A Comparative Analysis of the Three-Alternative Forced Choice Method and the Slider-Based Method in Subjective Experiments: A Case Study on Contrast Preference Task

Olga Cherepkova, Seyed Ali Amirshahi and Marius Pedersen
Norwegian University of Science and Industry, Norway

Keywords: 3AFC, Three-Alternative Forced-Choice, Slider, Contrast, Preferences, Response Format.

Abstract: When it comes to collecting subjective data in the field of image quality assessment, different approaches have been proposed. Most datasets in the field ask observers to evaluate the quality of different test and reference images. However, a number of datasets ask observers to make changes to one or more properties of the image to enhance the image to its best possible quality. Among the methods used in the second approach is the Three-Alternative Forced Choice (3AFC) and the slider-based methods. In this paper, we study and compare the two mentioned methods in the case of collecting contrast preferences for natural images. Fifteen observers participated in two experiments under controlled settings, incorporating 499 unique and 100 repeated images. The reliability of the answers and the differences between the two methods were analyzed. The results revealed a general lack of correlation in contrast preferences between the two methods. The slider-based method generally yielded lower values in contrast preferences compared to 3AFC experiment. In the case of repeated images, the slider-based method showed greater consistency in subjective scores given by each observer. These results suggest that neither method can serve as a direct substitute for the other, as they exhibited low correlation and statistically significant differences in results. The slider-based experiment offered the advantage of significantly shorter completion times, contributing to higher observer satisfaction. In contrast, the 3AFC task provided a more robust interface for collecting preferences. By comparing the results obtained by the two methods, this study provides information on their respective strengths, limitations, and suitability for use in similar preference acquisition tasks.

1 INTRODUCTION

Subjective experiments serve as the primary method for collecting and evaluating human preferences. Researchers use various methods to capture and quantify subjective opinions related to different stimuli and tasks, which are carefully selected according to their needs and objectives. In this study, the focus is on two commonly used methods: the Three-Alternative Forced Choice (3AFC) method (Wetherill and Levitt, 1965) and the slider-based method (Hayes, 1921). Like any other subjective experiment, the aforementioned methods have their advantages and limitations, and in this work, their effectiveness in the context of a subjective experiment for contrast preference is compared.

The 3AFC method presents participants with three choices simultaneously and requires them to select one that best matches the specified criteria. This method provides a discrete choice format, forcing participants to make direct comparisons among the available options. Despite the higher complexity, due to its effectiveness, stability, and precision, 3AFC is a replacement for the commonly used Two-Alternative Forced Choice (2AFC) method (Mantiuk et al., 2012, Shelton and Scarrow, 1984). The 3AFC method combined with the adaptive staircase method (Lu and Dosher, 2013) can provide precise results in estimating observers' preferences or stimuli threshold tasks (Schlauch and Rose, 1990). By incorporating multiple repetitions of the same task and gradual convergence, this combination of methods ensures that observers do not take shortcuts to complete the given task. However, one of the biggest limitations of this method is the time it requires, which can lead to participant fatigue and a limitation on the number of tasks that can be performed without losing focus.

The slider-based method uses a continuous rating approach, which is its most important distinction. In this case, participants are presented with a single stim-

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uli and use a slider to adjust their response on a continuous scale that represents the evaluated attribute or dimension. In theory, this method allows participants to provide a more precise assessment (Chyung et al., 2018), as they can freely adjust the position of the slider to indicate their level of agreement, preference, or intensity. One of the major advantages of this method is time efficiency which allows observers to perform a higher number of tasks per hour compared to 3AFC. However, one of the challenges of this method is ensuring the precision of the responses provided, as participants may find it simpler to alter their responses in this type of task.

Taking into account the advantages and disadvantages of the two mentioned methods, the objective of this study is to compare how similar the results of the two methods are in the context of contrast preference. In this study, contrast was selected based on previous studies (Cherepkova et al., 2022b, Cherepkova et al., 2022a) showing that it is one of the image attributes that influences the significant variability in the preferences of the observer when evaluating the quality of an image. In other words, this study tries to answer this question: do the 3AFC and the slider-based methods produce similar results in terms of precision and reliability? The objective is to examine the differences between these methods in capturing participant preferences for contrast levels for a dataset of natural landscape images. This is done by comparing the preferences of 15 observers, who evaluated 499 images with both methods and 100 repeated images, which were used for a reliability check. The aim is to provide insight that will help researchers in selecting the most appropriate method for conducting preference-related or other similar subjective experiments.

This paper is organized as follows. Section 2 provides a short discussion on similar studies that take advantage of either of the two methods. Details of the two subjective experiments carried out are provided in Section 3. This will include the experimental design and procedure, participant recruitment, and implementation of both the 3AFC and slider-based methods. Section 4 presents the results obtained from the two methods and compares them in terms of time, reliability, precision, and efficiency. Finally, Section 5 summarizes the main findings and give a short overview of the advantages and limitations of both methods.

