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NE328
Final Lab: Matterport

Introduction:
The Method of Loci suggests that the brain uses visualization of physical places to organize and enhance memory. According to previous research, our brains rely on environmental queues in order to construct an accurate mental map of a setting (Kivisik). We also know that hippocampal place cells are responsible for mediating a neural representation of physical space (Eichenbaum). Virtual reality is an emerging technology that allows us to explore these phenomena even deeper. In this experiment, we used a Matterport Pro 3D Camera to construct a 360 degree panoramic landscape in order to investigate our subject's ability to identify objects in a continuous recognition test within the constructs of a virtual reality space. We are curious about how different predetermined variables, such as repeated objects, implemented into the design of the scan affect subject's performance.

Hypothesis:
We expect that our largest variation will appear in performance between the first and second test. Due to the fact that subjects will have already seen half of the objects previously and are more familiar with the experimental design, we believe that reaction times as well as percentage correct will increase from test 1 to test 2. We also believe that objects that were repeated will have a faster associated reaction times. Repeated objects terminate more quickly than objects that are extralist intrusions (Miller & Kahana). If a subject views an object twice, even if they do not consciously recognize the object, they are more likely to say that they have seen the object. We predict that large objects will be more easy for subjects to see than small objects, so they will be more likely to view and store these objects in memory. Objects that are present in the scan may have a slightly quicker median reaction time than an object that they have not seen, because their brain would more quickly recognize a familiar object than a foreign object. Lastly, We do not have any predictions concerning false alarm rate or hit rate amongst both scans, but believe that this data will be somewhat uniform between subjects.

Variables tested:
-First scan vs. Second scan
-Repeat Objects vs. New Objects (i.e was it in previous scan or not?)
-Large vs. Small Objects
-False Alarm Rate
-Present vs. Not Present

Methods:

Overview:

2 locations were chosen for virtual reality scans and 27 objects were selected to use in this experiment. 15 of those items were present in scans and 12 of those items were not. For each virtual reality scan 10 objects were selected and placed in the room, 5 of which repeated across both of the scans. Subjects were given 1 minute to navigate each space and obtain as much information as possible. No other instructions were given.

Details:

We used a Matterport Pro 3D camera to construct two virtual reality scans. Subjects navigated the first scan for 1 minute, and then were presented with a PyscoPy experiment interface. We used a continuous recognition script with customized images both from the scan and not in the scan. Each trial contained 20 images, and subjects either pressed the right or left arrow if they had seen the object in the scan or not, respectively. PyscoPy recorded the reaction time and correctness for each object. This process was repeated for the second trial. All data was collected in a .csv file which was then imported into R-Studio. We then utilized R-Studio to examine the data; we calculated median reaction times for respective scans, present versus non-present reaction times, object-dependent reaction times and correctness, hit-rate, and false alarm rate. Finally we graphed the respective relationships and attempted to draw conclusions from these plots.

Results and Analysis:

