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Similarity in Faces and How it is Influenced by Proximity

The aim of this work was to attempt to replicate the finding by Casasanto (Casasanto 2008) who studied the relationship between similarity and proximity in abstract words, unfamiliar faces and common objects and one of his findings (upon which this research paper is built) was that the closer faces are to each other, the more dissimilar they appear. And to test a possible explanation. Casasanto's paper used the conceptual metaphor theory that similarity is closeness, however his results suggested that while words are judged to be more similar when presented spatially close, faces are judged to be more different. This project explored this phenomenon further and studied it in two separate experiments by testing both similarity of pairs of faces and accuracy in deciding whether they are of the same person over two experiments. Next, this experiment was to try and provide a potential explanation for this effect, which is the secondary hypothesis: faces distort their immediate surrounding which was studied by testing the point of subjective equality of two vertical and straight lines – one near and one further from an unfamiliar face. Should the line closer to the face be distorted, it would help provide an explanation as to why faces that are closer together might be judged as different. Regarding the primary hypothesis, no effect of distance was found for either the similarity rating or the matching task. Bayesian analysis provided support of the null hypothesis. However, there was evidence for the secondary hypothesis. There appears to be no effect present on similarity and accuracy when manipulating the distance between two unfamiliar faces. There is an effect however when the face distorted the line that was closer to it. A second experiment replicated the original study by Casasanto more exactly, presenting the two faces sequentially, rather than simultaneously. Again, however, no effect of distance was found; results were consistent with the first experiment.

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A) BACKGROUND AND LITERATURE REVIEW

The experiment studies the relation between similarity and proximity and how they influence the perception of faces. It has been based upon the study by Casasanto (Casasanto 2008). In his study, faces were rated as less similar if presented close together on screen and the aim of this study is to explore this more. The current work investigates the relationship between similarity and spatial proximity regarding similar unfamiliar faces. Based upon the study done by Casasanto, it seems that such a relationship is not just significantly present in perceptual judgements, but it would also be a significant new finding in terms of faces and their psychological

study, paving way for new experiments and potential new research.

How are things in the world that we perceive represented in our brains? Topographic maps in visual cortex have shown that similar things are physically close in the brain (Mineault 2012). Would it make sense then to hypothesise that stimuli which are presented closer together could appear as similar or dissimilar? Would spatial proximity have any effect on perceived similarity? Topographic maps show one way in which the brain automatically codes things that are close in the world so that they are also close together physically in the brain. There is a stripe of cells which all respond to a vertical bar, in neighbouring locations in the visual field, next there will be another stripe of cells, which responds to bars a bit off vertical in one direction. Move the other way in the brain, and the cells respond to bars that are anticlockwise off vertical. Therefore, the brain smoothly maps spatial location in one direction, and angle in the other. Once you've gone round the clock on an angle, you go back to vertical, in an adjacent bit of spatial location. This is relevant to this study because similar processes probably keep happening throughout the brain, so that things which are similar in the world – in semantics, or form – are likely to be coded physically close together in the brain. Such is the possible connection between spatial and semantic distance.

In his article, Casasanto is talking about linguistics and how people use spatial proximity as metaphors to describe similarity. The conceptual metaphor theory (Lakoff/Johnson 1980) states that language metaphors (very loyal, deep love, short time) acknowledge that many of our abstract concepts partly depend on a few simpler concepts grounded in perceptomotor empiric evidence. As such, our understanding of similarity is hypothetical as are our ideas of love, happiness and faith. Because it is vaguely, if at all, defined. It highly depends on context. And it is mentalistic, it lacks a specific referent in the real physical world that can be measured and perceived. For example, the words "close", "further apart" etc. These words are used to describe similarity in visual appearance as well as similarity in conceptual judgement. One of the main questions that Casasanto raised in his study was whether you can specifically define similarity? Precisely state how similar an object is to another? Is there something about similarity that people conceptualize when talking about it which could reveal an answer to any of those questions? Furthermore, Casasanto suggests that similarity is vague and abstract. He also mentions that he focused on this phenomenon in English. His hypothesis is that "Our notion of similarity depends in part on mental representations of physical distance". Meaning that the level of similarity can be influenced by how proximity is perceived and therefore it can be assumed that manipulating one ought to have an effect or the other.

He further states that up to that point (Casasanto 2008) behavioural studies have not sufficiently explored the relation between similarity and proximity in linguistics, in his own opinion. Furthermore, not many studies on this relation have been done since.

Casasanto performed three experiments for his study. The first one was with abstract words, the second with unfamiliar faces (this is what became the foundation for this project) and the last one with pictures of various objects.

The first experiment was about linguistics, the core of Casasanto's study. He tested whether similarity of abstract words depended on the actual distance between them. There were twenty-seven participants from the Stanford University in total.

He used seventy-two abstract nouns that were randomly combined into 36 pairs (example: pride/duty) and then were sequentially shown to the participants who were asked to determine how similar they appeared on a scale of 1–9. He had three conditions: close, middle and far. Also, participants were specifically asked to judge the similarity between these words based on meaning.

The results of this experiment were that the stimuli were judged to be more similar the closer they were to each other, however Casasanto did raise the concern that this was caused because the stimuli were of linguistic nature and highly abstract, and so he deemed the results to be unreliable. Casasanto was motivated to explore these results with different stimuli.

The second experiment was with unfamiliar faces. Thirty-three native English speakers were asked to judge the similarity of sixty pairs of unfamiliar faces (half were male-male pairs and half were female-female pairs). The methodology of the second part was identical to the first one with words apart from the slight adjusting of the frames so the faces would fit into them. Casasanto wanted to test whether the effect generalized to other types of stimuli, which lead to the second experiment. In this experiment participants were asked to judge the similarity based solely on visual appearance. Results from the second experiment were the opposite from what they were in experiment one – participants were judging the stimuli to be more similar when they were far away rather than close together, contrary to Casasanto's predictions.

The study concluded with Experiment 3. Casasanto was interested in exploring why different stimuli using the same experiment structure produced diametrically different results. For Experiment 3, participants were asked to judge the same set of stimuli (common objects). Half of participants were instructed to judge their similarity in visual appearance (perceptual judgement), half to judge their similarity based on function and use (conceptual). The reasoning behind this was to try and explain why proximity had opposite effects in the first two experiments.