2 BACKGROUND

Both 3AFC and slider-based methods are widely used in different research domains in signal detection, discrimination, decision-making, and preferences (Roster et al., 2015, Wickens, 2001), including the contrast preference task (Azimian et al., 2021). In (Wier et al., 1976) authors compare the method of adjustment that involves participants adjusting a stimulus parameter until it matches a reference stimulus, with the forced-choice method, which requires participants to choose the stimulus that differs most from the reference stimulus, in frequency discrimination tasks. To explore the effects on discrimination thresholds and response biases, they manipulated various factors, such as the number of response alternatives, stimulus duration, and stimulus intensity. The authors found that compared to the method of adjustment, the forced-choice method yielded more reliable discrimination thresholds across different conditions. They attribute this finding to the ability of the forced-choice methods in reducing response biases and offer a more objective measure of discrimination ability.

Various studies have compared category-based and slider-based responses, which involve the use of radio buttons and slider bars in web surveys. Jin and Keelan designed a new slider-based method to improve subjective image quality assessment (Jin and Keelan, 2010). They validated the effectiveness of their proposed method by comparing their slider-based method with the absolute category rating and pairwise comparison methods. They found that their proposed method produces a higher correlation with objective image quality metrics compared to other methods while reducing the time spent per assessment by two-fold. They concluded that the slider-based method provides a more reliable and calibrated approach for image quality assessment.

In (Roster et al., 2015) study the slider-based response format was compared with the category-based response format. Their results show that the slider-based response format provided more precise and fine-grained measurements, particularly for subjective parameters such as satisfaction and preferences. However, no statistically significant differences were found with respect to data quality and completion time between response formats. The same study (Roster et al., 2015) also found that slider bars yielded lower mean scores compared to radio buttons. Similarly, Bosch et al. (Bosch et al., 2019) concluded that slider bars provide responses similar in quality to radio buttons. Their research suggests that the slider-based method can be used without losing the quality of the collected data.

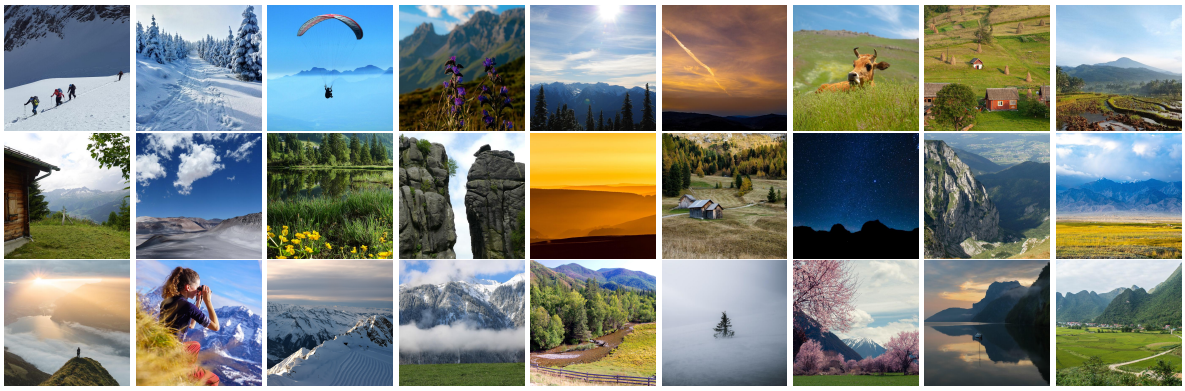


Figure 1: Sample images from the dataset.

The study (Toepoel and Funke, 2018) showcases the explored impact of different response formats and scales, specifically sliders, visual analogue scales, and buttons, on survey responses collected via mobile and desktop devices. In contrast to (Roster et al., 2015) and (Bosch et al., 2019), they found that the slider performed worse than other types of scales. In general, the slider bars were harder to use and more prone to observer bias. As in (Roster et al., 2015), they found lower mean scores produced by the use of slider bars.

A comprehensive survey of the use of continuous rating scales was introduced in (Chyung et al., 2018). The authors addressed the advantages and disadvantages of continuous compared to discrete-rating scales. They discussed the benefits of continuous scales in terms of increased sensitivity, reduced cognitive burden, improved measurement precision, and enhanced engagement by the respondents, as well as potential concerns, such as response style biases and measurement validity. They concluded that based on evidence research, no design format is significantly better than another, and selection should depend on researcher needs, keeping in mind the drawbacks of using sliders, which might outweigh their advantages.

3 SUBJECTIVE EXPERIMENT

In this Section, information about the experimental design and procedure, the dataset we used, the algorithms used in each experiment, and the participants recruited for the task is provided.

