False facial recognition of altered internal & external features

Introduction

Memories are not as concrete and accurate as we believe them to be. As we continue to experience new events, we are at the mercy of our memory's malleability and the power of suggestion when we attempt to recall such new memories. By virtue of exposure to misleading misinformation, not only can inaccurate details of a previously experienced event be induced, but an entirely false memory can also be implanted into the minds of unsuspecting participants (Loftus & Hoffman, 1989). Similarly, the reconstructive nature of memory can be found in the area of facial recognition.

The human face is an object most frequently viewed by humans and thus, human face recognition is such a familiar part of everyday life. However, studies suggest that the recognition of unfamiliar and familiar faces is processed differently. For instance, a study by Bruce (1982) conducted an experiment wherein half of the faces were familiar and half were unfamiliar to participants in the study phase. In the test phase, familiar and unfamiliar faces were either unchanged or changed in both angle and expression. Familiar faces were recognized more quickly and accurately than unfamiliar faces. That is, familiar faces had higher recognition rates than unfamiliar faces. Also, recognition for familiar faces was resistant to changes in view or expression between study phase and test phase. Bruce suggests that since a face is presented pictorially a pictorial code will be established. Thus, when an unfamiliar face is presented in a single exposure to a participant, a pictorial code and some structural code will be established (depending on length of exposure, the longer exposure the more attendant to inner features, the richer the code). However, when a familiar face is presented the previously established structural code is accessed, thereby facilitating recognition of the familiar face.

Another study conducted by Ellis, Shepherd, and Davies (1979) examined whether photographed familiar or unfamiliar faces were easier to identify from inner or from outer features. In one experiment, participants were asked to identify familiar faces on the basis of either their internal (i.e., eyes, nose, and mouth) or their external (i.e., ears, and hair) features. There were three slides of each face: the whole face, the outer features, and the inner features and thirty familiar faces were presented to participants. They found that better recognition occurred for internal features compared to external features for familiar faces. However, in a second experiment for unfamiliar faces, no difference was found in recognition test. Ellis et al. argued that the perceptual processing of familiar faces differs qualitatively from that of novel faces and that repeated interactions with a face lead to a structural code, which emphasizes internal features. Therefore, this study suggests that with repeated interactions with a face (i.e., faces become more familiar), internal features become more salient.

In contrast, Young, Hay, and Ellis (1985) found that recognition is more dependent on the external features of the face, such as the outline of the head, than on the internal features. Similarly, Fraser and Parker (1986) found participants were best at noticing the absence of the face outline, eyes, mouth and nose being the poorest. Haig (1984; 1986a; 1986b) also found that altering the outline of the face had the greatest effect in terms impeding facial recognition, followed by the eyes, mouth, and the nose. Sensitivities were high to inward but not outward eye changes, and the width of the mouth had little effect on recognition. Additionally, Haig (1984) has suggested that even slight misplacements of facial features can considerably alter the appearance of a face. Haig (1886a) supported the importance of hair and eye regions. However, he also noted how different individual faces seemed to be recognized by different salient features, which lead him to question the whole concept of “feature saliency” lists. Based on findings of these studies, facial recognition can be easily altered, especially for outer features for unfamiliar faces such as the outline of the head compared to internal feature (e.g., mouth and nose).

A false facial recognition study by Solso and McCarthy (1981) conducted a number of experiments, whereby a prototype *Identikit* face was formed on the basis of frequently shown features. These faces consisted of a particular combination of hair, eyes, nose+chin, and mouth. Then exemplars were produced of this prototype by varying one, two, three, or four of its components (75%, 50%, 25%, or 0% exemplars). Participants tried to memorize three 75%, four 50%, and three 25% exemplars and later performed a recognition test with confidence rating. In the recognition task, participants discriminated well between old and new faces, except when the new face was a prototype (which has never been seen in its entirety). Moreover, some participants falsely recognized the prototype with a greater confidence than the previously seen faces. The tendency to recognize a new prototype faces as old (previously seen) persisted for at least six weeks. Similarly, Bruce, Ness, Hancock, Newman, and Rarity (2002) suggested that a morph of four composites of a person together was on average rated as a better likeness than individual composites, and was good as the best individual likeness. These findings suggest that a better likeness may be obtained when the composites form multiple witnesses are combined. These studies also indicate that when features of shown faces are altered false facial recognition can be easily induced.

Misleading information or altering of facial recognition memory has been seen in the manipulation of inner and outer features of unfamiliar and familiar faces and the morphing of salient features. However, the present study will investigate whether facial recognition memory can be altered when new inner or outer features are presented in the context of old features. For instance, Sinha and Poggio (1996) created an illusion (see Figure 1) of an image that appears to depict two faces as those of former U.S. President Bill Clinton and former Vice President as Al Gore, at first glance. However, the faces were digitally manipulated via computer so that they look exactly alike- about halfway, between Clinton's real face and Gore's. This illusion illustrates how easily false facial recognition can be induced.

