Gaze Based Search Strategies for Finding Matching Images: Specific vs. Generic Search Instructions

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ABSTRACT

Fixations and saccades are used to conduct visual searches. The time and accuracy of these searches can be affected by the way the task is worded. Simply changing the wording can change the success and time spent finding a specific object during a visual search. Our work explores visual search strategies for finding image matches given specific or generic search instructions in full color and grayscale stimuli. Through an eye tracking experiment and pre- and post-experiment questionnaires, our nine participants showed how search times are faster when using the generic search instruction (find) than the specific search instruction (compare), and matching accuracy are significantly better when searching for a full color image than a grayscale image. These findings demonstrate that task wording and image coloration can affect the time and accuracy of finding the matching image.

CCS CONCEPTS

• **Human-centered computing**; • **Human-computer interaction**; • **Interaction techniques**;

KEYWORDS

Eye tracking, gaze behavior, task dependency, visual image search

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1 INTRODUCTION

Visual searching is conducted by humans and animals in the majority of their daily lives, from searching for predators and prey to finding an icon on a cluttered computer screen or your favorite snack in a vending machine [6, 9, 13, 20]. The task of conducting a visual search is undertaken by making fixations, periods of longer eye focus on a target, and saccades, rapid eye movements between fixations, while scanning the search area for the target of the visual search [1, 12, 22]). In visual searches where the search object is determined by the searcher or a task is presented to the searcher where they are asked to find a specific item in an environment, the searcher determines the search pattern. Credidio et al. found that undirected search patterns take on one of two distinctive patterns, systematic or random [3].

Search patterns can be affected in humans. Greene explored this by providing half of his study's participants with information about how the visual distractors could be used to find the target image. This resulted in shorter fixation length after correct saccade movements [8]. Modifying visual search patterns is not a new topic. In 1967, Yarbus reported finding that he could affect the eye movements and fixations by asking participants different questions about *They Did Not Expect Him*, a painting by Ilya Repin [21]. Thus the visual search pattern can be modified by providing information or presenting a specific task, task dependency, to the searcher.

This paper explores the saccades and fixations of participants conducting image search tasks and how task dependencies modify search patterns. Participants are asked to compare a target image with a group of similar images to find the target's match, or they are asked to find the target image's match in the group of similar images. Additionally, we explore how an image's difficulty affects the visual search process. The target and distractor images are all birthday cakes. The easier image version is a full color (Figure 2) version of the cakes, while the more complicated images are grayscale (Figure 3) versions. Finally, we investigate whether participants in both task dependency groups determine that the target image's match for the full color and grayscale stimuli are always in the same position.

1.1 Hypotheses

Our hypotheses for this study are as follows:

- **H1:** Participants given the specific search instruction condition will exhibit greater order of task performance as compared to the generic search instruction condition.
- **H2:** Participants will match images faster on full color trials than grayscale trials, and the search instruction condition moderates this effect.
- **H3:** Participants are more accurate at matching images on full color trials compared to grayscale trials.
- **H4:** Participants will learn that the target image's match for the full color trial and the grayscale trial is always in the same location.

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2 RELATED WORK

This section covers the related work on eye movements, visual image search, and task dependency.

2.1 Eye Tracking

Researchers have explored eye movements (i.e., fixations and saccades) for decades [4, 16, 21]. While people control the distance and direction of saccades, Hooge and Erkelens found that minimum fixation duration is not under a person's control [10]. While we do not control all aspects of our eye's movements, eye movements can be trained or affected by the environment. If placed under a higher mental workload, a person's fixation pattern results in greater randomization [5]. Additionally, luminescent objects can be overlaid on a static image that can draw a person's attention to that subtly marked image area [2, 14]. Finally, specific tasks, like cooking, driving, and flying an airplane, require learning eye movement patterns to complete the task successfully [9, 13]. Therefore, understanding eye movements is an integral aspect of understanding how a person conducts visual image searches.

2.2 Visual Image Search

Humans often undertake visual image searches throughout the day. These searches can take the form of basic searches for recognizable objects in a non-cluttered environment to highly complex searches in environments congested with distractor objects. No matter the environment, correctly identifying the search target requires a combination of conjunctions and serial scanning [4, 16]. Simple visual tasks, such as finding an object of one color amongst objects of a contrasting color, can be accomplished using peripheral vision scanning, while complex visual tasks require fixation eye movements [6, 15]. When searching for a specific object, Amor et al. and Rayner and Castelhano found that search memory can affect the participant's next saccade movement direction as people tend not to view already searched areas [1, 18].

