GIVE ME GESTALT! PREFERENCE FOR CUBIST ARTWORKS REVEALING HIGH DETECTABILITY OF OBJECTS - A REPLICATION STUDY

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Abstract
In the original study "Give me gestalt! Preference for cubist artworks revealing high detectability of objects**"** the authors (Claudia Muth et al.) found that there is a strong correlation between detectability of objects and preference with regard to non-experts looking at cubist paintings. That means that participants who can identify everyday objects and patterns in paintings by Picasso, Braque or Gris tend to like these paintings more. [1]

Introduction
After reading the original paper there was an explanation why many people, including us, do not enjoy cubist art: Because a lot of people seem to not be able to see any shapes or patterns in it.
After reading the paper there were some questions left, which lead us to adapt the study in different ways, which will be explained further in the procedure.

A brief history of cubism
Cubism first became fashionable in the 20th century around 1907. As one of the most influential art forms of the twentieth century its paintings by Picasso, Braque or Gris are characterized by combining objects and patterns in an abstract, fragmented way. This arrangement makes it particularly difficult for the viewer to immediately recognize patterns or objects. The term "cubism" was coined by an art critic called Louis Vauxcelles, who said that Braque's painting looked as though it is composed of cubes.[2] The period from 1910 to 1912 is often referred to as "analytical cubism", due to its complex forms, multidimensional view of the object and simplified color schemes such as browns, greys, creams, greens or blues, so as not to distract the viewer from the shapes and structures. Followed by the phase of "synthetic cubism" began, which was characterized mainly by more colorful and more textured paintings, which did not only use paint as a medium. Picasso and Braque are said to be the founders of cubism, many painters adopted it and further developed this style, including Juan Gris.[3]

A brief background on Gestalt psychology
Gestalt psychology was developed at the start of the 20th century and was highly influenced by Max Wertheimer, Wolfgang Köhler and Kurt Koffka. Gestalt theory laid a solid foundation, for how perception is studied today. The theory implies that looking at an image humans tend to not analyze single sections of work but rather see the whole picture. The first Gestalt experiments worked with optical stimuli. Those Gestalt principles (Principle of Organization, Principle of Proximity, Principle of Similarity, Principle of Continuity, Principle of Closure Principle of Symmetry, Principle of Figure-Ground

[1] 1. Muth et al., "Give me gestalt! Preference for cubist artworks revealing high detectability of objects" (2012), Leonardo, Vol. 46, No. 5, pp. 488–489, 2013

[2] Tate, "Art Term - Cubism"
[3] Encyclopaedia Britannica "Cubism"

Segregation)[4] were later also applied to aesthetics.[5]
Since only this single study exists, this replication experiment aims to further understand the relationship between people recognizing patterns and structures in paintings and their appreciation for those paintings.

Participants

99 participants took part in the study (M_{age}= 25.26 years; range: 11-63 yrs; 58 females, 34 males, 4 diverse and 3 did not provide the age data). 5 participants were excluded - 3 only rated "1" for all trials, one only rated "7", one participant was excluded because of invalid input for Standard Snellen's eye chart test. 10 (9 after exclusion) participants have indicated to be experts in cubist art.

Apparatus and Stimuli

In contrast to the original study, the stimulus set consisted of 60 photographs of exclusively monochrome cubist paintings (which will be referred from now on referred to as images)
The 60 paintings were created by three artists. Namely by Georges Braque who did 18 paintings, 20 paintings by Juan Gris and 22 paintings by Pablo Picasso. We chose to only use images of the monochrome paintings, which made up half (60) of the original studies used paintings (120) but were not mentioned in the paper.
Besides, we wanted to exclude a correlation between liking and the color of the paintings. Another reason which leads us to chose only 60 paintings was, to ensure a better concentration for the participants, by shortening the study. It is also interesting to use monochromatic images, since most paintings originate from the time of analytical cubism (37), where the emphasizes were laid on the form and therefore suit an experiment about Gestalt, very well.
The images still had a with of 450 pixels and a 600 pixels height.
As the experiment was conducted online the distance between participant and screen and the screen resolution may have varied slightly, we gave every participant the order to keep a distance of an arm-length from the screen. However, in order to ensure that the stimuli shown were displayed in the same size, participants were asked to adjust their browser viewport to a standard size using a credit card. We also used a Snellen's Eye Chart Test to ensure normal eye vision of participants.