Source: Casasanto 2008

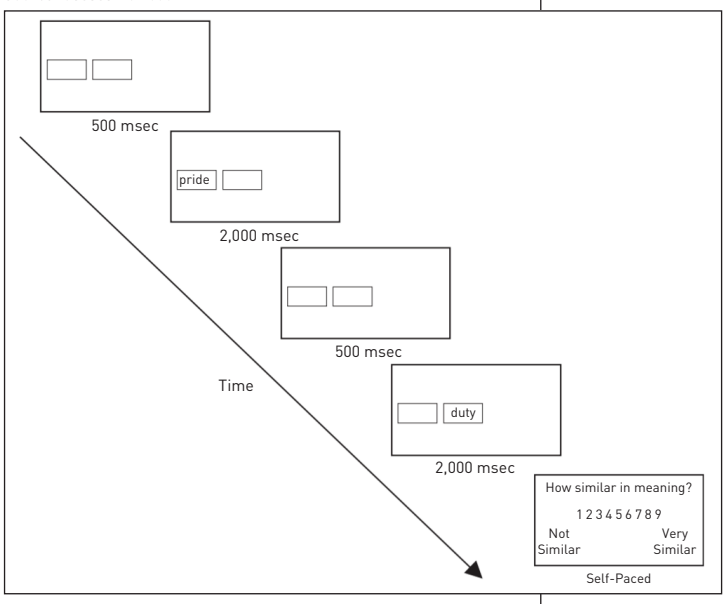

Figure 1: Schematic representation of the trial structure for Casasanto's Experiment 1 (close condition)

During conceptual judgements (function), the stimuli that were closer together were judged to be more similar. And by contrast, during perceptual judgements (appearance), closer stimuli were judged to be less similar. Thus, the effect of proximity on similarity depends on the kind of judgement participants were asked to make: conceptual judgements about abstract entities or unseen object properties versus perceptual judgements. Casasanto is aware that there is a chance that the experiment was too transparent, and the participants might have caught on to the true purpose.

The three experiments demonstrated that similarity ratings for pairs of words and pictures were influenced systematically by their spatial separation on the

screen. In all three, similarity judgements were affected by task-irrelevant variations in spatial proximity, but not always as predicted by the results of the abstract words exercise in Experiment 1.

In the first experiment, the results supported the hypothesis in the way that they explored the relationship between similarity and spatial proximity that is suggested by linguistic metaphors, when it was proposed by Casasanto that the closer the stimuli were, the more similar they appeared. However, in the second experiment (faces), the results were the exact opposite.

Finally, Casasanto draws the conclusion that proximity and similarity are not unrelated – they appear to be related in more complex ways than linguistics alone can discover (Casasanto 2008).

Following Casasanto's work, Boot and Pecher (Boot/Pecher 2010) did a study that deals with a similar topic and references the research study performed by Casasanto in 2008, while following the prediction of the conceptual mapping Similarity is closeness (Lakoff/Johnson 1980; id. 1999).

This study examined the relation between two colour squares and a colour similarity decision task – whether the distance between the squares had an influence over the similarity judgement. There were 4 experiments in total. In the first half of their study, Boot and Pecher found that there is an interaction effect between similarity and distance. The task was to decide whether two squares were similar or dissimilar in colour, while the distance between them was varied. Reaction time and accuracy were recorded. It was discovered that participants react faster to similar colours that are presented near each other rather than to those that are further away from each other. Moreover, participants responded faster to dissimilar colours that were presented far away rather than to those that were closer to each other.

The other half of the study was concentrated on trying to figure out whether this effect was asymmetrical. It was found that the similarity of colours of two squares had no influence on distance decisions, as such it was concluded that the conceptual mapping is asymmetrical – that similarity uses the mental representation of closeness, but not vice versa. Their study followed the predictions of Lakoff and Johnson in terms of similarity is closeness (meaning that the closer some things are the more similar they appear) (id. 1980). Furthermore, during the course of their study they used different stimuli to test whether conceptual mapping would produce the same results. Words, objects and colours produced consistent results that have shown that conceptual mapping is a process that takes over automatically during a task that used nonlinguistic stimuli, while this proved the hypothesis that what is closer, is more similar.

These were opposite to what Casasanto's study found out when in his study, the participants were asked to make perceptual similarity judgements, when his stimuli were judged to be less similar the closer they were together. The key difference here were the faces that Casasanto used as well as the objects that were supposed to be judged perceptually. They suggested that that the metaphorical mapping may be restricted to situations in which conceptual similarity judgements are requested. Therefore, different stimuli (faces) as well as different questions (function vs appearance) may provide different results.

Why would one study this phenomenon? For a start, because face matching matters – you present yourself and a passport every time you go through a border. And yet there is evidence that simply putting a passport frame around an image increases error rates (McCaffery/Burton 2016). As such, if a simple variation of the distance

has such an effect, this could have rather serious implications. There is an interest in seeing whether the effect is robust and whether it applies to different faces and to the task of establishing identity rather than just similarity.

Drawing inspiration from the work of Casasanto, it can be suggested that unfamiliar faces that are closer together might be judged to be different based on their visual appearance. How would this work with pictures of faces that are of the same person or different people? Would the results change if the requested judgement was phrased differently? In addition to trying to judge the stimuli on a scale of 1 to 9, it would be interesting to see what answers participants would provide if they were asked to accurately determine whether the two faces presented are the same person or not. Aside from the more focused stimuli and hypothesis, it would also be interesting to try and provide an explanation, if there would indeed be an effect.

Havard and Burton (Havard/Burton 2006) have found out that when comparing two faces positioned side by side, people fixated toward the inside half of each face – the right side of the face on the left, the left side of the face on the right. So, it is possible that two faces look different because people are fixating differently on the two, and that this difference is dependent on how far apart they are. Why are faces that are closer together judged as different? Alternatively, a possible explanation could be that they each have the other on opposite sides, which would support the existence of perceptual explanation. A face might somehow distort surrounding perceptual space. If this were the case, it could be assumed that it might be detected by judging the length of nearby lines.

B) EXPERIMENT 1

Methodology of Experiment 1

The main hypothesis of this research project is the following: The closer faces are to each other, the more dissimilar they appear. To test this hypothesis that is based upon the work of Casasanto, this experiment used a different face set. This would be by testing both similarity and the accuracy with which participants would identify similarly looking faces. If the effect were to be confirmed, this experiment would try and provide a potential explanation for this effect, which is the secondary hypothesis: Faces distort their immediate surroundings. The experiment will test this by testing the point of subjective equality of two lines – one near and one further from an unfamiliar face. Should the line closer to the face be distorted, it would help provide an explanation as to why faces that are closer together might be judged as different.

