The Cognitive Efficiency in Rough Texture vs Smooth Texture Stimuli

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Abstract

In many studies, visual search tasks tie into our daily lives in order to be efficient. To further expand our knowledge, we chose to examine the efficiency in texture search tasks, specifically smooth and rough textures. Participants were instructed to first search for rough among smooth and then smooth among rough. The stimuli used were zoomed in 100x100 pixels of fruits. It was predicted that the rough among smooth textures will be more efficient to find than the smooth among rough. The answers revealed that searching for rough among smooth is more efficient than smooth among rough, meaning that it was faster to find the rough texture. Results indicate that there was no significant interaction, even though it was close to being significant. There is some evidence that people are more efficient in detecting rough textures among smooth textures. Textures are important because they can apply to our daily life by detecting anything that isn't flat to understand pieces together for our safety.

The Cognitive Efficiency in Rough Texture vs Smooth Texture Stimuli

The way that our mind works is through efficiency. For our brains, efficiency is to do a task without wasting time and doing the least amount of effort possible to make our lives as easy as possible. When our brain is instructed to search for something it can either be easy to find or hard to find. A term for when our brain processes easily is called parallel processing and when it takes a longer time to process, it's called serial processing. Researchers have and still are studying what exactly is the most efficient for our brain in many topics whether its numbers, facial recognition and textures in various ages.

Researchers found that kids engage in visual search tasks daily like searching for their favorite toy to play with among toys they outgrew. Hunter & Markant (2022) had kids perform a visual search task by looking for a caregiver among distractors versus a stranger's face among distractors. The researcher's hypothesized that the child searching for the caregiver would be more efficient than a stranger's face due to a bias. The kids ranged between the ages of 6-10 and were recruited from an online website, social media and other lab databases. There was a compensation of a $15 gift card. There were three trials which were absent trials, caregiver present, and a stranger present. The trials were 3x3 collages with distractors like a butterfly, shell, kiwi, house, the caregiver's face and a stranger's face. The results indicated that there was no difference in performance across the first and second halves of the tasks and with the slow reaction times, this could be seen as serial processing. When the target was present, the reaction times were consistent and when the target wasn't present the kids had a slightly slower reaction time than when it was present. This means that there wasn't that big of a difference. They also found that the target absent and target present trials both didn't make much of a difference. The search study was more efficient when the caregiver's and stranger's faces weren't present. Some

conclusions were related to the caregiver's faces being neutral and not in an expression that the child would be able to identify quickly. Also, the missing piece for the child to identify would be the voice of the caregiver and the researchers thought that their voice would be helpful for the child to identify easier.

Other studies conducted an experiment to test whether or not the display of symbols in visual search asymmetries were efficient in cluttered and uncluttered stimuli, or in other words small or big set sizes (Yamani & McCarley, 2011). An example of a low clutter stimuli could be a zoomed in image of a piece of wood and the high clutter stimuli could be a bird's eye view of a suburban neighborhood. As the set size was small or big, the target would also be a regular "N" or a reverse "N." The participants were instructed to quickly identify whether or not the target was present or not. This study showed that search asymmetry was strong enough to support that searching for a target among distractors was more efficient to find than the normal target. The researchers found that the participants found it easier to find the reversed "N" in a smaller set size rather than a normal "N" in a higher set size and this could be seen as parallel processing. From this study, the visual search asymmetry was supported and that searching for a target with a higher set size is more inefficient than searching for a target among a smaller set size.

Although there was a difference in a smaller and larger set size, there have been other studies to search for large stimuli among small stimuli and vice versa. The participants were undergraduates and were presented with a visual search task by using line-segment digits for the numbers 2 and 5, then 6 and 9 (Motz, Goldstone, Busey, & Prather, 2021). For example, the numbers would be displayed in a circle within 6 place holders. Five of the numbers would be a 2 and the one number would be a 5. As the set size increased the reaction time also increased but the more efficient size of the target was the bigger target which is parallel processing. When

searching for the small target among big distractors, it was serial processing. This is very efficient because the target would easily pop out to the participant. The researchers' concluded how the size of a target can affect visual search and that it's easier to recognize the unfamiliar as opposed to the familiar.

