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Stephanie Kaplan

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The Effect of Gender on Recalling Facial Features: Does Our Gender Determine Which  
Features are Encoded at First Glance?

AN HONORS THESIS  
College of St. Benedict/St. John's University  
In Partial Fulfillment  
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in the Department of *Psychology*  
by  
*Stephanie Kaplan*  
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Abstract

Previous research has implied that the accuracy of facial recognition may depend on the amount of time and attention paid to a particular feature. Recent studies have suggested that there may be an observer sex difference in visual scanning of unfamiliar faces, implying women and men may be processing different information (Hall, Hutton, & Morgan, 2010). While it has been shown repeatedly that women are more accurate at facial recognition and recognition of emotion, it has not yet been discovered if there is an individual feature that makes their increased recall possible. A better understanding of the interaction between gender and facial feature recall will help to increase knowledge surrounding the cognitive processes associated with facial recognition. It may also provide an understanding of whether or not there are gender differences regarding which facial features make individuals memorable. The current study was conducted using 55 participants, 37 women and 18 men, who were asked to observe four faces, and then later distinguish features of those faces from a group of distractors. Results of a 2x5 ANOVA show a significant main effect of features, and a non-significant trend of participant gender. This indicates that men and women process and encode facial features differently, and certain features are remembered more than others in unfamiliar facial recognition.

The Effect of Gender on Recalling Facial Features: Does Our Gender Determine Which Features are Encoded at First Glance?

Humans have an uncanny ability to perceive and recognize faces. Our ability to easily identify other people and assess their emotion, gender, race, and age is dependent on facial perception and facial recognition (Corenblum, Meissner, 2005). Several studies have shown that after years without seeing a classmate, adults accurately recognized their peer's photographs (Bahrich, Bahrick, & Wittlinger, 1975). This ability to recognize others has important social, personal, and possibly evolutionary implications. Much research has been conducted in an attempt to discover the facial cues that underlie people's proficiency at these tasks, with facial identification receiving the most attention. Though the recognition of faces may seem effortless, one's brain must process the decoding of another's face in a systematic manner (Haig, 1986).

Identification and recognition of other's faces are some of the most important and complex cognitive skills humans have developed. Not only do individuals have the task of remembering faces of those they see every day (e.g., coworkers, neighbors, etc.), and those close to them (e.g., family members), but they also have the task of recognizing faces that are only a part of one's life for a short period of time (Want, Pascalis, Coleman, & Blades, 2003).

Many areas of psychology are concerned with the phenomenon of facial recognition. Developmental psychologists have long been interested in the facial communication between infant and caretaker, cognitive neuropsychologists study the possible specialized brain function that enables us to have facial recognition skills, and evolutionary psychologists are interested in this apparent special ability that has been sustained throughout human history (Nelson, 2001). The importance of understanding such a phenomenon can also be applied to today's legal system, where eyewitness recognition may lead to conviction or exoneration of another person (Kassin, Tubb, & Hosch, 2001).

Though humans have an extensive capacity to recognize and perceive faces, it is not without limitation. For example, people are more accurate at recalling faces of in-group members compared with out-group; they are also more likely to incorrectly identify which out-group member was actually seen when asked to choose from a line-up (Chance & Goldstein, 1996; Shaprio & Penrod, 1986). Humans are vulnerable to biases, such as same-sex, same-age, and same-race bias; these biases are found in both children and adults (Cross, Cross & Daly, 1971; Pezdek, Blandon-Gitlin & Moore, 2003; Deblieck, & Zaidel, 2003; Crook, & Larrabee, 1992).

Biases toward the familiar raise the possibility that facial recognition may be due in large part to humans' ability to identify one another's individual facial features. Features more similar to one's own seem to make a face more easily recalled. Corenblum and Meissner (2005) studied children's and adults' ability to recognize "in-group and out-group" faces. The members of the in-group were those of the same race as the participants (all Caucasian), while the out-group was composed of African-Americans. Participants more easily identified the in-group, but were more susceptible to falsely identifying faces of their in-group that they had not yet seen. In other words, Caucasian participants were more likely to falsely recognize a Caucasian face that they had not yet seen than they were to falsely recognize an African American face. This false positive was attributed, in part, to the fact that faces with features and dimensions similar to our own are often seen as familiar, even if one has never met or seen that person before. The researchers attributed these results to a cognitive source, i.e., out-group faces had unfamiliar characteristics that were unlike those of the in-group, therefore these features took longer to encode (Corenblum and Meissner, 2005). The fact that features unlike one's own are harder to recognize indicates that particular facial features may be the reason some faces are recalled more easily than others.

**Development of facial recognition.** The human capacity for facial recognition begins to develop during infancy; it continues to develop over childhood, and arguably throughout the individual's entire lifespan (Brunelli, & Poggio, 1993). For example, Fagan (1972) demonstrated that by four months of age an infant is more likely to pay attention to an upright face than an upside down one. This finding suggests that early in infancy, a human begins to view faces as a separate class of stimuli, in other words, they have a "face schema." Though a schema may be developing, research has shown that before the age of six, children encode faces through memorizing individual features, while from ages six to ten children begin recognizing faces using the entirety of the face. "Normal" processing, or utilizing inner-features for familiar face recognition, is not fully developed until the age of twelve (Tanaka, J., Kay, J., Grinnell, E., Stansfield, B., & Szechter, L., 1998).

The social importance of this skill, and the time dedicated to developing it, suggests facial recognition has been important in the course of evolution. The implications for survival are seen in three major findings from newborn studies: 1) the initial preference newborns have for faces over non-faces; 2) a newborn's ability to differentiate his or her mother's face from a stranger's face less than fifty hours after birth; 3) the imitation of facial gestures (a.k.a. facial expressions) (Face Perception, 2009). *The Encyclopedia of Perception* (2009) discussed the phenomenon of facial recognition and suggested that like most visual skills, facial processing must be part of a larger primitive mechanism from which more advanced processing skills can be learned.

Facial recognition studies have shown human brains have evolved to be specialized in perceiving and recognizing human faces. Research comparing facial recognition to other object recognition suggests that in facial recognition, one perceives a single and complex whole, whereas other objects can be seen in individual pieces (Nelson, 2001). Further evidence for brain

specialization is prosopagnosia, or the inability to recognize familiar faces. This impairment is often times the result of damage to the ventral occipitotemporal and temporal cortex (Nelson, 2001).

**Investigation of what enables facial recognition: Inner versus outer features.** The question remains, what about the face makes it memorable? Want and colleagues (2003) suggest that the manner with which humans recognize others changes as people age and depends on how familiar the other person is with the face. Early in the life span a face's outer features, such as the hair or jaw line, play a more important role than the inner facial features, such as eyes, nose, or mouth, when recognizing familiar faces. Maurer and Slapatek (1976) found that young infants are much less likely than older infants to even scan the inner features of a face, while Bartrip, Morton, and de Schonen (2001) found that infants less than 35 days old were unable to identify their mother if her outer facial features were covered. Even children as old as six were more likely to accurately identify celebrities and classmates in photographs if shown outer and inner facial features, instead of only inner facial features (Campbell & Tuck, 1995).

This reliance on outer facial features to recognize familiar faces seems to come to an end between the ages of seven and eleven (Ellis, Shepherd & Davies, 1979). A more mature reliance on inner features for facial recognition develops thereafter, and people are more likely to accurately identify inner, rather than outer facial features: a complete pattern reversal.