While searching for a specific object amongst distractors is the primary visual image search used in daily life, it is not the only one. Comparative visual searches are found in quality assurance departments and many digital and paper search games. In comparative visual searches, fixation time increases, and multiple saccades occur between the target image and its match when the match is believed to have been found [7, 17].

Historically most visual image searches have been done by humans. In this digital age, computers are starting to do or assist with searching. Zhang and Kreiman developed a neural network to learn from fixations on non-target objects during a visual image search and then predict the actual target object [22].

2.3 Task Dependency

Visual image searches can be affected by task dependency. When presenting a visual search task, the language and word choice have been shown to affect the fixations and search patterns employed during the visual search [11, 19, 21]. During a visual image search task, the fixation durations between errant and correct saccades are similar when participants' search pattern is only driven by visual information. Participants using visual information and task dependency information experience shorter fixations after making correct saccade movements that match the visual and task information provided [8]. While task wording affects eye movements, these movements can be further affected by whether the person is a novice or expert in the topic area of the task to be completed [19].

While wording affects visual search, it is not the only thing that can affect how a person searches an image for an object. The number of distractors changes the visual search strategy; systematic searching is used with a relatively low number of distractors, while a random search is used when many distractors are present [3]. These studies show how eye movements during a visual image search can be affected by task wording and image development.

Table 1: Participant Demographic Information

ID	Age	Gender	Corrective Lenses	Eye Condition	Eye Tracking Experience (1 to 10)
A01	25	F	Glasses	Strabismus	2
A02	51	F	- - -	- - -	1
A03	27	M	- - -	- - -	2
A04	27	M	Glasses	- - -	6
A05	25	M	- - -	- - -	4
J01	21	F	Glasses	- - -	1
J02	24	M	Contacts	Astigmatism	1
J03	21	F	Contacts	- - -	1
J04	20	M	- - -	- - -	3

3 METHODOLOGY

3.1 Participant Recruitment

Participants were recruited via direct email and flyers posted in McAdams Hall at Clemson University. Interested individuals were instructed to reach out to research personnel for more information or scheduling. Those 18 years of age or older were invited to participate. Each participant provided informed consent at the start of their scheduled session.

3.2 Description of Participants

We recruited and conducted sessions with nine participants (4 female, 5 male, mean age of 26.8 years, range = 20 to 51 years old) over two weeks at 112C McAdams Hall at Clemson University. Five of our nine participants used corrective lenses (glasses or contacts), and two participants had an eye condition, one with Strabismus and the other with Astigmatism. Finally, in terms of experience with eye tracking, our participants self-reported having an average of 2.33 out of ten. Table 1 summarizes the demographic information.

3.3 Apparatus and Materials

This study was conducted by using the following apparatus, software, and stimuli.

3.3.1 Apparatus. We used the Gazepoint GP3 standalone eye tracker mounted underneath a Dell P2213T computer monitor to conduct our study. The Gazepoint GP3 has a sampling rate of 60 Hz, 0.5 to 1 degree of visual angle accuracy, tracks pupil size, and has an operating distance of 50 to 80 cm. The GP3 eye tracker is a video-based

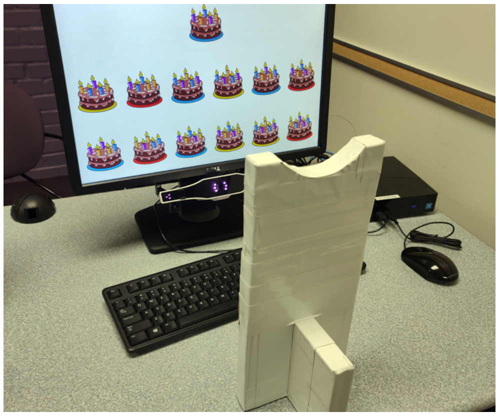

Figure 1: Apparatus setup including chin rest.

eye tracker using pupil-corneal reflection as its principal mode of operation. The Dell P2213T monitor used is a widescreen LCD flat panel monitor with a diagonal screen size of 22-inches, a screen resolution of 1680 x 1050, and a refresh rate of 60 Hz. To create an optimal eye-tracking environment, we used a chin rest (Figure 1) to limit head movement during the study. Study participants were positioned so that their eyes were 60 cm from the screen.