3.1 Dataset

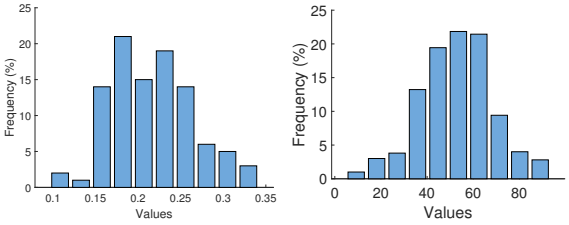
To avoid content bias, our dataset contains 499 original images with similar content. Images with the search tag “mountain” were downloaded from Pixabay (Pixabay, 2023). Original images with HD resolution of 1920x1080 pixels were cropped to 600x600 pixels around the salient regions in the image to ensure that three images fit in a row on a full HD monitor with a resolution of 1920x1080. The selection of images was also manually controlled to ensure their quality and to avoid complex scenes with multiple objects of interest to focus on.

For the experiment, the dataset was divided into five subsets, each consisting of 120 images: 100 original images (with the exception of the subset containing 99 images) and 20 repeated images allowing for the evaluation of intra-observer reliability. Within the 20 images, 10 were repeated locally, while the remaining 10 images were repeated in all five subsets (locally and globally repeated images, respectively). Figure 1 represents sample images showcasing the most diverse content within the dataset.

To ensure that the dataset is balanced, the distribution of original contrast and lightness was checked for all the images in the dataset and each of the subsets. To calculate the contrast, we checked how much pixels vary from the mean luminance. In our calculations the Root Mean Square (RMS) contrast equation 1 was used. The RMS contrast equation is defined as:

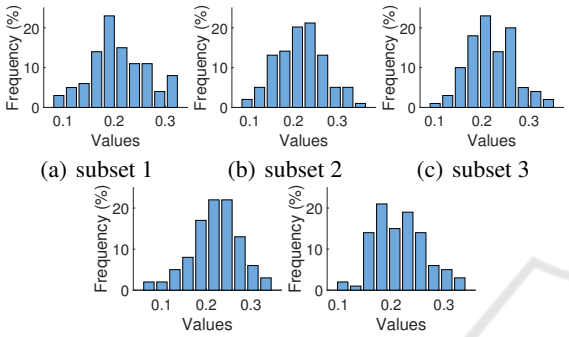
$$\text{RMS Contrast} = \sqrt{\frac{1}{MN}\sum_{i=0}^{N-1}\sum_{j=0}^{M-1}(I_{ij}-\bar{I})^2} \qquad (1)$$

where I_{ij}: intensity of i_{th} and j_{th} pixel, $\bar{I}$: mean intensity of all pixels, M and N: total number of image pixels. The pixel intensities are normalized in the range of $[0,1]$. The distributions are shown in Figure 2. Figure 3 demonstrates that five subsets containing randomly assigned images are also balanced, i.e. the contrast of the images are approximately normally distributed.



(a) Contrast (b) Lightness

Figure 2: Original RMS contrast and lightness distribution accross the dataset.



(a) subset 1 (b) subset 2 (c) subset 3

(d) subset 4 (e) subset 5

Figure 3: Original RMS contrast distribution in each of the five subsets.

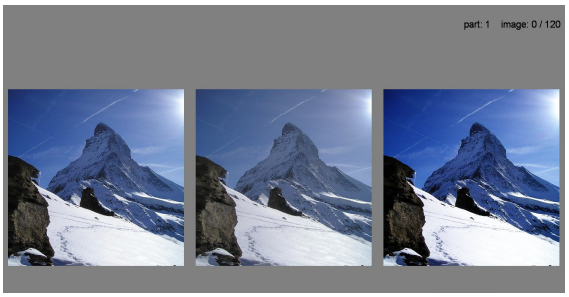


Figure 4: 3AFC experiment design, a set of images, illustrating the initial difference between low, medium, and high contrast images.

Figure 5: Slider-based experiment design.

3.2 Experimental Design

Two experiments were conducted to collect the contrast preferences of observers: first using the 3AFC method and then using the slider-based method. In the 3AFC experiment, participants are presented with three images simultaneously, each representing one of the low, medium, and high levels of contrast. Observers were asked to "choose the image you prefer". This will force participants to make a direct choice among the available options. The contrast values can change in the range from -1 to 1. For changing the contrast of the images the same algorithm used in the Kadid-10K dataset (Lin et al., 2019) [1] was used. The algorithm was chosen due to the results of previous studies (Cherepkova et al., 2022b, Cherepkova et al., 2022a), where changes in contrast with this algorithm produced one of the most variable results among observers, suggesting individual differences in contrast preferences. This algorithm entails modifying the tonal curve of the RGB image, affecting the luminance and color of both the bright and dark regions. Elevating contrast intensifies the brightness in bright areas and enhances the darkness in dark areas, whereas decreasing contrast minimizes the distinction between the darkest and brightest areas of the image.