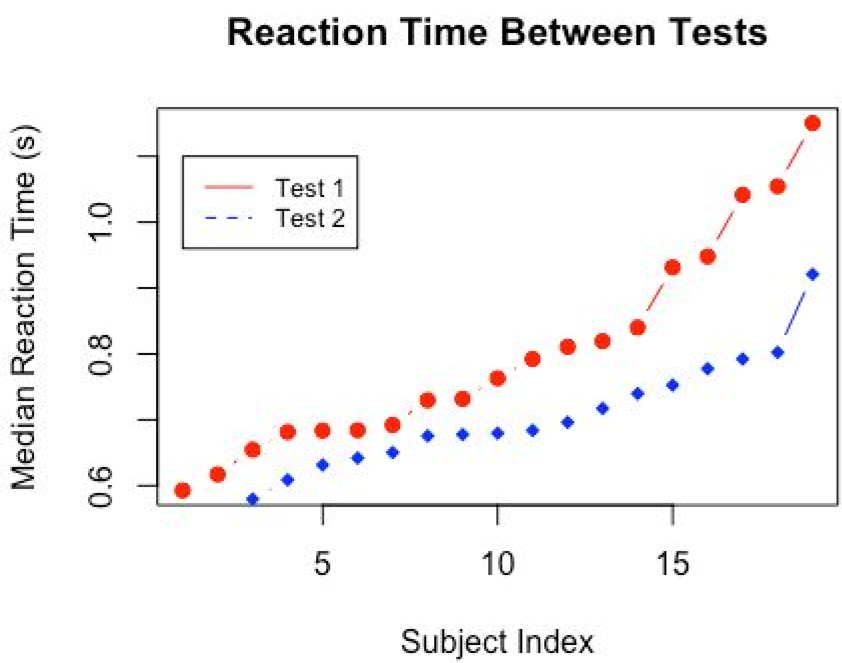

Figure 1: Median reaction times for Test 1 versus Test 2. Test 2 had significantly quicker reaction times than Test 1 for nearly every test subject.

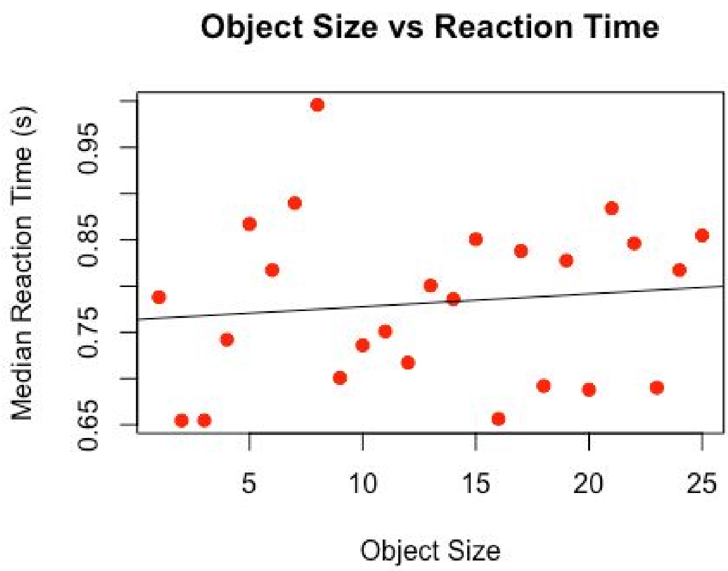

Figure 2: Objects were sorted from smallest to largest, then each reaction time was extrapolated. The data show no correlation between object size and reaction time with a p-value of .5816.

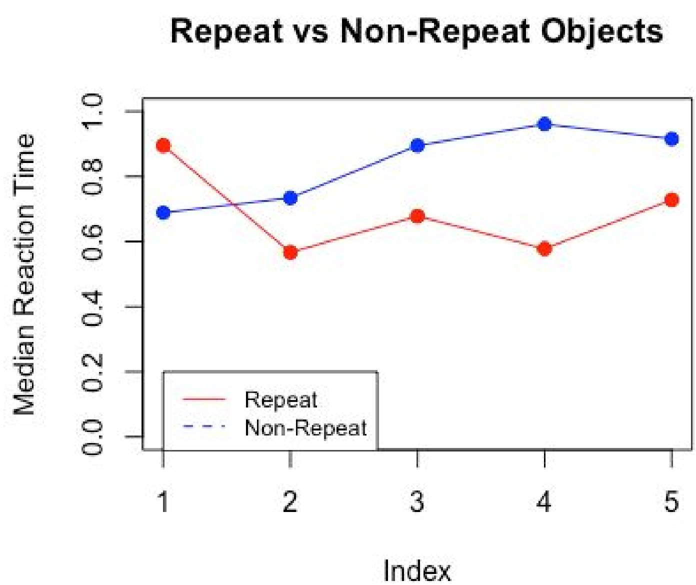

Figure 3: Median reaction times for repeated vs non-repeated object recognition. For almost all object groups the repeated object median recognition time was faster.