Horchberg and Galper (1967) discovered that facial recognition was poorer when faces were inverted. Galper (1970) elaborated on these findings with further studies on recognition impairment. He found that a person's ability to recognize a face is impaired when presented in the negative, similar to when it is shown upside-down. This drop in accuracy implies that information crucial to recognition is lost when a photograph is inverted or its brightness is reversed. Galper and Hochberg (1971) found that faces are not recognized solely by the

arrangement of their features. Participants were presented with smiling and non-smiling photographs. The two expressional conditions were further divided by those who saw the photographs in positive lighting and those who saw the brightness reversed, or in the negative. Therefore, four conditions were created: a positive/positive (smiling person in positive lighting), a positive/negative (smiling person in negative lighting), negative/positive (a person who was not smiling in positive lighting), and a negative/negative (a photograph not smiling in negative lighting). Participants who saw smiling photographs in positive lighting performed significantly better than those who saw the same smiling photograph in negative lighting. Those who were asked to identify non-smiling photographs in the negative performed worse than the other three conditions, indicating that facial expression may impact how accurately a face can be recognized. Galper and Hochberg (1971) concluded that the characteristics that differ in expressional action, such as the eyes and mouth, play a role in facial recognition. However, this difference in performance may have to do with more than expression, such as a facial cue present in positive lighting that was distorted in the negative.

Research has shown that adults recognize a familiar face's inner facial features at a significantly more accurate rate than outer facial features, meaning, when presented solely with all the inner features of a face, people can identify the person to whom they belong. For this recognition to be possible there must be some "cue" that is useful in identifying faces. This cue, according to the *Encyclopedia of Perception* (2009), must differ across faces, yet be consistent for any given face. Any cue that did not differ or discriminate between faces would be overlooked by the visual system. Cues important to facial recognition by this standard would be things such as shape or pigmentation, things intrinsic to that face or unchanging attributes (Face Perception, 2009).



Carey and colleagues (Carey & Diamond, 1977; Carey, Diamond, & Woods, 1980; Diamond & Carey, 1977, 1994) suggested that adults have developed a skill in recognizing the configuration of facial features as a cue for recognition. By using special relations between features, as well as the actual features themselves, people become familiar with another's face. The importance of inner features may be due in part to the fact that the inner-face (e.g., mouth, eyes) is recognizable at a number of different angles; it is view-variable. However, the outer-face (e.g., jaw line, hair) is not as distinctive in terms of contours or shapes, therefore making it less likely to provide useful information. From this research it can be inferred that it is the parts of the face that are stable in configuration, rather than those susceptible to change, that are responsible for humans' ability to become familiar with others.

Laughery, Alexander, and Lane (1971) found support for this idea in their study of eyewitness accuracy. They varied the coloring of the photograph (either color or black and white), as well as the position of the photograph on the presented screen. Neither one of these extrinsic factors were associated with variability in accuracy, leading researchers to believe it is the intrinsic features, not extrinsic, that allow one to recognize a face. When participants were asked to identify which facial feature they used to recognize faces, most participants reported the face's eyes, then a nose and general facial structure, thirdly skin/hair, then the mouth, and the least reported feature was ears. These self-reports illustrate our initial inclination to study inner facial-features to become familiar with the person.

Campbell and colleagues (1999) demonstrated the inner-face advantage using a blurring technique to defocus parts of the face. When comparing children with adults, the researchers found that when a person was an adolescent with a mental age under ten, or if they were between the ages of five and thirteen, there was a distinct outer facial feature advantage. An inner face advantage was found with adolescents aged fifteen and over (Campbell, et al., 1999). This

research showed an obvious adult advantage for inner feature recognition with familiar people (or people seen on multiple occasions), not present in the recognition of unfamiliar faces. This suggests that inner features are a more reliable source of information; i.e., the features do not change even when viewed in a number of different angles and illumination, suggesting it is the number of different viewings that leads to familiarity and the inner face advantage (Campbell, et al., 1999).

**Techniques of studying recognition.** Campbell and colleagues (1999) developed a new way to study partial facial recognition. Until this study, researchers had typically cropped photographs using similar trapezoids and parallel lines when removing features for recognition tasks, meaning when presenting stimuli to participants, photographs would be missing sections of the face. Faces cropped this way may be cognitively interpreted as a whole head, leading to disruption in accurate recognition. In other words, when participants were viewing faces that had been cropped they were still trying to process the information in terms of schemas already developed for a whole face, creating disruption in the recognition task. Instead of cropping, Campbell, et al. (1999) selectively blurred out either the inner or outer facial features. This new technique allowed the entire shape of the face to be preserved and avoided the disruption of the participants' schemas. The blurring upheld the reliability of the inner-face advantage for experimentally learned (familiar) faces when compared to previous studies, and appeared valid across all presentations of the stimulus.

A study by Seamon, Stolz, Bass, and Chatinover (1978) found results consistent with previous research on human facial feature recognition. Participants were shown ten black and white photographs and were asked to select the specific facial features they had previously seen independent of the entire face. Features were presented together on test cards in random order. Some of the target photographs and features were oriented differently and some were similar.

Seamon, et al. (1978) found that though eyes and mouths were identified more accurately than the nose when the photograph was forward-facing, there was no difference in accuracy if the orientation of the target and features was inconsistent, meaning features were shown at different angles. It was suggested that this difference in performance arose because the shape of the eyes and mouth changed more than the nose when shown from different views. (This hypothesis was in contradiction to the previously mentioned research of Campbell and colleagues.) The greater the difference in feature size and shape, the less likely one is to recall it accurately. This finding has directed researchers' attention not only to the size and shape of features, but also to which features are being attended to most closely when learning an unfamiliar face.

Ellis et al. (1979) researched recognition of unfamiliar faces. Participants were shown photographs of whole faces for six seconds and then asked to identify which faces they had previously seen among a group of distracters. Both the target photos and the distracting photos used during the recognition portion showed just inner or outer features of a face. Though no measurement of reaction time was taken, the study showed no difference in accuracy between the two stimuli. Young and colleagues (1985) found participants were equally able to identify photographs of unfamiliar whole faces and parts of faces, as long as the parts were outer facial features and not inner facial features. This suggests that in recognizing unfamiliar faces, adults rely more on outer facial features than inner, much like children in early development.

McKelvie (1976) studied the importance of individual feature recognition by removing features from target photographs and seeing how memory was affected. By doing so, the study was investigating which portions of the face are best remembered. If recognition was unaffected by removing the stimulus, or feature, it can be inferred that the particular feature is unimportant for facial recognition. It was hypothesized that areas of the face that convey information through their movement, such as the eyes or mouth, would be best recalled because of the higher amount

of attention paid to them. When participants were tested solely for inner-facial feature recognition, McKelvie (1976) found that participants were equally as confident and quick to respond when either the eyes or mouth were masked, but participants who viewed photographs with masked eyes performed significantly worse in identification tasks. The results of this study may be due to participants relying on facial features other than the eyes when the eyes were masked. Using features such as mouth, chin, or nose when eyes were not present resulted in significantly poorer performance; if other features were as salient as the eyes it would not cause such difficulty. The results of this study imply that eyes are an integral part of facial representation in memory.

Haig (1986) supported McKelvie's findings in the recalling of unfamiliar faces. The results of Haig's (1986) experiment clearly showed that the facial features which are the largest in size had the greatest influence on facial recognition. The largest feature studied was the outline of the head, then the eyes and eyebrows, followed by the mouth. The nose was shown to have almost no influence whatsoever. Researchers also investigated the pattern of eye movements during the study of unfamiliar faces. A review of these eye movements made it clear that the majority of fixations occurred in the area between the eyebrows and mouth, while seeming to completely ignore the outer areas of the face (i.e., the outline of the head.) Ellis, Shepherd, and Davies (1975) used a Photo-fit technique to investigate feature recognition. Participants were shown two faces, and then asked to recreate these faces using their individual features. The researchers found that the forehead and mouth were best identified, but faces were usually constructed from top to bottom, implying that the upper portion of a face holds priority. This study's findings imply that recognition of faces seems to follow a feature priority that is somewhat proportional to the size of each individual feature, with most priority given to the head outline.