In the first experiment (3AFC), for the first triplet of images, a medium contrast value was chosen from a normally distributed probability of contrast values in the range [-1;1] (Figure 6). This choice was made to avoid the influence of the same starting point. The use of a normal distribution helped to avoid extreme values in the beginning of the experiment. Low and high contrast levels were created by adding -0.25 and +0.25 contrast changes to see noticeable differences without being overly intrusive. The next triplet was derived based on previous responses, where each step (the difference between low, medium, and high contrast levels) was decreased after each choice of medium contrast and increased after two consecutive choices of high or low contrast to give the observer the opportunity to change their mind. When high or low contrast was chosen, it became the new triplet medium contrast value, while the step remained the same. The adaptive staircase algorithm for this specific task was modified to gradually come to an optimal point of contrast preference for each observer. The optimal point was considered to be found when the difference between the four last answers was less than one JND, indicating that the observer cannot see a difference, which were calculated using the delta E2000 difference (Sharma et al., 2005). Based on the

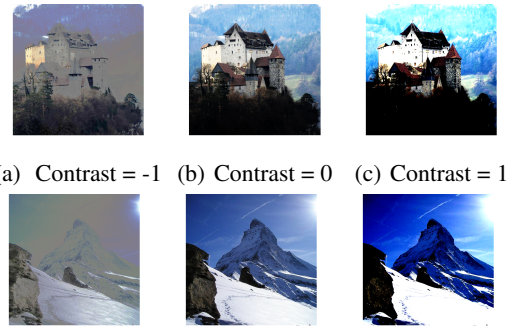
[1]The Matlab source code for changing contrast in the image can be downloaded from the KADID-10k IQA dataset webpage: http://dataset.mmsp-kn.de/kadid-10k-dataset.html using the function "imcontrastc.m"

CIE standard (Karma, 2020) the assumption is that the delta E2000 should be less than 1 for the stopping rule to be satisfied. The number of trials for each image was not greater than 30 and not less than 10. The minimum number of trials ensures that the algorithm will not mistakenly stop at a local minimum, while an observer might continue selecting the same image if their preference lies close to the starting point. The maximum number stops the algorithm in case one JND is unreachable for any reason. The left, central, and right positions of the images were randomly selected. An example is shown in Figure 4. The contrast preference for each image in this task was calculated as an average of the four last answers given (with JND less than one), which provides a more precise result and minimizes the noise.

In the second (slider-based method) experiment, participants were presented with a single image and instructed to use a slider to adjust and indicate their subjective preference for the level of contrast. Participants can freely move the slider along a continuous scale from -1 to 1 to reflect their preference of contrast, allowing fine-grade precision. There were no marks on the slider to avoid preference or anchoring to any particular number. The design is shown in Figure 5. In this task, observers were asked to "adjust the contrast with the slider using the mouse until you are satisfied with the result". In this case instructions were changed from the previous experiment due to the nature of the setup. Contrast values were obtained from the slider location after the observer confirmed their choice with a press of a button. The slider position was kept in the previously chosen place for the next image. In the case of the slider-based method, the use of a random starting point could potentially introduce confusion into the results, as observers might "cheat" by repeatedly choosing the value of the starting point. This behavior would naturally not accurately reflect their actual choice and would be challenging to control. Therefore, keeping the previous position for the slider will provide an additional parameter for inclusion in the reliability assessment.

3.3 Experimental Procedure

The experiments were conducted in a controlled laboratory environment. Lighting conditions were adjusted to a dimmed level of 20 lux, and the participants maintained a viewing distance of 50 cm. Before the experiments, the participants underwent an Ishihara color blindness test and a Snellen visual acuity test, which they passed successfully. They were provided with detailed instructions and, as a trial, completed the process for a test image to familiarize themselves with the techniques.



(a) Contrast = -1 (b) Contrast = 0 (c) Contrast = 1

(d) Contrast = -1 (e) Contrast = 0 (f) Contrast = 1

Figure 6: Example of two images with the minimum contrast value of (-1) (a) and (d), zero (b) and (e), and maximum contrast value (one) (c) and (f).

The experiments were divided into five parts, each part containing 120 (in one set 119) images that allowed the observers to start and finish the experiment in a reasonable time. Nevertheless, observers could stop after any number of images and continue the experiment from where they left later on. The order of the images was individually randomized in both experiments. The data collection phase for the first experiment (3AFC) lasted about three months, while for the second experiment (slider) it took around a month. It is important to mention that the time to complete one subset of images (120 images) in the 3AFC experiment was around 1.5 hours (excluding the time for rest, which observers could take whenever they wanted). For the slider-based experiment, the average time to complete one subset was around 8 minutes, which is a big advantage of this method. The 3AFC experiment was completed by all observers before they started the slider experiment. The time between the two experiments varied for observers, ranging from a few weeks to a few days for some.

In total, 19 participants (11 men and 8 women) of an average age of 27 completed both experiments and evaluated 599 images, out of which 100 images were repeated for a reliability check. 11 observers had a background in image processing or photography. In total, 9481 preference values were collected in each experiment, of which 2850 values were used for a reliability check.