Pilot testing

To investigate these two theories, data collection was comprised of three main parts: Similarity, Accuracy and Lines. For all three parts of this experiment, the data was collected from 51 participants without any special requirements in terms of gender or age (other than the age of consent).

The pilot study collected feedback from volunteers and then applied to the development of the experiment's parts. During the testing phase of the pilot several participants asked why these keys were used instead of Y and N and the reason for this is the fact that M and Z keys are on the opposite sides of every keyboard and are in practice easier to distinguish than the Y and N keys that are closer together. Also, most of the feedback that was collected regarding Parts 1 and 2 was constructive and mainly centred around how to make

the instructions easier and better to understand. During the testing Pilot phase, there was supposed to be a break between when the lines switch from being on the right side of the face to being on the left side of the face; this is something that was not communicated clearly in the original experiment and thanks to the participants, this was corrected, and a new separate slide was inserted to indicate that the participant should take a break to rest their eyes (and mind). It was during this break that the participants were asked to call the researcher who asked them for feedback regarding the whole experiment. After a brief period of two weeks, the core of the project was finished, and main testing started.

Participants

There were 51 participants. The participants were mainly drawn from the University of Stirling undergraduate Psychology students[1] (a recruitment website), the main incentive for these students was the 1 Token they would receive upon completion of this study. Participants were drawn from other sources as well (these included personal approach of acquaintances of the researcher, fellow postgraduate researchers, etc.). The mean age of participants is 21.9. Ranging from 18 to 47. Seven participants decided not to include their age. There were 41 females and ten males.

Materials

The images that were used come from the model face matching task from (Robertson et al. 2016). The pictures used are coloured and the face image size is 8.5 x 11.5. The separation between them is 2 cm or 28 cm (between the near edges of the image rectangle). Fixation crosses are on screen for 1 second. Altogether there were 40 trials (80 images in total). A widescreen monitor (1680 x 1050 pixels) was used for the entire experiment. Standard USB keyboard for responses.

PART 1 – Similarity

The first part used pairs of unfamiliar faces that were acquired from a colleague within the Psychology department in Stirling. These were two sets of faces with 30 each where one set were pairs of the same people while the other set were pairs of different people that looked similar. E-Prime paired these faces according to either two categories – matching faces or two different similarly looking faces with the main variable being the distance at which the pairs were presented – sometimes they were right next to each other, while during other trials they were further apart (see Figures 2 and 3, page 65). The participants were asked to determine how similar each pair appeared to them on a scale of 1 to 9.

In effect, the first part is demonstrated with the example below. The faces used are drawn from the face resource that was used for the actual experiment.

PART 2 – Accuracy

The second part was identical to the first except that participants were asked whether the faces in the picture are the same person or two different people. The corresponding keys for answers were M for not same and Z for same.

PART 3 – Lines

To try and provide some evidence for or against the hypothesis above, the third part used an unfamiliar single face that appeared throughout the entire experiment with two lines beside it. The lines would change in length and the participants were asked to determine which of the lines were longer. There was always one line that was longer than the other and they were never the same – something that every participant was told at the beginning of the exercise.

Source: Janek

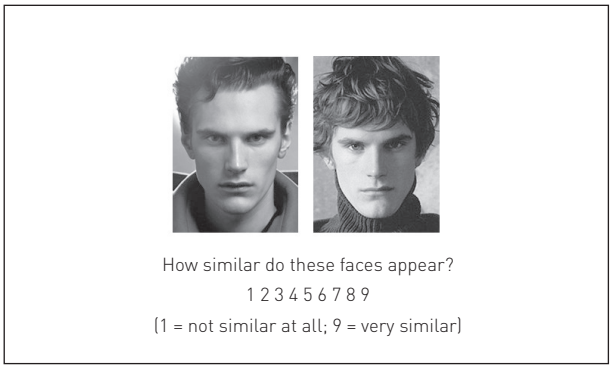

Figure 2: Schematic representation of the trial structure for Experiment 1 Similarity (close condition)

Source: Janek

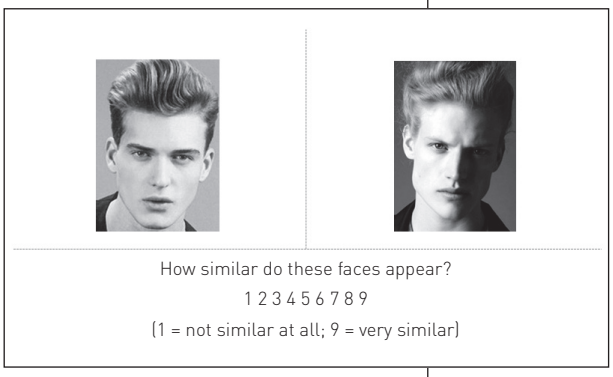

Figure 3: Schematic representation of the trial structure for Experiment 1 Similarity (far condition)

The experiment was also split into two parts – during the first, the face appeared on the left while the lines appeared on the right. During the second part, they switched places with the face being on the right and the lines on the left. Participants were asked to take a break between these two parts and this is where feedback on the whole experiment was collected by the researcher.

Data from first thirteen participants was examined and it was found that the exercise was too difficult, where many participants guessed and/or were incorrect too many times. Therefore, the experiment was adjusted to be more obviously different line lengths.

The first phase consisted of 13 participants and was deemed by both the researcher and the project supervisor to be too difficult. The answer (which line is longer) was recorded on a blank screen after the face and the lines disappeared – they only appeared for a short time (1,5 second) as well as the answer screen. The proposed idea was that the participants need to solve this exercise fast. While the supervisor tinkered with various ways on how to make this exercise easier, the researcher collected data with the slightly changed phase 1.6 where additional second was added to the time the face with the two lines appears on screen. After that, a new revamped phase was introduced (2.0) which made the answer screen infinite (it would only move onto the next trial once the participants made a choice between the two lines) and the differences between the lines were made much clear since one of the variables that was introduced was a pair of two lines with a bigger, more obvious difference in length.