**Gender differences in studying and recognizing faces.** McKelvie (1981) studied sex differences in identifying faces. Participants would judge a presented photograph as either “old,” if they believed they had seen the photograph previously, or “new,” if they believed that they had never seen the photograph. The results of the study showed that participants most often remembered photographs of the same sex; the best performance in recall tasks were females recognizing female faces. McKelvie (1981) interpreted these results to mean that women must be comparing their own faces to the ones in the photographs, giving special attention to general attractiveness. In order for this comparison to occur, a woman must be identifying with the person in the photo, or alternately the person appears familiar. However, McKelvie (1981) suggests that a study should be conducted to test what particular stimulus is of interest to males and females. If one feature in particular is critical to attention, it may explain the apparent same-sex bias McKelvie (1981) discussed.

The amount of time and attention paid to a particular feature may be the best predictor of whether it is recognized later or not. Recent studies have suggested that there may be an observer sex difference in visual scanning of unfamiliar faces, implying women and men may be encoding different information (Hall, Hutton, & Morgan, 2010). When presented with unfamiliar faces, research found that women and men have equal numbers of fixations on the face; the difference found between the genders was that women spent more time observing the eyes and mouth compared with men. The longer dwell time indicates that women are more attentive to the eye region than men are. A difference in how faces were scanned was also apparent; while men first looked to the mouth and then the eyes, women typically scanned the eyes first, then the mouth. Vassallo, Cooper, and Douglas (2009) found similar results in their study, finding that men spend more time looking at lower parts of the face, such as the nose, compared with women.

Their focus on these non-salient, or harder to recognize, portions of the face may result in poorer performance on recognition tasks, and perhaps encoding different features than women.

Women typically perform better at facial recognition tasks compared with men, and typically outperform them in identifying facial expressions (McKelvie, 1981; Montage, Kessels, Frigerio, de Haan, & Perrett, 2005). There are many theories regarding why women are inherently better at reading other's expressions: they are genetically predisposed to be sensitive to others' expressions to better care for infants or children; there is a social expectation for emotional maturity from women, so they attend more to developing their ability to read others; or women are more relationship oriented, causing them to care more for how others are feeling (Taylor, Peplau, and Sears, 1994). If women are more adept than men at reading others' expressions, it may be due to spending more time studying features, such as the eyes and mouth, features that typically convey emotion. If women spend more time than men studying these features, whether it is because of biology or environment, they would probably be more apt to recall them accurately.

Cellerino, Borghetti, and Sartucci (2004) discussed similar results in their study of sex differences in gender recognition. There was a clear difference in men's and women's ability to recognize faces, women being much more efficient at recognizing women's photographs. Researchers found that the process of recognizing male and female faces may actually require two separate cognitive processes. This hypothesis was based on studies that used pixelated frontal pictures of men and women for recognition tasks after presenting untouched photographs to study. Researchers found that identification of female faces are reduced to chance at 1792 pixels, whereas men are still accurately recognized above chance level at 112 pixels. This means women's faces need much less blurring to make them unrecognizable, while men's faces can be pixelated to a much higher degree and still be accurately recognized. The results are indicative of

two separate cognitive processes when recognizing either a male or a female face, though they do not describe what feature is being used to decode the incoming information (Cellerino, et al., 2004). It may be that the very feature that cues same-sex bias is also responsible for determining which cognitive process is utilized, i.e., the way the brain is collecting, encoding, and storing information.

Wright and Sladden (2003) supported this hypothesis with a study on the importance of hair in facial recognition. These researchers found that women were more prone to remember women's hair, while men who were studied recalled men's hair more easily. Adults presented with photographs of various faces seemed to have almost no ability to recognize faces originally shown without hair. This significant difference in ability seems to indicate that there are specific features that allow a person to encode another's face (Wright and Sladden, 2003). This finding may indicate that one's gender, or the gender of the face being studied, may in part determine which unfamiliar facial features are encoded most effectively.

In support of Cellerino et al. (2004), Megreya, Bindmann, and Havard (2011) found evidence of dual cognitive processing in their study of unfamiliar face identification through matching tasks. Men and women were told to decide whether two unfamiliar faces were the same person or two different people. A separate test was done in identifying internal and external features. The error patterns of test participants revealed that both the sex of the observer and the photo participant's gender were influential in performance. Women outperformed men at matching faces, as well as "mismatching." Authors of this study use "mismatching" to describe the task of pairing two photographs which only contain inner or outer features to reconstruct a photographed face previously shown. In the mismatching portion of the test participants were asked to recognize a face after viewing either the inner or outer features only. Though women recalled faces at a significantly higher level of accuracy, there was a significant same-sex bias in

women identifying women's photographs. Male "mismatched" (inner or outer features only) photographs were identified more easily than women's, meaning that the inner or outer feature only photographs of males were recognized at a higher rate. Photographs of men's outer features were recognized more easily compared to their inner features, while women's external feature identification created a disadvantage. Photographs of the two sexes' internal features were recognized relatively equally. In sum, this study suggests that women may be better at identifying both the internal and external features of other women's faces. The results of the mismatching task revealed that when recognizing men's photographs, participants did so most easily using their external features. Women and men's photographs were identified equally as well when participants were using their internal features. Men also performed most poorly at identifying women by their external features, which is in contradiction to previous results that showed external features are most often used for unfamiliar facial recognition. What this study suggests is that there are cognitive sex differences in the way facial features are encoded and recalled, and that different features may increase or decrease either sex's accuracy. The way faces are processed and encoded may depend on the observer's gender.

Information about another human's face is processed rapidly and efficiently. The amount of information a person understands from just observing a face is incredible; in under a second a person can categorize age, race, sex, and identity (Baudouin, & Tiberghien, 2002). A person uses stable information to categorize faces quickly. Features like race and gender are used rather than variable information, such as age or emotions, to ensure the cognitive system is able to accurately recognize faces. Information that is irrelevant is therefore weeded out, and information important to recognition is encoded. In other words, when observing a face a structural encoding is engendered that is comprised of the facial features. When recognizing another person, humans use this structural encoding to compare other's faces until finding a



match. Though this process is efficient, the process that allows one to perceive another's sex is even faster, implying that when taking in information about another's face, many cognitive processes are being utilized. One of these processes may be the *similarity effect*, or that people assume women's faces will be more similar to other women's as opposed to men's. This assumption is made on "typical characteristics," such as spacing between women's features that differ from their male counterparts. Therefore, when women are searching to identify other women's faces, those that do not have the "typical characteristics" will quickly be ignored (Baudouin & Tiberghien, 2002).

**Current research.** Using this information, one may assume that when studying unfamiliar faces, certain features are being used to categorize it efficiently and to encode the information in order to more quickly recall it for recognition. The cognitive processes utilized to organize the incoming information differ between the sexes, as shown in previous studies, and so may differ in what feature is most efficiently encoded. The difference in recognition performance may be indicative of differences in the way that the two sexes perceive and encode facial feature information. If this is so, it may be helpful to better understand which features in particular are utilized by either sex for facial feature encoding, explicitly for recognition tasks.

The purpose of the current study is to find if men and women encode different features at first glance. Though it has been previously shown through research that women are typically better at facial recognition, it has not been found whether or not this is due to their recognition of a specific feature. By using the blurring technique to save the shapes of faces, and separating stimuli by individual features, current research will delve into the possibility of finding which features of unfamiliar faces are encoded first, and whether this depends on a participant's gender. Based on previous research, it is hypothesized that: 1) women will recall unfamiliar faces, eyes, and mouths more accurately than men due to their attention to emotion; 2) that both men and

women will perform best at recognizing the outer features, hair in particular, of unfamiliar faces; and 3) women will outperform men on all recognition tasks presented, including how accurately they rated their performance.

## **Method**

### **Participants**

Participants were undergraduate students from the College of St. Benedict and St. John's University. Fifty-five students (37 women, and 18 men) participated in the study, all of whom were eighteen years of age or older. Forty-six of the participants were recruited using student Psychology Research in Action (PRIA) accounts, an online tool that Introduction to Psychology students utilize to complete a course requirement. Nine participants were offered extra credit points in their Developmental Psychology courses in exchange for their participation. Of the 55 total participants, three participants identified themselves as Hispanic, six identified themselves as Asian, and forty-six identified as Caucasian. All participants were told that the purpose of this study was to correlate performance on puzzles (a.k.a. brainteasers) with performance on recognition tasks. Participants were told that performance on puzzles is thought to predict how well one is able to recognize faces, a cover story meant to distract participants from the purpose of the study. This deception was thought to be necessary to preserve the validity of the study.