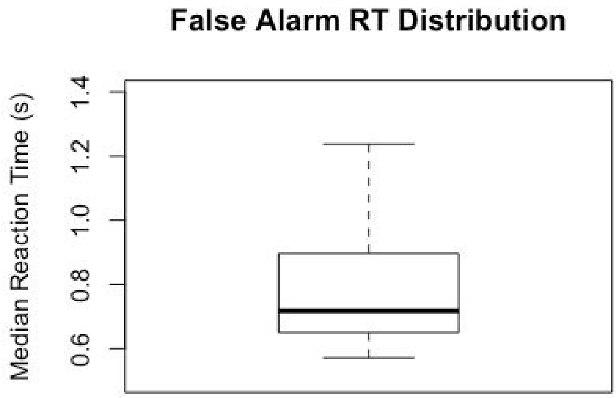

Figure 4: Boxplot distribution of median reaction times for when a subject said they saw an object, but did not.

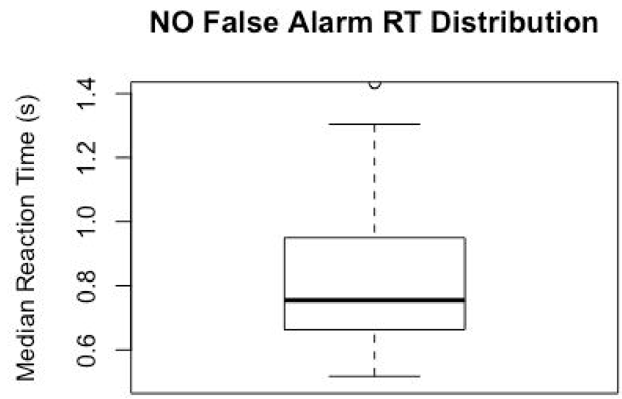

Figure 5: Boxplot distribution of median reaction times for non-false alarm responses.

Test 2 had significantly quicker reaction times than Test 1 for nearly every test subject. The p-value for correlation between Test 1 and Test 2 was .0325, giving us high confidence there is correlation. As seen in Figure 1, Test 1 median reaction times were almost always higher than Test 2 median reaction times. Furthermore, there appeared to be very little correlation between object size and median reaction times. Our p-value was .5816, indicating very little to no correlation between these variables (Figure 2). One unexpected result of this figure was an extremely high median reaction time when subjects were presented the calculator (not present in either scan) with a median reaction time of 1.1, when all of the other objects hovered between .65-.85 usually. When examining median reaction times between repeated and non-repeated objects the overwhelming majority of faster reaction times belonged to the "repeated" category (Figure 3). This indicates, not surprisingly, that test subjects had improved responses for images they had seen before.

The boxplots for false alarm vs. non-false alarm were similar for the most part with a median reaction time of .703 (Figure 4) and .734 (Figure 5), respectively, but the spread of the non-false alarm was significantly higher. There was minimal correlation with a p-value of .342, but not enough to suggest a relationship. The distribution of false alarms was much more right-skewed than our relatively Normal "not false alarm" data. Finally, examining the relationship between present and non-present object response median reaction times, we discovered that for Test 1 the median reaction time for present objects was .7507 seconds and .6753 seconds for objects not present, respectively. For Test 2 the median reaction time for present objects was .9004 seconds and .8171 seconds for objects not present, respectively.

Conclusion:

The most apparent conclusion that we can draw from our data is that median reaction times between the first and the second scan drastically decreased for nearly every subject. Our low p-value gives us confidence that this is the case, and we can safely accept our null hypothesis. Object size seemed to have little influence on median reaction times. The outlying reaction time for the calculator could potentially be explained by the fact that calculators look similar to a lot of household objects and objects that were presented in our scan (controller, electronics). For repeated versus non-repeated object response median reaction times we found that repeated objects yielded significantly faster responses. This leads us to conclude that our data supported our initial hypothesis. Finally for our false alarm comparison analysis our data did not provide statistically significant evidence to draw a conclusion regarding the relationship between reaction time and false alarm rate. Going forward we would like to expand on the virtual reality component of our experiment; constructing a more controlled but intricate VR tour would allow us to test more variables.

Works Cited:

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Miller, J. F., Weidemann, C. T., & Kahana, M. J. (2012). Recall termination in free recall. *Memory & Cognition, 40*(4), 540-550. doi:10.3758/s13421-011-0178-9

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