Examples of how Part 3 – Lines worked are below. Each box represents a single slide of the experiment. The face image size is 7.5 x 10.5 cm. The lines average 200 pixels long. They are placed 5 mm away from the face. The second one is a further 55 mm apart. The vertical positions of the lines are placed randomly with a y position 505 – 550 pixels. Screen middle is 525 pixels, so the lines are placed +/- 6 mm of the vertical centre. Timing is blank slide for 500ms, image and lines for 1sec. After that the response slide appeared.

These were the three parts of main testing. The experiment was planned to take approximately 30 minutes in total, 10 minutes for each part. The entire experiment was programmed in E-Prime.

Design

For Parts 1 and 2, the independent variable is the separation between the faces, whether they were near or far, and the dependent variable is similarity (scale of 1–9) for Part 1,

Source: Janek

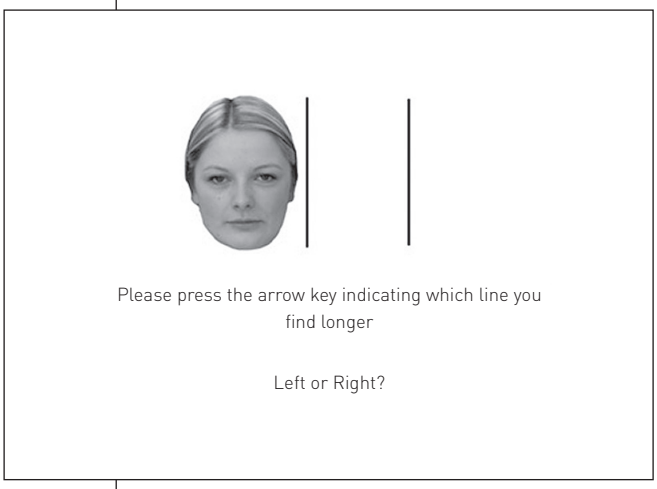

Figure 4: Schematic representation of the trial structure for Experiment 3 Lines (left face condition). The lines are 5 and 62 mm from the face

Source: Janek

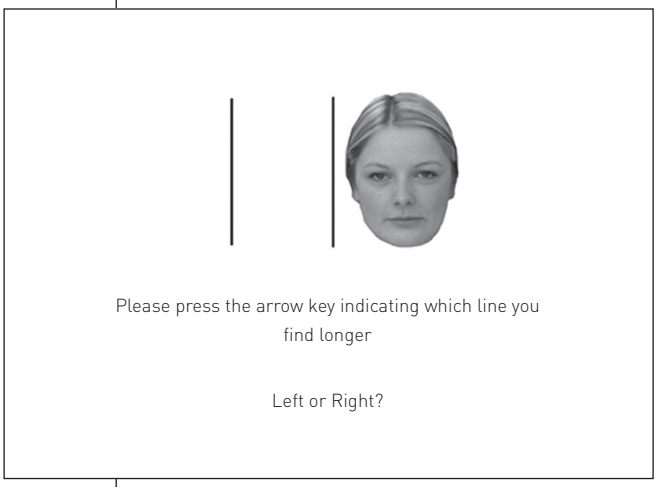

Figure 5: Schematic representation of the trial structure for Experiment 3 Lines (right face condition). Again, same distance applies between the lines and the face

and identity/accuracy (same/different) for Part 2. In Part 3, the Independent Variable is the relative length of the two lines and the dependent variable is the "which is longer" response, left or right line. Design is within-subjects; all participants did all conditions.

Results and Analysis of Experiment 1

The main objective of the experiment was to either confirm or question the phenomenon where the closer 2 faces are to each other, the more dissimilar they appear, an effect that was first introduced by Casasanto (Casasanto 2008) and to determine whether it might be explained by a distortion of visuals surrounding a human face.

PART 1 – Similarity

Figure 6 (see page 67) shows the average similarity scores for faces in each of the four conditions. It is apparent that people do give a higher similarity score to pairs which are indeed the same person (match). However, there appears to be very little effect of distance. Since the effect on similarity of whether the faces match is not of interest, separate t-tests were carried out on the match and no match data to test for an effect of distance. To test for evidence in favour of the null, Bayesian t-tests were performed using JASP version 0.8.6.0. The prior is that there will be an effect providing support for the hypothesis, given the results from Casasanto's study. The following results are going to be described in sequences.

The Bayes values for the first sequence (Close No – Far No) is BF0=2.54, meaning that the null is 2.5 times more likely than the hypothesis.

The Bayes values for this second sequence (Close Yes – Far Yes) is BF0=16.98, meaning that the null is 17 times more likely than the hypothesis.

Furthermore, when doing the analysis by averaging by file – looking at average scores for each image across all participants it gives more continuous data. The scores were adapted to give an average similarity rating for each file and worked out the difference between near and far ratings and plotted the result, using red dots for matched pairs and blue for mismatch. This can be seen in Figure 7 (see page 67).

The aim was to see if there was any pattern apparent. What can be observed is that there is a greater range of change in the middle of the similarity scores (circa 4–5)

and less at the right-hand end (circa 8). It could simply be an effect that the scale has on how participants are judging the stimuli; a high rating might be a result of people thinking that the faces look similar leaving less room on the scale to shift. In the middle of the figure, there is a higher possibility of scores varying. However, it can be seen in the figure that dots are equally both above and below the line. No hint of an overall effect of distance.

PART 2 – Accuracy

The results are the average again from the same 51 people as with Part 1. While the data here shows that there is a slightly bigger impact, the effect is still not that large and as such can be interpreted as not providing any evidence supporting the primary hypothesis. The median values are the following: for Close Not Same is 0.78 and Far Not Same is 0.80; Close Same is 0.65 and Far Same is 0.62. This can be seen in Figure 8.

The Bayes values of both sequences where for the first one (Close Not Same – Far Not Same) it is BF0=9.72 and for the second sequence (Close Same – Far Same) it is BF0=1.82. The results of Part 1 and Part 2 show that there is no effect and there does not seem to be any relation between similarity and proximity when it comes to unfamiliar faces.

PART 3 – Lines

The prior for this part is that an effect might be shown by the line that is nearer to the face is appearing to be either longer or shorter than the one further away.