Procedure

After welcoming the participants, we asked them to do a resolution check to see if every participant could see the Snellen's Eye Chart Test and the images at approximately the same size. Afterward, people were asked to look at the Snellen's Chart and report which line, was the last, they could correctly identify all letters on.
Following this procedure, the first block of the Experiments started. Participants were given instructions to rate the 60 images (*"How much do you like this painting?")*, presented to them in a randomized order on a scale of 1-7, with 1 being "not at all" and 7 being "very much". After the first block, the participants saw the same images, but in a newly randomized order and were asked: *"How well can you identify patterns in this painting"*. They rated their ability to detect patterns on the same scale
In the end, the participants were asked for personal information including age, gender and further comments, which they could answer voluntarily. When they pressed the "submit" button a "Thank you" message was displayed.

[4] As presented in the Cognitive Neuropsychology lecture SS2018
[5] Encyclopaedia Britannica "Gestalt Psychology"

Analysis

The variables analyzed are the liking of the painting in relation to the detectability on a scale of 1-7. We collected additional variables, which we thought might be interesting and were also collected in the original study. The first variable collected is the result from the Snellen's Eye Chart Test, to ensure normal vision, even though it is difficult to use it as an online test, we wanted to stay close to the original and include it. We will not generally exclude everybody who does not meet the required criteria. Furthermore, we will make another regression with them separately and in case it becomes clear that they definitely could not see the images clearly exclude them afterward.

Then we moved on to ask the participants about their expertise in cubist art or if they ever received any education about it. We wanted to exclude all the experts in cubist art, because they might prefer other cubist paintings, and they may criticize them with different criteria than everybody else or they might have seen the picture before and analyzed it and are therefore able to identify more forms or prefer/dislike it due to the paintings historic and/or artistic background. On the other hand, it is possible that those experts are able to see more forms and patterns and like it, therefore, a lot more, which would suit the hypothesis. We decided to not exclude them a priori but if they change the result to exclude them later.

Detection and subsequent exclusion of outliers were done using the standard deviation of each variable. Since there were not any outliers seen in the frequency histograms, no trails were excluded. We also planned to exclude trials if the standard deviation of the RT is +/-2.5%. We decided not to do that since we detected no strong outliers in general.

To make sure that there is no hidden correlation between age and liking or age and detectability, we tested these two relations, as well.

For each dataset (participants without special features, only experts, only failed vision test) we test both, the aggregated data across participants (like the original paper) and the non-aggregated data, first using a linear regression model and second using different bayesian fixed-effect models. We then compare the different brm models and calculate the marginal effects.

Results

1. Age and Liking/Age and Detectability

The correlation value between age and detectability is 0.07. The correlation value between age and liking is 0.33 and the lm function shows no significant correlation. So it becomes visible that according to our data, there is no correlation between age and liking or detectability.

2. Participants without special features (failed vision test or expertise)

Since the non-aggregated data failed most of the necessary assumptions for linear regression models, we used the aggregated data like the original study. Most of the assumptions for linear regression are fulfilled for the aggregated data (except for skewness). However, the distribution of the residuals shows not enough asymmetry around the zero lines to make the use of linear regression unreliable. the p-value near to zero shows us that the model is significant, the linear regression remains non-optimal for the data. However, it gives us a positive correlation value of 0.61 and an R-squared value of 0.3595. This is lower than in the original study. (Fig.1)

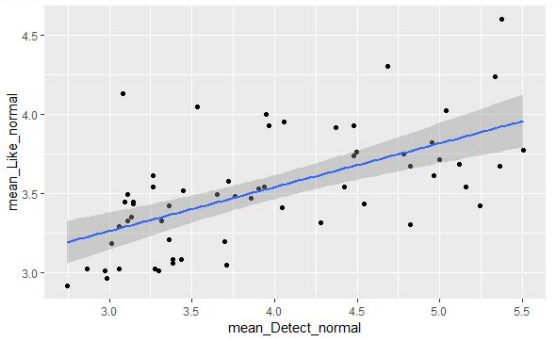

Fig. 1: Linear regression plot of aggregated data of participants without special features, cor=0.61.