3.3.2 Software. Three different software applications were required to conduct this study. First, Gazepoint Control is a server that is necessary to run in the background, allowing eye movements to be tracked. Next, PsychoPy3 was used to present the study instructions and stimuli to our participants. It records the eye tracking data collected from Gazepoint Control while also recording interaction information (i.e., spacebar presses). Finally, RStudio was used to conduct data analysis on the information collected by PsychoPy3.

3.3.3 Stimuli. The primary stimuli for this study are two images (Figures 2 and 3), one in full color and the other grayscale. The subject matter of the images is a birthday cake. A target image is placed at the top of the stimulus, and ten additional images are placed at the bottom. The images at the bottom are similar to the top target image, but only one is an exact match. The other nine images have different colors or features differentiating them from the target image. The grayscale stimulus was created using Adobe Photoshop and changing the full color images to grayscale. Other than the stimuli color, the only difference between the two images is the placement of the matching image.

In addition to our primary stimuli, participants look at an image with a dot above the target image to direct the participant's focus before the stimulus image is presented.

3.4 Experimental Design

This study uses a mixed factorial design of 2 (image color scheme: full color, grayscale) x 2 (search instruction: specific, generic). Image color scheme is the within-subjects factor, while the search instruction is the between-subjects factor. Participants were either given the instruction to compare the target image to the other images to find its match or find the match to the target image amongst the other images, but not both.

We presented participants with five groups composed of two target matching trials. Each group contained one full color (Figure 2) and one grayscale (Figure 3) stimulus image. Groups were counterbalanced to ensure that the presentation order of the image color scheme did not result in a confounding variable. Half of our participants experienced a repeating order of full color then grayscale stimulus, while the remainder experienced repeating groups of grayscale then full color stimulus.

3.5 Procedure

Participants were welcomed when they arrived for their scheduled session and brought into the testing area. Participants were given the IRB-approved informational letter of consent to read and learn about the study's activities, procedures, potential risks and discomforts, and approximate length of the session. Once read, participants were allowed to ask questions. If they agreed to participate in the study, they gave verbal assent to the informational letter of consent and received a copy for their records. Before participants began interacting with the eye tracking system, they were asked six demographic questions.

Participants were directed on how to use the chin rest, and the chair and GP3 eye tracker were adjusted to provide the best opportunity for data collection during the study. The eye tracking system was then calibrated to the participant using a five-point on-screen calibration image. If calibration failed or was deemed

Figure 2: Full color image search stimulus. Image match is bottom row, third from left.

Figure 3: Grayscale image search stimulus. Image match is bottom row, second from left.

Table 2: Effect of color and wording on participants' image matching times

Predictor	Sum Sq	Df	Mean Sq	F	$\eta_p{}^2$
Color	0	1	0.4	0.001	- -
Wording	1703	1	1702.9	5.752*	0.06
Color * Wording	238	1	237.6	0.802	- -
Error	25,461	86	296.1	- -	- -

Note: * $p < 0.05$

inaccurate, calibration was re-run. Once calibration was complete, participants were informed to follow all on-screen directions.

The on-screen directions informed participants to locate the target image at the top amongst the images at the bottom of the screen. Half of the participants were told to "compare" the images, while the remainder were told to find the matching image. Participants were instructed to keep their gaze focused on the matching image when they found it and press the spacebar on the computer's keyboard. Participants were presented with alternating full color and grayscale stimuli, with half starting with full color stimulus images and the other half with grayscale stimulus images. Once participants reported finding the matching image ten times, the eye tracking portion of the study was complete.

Participants were then asked to complete a post-experiment 7-question questionnaire. Upon completing the questionnaire, participants were given a final opportunity to ask questions about the study. After answering any questions, participants were thanked for their time and participation and received their incentive.

3.6 Data Capture

Each session's participant's eye movements and image match selections were captured using Gazepoint Control and PsychoPy3 software applications. Recorded data was stored in hdf5 file format.

3.7 Analysis

Analysis was conducted on the captured data and pre- and post-study questionnaires, using RStudio to explore our hypothesis.