In Part 1, with lines to the right, the average point of subjective equality (PSE) is below 0 – so the left line must be bigger for participants to judge it the same length. In Part 2, the PSE is slightly positive, therefore participants think the right line must slightly longer for it to appear

Source: Janek

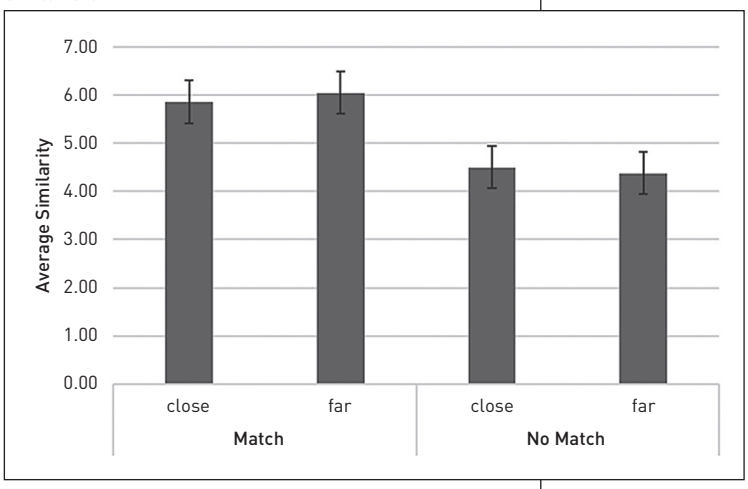

Figure 6: Average similarity ratings for Experiment 1, Part 1

Source: Janek

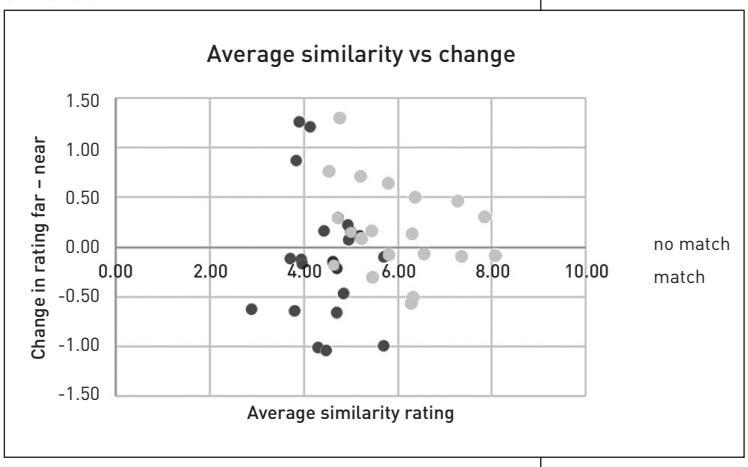

Figure 7: Average results by file

Source: Janek

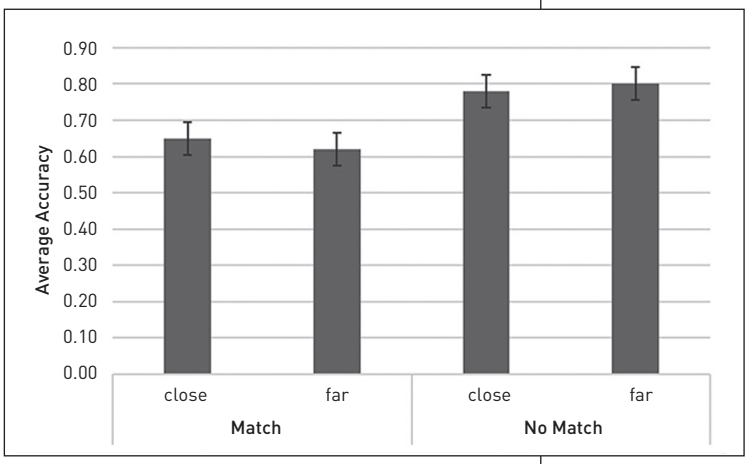

Figure 8: Average accuracy ratings for Experiment 1, Part 1

the same. In both cases, the line nearer the face must be a bit longer for people to think them the same length – the face makes the line look smaller. The results from Part 3 show that there is evidence of the secondary hypothesis that distortion of visuals surrounding a human face is happening to some degree, as the null is rejected and there is evidence that a face does distort the perception of the line. The BF10=3.47 means that the hypothesis is 3.5 times more likely than the null; showing that there is evidence in favour of there being a difference.

Discussion of Experiment 1

The first two parts of Experiment 1 have provided no significant evidence in support of the hypothesis, going against the findings of Casasanto and the expected results. There are two major possibilities as to why this have occurred. The main difference between this study and that of Casasanto was the design of the first two parts, which was slightly different.

Seeing the results of the first two parts of Experiment 1 and seeing how different in structure they were to the original Casasanto study, it was decided by the project‘s researcher to create a second experiment which would closely emulate the original study and see if the changed formula would produce different results.

C) EXPERIMENT 2

Methodology of Experiment 2

When the main block of testing was done, the project supervisor proposed to do a follow up experiment which would be more in line with the original study that was performed by Casasanto and upon which this research project is based on as the first two parts were not an exact replication of his study.

Participants

Data was collected from 21 participants. 16 females and 5 males. The average age was 22.0; ranging from 18 to 31. Same recruitment methods as for Experiment 1 were used.

Materials

Materials that were used were the same as with Parts 1 and 2 from Experiment 1.

Design

Experiment 2 was created, which was a more exact replication of Casasanto’s study. It was a new version of Parts 1 and 2 of Experiment 1. The experiment was as follows: Two boxes appeared. First, an unfamiliar face appeared in the left box with the right box empty, then, in the next slide, another unfamiliar face (paired with the previous face to be either matching or different but similar) appeared in the right box with the left box empty. Finally, the answer slide which asked the participants to determine how similar they find the faces on a scale of 1 to 9 (see Figure 9, page 69). Also, the distance between the boxes would alternate between being right next to each other to being further apart (see Figures 9 and 10, page 69, for comparison). The boxes on screen are 9.5 x 12.5 with a 5 mm gap around the face. The separation between the boxes is 1 cm or 21 cm. Faces are on screen for 2 seconds. Fixation crosses are on screen for 0.5 second. Casasanto did not have a match condition, this was for consistency with Experiment 1; therefore, there was another phase to this which was the same as the first one but instead of asking how similar the faces appear, the participants were asked whether they were the same person or not.