To test the results of the linear regression above we used different bayesian models:
For the aggregated data we used a gaussian brm model, that resulted in a positive correlation value with an estimated value of 0.28.
For the non-aggregated data, we used a cumulative brm model, that resulted in a positive correlation value with an estimated value of 0.34 and two mixed effect models that consider participant id and image id as different effects with results of 0.27 and 0.24.
The comparison between these brm models using the loo() function showed that for this dataset the mixed model (participant id and image id) with a positive correlation value of 0.24 gives the best predictions.

The marginal effects show how the magnitude of liking increases in response to increases in detectability values (Fig. 2).

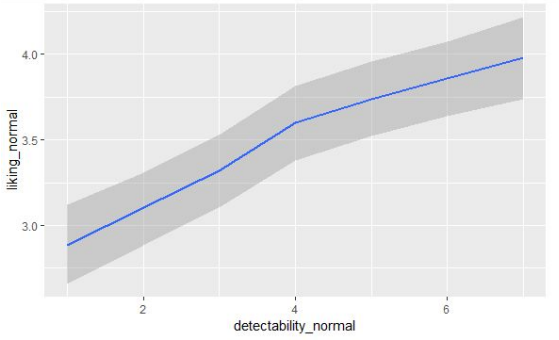

Fig.2: Marginal effects of the mixed brm model for participants without special features.

3. Participants who stated they are experts

Some of the necessary assumptions for linear regression failed for the non-aggregated data, so the aggregated data was used instead, because most of the assumptions for linear regression are fulfilled for it. For this data, the linear regression yielded a p-value = zero shows us that the correlation is significant. A positive correlation value of 0.7 and an R-squared value of 0.4872 were obtained. This is still lower than in the original study but higher in comparison to the data without special features. (Fig.3)

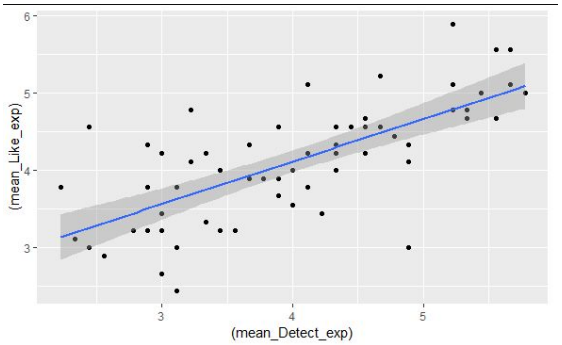

Fig.3: Linear regression of aggregated data for experts, cor=0.7.

The bayesian models supported this outcome:
For the gaussian brm model, the correlation value is positive with an estimated value of 0.55.
For the non-aggregated data the cumulative model (0.29), and the mixed models (0.31 and 0.29) show positive correlation values, as well.
Moreover, the second mixed model (participant id and image id) with a value of 0.29 gives the best predictions.
The marginal effects show how the magnitude of liking increases as the detectability increases. However, there was more variation in the plot than earlier plots. (Fig.4).

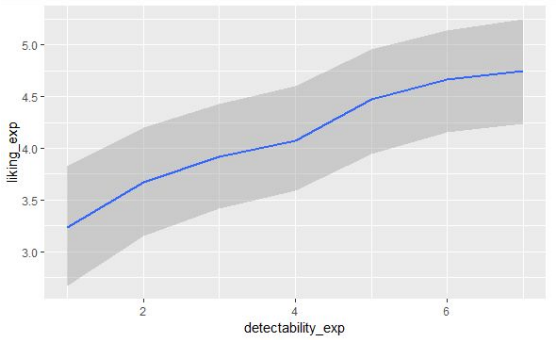

Fig.4: Marginal effects of the mixed brm model for experts.

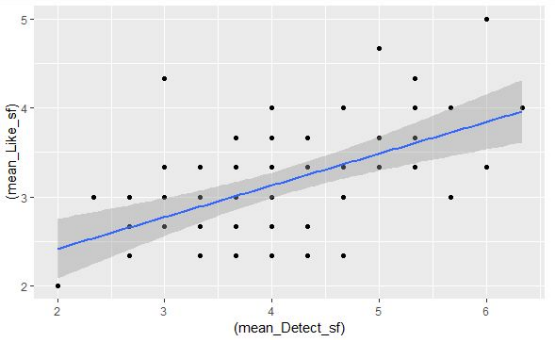

Fig.5: Linear regression for participants who failed the vision test, cor=0.54.