4 RESULTS

To assess the effect of color and search instruction wording on participants' image matching times, we conducted a two-way analysis of variance (ANOVA). See Table 2 for the results of this test. Results indicated a medium effect size, $\eta_p{}^2 = 0.06$, of search instruction wording, such that participants' image matching times were significantly longer in the "compare" condition (M = 29.3, SE = 2.72) compared to the "find" condition (M = 20.6, SE = 2.43) ($F(1) = 5.752, p = 0.018$). The two-way ANOVA revealed no significant interaction between time and color stimuli ($F(1) = 0.001, p = 0.971$, n.s.) nor between time and both color stimuli and search instruction wording ($F(1) = 0.802, p = 0.373$, n.s.).

To assess the effects of search instruction wording and color on accuracy, we first conducted a chi-square test of independence on the effect of wording on accuracy. The results of this test were not significant, $\chi^2(1) = 0.5, p = .464$ (n.s.). Next, we explored the effect of color on accuracy by conducting another chi-square test of independence. The results of this test indicated a statistically significant relationship between color and accuracy, $\chi^2(1) = 7.2, p = .007$ (Figure 4). Thus, participants were more likely to match correctly on color trials compared to grayscale trials.

Furthermore, we found that six participants noticed that the image location was the same across the trials for the color condition. However, only four participants noticed that the image match location was the same for the grayscale trials.

Finally, visual inspection of search fixation patterns did not definitively show pattern significance related to the specific search instruction (compare, Figure 5 Left) compared with the generic search instruction (find, Figure 5 Right).

5 DISCUSSION

While an order of task performance is visually noticeable between the specific search instruction (compare) and the generic search instruction (find), it is unclear whether this was due to the color stimuli, the search difficulty, or the wording of the search instruction. All of our participants reported that the color image was easier to find (Table 3). Therefore the more ordered search pattern shown in Figure 5 Right may result from the task difficulty. Additionally, an ordered search pattern is difficult to determine and define based on different stimuli. Figure 5 Left shows a type of ordered search by the search focusing on the images with blue plates when given the specific search instruction (compare). Therefore our results related to a greater order of task performance based on the wording of the search instruction, compare vs. find, are not conclusive and do not support our hypothesis (H1).

We found that the time it takes participants to find the target image's match is significantly longer when asked to compare it to the other images than when asked to find the target image. Finding that the "compare" search instruction wording results in a longer search time makes sense since comparing requires looking from the target image to the potential image match at least once before moving on to the next potential match. Being asked to "find" the match to the target image can allow for multiple potential matches

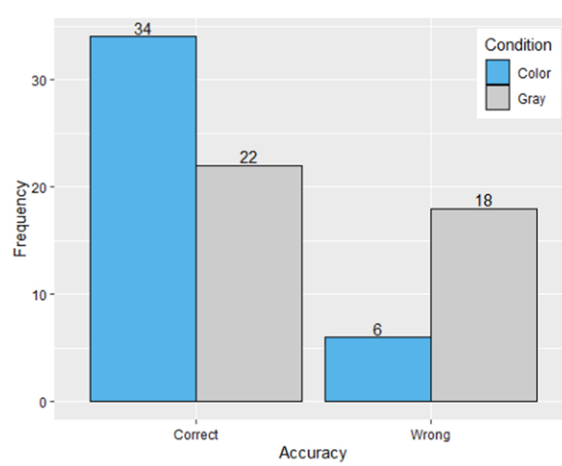

Figure 4: Relationship between color and accuracy.

Figure 5: The figure on the Left shows the search fixation pattern for the full color stimulus given the "compare" search instruction. In contrast, the figure on the Right shows the search fixation pattern for the grayscale stimulus given the "find" search instruction.

Table 3: Post-questionnaire results

Question	Response Option	Number of Responses
How often do you do image matching activities?	Never	2
	Rarely	5
	Sometimes	2
	Often	- -
	Always	- -
Which target image match did you prefer finding?	Color	8
	Grayscale	1
	About the same	- -
Which was easier to find?	Color	9
	Grayscale	- -
	About the same	- -
Finding the first color target image match was?	Very difficult	- -
	Difficult	2
	Neither easy/difficult	4
	Easy	3
	Very easy	- -
Finding the first grayscale target image match was?	Very difficult	2
	Difficult	6
	Neither easy/difficult	- -
	Easy	- -
	Very easy	1

to be skipped as they are immediately known not to be a match, therefore allowing the search to complete faster. Thus, our findings support that the search instruction condition moderates the time it takes for participants to find the target image match (H2).