Source: Janek

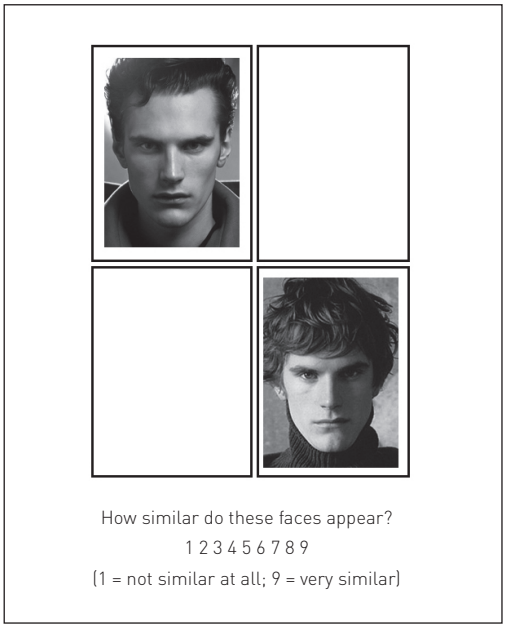

Figure 9: Experiment 2 - Part 1 (close condition). In the image above, it is demonstrated how exactly the new revamped Parts 1 and 2 worked. Each box represents a new slide of the experiment

Source: Janek

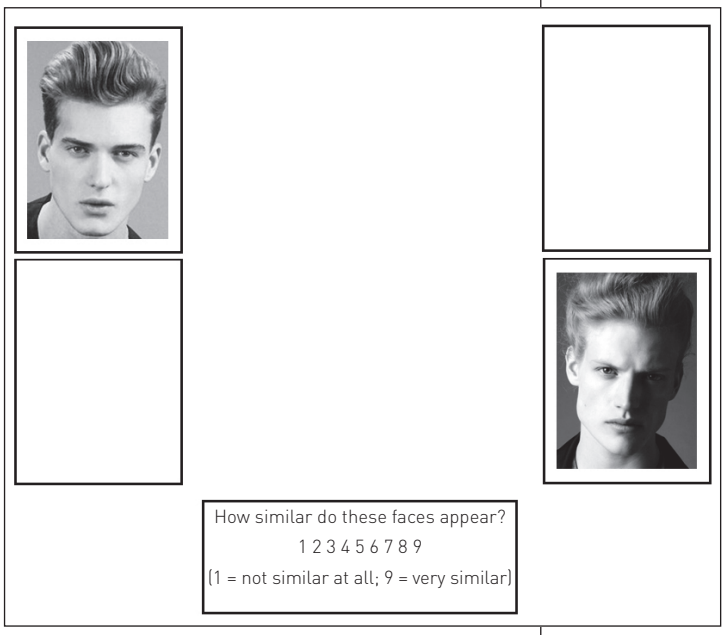

Figure 10: Experiment 2 – Part 1 (far condition)

Results and Analysis of Experiment 2

PART 1 – Similarity

Even with the adjusted experiment parameters and a new design to replicate Casasanto's study more exactly, no evidence of any significant effect was found.

The median values for Close No is 4.15; Close Yes is 5.87 and for Far No is 4.40; Far Yes is 5.78. The results are consistent with those from Experiment 1, Parts 1.

The Bayes values for the first sequence (Close No – Far No) is BF0=7.98, meaning that the null is 8 times more likely than the hypothesis. The Bayes values for this second sequence (Close Yes – Far Yes) is BF0=2.88, meaning that the null is 2.9 times more likely than the hypothesis.

PART 2 – Accuracy

The median values are the following: for Close Not Same is 0.81 and Far Not Same is 0.80; Close Same is 0.65 and Far Same is 0.62.

The results are consistent with Experiment 1, Part 2, there is no significant effect present. The Bayes values of both sequences where for the first one (Close Not Same – Far Not Same) it is BF0=3.57 and for the second sequence (Close Same – Far Same) it is BF0=2.18. The results from Experiments 1 and 2 are consistent with one another – there is no significant effect present in either, whether the experiment was attuned to better accommodate research with faces or exact replication of Casasanto's original study on which this research project is based.

As with the first part, the second part was also averaged by file and a correlation between Experiments 1 and 2 was made. It can be seen in Figure 13 (see page 71) below that participants were not responding randomly, they have a consistent evaluation of similarity, across the two different presentation methods.

However, in Figure 14 (see page 71), the difference between near and far is random

and there is no consistency at all. The correlation is slightly negative (-.29), so the trend is for an image pair that showed a big difference in one experiment to show a small one in the other. The Figures 13 and 14 (see page 71) both demonstrate that no significant proof exists to support an effect that distance might have across both Parts 1 and 2 of Experiment 2.

D) DISCUSSION

This study examined whether the distance between two unfamiliar faces influences how similarly they are perceived and whether such an effect could be explained by a psychophysical anomaly surrounding a human face that would distort any objects around it (including another human face). The main hypothesis, the closer faces are to each other, the more dissimilar they appear was based upon the work of Casasanto (Casasanto 2008), who did similar research and suggested himself that further research into the relation between similarity and proximity was needed. He found that faces were judged to be more similar when they were presented farther apart rather than when they were presented closer together – contrary to predictions based on spatial metaphors for similarity in language; which was the first experiment that Casasanto did in his study. Casasanto's original experiment was adjusted to better fit this study which was focused solely on faces. This change was that the stimuli in this study were presented simultaneously (this was done because it was thought that it would increase the effect that distance might have on similarity). However, in both parts (similarity and accuracy), the judgements made by the participants in similarity ratings, nor the face matching task has shown any effect. Furthermore, the Bayesian analysis is providing support for the null hypothesis.

In Part 3, this study tried to provide an explanation for such an effect, if it existed. It put two lines next to a face; the two lines that were at first on the right, and then on the left of the static face were being changed in each slide in length. Participants were supposed to determine which one was longer. If most of them judged the wrong line – and it would be the one closer to the face, we would have support of the secondary hypothesis. Which they did, and we have.

Having finished the study, it was decided by the researcher that another set of testing would be suitable – perhaps an exact replication of Casasanto's study would provide different results that would be more consistent with his.