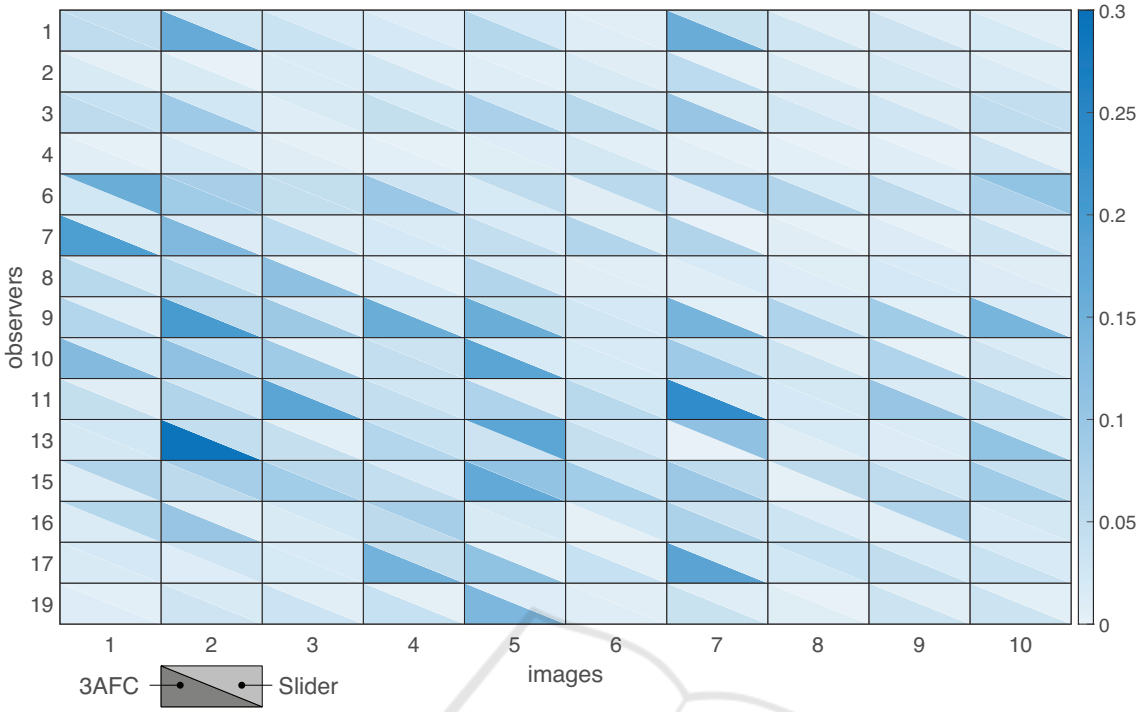


Figure 7: Comparison of preferences variances for 10 globally repeated images between the 3AFC and slider-based methods. The bottom-left triangle corresponds to the 3AFC method, top-right corresponds to the slider-based method.

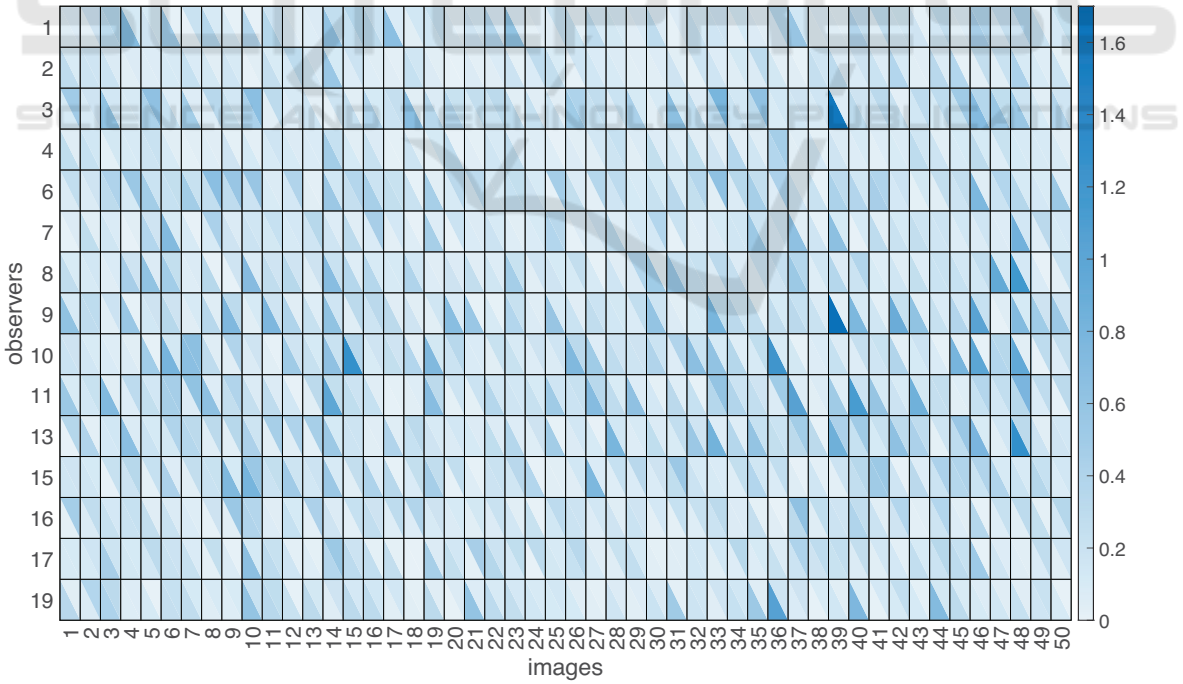
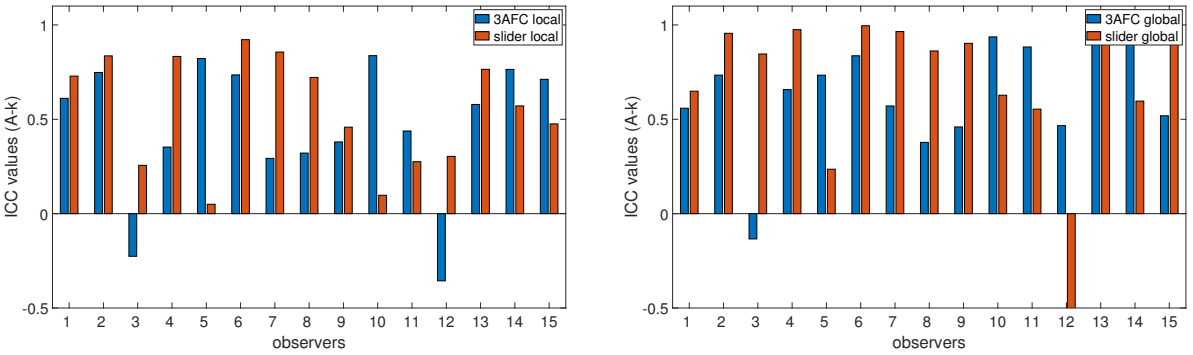