### **Materials**

**Equipment.** Experimental stimuli were displayed on one of two 15" MacBook computers. Participants were seated at a desk with the computer placed approximately 6" away. The computer program Psyscope was utilized for the programming of the experiment. Psyscope regulated the time constraints of the stimuli, pseudo-randomized the order of photographs presented, and recorded the responses, as well as reaction time of each participant.

**Stimuli.** Twenty photographs (10 male, 10 female) were taken from the Psychological Image Collection at Stirling (PICS) database (Hancock, 2004). The Aberdeen and Pain Expression databases were used exclusively. These databases are sets of photographs of men and women, each of whom has at least one photograph that is forward facing with a neutral expression. Together, the databases had 152 unique individuals from which to choose, more than enough for the purpose of the experiment. Only neutral expression, forward facing pictures of young adults were used. Photographs were uniformly sized at 7.0 cm x 9.5 cm in size. No known quantitative measures have been performed regarding this facial recognition database to determine validity or reliability, though numerous other studies have used these databases in recognition research (Andrews, Ewbank, 2004; Bering, McLeod and Shackelford, 2005; Seymour and Kerlin, 2007). Photographs were selected for this experiment based on their participant's neutral expression, positions relative to the camera (head orientation), and the illumination of their face. Each participant saw the same twenty photographs; all photos were of a man or woman facing the camera, and were cropped to show only the neck and head. All photos were of Caucasian individuals in an attempt to eliminate same-race bias influencing results. The decision to use photographs of one racial group only can be attributed to the high ratio of Caucasian students that attend CSB/SJU. Photographs were presented in color to preserve external validity.

### **Procedure**

**Practice session.** Participants were seated in front of a computer and asked to answer questions about their age, gender, and race. After demographics were gathered, participants were asked to read the directions presented on the next screen.

“You will be asked to observe four photographs for seven seconds each. Study each photograph closely, as you will be asked to recognize them after a short break.”

Participants were then asked to participate in a short practice test to familiarize them with test protocol. The practice test began with a slide show of four photographs. These photos were pictures of celebrity faces, and each was presented individually for seven seconds. When all four images were presented the participants had a ten second break before they were asked to perform a short recognition task. Seven photographs were then shown individually; two had been previously shown and five were distracter photographs of other celebrities. Participants were asked to answer as quickly as possible whether they had previously seen each photograph or not by hitting either the "O" key, indicating they believed it was old, or the "N" key, for new, meaning they did not believe they had previously seen that photograph. Following each response, participants were asked to fill out a confidence rating of 1 to 5 to scale how sure they were that they had labeled the previous photograph correctly. The scale was labeled as 1= possibly, 3= probably, 5= certain. Directions using the scale read:

"You reported that the previous drawing was either old or new. Now I am interested in how sure you are about your answer. If you feel you have possibly answered correctly, please select "1." If you believe you probably selected the right answer, please select "3." If you certain about your answer, please select "5."

**Face recognition task.** After the practice test, participants saw a slide that reiterated directions regarding the task.

"You will now be presented with four faces, one at a time, for seven seconds each. You will have seven seconds to study each face closely, so please concentrate. After these faces are shown you will be asked to participate in a short activity. Your performance on this activity will be used to predict your performance on the recognition task that follows. Try your hardest! If you have questions please turn and ask the attendant now. If you have no questions please hit the space bar to continue. Please note that after hitting the space bar your first face will be presented and timing will begin."

After pushing "space," the first face appeared for seven seconds, followed by a blank white screen for one second. Three more faces followed with the same time constraints. After all four faces had been shown, always two male faces and two female faces, participants were given

three minutes to complete a brainteaser to the best of their ability. Once the three minutes had passed, a screen appeared letting participants know they are about to be tested for facial feature recall.

After a participant indicated he or she was ready to begin the recognition task by pushing the space bar, a slide appeared with the first feature. Using the method that Campbell and colleagues (1999) described, faces were blurred around individual features using an online photo-editing site. Participants would see a face completely pixelated except for the feature being tested. All photographs were centered on the screen and facing forward. The participants were asked to identify these individual features as previously seen or unfamiliar using the "O" and "N" keys; responses on the keyboard were timed. After pushing "O" or "N," a screen appeared asking participants to rate their confidence using the same five-point scale described in the pilot test. Seven individual features were presented in each condition (eyes, hair, jaw, mouth, nose); three of them had been previously shown, while four were distractors. This ratio stayed consistent throughout the entire experiment. All seven features shown in a condition were similar (either they were all eyes, noses, mouths, jaws, or hairlines). For example, if the first condition was the jawline, participants would see seven individual jawlines in the recognition portion of their test. Individual features were grouped into conditions to better rate a participants' capability. Participants had to continue to study the faces as they typically would outside of the study because they did not know what feature would be tested next. If all features were tested at once, participants may have attempted to study all parts of the unfamiliar photograph equally, or given attention to parts they typically do not. Since the participants knew that not all parts would be tested at once, and that only one feature would be tested at a time, this type of split attention would not have given them an advantage. Distracting features were chosen from the same online

database as the other photographs. The faces that were used to create the distracting features were not used in any encoding portion of the study.

The photographs used for this experiment stayed consistent for each participant, but the order of their presentation was pseudo-randomized to eliminate the chance of order effects. The test was set up so that each of the photographs was shown in all of the five feature categories at some point, but no face was presented more than once during each participant's test to avoid familiarization. Though not truly randomized, Psyscope was programmed to pull groups of faces in different orders randomly when the test started. Therefore, no participant was guaranteed to see the faces in the same order or see the same faces in each group. Psyscope recorded participants' responses to the features, as well as their confidence ratings for each response. Participants' demographics, and their responses, were then analyzed for accuracy in each feature condition.

## **Analysis**

### **ANOVA**

A 2x5 (gender of participant x facial feature) repeated measures ANOVA was used to measure the effect of gender on the individual facial feature best remembered.

### **Independent t-test**

Correct answers to the feature recall ("hits") and wrong answers ("misses") were analyzed using an independent t-test. Correct responses to the 20 distractors were identified as correct rejections (CR), while answering "O" to a new face was measured as a false alarm (FA). In order to account for a participant's confidence levels, a numerical scale has been created (Laughery, 1971). The first scale of accuracy is based on hits and misses (as described above), a score of 1 was awarded for a miss that the participant rated as "certain" on their confidence scale (e.g., labeling a feature that was shown as "N" and then reporting a 5 for confidence), 2 for a probably miss and 3 for a possibly miss, 4 for possibly hit, 5 for a probably hit, and 6 for a

certain hit. The other scale was based on false alarms and correct rejections (as described above). Again, a numerical scale was used to investigate accuracy. One point was be allotted for a false alarm (FA) rated as certain (e.g., rating a never before seen face as "O" and then reporting a 5 on the confidence scale), 2 for a probably FA, 3 for a possibly, 4 points will be given for a possibly correct rejection, 5 for a probably CR, and 6 for a CR rated as certain. A participant could have a high score of 18 in each feature condition (90 overall) on the first scale, and a high score of 24 in each condition for the second scale (120 overall). A score of ninety is possible because three old faces were shown in each recognition task, making eighteen a perfect score per condition (a certain hit is worth 6 points); 120 points were possible because four new faces were shown in each of the five recognition tasks, making twenty-four the top score per condition (a certain correct rejection is worth 6 points). Simply put, these scores are based on the total correct responses for the previously seen and not yet seen features, and how confidently answers were rated. This single numerical score was scaled against the participant's gender, then analyzed by gender and the likelihood of accurate responses. See Figure 1 for clarification.

