Axis of rotation as a basic feature in visual search

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Introduction:

The topic discussed in the article is based around cognitive searching methods, fundamentals of search and information gathering, and underlying methods of search specific to the area of visual search. The article begins its discussion of the topic by introducing the work of Treisman and Gelade. They state the objective, results, and conclusions of the scientists work and use it to introduce their own experiments. What they primarily drew from the work of Treisman and Gelade is that the cognitive function of search aims to be as “efficient” as it can, by searching for defining features in objects. For example, the article describes the ease of finding Q amongst O’s because of the tail feature of Q. The authors of the article then discussed that, with regards to motion, experiments on search have focused on objects translating across the plane. They choose to explore another factor of movement: rotation and rolling. The hypothesis proposed by the article is stated as follows: If visual search with regards to motion has basic cognitive features used for distinguishing objects, then rotational motion and rolling motion are of those basic cognitive features. Other than determining if the hypothesis was true, another research question that they answered was “is it not rotational motion, but rather 2-D texture motion that is a basic feature?”

Experiment:

The article ran 2 categories of tests where 5 experiments were split into the 2 categories. Experiments 1 – 4 were in the 1st category: objects that were either spinning or rolling along their axis of rotation. Experiment 5 was in the 2nd category: flat circles that had either a horizontally or a vertically moving texture. Each experiment had 4 blocks, 2 of which were used to find “rolling” objects amongst “spinning” objects, and 2 of which were used to find “spinning” objects amongst “rolling” objects.

Experiment 1 compared roll and spin with complex objects, or shapes that were specifically designed to give off the impression of spinning, or rolling. The researchers found that there was search asymmetry, but it was unclear as to where the direction of the asymmetry was headed. Spin seemed to be less accurate than rolling, but both seemed to be less efficient that other parallel search experiments such as Treisman’s.

Experiment 2 ran very similar to Experiment 1. The main difference was instead of complex objects, the stimuli instead were simple spheres. Results from this experiment showed that spin may still be slower than rolling, but there was no overall effect on participant’s accuracy. Set size did affect response time significantly, but nothing worthwhile relating back to the initial condition.

Experiment 3 removed the horizontal plane and instead had all virtual objects arranged on invisible vertical planes. Results were decently consistent with Experiments 1 & 2. The slope of response time was much less than 1 & 2 though, suggesting that the horizontal plane did make the trials harder. No significant effect on accuracy and spin was still worse than roll overall. The search asymmetry catalyst was still yet to be discovered for the researchers.

Experiment 4 changed the scenario. The researchers determined that rolling motion would be expected to have a position change associated with it, so they impaled all the spheres with rods, and ran tests. However, there still was no statistical evidence that proved Experiment 4 got rid of the search asymmetry. Set size played a much larger role in affecting response time in this experiment, and roll was still better than spin.

Experiment 5 was the control. Rolling was represented as a 2-D vertical moving texture, and spinning was a horizontal moving 2-D texture. There was no search asymmetry in this experiment. Participants were not faster searching for anything in any of the trials. This shows that 2-D texture movement was not the driving factor for the search asymmetry in other experiments. Thus, because the experiments ruled out almost all physical qualities, axis of rotation was determined as critical for producing the asymmetry.

Conclusion:

The authors of the article claim that rotational motion was the driving force of the search asymmetry throughout their trials. They turn back to Treisman and discuss how it is easier to detect the presence of a feature in its absence. The authors show that rolling was more efficiently found than spinning, but neither were particularly efficient, but this can be due to the inefficient nature of spatial search as compared to visual search. They support their method of study by showing that if both processes are inefficient, then it is likely that the faster processing of one type of distractor will cause an asymmetry. Thus, for them, axis of rotation feature recognition was the fastest processed.

The authors end their discussion stating that, there is strong evidence of an asymmetry, but not a strong explanation why. They’ve shown that other physical qualities are not at fault for the asymmetry, but there is no clear cut reason, as shown in their experiments, why rotational motion is at fault. These search asymmetries, however, remain a valuable tool in visual search study. Their experiments have just discovered a new example of one, and more research needs to be done to explain, in detail, how the visual search process operates.

Citations

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