Figure 8: Comparison of preferences absolute differences for 50 locally repeated images between the 3AFC and slider-based methods. The bottom-left triangle corresponds to the 3AFC method, top-right corresponds to the slider-based method.



(a) ICC for locally repeated images

(b) ICC for globally repeated images

Figure 9: Bar graphs represent intra-observer reliability with ICC values. A higher ICC value indicates better reliability. Locally repeated images.

4 RESULTS ANALYSIS AND DISCUSSION

4.1 Removing Outliers

Before analyzing the differences between the 3AFC and slider-based experiments, the reliability of the observers was evaluated. For this aim Cohen's kappa (Landis and Koch, 1977), standard deviation, mean squared error, and Intraclass Correlation Coefficient (ICC) (McGraw and Wong, 1996, Salarian, 2023)

$$ICC(A-k) = \frac{MS_R - MS_E}{MS_R + \frac{MS_C - MS_E}{n}} \quad (2)$$

indicators were used. In Eq. (2) MS_R corresponds to the Mean Square for the observers (variance between observers). MS_E represents the Mean Square Error (variance within images, representing random error), and MS_C corresponds to the Mean Square for Cases (variance between images). The number of images is represented by n , while k corresponds to the number of trials (two for local, five for global). For ICC, the mean-rating, absolute-agreement, and the 2-way mixed-effects (A-k) model were used which all have been suggested in (Koo and Li, 2016). The formula calculates the ICC by comparing the variance due to observers (MS_R - MS_E) with the variance due to images (MS_C - MS_E), while considering the sample size (n). ICC is suitable for continuous values, which aligns with our data, while Cohen's kappa is designed for categorical data. Therefore, to apply Cohen's kappa to our continuous data, which ranged in [-1; 1], were discretized into 20 categories with a step size of 0.1. In addition, the average time it took an observer to make a choice was checked. For the slider-based experiment, in addition to the same indicators and decision time, the number of images in which the slider was not moved at all was checked, indicating that the image was skipped (in average, 6 images per observer out of 599). After analyzing the results, based on the indicators mentioned and reaction time (which was significantly lower) in the 3AFC experiment, observers 14 and 18 were excluded. Based on the indicators in the slider-based experiment, observers 5 and 12 were also excluded from the final analyses, resulting in a total of 15 observers for further analysis.

To answer the question whether the 3AFC and slider-based methods produce similar results, the reliability of both methods was initially evaluated. For this, the differences between the responses for repeated images in both methods for each observer were evaluated. The absolute differences for locally (twice) repeated images and variance for globally (five times) repeated images were calculated. Greater differences correspond to lower reliability of the method. For convenience, heatmaps were used that provide a visual representation of these differences (Figures 7-8). The results show that the differences in preferences for both globally and locally repeated images in the 3AFC experiment are greater, suggesting that the slider-based method yielded more reliable results. There could be several reasons for this observation. First, the shorter time that participants spent in the slider-based experiment may have contributed to similarities, as they may have remembered the values they selected earlier. Second, the nature of the experiments itself may have played a role, as randomization of the starting contrast level in the 3AFC experiment made it more challenging for participants to end up in the same position as before, while the slider position was easier to remember and replicate. Furthermore, unlike in the 3AFC experiment, observers had access to the entire range of possible variations in the slider-

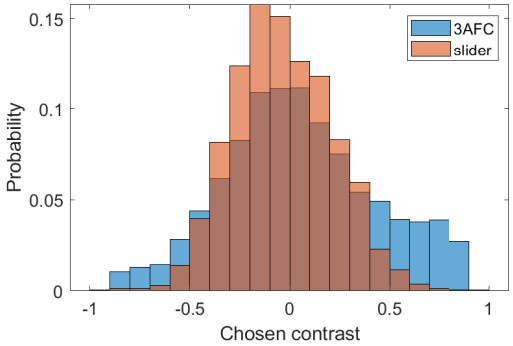


Figure 10: The overall preferences distribution in the 3AFC and slider-based experiments.

based experiment.