Participants conducted image matching searches for both full color and grayscale stimuli. In a post-experiment questionnaire, eight of the nine participants reported preferring to find the match of the color target image (Table 3). Additionally, participants unanimously reported that finding the target image match in the full color trials was easier (Table 3), which was also reflected in the significance of participants being more likely to find the correct target image match in the full color stimulus than the grayscale stimulus. Therefore, our findings support that participants are more accurate when finding the full color image matches than the grayscale image matches (H3).

The majority, six out of nine, of our participants, reported learning that the location of the target image's match for the full color stimulus was always the same. However, less than half, four out of nine, reported learning that the target image's match for the grayscale stimulus was always in the same location but different than the full color's match location. While these statistics initially appeared potentially significant, two situations brought any significance into question. The first was the wording of the post-experiment questionnaire question. The question may have been leading by asking if the participant noticed that the images match were always in the same location. Participants that had not noticed during the study may have used their memory to have claimed success. Second, the expected outcome of shortened search times from learning the images match was always in the same location was not discernible. This lack of decreased search time may result from believing the image match would eventually move locations. "I kept looking at the other images expecting the target image to suddenly move" (A01). Further study is required to determine if there is support for location learning. Therefore our current results do not support the location learning hypothesis (H4).

6 LIMITATIONS

While we attempted to design and develop an appropriate study and questionnaires to explore our hypotheses, we experienced some limitations to our study. We could only recruit nine participants for our study and could not use all the data captured by one participant (J04) because the eye tracker did not track their eye movements. Having additional participants would have strengthened the collected data. Additionally, our full color and grayscale stimulus may have been too complicated for our participants to successfully match the target image to the correct image from the potential matches. Multiple stimulus options should have been pilot tested to determine the best option for the study.

Furthermore, question six in our post-experiment questionnaire inquired if the participant noticed that the full color and grayscale image matches were in the same position each time. This question should have asked if the participant noticed anything about the trials, rather than potentially leading participants to report something they believe they should have noticed. Finally, we acknowledge that the Dell P2213T monitor was not color calibrated correctly, and the colors were brighter at the top of the monitor than the bottom of the monitor, which may have resulted in matching errors and increased search times.

7 CONCLUSION

This paper presented a study exploring how task wording affects the search patterns of participants matching full color or grayscale target images amongst similar images. We asked our participants only to use their eyes to find the matching image and measured time, accuracy, and search patterns. We found significant results supporting two of our hypotheses that finding the image match in the Full Color stimulus is faster than the grayscale stimulus moderated by the task wording condition and that participants are more accurate when making matches in the full color stimulus (H2 and H3). The other two hypotheses, specific search instructions (compare) increasing task performance order and participants learning that images matches were always in the same position per stimulus, were not supported by the results of this study.

While search patterns based on task wording proved inconclusive, we believe that more explicit wording along with an experiment designed only to explore task wording may result in different findings. Future research into visual search patterns based on specific task wording is needed to understand better how words can affect a persons visual search.

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REFERENCES

[1] Tatiana A. Amor, Saulo D. S. Reis, Daniel Campos, Hans J. Herrmann, and José S. Andrade. 2016. Persistence in eye movement during visual search. *Scientific Reports* 6, 1 (Feb. 2016), 20815. https://doi.org/10.1038/srep20815

[2] Reynold Bailey, Ann McNamara, Nisha Sudarsanam, and Cindy Grimm. 2009. Subtle gaze direction. *ACM Transactions on Graphics* 28, 4 (Aug. 2009), 1–14. https://doi.org/10.1145/1559755.1559757

[3] Heitor F. Credidio, Elisângela N. Teixeira, Saulo D. S. Reis, André A. Moreira, and José S. Andrade Jr. 2012. Statistical patterns of visual search for hidden objects. *Scientific Reports* 2, 1 (Dec. 2012), 920. https://doi.org/10.1038/srep00920

[4] Stanislas Dehaene. 1989. Discriminability and dimensionality effects invisual search for featural conjunctions: A functional pop-out. *Perception & Psychophysics* 46, 1 (Jan. 1989), 72–80. https://doi.org/10.3758/BF03208076

[5] Francesco Di Nocera, Michela Terenzi, and Marco Camilli. 2006. Another look at scanpath: distance to nearest neighbour as a measure of mental workload. 295–303.