### **Pearson's r**

Participant's raw scores were correlated with responses from their confidence ratings using a Pearson's r. This correlation was used to observe the relationship between a person's actual and perceived recall, and was run in each feature condition (eyes, hair, jaw, mouth, and nose). A correlational test was also run for men only, women only, and for all participants, i.e., three correlations were run per feature condition. By doing so, one is able to see if there is a relationship between gender and perceived success at recognizing different facial features. Correlational tests were also used to observe participants' overall ability on the test. If all scores on the jawline had shown that there was low confidence and a low level of correct responses, it

may be inferred that the jawline condition was too difficult, or that most people have a low capacity for recognizing unfamiliar people's jaws.

## Results

The mean score for each experimental condition is presented in Table 1. A 2x5 repeated measures ANOVA (gender x facial feature) was used to analyze the gender's performance in each feature condition, specifically to test the predictions that women would outperform men in recalling unfamiliar faces' eyes and mouths, and that all participants would more accurately recall outer-features. The ANOVA showed neither the main effect of participant's gender [ $F(1,53) = 3.78, p = .057$ ], nor the interaction between target gender and feature [ $F(3.618, 191.757) = 1.274, p = .283$ ], was statistically significant at the  $p \leq .05$  level. The main effect of gender had a partial eta squared of .067, with a power of .48; the interaction had a partial eta squared of .023, with a power of .373. There was a robust statistically significant finding for the main effect of specific facial features on recognition [ $F(3.618, 191.757) = 8.938, p < .001$ ]. The main effect of features had a partial eta squared of .144, and a power of .998. Overall, hair was remembered more often than any other feature [ $F(3.618, 191.757) = 8.938, p \leq .001$ ] except for eyes [ $F(3.618, 191.757) = 8.938, p = .072$ ]. Eyes were not remembered significantly more or less than any other feature, including jaw [ $F(3.618, 191.757) = 8.938, p = 1$ ], mouth [ $F(3.618, 191.757) = 8.938, p = 1$ ], and nose [ $F(3.618, 191.757) = 8.938, p = .115$ ]. See Figure 2.

The main effect of the participant's gender on his/her recognition of specific features did not reach the .05 level, which generally demarcates statistical significance. However, finding a probability level of .057 indicates a non-significant trend of behavioral differences between men and women that has clinical implications, as well as heuristic value to encourage future research.



These data show a definite trend toward men having more ability than women to accurately identify unfamiliar features in the current research.

The study employed a series of correlation coefficients (Pearson's  $r$ ) to examine the relationships between individual participants scores and their confidence in labeling a feature as either old or new. Pearson's  $r$  was used to analyze the hypothesis that women would outperform men at all recognition tasks by correlating the confidence ratings and scores of participants. According to the hypothesis, women would more accurately rate their responses than men. Three separate correlation profiles were constructed; the conditions were all participants, women, and men. Statistically significant results were found in the overall participants condition and confidence ratings ( $M = 21.421, SD = 7.391$ )  $r = .282, p < .001$ , and, specifically for eye recognition and confidence ( $M = 4.80, SD = 1.419; M = 23.018, SD = 7.467$ )  $r = .346, p < .01$ , as well as for mouth recognition and confidence ( $M = 4.40, SD = 1.523; M = 20.40, SD = 7.971$ )  $r = .362, p < .01$ . Please refer to Figure 3 for more details.

Women scored better than their male counterparts on judging the accuracy of their test performances. In other words, women, much more so than men, had correspondence between their actual performances and their confidence levels in those performances. These differentials are most salient in female participants' mouth recognition and confidence ( $M = .4027, SD = 1.572; M = 19.730, SD = 8.095$ ),  $r = 4.37, p < .01$ , and in eye recognition and confidence ( $M = 4.649, SD = 1.317; M = 22.460, SD = 8.095$ ),  $r = .326, p < .05$ . Male participants did not show any statistically significant relationships between actual performance and their confidence levels in the accuracy of their performance. Men were better at recognizing mouths, but women were more aware of their ability to do so. Please see Table 2, and Figures 3, 4 and 5 for additional details.

The participants' ability to accurately differentiate between faces/features they had or had not previously seen was assessed using independent t-tests. Though it was hypothesized that women would outperform men on all recognition tasks, no gender differences were found on either of the two accuracy scales. However, women were more likely than men to incorrectly label unfamiliar faces as ones they had seen previously; in other words, women raised more "false alarms" or committed more false positive errors than the men did (women  $M = 15.081$ ,  $SD = 4.950$ ; men  $M = 10.667$ ,  $SD = 6.192$ ,  $t(53)=2.548$ ,  $p=.014$ ). Men were also more likely to correctly identify faces as unfamiliar when they had, in fact, not been previously viewed; statistically speaking, men labeled unfamiliar faces correctly more often than their female counterparts did (men  $M = 72.333$ ,  $SD = 17.242$ ; women  $M = 63.487$ ,  $SD = 13.19$ ;  $t(53)=2.107$ ,  $p=.04$ ). Overall, these results show that the female participants were more likely than the male participants to label unfamiliar faces as "old" (as previously viewed), and less likely to label these faces as "new" (as not previously viewed). This higher rate of false familiarity appears to be why men had a pattern of higher scores in the recognition phase of this study. Please see Table 2 and Figure 6 for additional details.

The results of this study indicate that hair is more accurately recognized than all other features of unfamiliar faces, except for eyes. Results also showed that women were more accurate in self-assessment of their performance compared to the men. Finally, a strong trend toward statistical significance was seen in the main effect of gender on facial recognition. In aggregate, these results support the notion that we have real, gender-based differences between men and women in our facial recognition skills.

### **Discussion**

The purpose of this study was to determine whether men and women initially encode different features of unfamiliar faces. Based on previous research, I hypothesized that women,

more so than men, would accurately recall unfamiliar faces, eyes, and mouths. I also hypothesized that both men and women would perform best at recognizing outer rather than inner features, and particularly the hair, of unfamiliar faces. Finally, I predicted that women would outperform men on each of their assigned recognition tasks. The initial hypothesis that women would recall unfamiliar faces' eyes and mouths more accurately than men was not supported by the current research. In fact, men had a non-significant trend of outperforming women, as demonstrated by the 2x5 repeated measures ANOVA. The second hypothesis, that unfamiliar outer features would be recalled more accurately compared with inner-features was supported; the participants remembered hair more often than any other feature except for eyes. The jaw-line, however, was not remembered more often than any of the inner-features. Finally, the hypothesis that women would outperform men at all recognition tasks was not supported by their recognition performance, as seen in results of the ANOVA and t-tests, but was supported in their ability to more accurately rate their own performance through their self-report with the confidence scales presented.

The male participants had a non-significant trend of more accurate recognition than women. Participants most accurately identified the hair of unfamiliar faces, in comparison with all other features except for eyes. In addition, there were positive correlations between the female participant's confidence and their scores in both the eye and mouth conditions, while no significant correlations were found between men's scores and their reported confidence in any of the feature conditions. Finally, women had significantly fewer correct rejections, and significantly more false alarms than the men who participated in the experiment. As such, the only original hypothesis supported in this sample was that participants would remember hair at a higher rate than any other feature.

Results of this study support Wright and Sladden (2003), who found that hair is a significant contributor in unfamiliar face recognition. Participants in the (2003) study performed less well when they attempted to recognize faces without hair; participants most often recognized the hair of an unfamiliar face in the current experiment. Interestingly, the results of this study contradict the theory that people rely more on outer-features to recognize unfamiliar faces. Although hair was recognized more often than the jaw, mouth, or nose, it was not recognized more often than the eyes. This finding indicates that the jaw, an outer-feature, was not recognized more often than any of the inner-features. These results support Want et al.'s (2003) contention that since inner-features are more consistent than outer-features, we tend to depend on them for recognition of unfamiliar faces.