In conclusion, this shows that the correlation between liking and detectability is higher in experts. However, this difference could indicate that experts are better at recognizing patterns and therefore the slope is higher. The significance of this difference would be an interesting research question for future studies.

4. Participants who failed the vision test

The non-aggregated data did not fulfill some of the necessary assumptions for linear regression models, so we used the aggregated data. Most of the assumptions for linear regression are fulfilled for the aggregated data, and even though the distribution of the residuals shows asymmetry around the zero lines it is not enough to violate the normality assumption. For this data, the linear regression yielded a p-value near to zero indicating a significant correlation. The positive correlation was of 0.54 with an R-squared value of 0.2834, which is lower than for the data without special features. (Fig.5)

While the gaussian bayesian model for the aggregated data supports the results of the linear regression with an estimated value of 0.36, the brm models for the non-aggregated data yielded different results:
The cumulative brm model showed no correlation with an estimate of -0.03 and the mixed models having a low positive correlation (0.19 and 0.18). The first mixed model (only participant id) with an estimated value of 0.19 gives better predictions.
The marginal effects showed a lot of variances (Fig. 6).

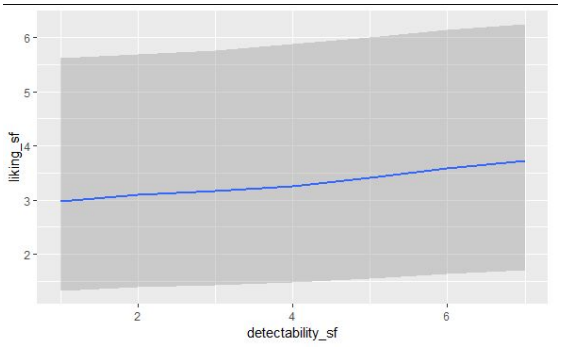

Fig.6: Marginal effects for the mixed brm model for participants who failed the vision test.

These results supported the hypothesis that the detectability of patterns increases the liking, since detecting patterns is probably harder for vision-impaired people.

Conclusion

Similar to the original study our data support the hypothesis that pattern recognition in cubist art increases the liking of an image. However, our experiment shows a slightly lower positive correlation value and we would recommend using linear regression models only in combination with more robust models. Our results show that excluding experts and participants who failed the vision test completely as the original paper did, means to exclude data that could contain interesting further information or inspiration for further research.

Discussion

There are several things left, which could be further proven or be looked at. After researching Gestalt theory and cubism and finding out they got public in the same time period, it leaves the question open whether Picasso or Braque knew any of the founders of Gestalt theory. If that is not the case, the historical background might be interesting and why people were starting to look into human perception in this split up indirect way at that point of time.

Besides, you could also further test what influence the colored paintings have on the viewer's perception and if the results would differ and in how far they would differ if you would redo the study with the coloured cubist paintings.

Another possibility would be to dive into cubism and find out, what cubist experts value in cubist paintings especially, since we found that they had a different rating than the other participants. In this paper we did not test if the difference between experts and non-experts is significant, this should be done to answer further questions.

After finding out about this slight positive correlation, it would be interesting to know more about the psychology and neurology behind recognizing patterns in cubist paintings and how the visual system does it.

Some other interesting things that could be tested now would be where and with which aesthetic a person was brought up and what historic knowledge they might have.

The last question which could be further investigated was the choice of Gris paintings because we could not think of any plausible reason why he was the third painter chosen. It would be interesting if that correlation is also visible when using paintings of other cubist artists.

References

1. Muth et al., “Give me gestalt! Preference for cubist artworks revealing high detectability of objects” (2012), Leonardo, Vol. 46, No. 5, pp. 488–489, 2013

2. Tate, “Art Term - Cubism”, <https://www.tate.org.uk/art/art-terms/c/cubism>, accessed July 2019

3. Encyclopaedia Britannica “Cubism” <https://www.britannica.com/art/Cubism >, accessed July 2019

4. Encyclopaedia Britannica “Gestalt Psychology”, <https://www.britannica.com/science/Gestalt-psychology>, accessed July 2019