One of the main differences between this study and that of Casasanto are the resources – this study used just male figures, while Casasanto used faces from both genders. The images that were used in this study were from the model face-matching task (Robertson et al. 2016), they were coloured, there was no alteration to the images (no smudging of the hair, hairline, ears, outline of the face) while the images that Casasanto used were from the IDs of the University of California. However, it is the speculation of the researcher that this should not have had any meaningful impact on the results and yet it is still worth

Source: Janek

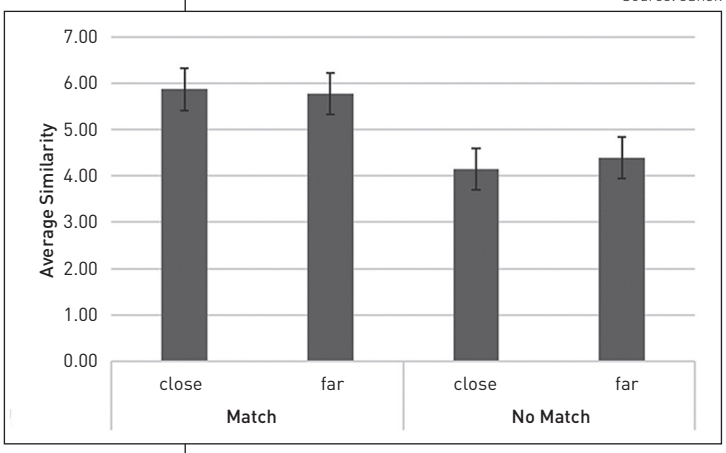

Figure 11: Average similarity ratings for Experiment 2, Part 1

mentioning and given time and additional resources, it would have been interesting to see if there would be any difference if both male and female unfamiliar faces were used in the same experiment structure. Another difference was the actual design – Casasanto designed his study in a sequential manner while Experiment 1 had the stimuli side by side in one slide. There is a possibility that these two differences might have provided this study with different results.

Therefore, we designed Experiment 2, which was a replication of the study that Casasanto performed. The stimuli were sequential, rather than being side by side as in Experiment 1. The results however, were still not consistent with his findings. Experiment 2 has produced the same results as Parts 1 and 2 of Experiment 1 – that there was no significant evidence in support of the main hypothesis that there is any relation between proximity and similarity in unfamiliar faces, and this being with the adjusted parameters to mimic the Casasanto experiment more closely. The only differences being the different stimuli (Experiment 2 used the same face images as Experiment 1) and that there was no blank space in the middle between the faces.

The verification of the null hypothesis in both Experiments 1 and 2 was surprising as it was expected that Casasanto's result would prove to be easier to replicate. At the same time the secondary hypothesis was devised as a potential explanation of the primary hypothesis – which was proved null, while the secondary was not. When analysing the data by file, it has shown that while people are rating the faces consistently, distance has no reliable effect. The results from Experiments 1 and 2 were not consistent with Casasanto – there was evidence in favour of the null hypothesis and no effect was found. Why could this have happened?

Source: Janek

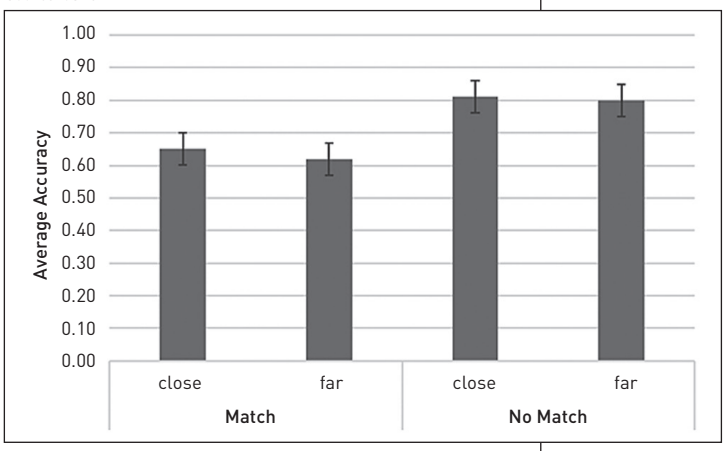

Figure 12: Average accuracy ratings for Experiment 2, Part 2

Source: Janek

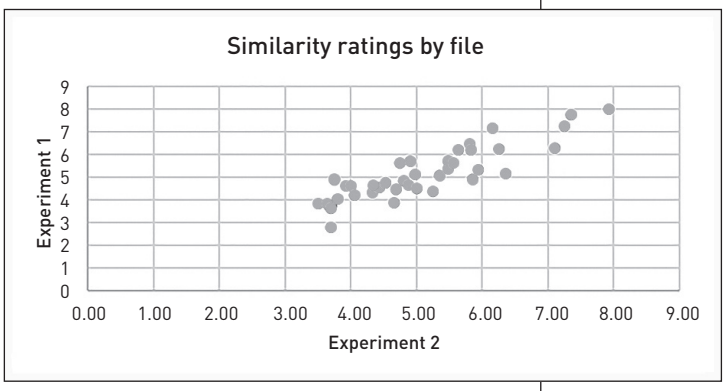

Figure 13: Average similarity ratings by image pair for Experiments 1 and 2

Source: Janek

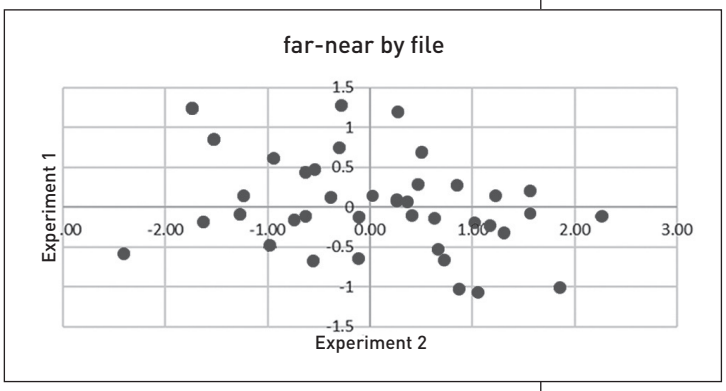

Figure 14: Difference between near and far

The conceptual metaphor theory of Lakoff and Johnson (Lakoff/Johnson 1980; id. 1999) suggests that similarity is closeness is fundamental to the concept

of similarity. It states that language metaphors (very loyal, deep love, short time) acknowledge that many of our abstract concepts depend on simpler concepts grounded in empiric evidence. As such, our understanding of similarity is hypothetical as are our ideas of love, happiness and faith (id. 1980). Boot and Pecher (Boot/Pecher 2010) have confirmed this theory suggesting that the mapping was an automatic process and that there is an interaction effect between similarity and distance. It was discovered that participants react faster to similar colours that are presented near each other rather than to those that are further away and that participants responded faster to dissimilar colours that were presented far away rather than to those that were closer to each other (ibid.). The findings of Experiment 1 and 2, Parts 1 and 2 however do not support these claims – Similarity is not closeness when it comes to faces. According to Casasanto and Boot and Pecher, this theory applies to linguistic metaphors, conceptual judgements on common objects and coloured shapes – it does not apply if the task is to make perceptual similarity judgements on objects (and in case of this study, to faces either). Casasanto has found that common objects were perceptually judged to be less similar if they were presented near each other, rather than when they were further apart (Casasanto 2008). In contrast, Boot and Pecher had the opposite result with coloured shapes – the participants in their study responded faster to similarly coloured shapes when they were presented close to each other (Boot/Pecher 2010).