The intra-observer reliability in each experiment using ICC indicators can be compared for both locally and globally repeated images. The results in Figure 9 from the 3AFC and the slider-based methods show that the slider method provides higher reliability for each observer. The results show that for nine out of 15 observers, both ICC indicators for locally and globally repeated images show better reliability in the case of the slider method used. These results are closely related to the previous Figures 7-8 and can be explained in a similar manner. Another observation from the ICC reliability check is related to higher ICC values for globally repeated images compared to locally repeated images. This is attributed to the higher absolute differences observed for locally repeated images compared to the mean absolute differences for the five globally repeated images, leading to smaller MS_E and therefore a larger ICC. Despite the longer time intervals between the evaluations of the globally repeated images, the fact that they were assessed multiple times could result in better recall and more consistent responses.

4.2 Comparison of the Results for both Experiments

In addition, we studied the differences in preferences for all images between the two methods in general (Figure 10) and for each observer (Figure 11) independently. The overall distributions in Figure 10 show that the preference distribution in the slider-based experiment has a higher kurtosis. Observers were more likely to choose images with more natural contrast (μ 0.03, σ 0.35), while in 3AFC experiments observers were more likely to choose images with higher contrast (μ -0.04, σ 0.25). When performing a significance test to compare the two distributions using the Kolmogorov-Smirnov test (Massey Jr, 1951), we

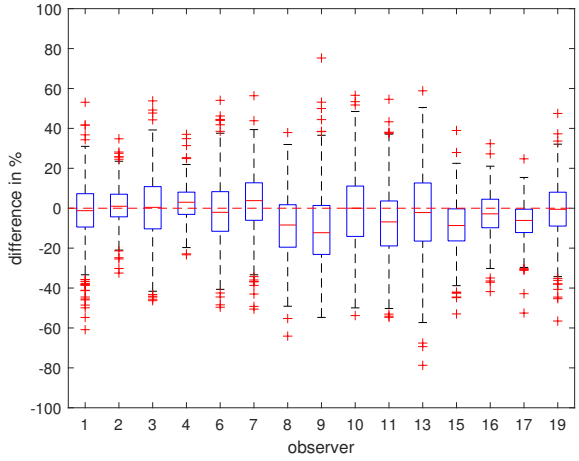


Figure 11: The differences between 3AFC and slider-based experiments in chosen contrast values in %, where 100% corresponds to maximal difference equal 2. The boxplots represent the range of differences. A negative difference means that observers chose lower contrast in the slider-based experiment compared to the 3AFC experiment.

found that the two distributions are significantly different, meaning that the two experiments do not yield the same results in responses.

The results in Figure 11 indicate that, on average, the difference for most observers hovers around 0. However, for certain observers, this difference can range from 0 to 60%. We checked the significance of the differences with the Wilcoxon Signed-Rank Test (Litchfield and Wilcoxon, 1949) and found that for most observers (12 out of 15) there is a significant difference between the distributions of the chosen values in the two experiments. It should be emphasized that as the number of evaluations per image increases, the average differences between the mean values of the chosen contrast level in the two experiments decrease. For example, when comparing the mean contrast values for two locally repeated images, instead of considering only the first subjective score given by an observer, the average difference decreased from 0.26 to 0.22. Similarly, for globally repeated images, when comparing the mean of five responses given by observers instead of only the first, the average differences between the two experiments decreased from 0.27 to 0.2. Therefore, we can improve consistency by increasing the number of repetitions per image and considering the mean of observations.

To determine if the two methods yield significantly different results, we compared the differences in preferences obtained with them. However, responses provided for non-repeating images can be affected by many factors and are not as consistent as comparing the mean values of repeated images. To find if the differences between the two methods

Table 1: Comparison of preferences between two experiments. Pearson correlation, the results of the sign test indicating significant differences in medians of observers' responses, the number of images (in %) with higher contrast chosen in slider-based experiment compared to the 3AFC.