Objective/thesis

This study will investigate whether or not an altered face will be falsely recognized as a previously seen face. In other words, for unfamiliar faces will a manipulation of features (external or internal) be integrated into memory as the original studied face? Moreover, for unfamiliar faces, will the effect of the external features (head shape, hair, ears, facial contour) be more influential in the accurate recall of a previously seen face (original not altered face) as opposed to internal features (eyes, nose, mouth, and their spatial configuration)?

Methods

Participants: One hundred undergraduate students at the University of California, Irvine will serve as participants and will be recruited from the Social Science Human Subject Pool. They will be compensated with extra credit.

Apparatus: A Pentium 4 computer will display the stimuli on a 30-inch CRT monitor with a pixel resolution of 1280 by 1024, and will be controlled by a windows XP workstation. The pixel resolution of the stimuli will be 383 by 525 pixels. The distance between the participant and the screen will be 30 inches.

<u>Experiment 1a</u>: Altered Internal Features

Design: The experiment will be a one-way within subjects design. The independent variable is type of *face* with four levels which are: New (the distractor), OSF (the original studied face), AISF (altered internal study face), New ASF (novel altered face). The dependent variable will be hit rate (i.e., the amount of correctly recalled faces) and false alarm rate (i.e., the amount of falsely recalled altered faces as original faces).

<u>Experiment 1b</u>: Altered External Features

Design: The experiment will be a one-way within subjects design. The independent variable is type of *face* with four levels which are: New (the distractor), OSF (the original studied face), AESF (altered external study face), New ASF (novel altered face). The dependent variable will be hit rate (i.e., the amount of correctly recalled faces) and false alarm rate (i.e., the amount of falsely recalled altered faces as original faces).

Procedure: In each experiment, 48 different faces will serve as stimuli, with 24 target and 24 distractor faces. The set of original target (OT) faces will be copied and edited using Photoshop to create another set of 24 edited target (ET) faces, each copy having some of the same features (e.g., external) and some different features (e.g., internal) as its original counterpart, with the different features taken from another set of faces. The set of 24 target faces (half OT, half ET, all different in identity) will be presented in a random order during the study phase. Each face will appear only once for 3 seconds with an inter-stimulus interval (ISI) of 500 milliseconds. After the study phase is completed, participants will be given a distraction task for 7 minutes, which will be to count the number of times a letter appears in a paragraph. The participants will be unaware that half the original study faces (OSF) were edited due to similar editing artifacts that will be added to the OT faces. During the intervening recognition phase, each trial will consist of a studied face (OSF, see Figure 2) and a new distractor face (i.e., never seen before, see Figure 3), and the participant's task will be to choose the face they recognize from the study phase. On half the trials, the studied face will be an OSF (see Figure 4), and on the other half, the studied face will be altered (ASF), for experiment 1a the alteration is of the internal features (AISF) (i.e., eyes, nose, mouth and their spatial configuration (see Figure 5). However, for experiment 1b the alteration is of the external features (AESF) (i.e., head shape, hair, ears, facial contour, see Figure 6). After the intervening recognition phase is complete, participants will be given another distraction task for 7 minutes, which will be to count the number of times a letter appears in a paragraph. During the final recognition test, each OSF will be presented next to its corresponding ASF on half of the trials, and the participant's task will be to choose which face is from the study phase. For experiment 1a, each OSF will be presented next to its corresponding AISF (see Figure 7) and for experiment each OSF will be presented next to its corresponding AESF (see Figure 8). As an extra control, half of the trials in this final test is an OSF is paired with a novel ASF that was never before seen. After the final recognition test is complete, participants will be debriefed.

Expected results & Problem with classification

I predict that during the intervening recognition phase, when the test will be forced choice, and it is likely that participants will choose the OSF on OSF trials, and the ASF on ASF trials because of the perceptual similarity of the ASF to its corresponding OSF from the study phase. It is unlikely that the distractor faces will be chosen because they will be new and will not share any features with the OSFs. Put another way, the effect of shared context between the OSFs and the ASFs will likely cause the participants to choose the ASFs over the new distractors.

I also expect there will be more false alarms for the ASFs that appeared and were chosen during the intervening recognition test than for ASFs that were never viewed. Presumably, the ASFs that were viewed and chosen during the intervening recognition test will have altered the participants' memories of the OSFs. In the final recognition phase, the context will be the same for the two faces, so I will be testing whether memory for the original features of the OSFs is susceptible to the misleading information presented during the intervening recognition test, and whether the altered features in the ASFs from the intervening recognition test were incorporated into memory for the original face.