What is the difference between coloured shapes and common objects? Why is it that they both produce different results from the same perceptual matching task? Could it be because common objects are more complicated in their appearance? This suggests that when judging the similarity between two faces, one is performing a perceptual task. In that case it should follow that faces that are closer together would be judged to be less similar – as was the case in Casasanto's study with faces and the perceptually judged common objects. The results from this study were inconsistent with this finding. The correlation between similarity ratings in Experiments 1 and 2 shows that they were being consistent in ratings.

As mentioned previously, during the initial testing of Part 3, it was slightly changed so to make it cover a bigger range, so that some of the differences are more obvious and there was a clearer transition from 0 to 1 in the probability of saying the right line is longer. Regarding Part 3, this study has provided a significant difference. Could it be that having anything next to a line makes its apparent length alter? Any other object, it does not have to be just a face. The other line is closer to the edge of monitor screen? Did that have any effect on it?

Even though the null hypothesis has very strong evidence in favour of it and there does not seem to be any relation between proximity and similarity in faces within the context of this study (and that of Casasanto 2008), that does not necessarily mean that this is fact outside this context. The verification of the secondary hypothesis has shown that there are effects related to faces that we might not have fully grasped yet and further study on this subject might provide interesting results – it might not be the relation between proximity and similarity, but perhaps there might be specific aspects of the face that make them different. It would be interesting to create a study in which these aspects are thoroughly studied; to see whether we could identify what exact features of the face are the ones that stand out and might distort the other lesser salient features.

And to also identify the most prominent features that differentiate faces the most. Is it the eyes? The eyebrows? The hair/hairline? How different does a face look if you take these away? Can you still identify the person even if these features are not present? What if there is nothing else but eyes, brows and the hair? Would it be possible to identify someone simply by looking at these features without anything else to go on?

Abudarham and Yovel (Abudarham/Yovel 2016) performed a study that tried to provide answers to some of these questions. They have based their research upon the work of Valentine (Valentine 1991; id. 2001) and the face space theory – according to which faces are being represented in a multidimensional space in which each dimension corresponds to distinctive features of a face, therefore every face is represented by a specific point in space, in which each value indicates the saliency of the uniqueness of such feature. Examples of such features also include subcategories that have an influence on face recognition, such as head pose, illumination, aging, expression, etc. (id. 1991; id. 2001). The original theory, nor any following studies have revealed what the exact dimensions of the face space are, and which features of a face are used for determining the identity of a face – up until the study by Abudarham and Yovel. They were deliberately manipulating and changing features to discover which of them are critical for recognition. In this study, unfamiliar faces of male Caucasian adults were used, however they have stated that the method they used can be applied to any other type of face.

Therefore, it can be said that even though this project used a very similar type of stimuli – which was different from Casasanto (male Caucasian faces vs. male and female random faces), the difference in faces might not have played a big part. Abudarham/Yovel then went on to assign features values of either high discriminative power (HDP) or low discriminative power (LDP) – throughout their five experiments they have identified these features, confirmed them, detected the perceptual sensitivity of people to detect differences in each of these features across different faces (long hair, small nose, big chin, etc.), confirmed that exchanging features that have high discriminative power with those that have LDP changes the identity more and have shown that features with HDP vary minimally across different variations of the same identity. Their study has identified a whole range of features that are essential for face recognition by experimenting with various levels of saliency and HDP vs LDP. These features include: lip thickness, hair and eye colour, eye shape, thickness of the eyebrows, etc. (Abudarham/Yovel 2016).

To conclude, it was found in the average from 51 participants that the results do not lean to either of those, suggesting that there is no evidence in support of the main hypothesis the closer faces are to each other, the more dissimilar they appear. Part 3 for the experiment has shown however, that there is an effect present proving the secondary hypothesis that faces distort their immediate surrounding and that a human face does seem to have a distortion effect on a line that was closer to it.

[1] *Via https://stirling.sona-systems.com/Default.aspx?ReturnUrl=%2f.*

Sources of information

Abudarham, Naphtali/Yovel, Galit (2016). Reverse engineering the face space: discovering the critical features for face identification, Journal of Vision, 1–18.

Boot, Inge/Pecher, Diane (2010). Similarity is closeness: Metaphorical mapping in a conceptual task, The Quarterly Journal of Experimental Psychology, 942–954.

Casasanto, Daniel (2008). When does close in space mean close in mind?, Memory and Cognition, 1056–1074.

Havard, Catriona/Burton, A. Mike (2006). The eye movement strategies performed during a face-matching task, Perception (35), 210.

Lakoff, George/Johnson, Mark (1980). Metaphors we live by, Chicago.

Lakoff, George/Johnson, Mark (1999). The philosophy in the flesh: The embodied mind and its challenge to the western thought, New York.

McCaffery, Jennifer M./Burton, A. Mike (2016). Passport Checks: Interactions Between Matching Faces and Biographical Details, Applied Cognitive Psychology, 925–933.

Mineault, Patrick (2012). Topography conquers all, Online: https://xcorr.net/2012/04/05/topography-conquers-all/.

Robertson, David J. et al. (2016). Face Recognition by Metropolitan Police Super-Recognisers, PLoS ONE, 1–8.

Valentine, Tim (1991). A unified account of the effects of disctinctivness, inversion, and race in face recognition, The Quarterly Journal of Experimental Psychology (43), 161–204.

Valentine, Tim (2001). Face-space models of face recognition, in: Wagner, Michael J./Townsend, James T. Computational, geometric, and process perspectives on facial cognition: Contexts and challenges, Mahwah, 83–113.

https://stirling.sona-systems.com/Default.aspx?ReturnUrl=%2f.