure 1*. Accuracy vs Salience

Chart, line chart

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