It is not clear whether the OSFs should be classified as familiar or unfamiliar after they have been learned. Recognition for unfamiliar faces is more dependent on external rather than internal features (Young et al., 1985). If the OSFs are classified as unfamiliar, participants should rely on their memory of the external features, and should readily choose the ASFs in the intervening recognition test because of the match between the external features of the ASFs and their corresponding OSFs from the study phase. The participants may not encode the internal features of the OSF as distinctly as a result of their reliance on the external features. Although they also may not have encoded the internal features of the ASFs with great detail, on the final recognition test, they may be more likely to choose the ASFs that were presented and chosen in the intervening recognition test because of their recent exposure. If the OSFs are classified as familiar, it is still likely that participants will choose the ASFs rather than the distractors on the intervening recognition test because of their similarity to their corresponding OSF from the study phase. However, because of the importance of internal features in recognition of familiar faces, they may have encoded the internal features of the OSFs more clearly, and as a result, may not choose the ASFs that were presented and chosen in the final recognition test at quite as high a rate.

These experiments will provide a comparison of the false alarm rates resulting from the two manipulations. If the false alarm rate is greater for altered internal features, I will conclude that memory for internal features is more malleable. However, if more false alarms occur when the external features are altered, then memory for the external features is more susceptible to the misleading information presented during the intervening recognition test. Again, the issue of whether to classify the faces as familiar or unfamiliar is of importance. If I classify the faces as unfamiliar, then I predict memory for the internal features to be more susceptible to misinformation, but if they are classified as familiar, I predict the internal features to be of more importance, perhaps allowing memory for the external features to be more malleable.

Impact of research

The relative importance of the internal and external facial features has obvious implications in eyewitness identification situations. Generally, a witness is questioned about descriptors such as height, weight, hair color and style, clothing, and age of the perpetrator. Additionally, the witness may work with a police sketch artist to create a composite drawing of the perpetrator’s face. If the external features are recalled more accurately or vividly than the internal features, the chances of the real criminal being caught are reduced, and the chances of an innocent person (IP) sharing the same external features as those in the description or composite are increased. Furthermore, if an IP is apprehended, the victim of the crime may mistakenly identify this person as the criminal if the influence of the external features is great. Suppose further that the victim identifies the IP from a lineup, and the victim is later required to identify the criminal during trial. It is likely that their memory of the criminal has been altered to resemble the IP. Memory is faulty and thus, eyewitness testimony may not always be accurate. We all need to help the justice system realize the significance of memory malleability, so the injustices that are being committed to innocent people will cease. We have been shown that we are not only the creators of our own memory, but we also have the dangerous power of being the creators of other people's memories.

Figures

Figure 1: This is an computer manipulated illusion by Sinha and Poggio (1996) of Bill Clinton and what seems to be Al Gore standing behind Bill Clinton at first glance. However, it is really Bill Clinton's face with Al Gore's hair and suit on.

Figure 2: This is one of the original study faces (OSFs).

Figure 3: This is one of the distactors (i.e., faces participants have never seen before, new face)

Figure 4: During the intervening recognition phase for both experiments, half of the trials will consist of an OSF (on the left) and a new distractor face (on the left)

Figure 5: During the intervening recognition phase for experiment 1a, half of the trials will consist of AISF (on the left) and a new distractor face (on the left)

Figure 6: During the intervening recognition phase for experiment 1b, half of the trials will consist of AESF (on the left) and a new distractor face (on the left)

Figure 7: During the final recognition test for experiment 1a, half of the trials will consist of AISF (on the left) and the OSF (on the left)

Figure 8: During the final recognition test for experiment 1b, half of the trials will consist of AESF (on the left) and the OSF (on the left)

Student responsibilities

Prior work: I will be helping a graduate student run subjects regarding this field and learn how to improve on my topic. Start to develop my stimuli for my topic.

Over the course of the project I will take responsibility for the following tasks:

- I will meet with my faculty mentor at least once a week and stay in communication via e-mail between meetings
- Develop the stimuli
- Program the experiment in Matlab.
- Recruit participants through the Social Science Human Subject Pool
- Reserve lab room with computers to run participants in the experiment.
- Analyze the data and run tests for statistical significance.
- Analyze and interpret the results.
- Write a paper detailing a complete account of my research findings.

Timeline

Over the course of the 10-week summer program, the following schedule will be followed:

- Week 1: Complete stimuli and run pilot study
- Week 2: Make adjustments to experiments and finalize programming of experiments.
- Week 3-4: Recruit participants, reserve lab rooms, and begin running participants.
- Week 5: Begin data collection and data analysis while continuing to run participants in the experiment.
- Week 6-7: Complete data analysis.
- Week 8-10: Complete write-up of findings.

*Stipend requested for 400 hours is $3,000

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