Though the original hypothesis was that outer features would be remembered more often than inner, there was no significant difference between the ability of participants to recall eyes and their ability to recall hair. These results support findings from McKelvie (1976), who said that people were less accurate at recognizing unfamiliar faces without the eyes than they were when the stimulus face was shown with eyes, implying the integral importance of that feature in facial recognition. It is also in support of Seamon et al. (1978) who found that when recognizing forward-facing unfamiliar photographs, eyes were recognized more often than noses; these data support the current finding that noses were remembered significantly less than hair, while eyes were not. This may be because eyes and the general bone structure surrounding them are one of the largest features on the face. It may also be due to how unique eyes are to each individual. If people are encoding features in hopes of later recognition, examining the largest and most unique features first would be extremely logical.

**Reasons for Gender Differences in Ability.** There is precedence in the literature for the finding that men had a trend of performing better at the current recognition task. Vassallo et al.

(2009) found that men spend significantly more time observing the lower-portions of unfamiliar faces as compared to women. The researchers attributed this behavior to a male proclivity to concentrate on harder-to-remember portions of the face. Men's inclination to study the more difficult-to-recall portions of unfamiliar faces may be due to their use of a feature's relationship to other facial features for recognition purposes, rather than a feature's individual characteristics. If men are looking at the spatial-relations of features, it would make sense to study those that seem harder to remember. For example, though the mouth may be harder to identify individually than the eyes, it might serve as a better spatial cue because of its more central placement and orientation on a face. This gender-dependent tendency to study harder-to-remember features is what may have given men an advantage in the current study.

Research by Cellerino et al. (2004) offers an additional explanation for why men may have better feature recognition accuracy. These researchers not only showed the already well-established same-sex bias (women had an easier time remembering women's faces and men had an easier time remembering men's), they also found that men and women's faces are processed differently by each gender, and that women's faces needed much less blurring to make them unrecognizable. If Cellerino et al. (2004) are correct, it implies that the female participants in the present study may have already been at a disadvantage; men not only recognize men more often and accurately, but male faces are more easily recognized than women's at the same level of blurring.

Results from the current study may be evidence of women observing the face holistically, while men observe and process the face by relating individual features to one another. In other words, women are attentive to the face in its entirety during encoding and use general facial structure as a cue for recognition, while men see it piece-by-piece. This would explain why women typically perform better at facial recognition, and why blurring the general structure

would greatly reduce their ability. Men appear to use features as pieces of a puzzle; one piece's relation to another piece cues familiarity. This processing would have an advantage in a test using the blurring technique because each feature still has reference to other features (size, space between) and a clear placement on the face; while women were observing a blurred face and processing only the feature that was not pixelated, men were processing that feature plus its placement, size, and reference to other features.

**Investigating Differences in Awareness.** Although women did not out-score men on identifying unfamiliar features, they were more aware of how well they were performing on the test. The women's test scores positively correlated with their confidence, while the men's scores were unrelated to their perceptions of how well they were doing. The female participants did not obtain higher scores than their counterparts, but they were more aware of their own successes and failures. This higher accuracy may be due to women realizing their typical "cue" for recognition was not available during testing, meaning women may actually have a better sense of what they are encoding when viewing faces.

Future research should investigate this hypothesis by having men and women observe unfamiliar faces while recording their eye movements. After observing the unfamiliar faces, participants should be asked to record which facial feature feature they were paying most attention to in descending order. Their responses should be compared with their eye movements in order to gather a sense of how aware participants are of where their attention is being placed. A later recognition task should ask which feature was used most for reference, again comparing recognition with eye movements and previous self-reports. If this hypothesis is correct, women would more accurately report what they were observing and what was used for recognition.

While women were more aware of their performance, they were no more accurate than the men as measured by the number of correct rejections, or false alarms (false positives) they

committed when they viewed faces that had not been presented previously. During the recognition phase of the test, women, more often than men, incorrectly labeled the faces they had not actually seen before. Female participants had significantly more false alarms and significantly less correct rejections than men, meaning they had labeled more faces as “old” than men did. This higher level of inaccuracy in rejecting the unfamiliar may be due to same-sex bias. Because women recognize women’s faces more easily (and vice versa for men), the fact that women’s faces are less recognizable at a lower level of pixilation means a disadvantage for women in this study, and an advantage for men. In other words, because women’s faces are recalled at chance with much lower levels of blurring, a woman will not only recognize men’s faces less often than their male counterparts, but they will also be at a disadvantage recognizing other women.

**Future Research.** Future research may want to investigate this further using graded pixilation, and separating the stimuli by gender (male and female photographs) to test if it is one or multiple features that are affected by blurring. If blurring a specific feature greatly reduces the accuracy of recognition it may be inferred that the feature acts as a cue for recognition. If blurring other features does not affect recognition in any significant way, it could be inferred that people do not depend on it as a cue for recognition. It may also suggest which feature men and women use when recalling unfamiliar faces of the opposite sex. By grading the pixilation of features (e.g., very pixilated/slightly pixilated) researchers may be able to reveal how sensitive each feature is to blurring, and whether it is each feature’s exact shape or its reference to other features that is important. For example, research may investigate how well men recognize a photograph of a male whose mouth has been slightly pixilated, moderately pixilated, or very pixelated. If the level of pixilation does not affect their ability to recognize the face, but their ability to identify the face is lessened compared with the mouth not being pixilated at all, it could

be inferred that the mouth is an important cue for male recognition of men's faces, but it is the position of the mouth or its relation to other features, not the shape of the mouth, that is important.

Women's higher rate of recognition may be due to a more efficient system of encoding and recalling whole faces, or it may be due to storing structural descriptions of a face (Megreya et al., 2011). Disruption of this system with a blurring technique reasonably explains the lack of significant gender differences in most feature conditions. These results support previous research showing that men and women use different cognitive processes to encode and recognize faces; it also explains the male participants' apparent, and unexpected, superiority at the current test of recognition.

In summary, these results indicate that men and women encode and recognize unfamiliar faces differently, and the manner in which faces are presented may affect the ability of either sex to accurately recognize them. Men seemed to have a higher capacity for unfamiliar feature recognition, which may be explained by previous research findings that men are more apt to pay attention to harder-to-remember features of the face. Further, it seems women are more self-aware of their performance in inner-feature recognition, though neither gender showed significant correlations between their confidence and the number of correct answers in outer-feature recognition. Finally, women were less likely to correctly reject unfamiliar faces, and more likely to label them as familiar, which may mean that the women's cue for recognition was being somehow disrupted by the methodology of this test. The *Encyclopedia of Perception* (2009) discusses these "cues" as remaining constant across any given face, but providing sufficient variability to allow for discrimination between faces. If the cue women use as an identifier was somehow disturbed by the blurring technique, it may explain their lower-than-expected performance in comparison with the male test participants.



Differences in performance may be due to women using a top-down processing approach, while men are utilizing a bottom-up approach. This would mean that women first recognize a whole face, then “break it down” feature-by-feature to recognize its individual parts. Men, on the other hand, use bottom-up processing approach in which individual parts are recognized before the whole face. Future research should investigate the process that men and women use when observing unfamiliar faces, specifically whether women use a more holistic processing, or top-down approach, and men a piece-by-piece, or bottom-up processing approach.

To test this idea, future research could have men and women draw photographs of unfamiliar faces. The way that the participants go about completing their sketch may reveal how they processed the information. For example, if women draw the face beginning with outer features, then hair and eyes, then nose and mouth, it may be inferred that this was the way the information was encoded. The accuracy of the drawings may also reveal something about the cognitive process. For example, if men's drawings are more spatially accurate than the women's, it may suggest that men pay more attention to the spatial relationship of its features compared with women. If women's drawings were more attentive to the general shape of the face and features it may suggest that women are more attentive to the structural layout of a face and its parts.