Observer	1	2	3	4	6	7	8	9	10	11	13	15	16	17	19
Pearson correlation	0.06	0.44	0.22	0.45	0.46	0.34	0.30	0.18	0.01	0.19	0.15	0.18	0.35	0.41	0.13
Sign test, p-value	0.11	0.04	0.59	0	0.01	0	0	0	0.93	0	0.15	0	0	0	0.37
higher contrast (%)	46.3	54.7	51.3	63.7	44.1	59.7	28.3	26.5	50.3	30.9	46.7	24.6	40.7	23.0	47.9

are significantly different, we decided to run a statistical analysis on globally repeated images. We compared the mean values of the two groups with a Wilcoxon Signed-Rank Test. The first group consists of observers' preferences given in the first experiment, while the second group comprises preferences from the second experiment. We chose the Wilcoxon test over the t-test because our data is not normally distributed. The test resulted in a p-value of 0.7695, indicating that we cannot reject the null hypothesis with 95% confidence, suggesting that there is no significant difference between the results obtained from the two methods.

To further explore the differences between the two methods, we checked the correlation between the results for each observer (Table 1). From the correlation values we cannot conclude that the answers are well correlated. Several observers (2, 4, 6, and 17) show more consistent results, while others do not have an obvious correlation between the contrast preference values in the two experiments. This suggests that observers do not consistently reach the same conclusion in the two methods. One reason for this is the randomized starting point in the 3AFC experiment and the absence of it in the slider-based experiment, which could potentially impact the results, although verifying this would require a significantly larger dataset. Another possible reason for this difference is that since we are comparing only one value per image, there may be other factors that influence the choice, unlike when comparing averaged values for repeated images.

In addition, we examined whether observers consistently choose higher or lower values with a slider method compared to the 3AFC method. We performed the sign test for each observer to see if there are consistent differences between the results for all 499 images. Results (Table 1) show that with 95% confidence level there is a significant difference between the median of the results of the two experiments for most observers, with p-values below 0.05. A low p-value also indicates that the majority of the preferences are higher or lower in the slider-based experiment compared to the 3AFC. To check if the preferences are higher or lower in the slider-based experiment, we compared the mean values of the contrast chosen between the experiments. We found that the average preferred contrast level of -0.0355 in the slider-based experiment was slightly lower compared to 0.0137 in the 3AFC experiment, which corresponds to the findings in (Roster et al., 2015, Toepoel and Funke, 2018). We also compared the number of images in which observers preferred lower contrast in the slider-based experiment, and confirmed that the majority of observers indeed preferred images with lower contrast in this experiment (Table 1).

4.3 Discussion

We checked the reliability of two tests, comparing variances for globally repeated images, absolute differences for locally repeated images, and ICC values. The results suggest that the slider-based method yielded results with a higher consistency for each individual observer compared to the 3AFC procedure (Figures 7-8 and 9). The disparity in the results may be influenced by factors such as starting point, variations in observers' tolerance to different levels of contrast, shifts in attention to different regions of the image after repeated viewings, observer fatigue, impatience, and other individual factors.

While comparing the preferences obtained by the two experiments, we found that observers' answers in the slider-based and the 3AFC experiments do not correlate well (Table 1, row 1). The absolute differences between the two experiments were as high as 60% for some images (Figure 11). However, when comparing the mean contrast values for all observers for globally repeated images with the Wilcoxon test, there was no significant difference between the results. We found an improvement in the consistency of the answers as we averaged the result for multiple assessments for images. We also found that most observers consistently preferred images with a lower contrast level in the slider-based experiment compared to the 3AFC experiment (Table 1, second and third rows).

Naturally, both methods have their own limitations and advantages. The design of the 3AFC experiment provided certain advantages such as reducing observer bias and preventing shortcuts. However, a longer completion time and repetition of trials in the 3AFC experiment may have led to observer fatigue, resulting in reduced concentration and lower

reliability. The strict stopping rule in the experiment also led to a greater number of trials, in which observers viewed each image a high number of times, which could have caused annoyance and decreased participant satisfaction. In the case of the slider-based method, a shorter completion time and viewing the image only once increased the interest and concentration of the observer, leading to greater consistency in given answers. However, the simplicity of the test also made it more susceptible to shortcuts, which could introduce bias and rely more on the honesty of the observer.

5 CONCLUSION

In this study, we conducted a comparison between 3AFC and slider-based methods to determine contrast preference. We compared the reliability of the data obtained from both methods for locally and globally repeated images using statistical analysis and visual comparisons to assess the differences between the responses. We found variations in the results while analyzing individual observers. However, on average, the differences between the experiments were consistent, with slightly lower mean contrast preferences observed in the slider-based experiment.

Results suggest that neither method could be substituted for the other, as they did not correlate well and results were significantly different. However, increasing the number of repetitions could stabilize the results and improve precision and reliability. In cases where time is crucial and a large number of samples need to be processed, a slider-based test could be a better option. To achieve the compromise between time and reliability, the images can be repeated at least twice to gather the mean of preferences, while using the slider-based interface. However, when dealing with a smaller number of samples where reliability is crucial, the 3AFC test can be considered. Ultimately, the choice of the most suitable method should always be made in accordance with the specific research objectives. Factors such as time constraints, sample size, and desired reliability should be carefully considered. Further improvements can be made to both methods by addressing the bias in the starting point and ensuring an optimal duration of the experiment to prevent observer fatigue.

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