[6] M. P. Eckstein. 2011. Visual search: A retrospective. *Journal of Vision* 11, 5 (Dec. 2011), 14–14. https://doi.org/10.1167/11.5.14

[7] Adam J. Galpin and Geoffrey Underwood. 2005. Eye movements during search and detection in comparative visual search. *Perception & Psychophysics* 67, 8 (Nov. 2005), 1313–1331. https://doi.org/10.3758/BF03193637

[8] Harold H Greene. 2006. The Control of Fixation Duration in Visual Search. *Perception* 35, 3 (March 2006), 303–315. https://doi.org/10.1068/p5329

[9] Mary Hayhoe and Dana Ballard. 2005. Eye movements in natural behavior. *Trends in Cognitive Sciences* 9, 4 (April 2005), 188–194. https://doi.org/10.1016/j.tics.2005.02.009

[10] Ignace Th.C. Hooge and Casper J. Erkelens. 1998. Adjustment of fixation duration in visual search. *Vision Research* 38, 9 (May 1998), 1295–IN4. https://doi.org/10.1016/S0042-6989(97)00287-3

[11] Falk Huettig, Ernesto Guerra, and Andrea Helo. 2020. Towards Understanding the Task Dependency of Embodied Language Processing: The Influence of Colour During Language-Vision Interactions. *Journal of Cognition* 3, 1 (Oct. 2020), 41. https://doi.org/10.5334/joc.135

[12] Arthur M. Jacobs. 1986. Eye-movement control in visual search: How direct is visual span control? *Perception & Psychophysics* 39, 1 (Jan. 1986), 47–58. https://doi.org/10.3758/BF03207583

[13] Michael F. Land and Mary Hayhoe. 2001. In what ways do eye movements contribute to everyday activities? *Vision Research* 41, 25-26 (Nov. 2001), 3559–3565. https://doi.org/10.1016/S0042-6989(01)00102-X

[14] Ann McNamara, Reynold Bailey, and Cindy Grimm. 2009. Search task performance using subtle gaze direction with the presence of distractions. *ACM Transactions on Applied Perception* 6, 3 (Aug. 2009), 1–19. https://doi.org/10.1145/1577755.1577760

[15] E.A.B. Over, I.T.C. Hooge, B.N.S. Vlaskamp, and C.J. Erkelens. 2007. Coarse-to-fine eye movement strategy in visual search. *Vision Research* 47, 17 (Aug. 2007), 2272–2280. https://doi.org/10.1016/j.visres.2007.05.002

[16] Harold Pashler. 1987. Detecting conjunctions of color and form: Reassessing the serial search hypothesis. *Perception & Psychophysics* 41, 3 (May 1987), 191–201. https://doi.org/10.3758/BF03208218

[17] Marc Pomplun, Lorenz Sichelschmidt, Karin Wagner, Thomas Clermont, Gert Rickheit, and Helge Ritter. 2001. Comparative visual search: a difference that makes a difference. *Cognitive Science* 25, 1 (2001), 3–36. https://doi.org/10.1207/s15516709cog2501_2 _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1207/s15516709cog2501_2.

[18] Keith Rayner and Monica S. Castelhano. 2008. Eye Movements during Reading, Scene Perception, Visual Search, and While Looking at Print Advertisements. In *Visual Marketing: From Attention to Action*. Taylor & Francis Group, LLC, 9–42.

[19] Nino Sharvashidze and Alexander C Schütz. 2020. Task-dependent eye-movement patterns in viewing art. *Journal of Eye Movement Research* 13, 2 (Dec. 2020). https://doi.org/10.16910/jemr.13.2.12

[20] Ralf Van Der Lans, Rik Pieters, and Michel Wedel. 2008. Eye-Movement Analysis of Search Effectiveness. *J. Amer. Statist. Assoc.* 103, 482 (June 2008), 452–461. https://doi.org/10.1198/016214507000000437

[21] Alfred L. Yarbus. 1967. Eye Movements During Perception of Complex Objects. In *Eye Movements and Vision*. Plenum Press, 171–211. http://wexler.free.fr/library/files/yarbus%20(1967)%20eye%20movements%20and%20vision.pdf

[22] Mengmi Zhang and Gabriel Kreiman. 2020. What am I Searching for: Zero-shot Target Identity Inference in Visual Search. *arXiv:1807.11926 [cs]* (June 2020). http://arxiv.org/abs/1807.11926 arXiv: 1807.11926.