To further explore research in rough texture vs smooth texture, we propose the following experiment. Participants from the community of Cal State East Bay will participate in a cognitive visual search task such as identifying if the target is present or not, as quickly as possible, and as accurately as possible. Based on previous studies, we hypothesize that it is more efficient for our brain to identify a rough texture than a smooth texture. To relate it to real life, it is easier to identify rough textures or any object that might be sticking out so that we don't injure ourselves.

As shown in past studies, search efficiency is important across all ages such as detecting danger and keeping ourselves safe. A common theme past studies have in common is having their participants do a visual search task by looking for a target among distractors. Hunter & Markant (2022) conducted a study that included young children, specifically 6-10 year olds. As kids get older, it's crucial to learn how to be efficient. Researchers, Goldstone et. Al (2021) and Yamani & McCarley (2011) also conducted a study to test search efficiency with community members of the college or the college students themselves. There was also a difference in set sizes, which is the amount of stimuli. Results varied among the study, but the common finding was that searching for the unfamiliar was more efficient than searching for the familiar. Another way of saying it is when the target has something in a segment that makes it stand out it's more efficient as opposed to searching for a target that is already lacking that piece.

Method

Participants

Participants are members of the community at Cal State East Bay and were gathered by experimenters as students. Participants completed the experiment either on campus at Cal State East Bay or at home. There were a total of 15 participants, 8 of them were women and 7 were men. The range of age was 25.2.

Apparatus

The equipment included Google search to select the rough textured and smooth textured. A photoshop app was used to zoom in 100x100 pixels and an iPhone filter to make the stimuli grayscale. The experiment will be controlled by PsyToolkit. The monitors and keyboard will be used in order to respond in trials.

Stimuli

The stimuli used were images found on Google with rough texture and smooth texture for the experiment. These pictures are grayscale, meaning it is black and white with no color, and are zoomed in to be 100x100 pixels. Before zooming into the picture it's easy to identify that the stimuli is either rough or smooth texture. When zooming in to the stimuli, you can still identify that the image is rough or smooth. There are a total of 16 rough textured and 16 non textured images which are going to be used in a collage of 15 stimuli and one target. This could either be 15 rough textured and 1 smooth or 15 smooth and 1 textured.

Procedure

Each trial began with a blank screen that lasted for x ms. Next, a fixation cross appeared

in the middle of the screen to give the participant a chance to reset for __ ms. This was followed by a collage of either rough or smooth textures, which is visible until the participant responds quickly. Then the screen changes to a blank screen after the participant identifies if the target is present or not. Trials were grouped into two blocks of 15 trials each. Time was given to participants to let them have a quick break after each trial to prevent fatigue. After each block, there were instructions presented on the screen to let the participant know what target is next. The four blocks included rough and smooth textures. The stimuli used were of fruits zoomed in 100 x 100 pixels. In each block, the purpose is to identify the target as accurately and quickly as possible and/or identify if it's there or not.The organization of the categories was randomized.

The independent variable is the set size or total number of stimuli on the screen and the dependent variables are the reaction time and accuracy. This study is a within subject test, meaning that the subject will be put through all of the blocks and trials. The two conditions were rough textured or smooth textured.

Results

We conducted repeated measures ANOVA with2 factors: texture and set size. There was a significant effect of texture on reaction time; $F(1,14) = 12.75$, p=0.003, $\eta^2 = 0.319$. There was no significant effect of set size on reaction time; $F(1,14) = 1.54$, p= 0.235, $\eta^2 = 0.014$. There was no significant interaction between texture and set size; $F(1,14) = 3.51$, $p = 0.082$, $\eta^2 = 0.03$.

Discussions

In this study it was predicted that searching for rough among smooth textures would be more efficient as opposed to searching for smooth among rough. But unfortunately, in the effect of rough and smooth textures there was no difference. Results showed that the search efficiency

in texture was not important in both conditions, meaning that one group did not perform better than the other. There is no effect with texture and it didn't matter with reaction time with set size or even texture and set size. It does look like we could have been headed towards a slight interaction.