**Limitations and Reasons to Move Forward.** The current study had limitations. One major limitation was the number of male participants; only 18 of the 55 participants were male, making up only about thirty-three percent of the sample. Future researchers should recruit more equal, and larger, samples of men and women. Further, the faces were pixelated on a free online website that did not offer a numerical description of the degree of pixilation. Without a numerical label there is no way of knowing whether there were subtle differences between the photographs in the amount of blurring. Further, the photographs came from two different

collections on the PICS database. Different illumination and coloring were apparent, and may have led to some problems with recognition. Though Campbell et al. (1999) found that illumination does not affect accuracy, it is a possibility that this illumination was a factor in the way participants responded to faces. For example, if a participant was shown whole faces in one condition that were all from the same database, and then was presented with distracters from the other database, the differences in lighting may have cued him or her to whether or not that face had been presented. Finally, because there was little reward for this task, participants' motivation may have been questionable. At certain points in the study, participants were instructed to "try their hardest," but there was no way to gauge interest or intent. An unmotivated participant hurrying through the study could have obtained much lower scores than one who was interested and motivated. In order to motivate participants a small monetary reward or refreshments could be traded for their time.

Future research could account for these limitations with more equal sample sizes, more controlled editing of faces, and the utilization of one standardized set of faces. It is also suggested that future research investigate race differences, as well as gender differences, to explore the possibility of cultural/racial effects on feature recognition. Finally, it is strongly suggested that there be continued probing of gender differences in feature recognition, bearing in mind the strong possibility of cognitive differences in encoding and recognizing unfamiliar faces.

Gender is a relatively new and unstudied variable in psychology, and the results of previous research indicate very plausible differences in the way men and women process, encode, and recall information. The issues investigated in this study deserve more consideration and investigation due to possible cognitive differences between men and women. If men are more prone to encoding and recalling visual information using bottom-up processing, it may

suggest that they are more prone to remember more detailed and specific information about individual parts of an image. This style of recall may affect the way men process, view, and understand information, and is worth gaining a better understanding of in order to work most effectively with men's memory. For example, if men are prone to remembering small details before the "whole picture," it may result in recalling particular pieces of an image with great specificity, but that image may have no structure or outline. In essence, a man may remember the pieces, but have no outline to guide how those pieces fit together.

If women are more prone to top-down processing, they are essentially seeing the whole, and then breaking it down into its individual pieces (e.g., recognizing the whole face and then the features), essentially opposite of their male counterparts. This processing seems to serve women well in day-to-day facial recognition, and also explains why women are more successful at recognizing emotion; they see the face as a whole instead of attempting to understand the expression one feature at a time. If women use top-down processing to recall other visual information (besides faces), they would be more successful at remembering frameworks (e.g., general shapes or silhouettes) rather than small, specific details. This processing may result in memories that serve more as general layouts than detailed figures.

If the genders are encoding visual information using either the top-down or bottom-up approach, it is important to understand the challenges and rewards that accompany their processing style. By better understanding how visual information is encoded, psychologists may have an improved appreciation of how visual information is represented and recalled depending on gender. This information is not only interesting, but could change the way the genders are approached in situations in which visual recognition is needed. Day-to-day life, from studying for exams to eye witness testimony, may be improved through more consideration of cognitive

differences between the genders. Further investigation is needed for a more comprehensive understanding of how men and women encode, process, and recall visual information.

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Table 1

*Summary of participants' scores, and confidence ratings in each feature condition*

Mean score and confidence rating in each feature condition

	Eyes	Hair	Jaw	Mouth	Nose
Women	<i>4.6</i> / <b>22.5</b>	<i>5.7</i> / <b>26</b>	<i>4.5</i> / <b>20.8</b>	<i>4</i> / <b>19.7</b>	<i>4.1</i> / <b>17.7</b>
Standard Deviations	<i>1.3</i> / <b>7.8</b>	<i>1.2</i> / <b>4.8</b>	<i>1.1</i> / <b>6.5</b>	<i>1.6</i> / <b>8.1</b>	<i>1.6</i> / <b>7.9</b>
Men	<i>5.1</i> / <b>24.2</b>	<i>5.7</i> / <b>25.1</b>	<i>4.8</i> / <b>19.2</b>	<i>5.2</i> / <b>21.8</b>	<i>4.3</i> / <b>17.7</b>
Standard Deviations	<i>1.6</i> / <b>6.9</b>	<i>.89</i> / <b>5.8</b>	<i>1.5</i> / <b>4.5</b>	<i>1.1</i> / <b>7.8</b>	<i>1.0</i> / <b>7.3</b>

*Note.* Mean scores are italicized, while mean confidence ratings are bolded. Possible of 7 correct per each condition, and a possible high of 35 in each condition's confidence rating.

Table 2  
*Summary of participants' outcomes on two scales of accuracy based on independent t-test*

Participants' mean scores in both accuracy scales

	Scale 1	Hits	Misses	Scale 2	FA	CR
Women	62.84	52.2	10.6	78.6	15.1	63.5
Standard Deviations	8.8	12.6	5.2	8.9	5.6	13.2
Men	63.61	54.1	9.8	83	10.7	72.3
Standard Deviations	7.3	12.3	5.9	12	6.2	17.2

*Note.* First scale out of possible 90 (all certain hits) and second scale out of possible 120 (all certain correct rejections); possible 45 for misses, possible 60 for false alarms.

Key: FA=False Alarms; CR=Correct Rejections

Figure 1. Scoring of Two Scales of Accuracy Based on Participant's Response to Face and Confidence Rating