It was hypothesized that rough textures were going to be more efficient than smooth textures. We can see the same trend in the study where the purpose was to search for large stimuli among small or small among large stimuli. This is related because searching for large among small stimuli is more efficient like searching for rough among smooth was the purpose in Motz et. Al (2012). What we can learn from these results is that there is no difference between the textures. There is no real difference between detecting smooth and rough textures. We see this trend in the study about how the children's results showed how searching for their caregiver's face among the distractors versus stranger's face both did not make any difference. In fact, it was more efficient for neither of the faces to show up (Hunty & Markant, 2022).

Some problems with our study is that since this is a college course, some students' perspective on school isn't all on the same level. I feel as though the experiments might have been rushed through due to doing other people's experiments. There is also no compensation for doing the experiments so that could be a factor of not doing the experiment with intention. One thing I'd change about this is doing it in a controlled environment with no distractions such as music, electronics, or people. Another problem was my lack of research for this experiment. First, I gathered research that was far too complex for this study and I think I lacked using my time wisely for researching textures. The last limitation is that we were super close to supporting our hypothesis with statistical evidence. But if it were to be run again, we would know what to do in order to achieve that.

Throughout this experiment, more questions for future research were brought up and spoken about. Just like in Hunter & Markant's study I would love to see this experiment be done by kids within the same age range. I think texture is important but also adding color to our images would be more interesting to kids. This relates to the attention of kids. Although the attention of kids isn't the best, I would love to see how this experiment could apply to kids and the importance of texture. Learning isn't just black and white, colors are utilized in order for young kids to remember. For example, if a first grader is learning subtraction you might say "I have 4 red apples in total and 2 red apples are taken away. How many red apples are left?." This could lead into how kids associate color and texture into learning. The first grader would already know that an apple is smooth and red but how could a smooth apple differ from remembering a spiky pineapple? It definitely is more advanced than just searching for rough among smooth or vice versa.

Still brainstorming with the thought of kids, I thought about how texture and color take such huge roles when learning new information. Not only is learning important for the student, but also the learning environment. Kids love colors, textures and anything colorful. So for teachers, they have to learn how to utilize their classroom into a fun but not too distracting classroom, into a fun and focused environment. Kids can get very overwhelmed with too much rainbows and textures like a fuzzy carpet being paired with different colored desks and chairs. What this might do is overstimulate the child student and make them unable to learn. But if the teacher had a carpet with roads, cars, and stop lights with normal brown desks, and blue chairs, that might be a little bit more balanced. The student's desk area is important so letting them decorate their name card could help them feel like they have their own area to be responsible for such as staying neat and tidy.

We saw how search efficiency isn't affected by the two conditions: smooth textures and rough textures. To fully understand the main difference between the two conditions simply means searching for a target that contains something that the distractor lacks. Whenever we are in or sense danger, it is important that we are able to detect the room for sharp edges that are present to escape efficiently.

In conclusion, what it means for our brains to be efficient is when our set size is low then our reaction time will be fast. This is called parallel processing which is where our brain does something efficiently with no struggles at all. On a graph, it can look like a flat horizontal line which would mean that there was an interaction between the two conditions. On the other hand, there is serial processing which is where the reaction time is slower and the set size is larger. This means that our brain would take more time to process, causing a steep and increasing line on a graph. In our study, we were heading toward a slight interaction but if there were more people we definitely would've been able to achieve that. But statistically, we did not reach the interaction. We had the search asymmetry, which is a pop out kind of visual search task, for the conditions but didn't achieve success. But to apply it to our daily lives, textures should be taken into account to detect anything that isn't flat to understand pieces together for our safety. Some examples could be not letting babies near sharp corners otherwise they'd bump their head or when you're walking down the street and you avoid a banana so you don't slip. Either way, these two examples are ways to avoid danger no matter the age. Just as long as the individual is paying attention to their surroundings, the individual must be able to understand what to do to avoid danger so we don't injure ourselves.

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