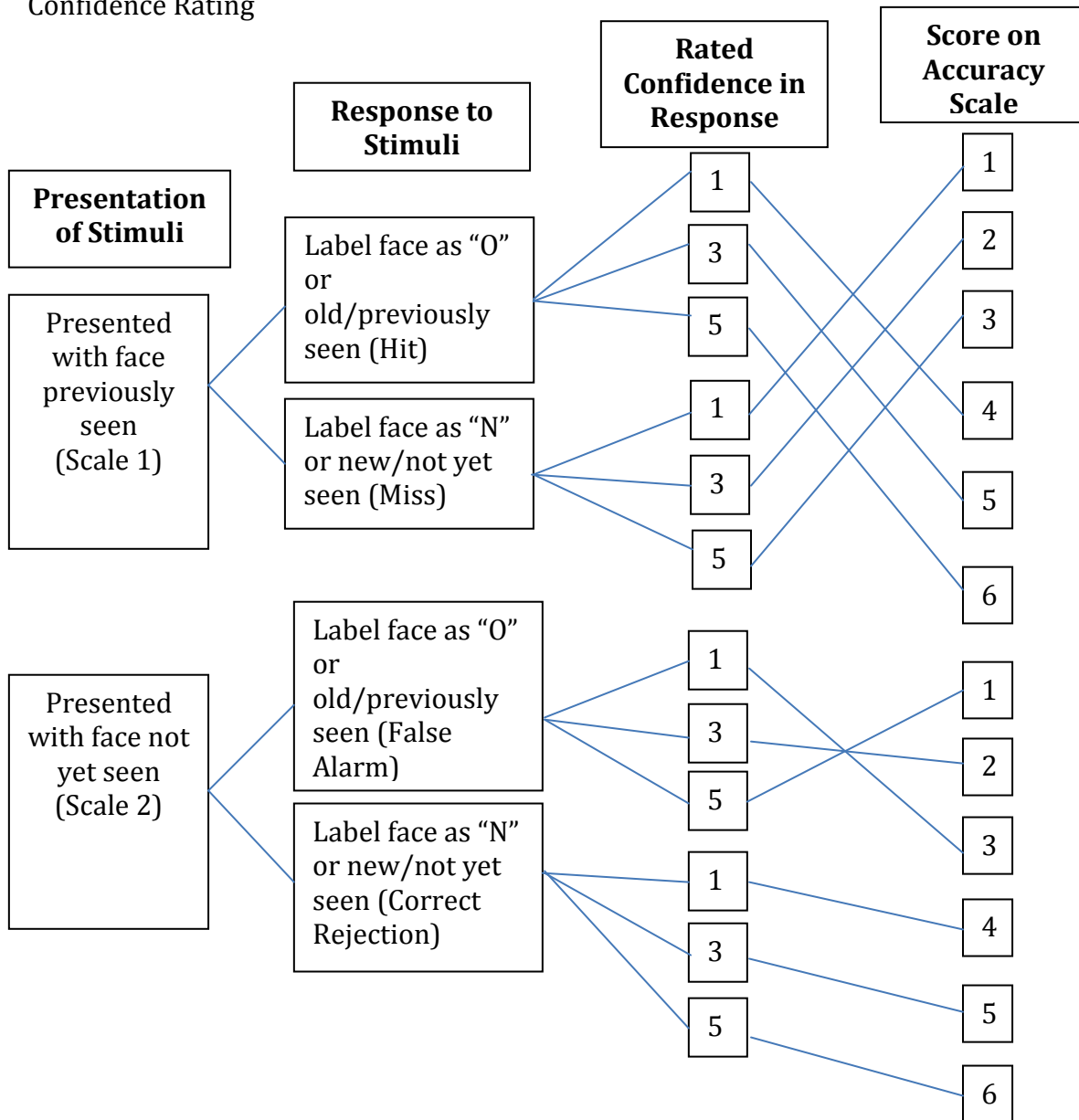


Figure 1. Scoring of the two scales of accuracy adapted from scales described in "When Does the Inner-Face Advantage in Familiar Face Recognition Arise and Why?" by R. Campbell, M. Coleman, J. Walker, P. Benson, S. Wallace, J. Michelottie, and S. Baron-Cohen, 1999, *Visual Cognition*, 6, page 197-216. Based on the first scale a participant could attain a high score of 18 in each feature condition (90 overall); based on the second scale a participant could attain a possible 24 in each condition (120 overall).

Figure 2. A Comparison of all participants' average scores in each feature condition

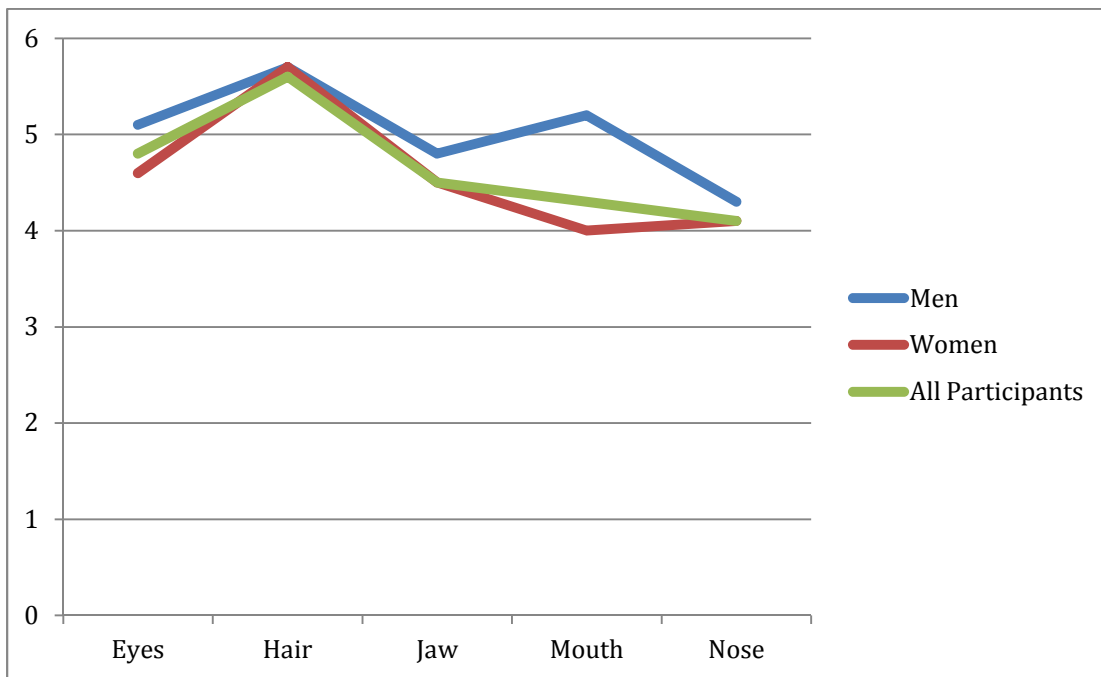


Figure 2. Lines represent participants' average scores in each of the five feature conditions. The blue line is men's scores, red is women's, and green represents all participants.

Note. Possible score out of 7

Figure 3. Comparisons of participants' mean correct responses in each figure condition vs. mean confidence ratings

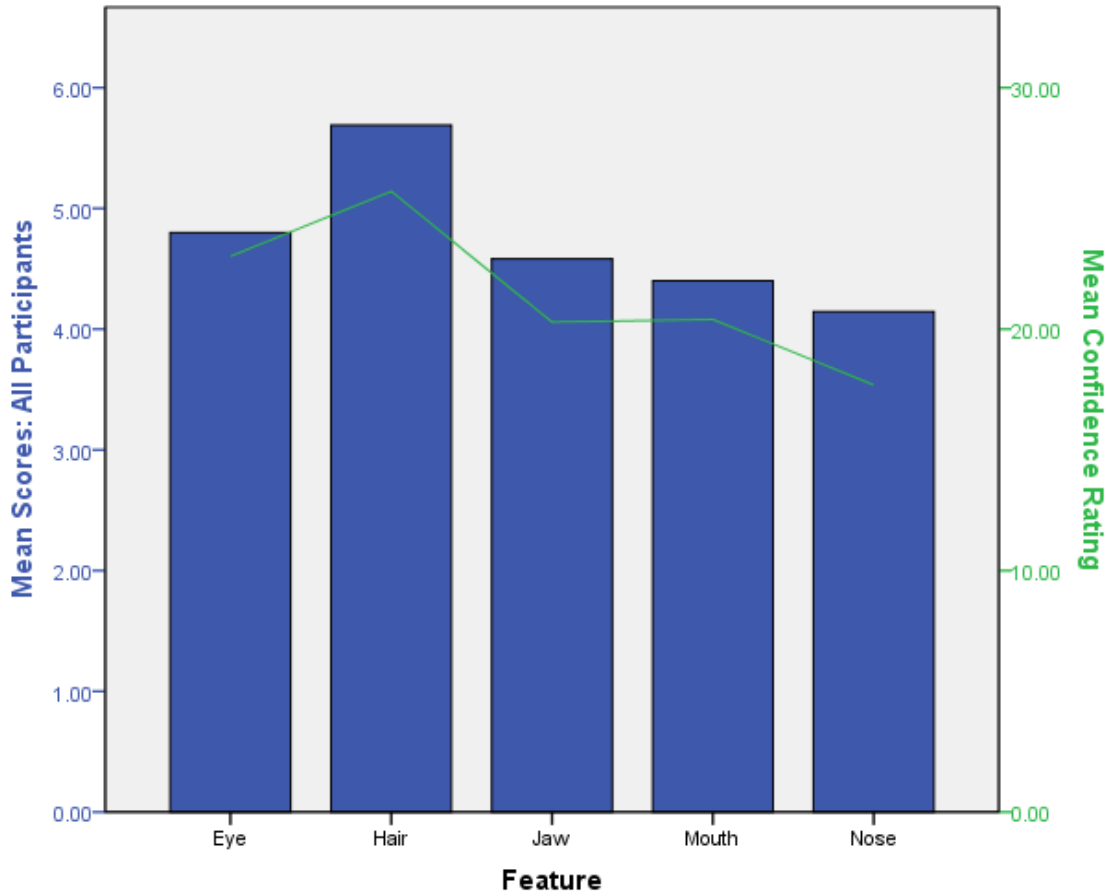


Figure 3. Participants' scores in each of the five feature conditions and their average confidence rating for each response; scores are represented by the blue bars, and the average confidence rating is represented by the green line.

Figure 4. Women's mean correct responses in each feature condition vs. mean confidence ratings

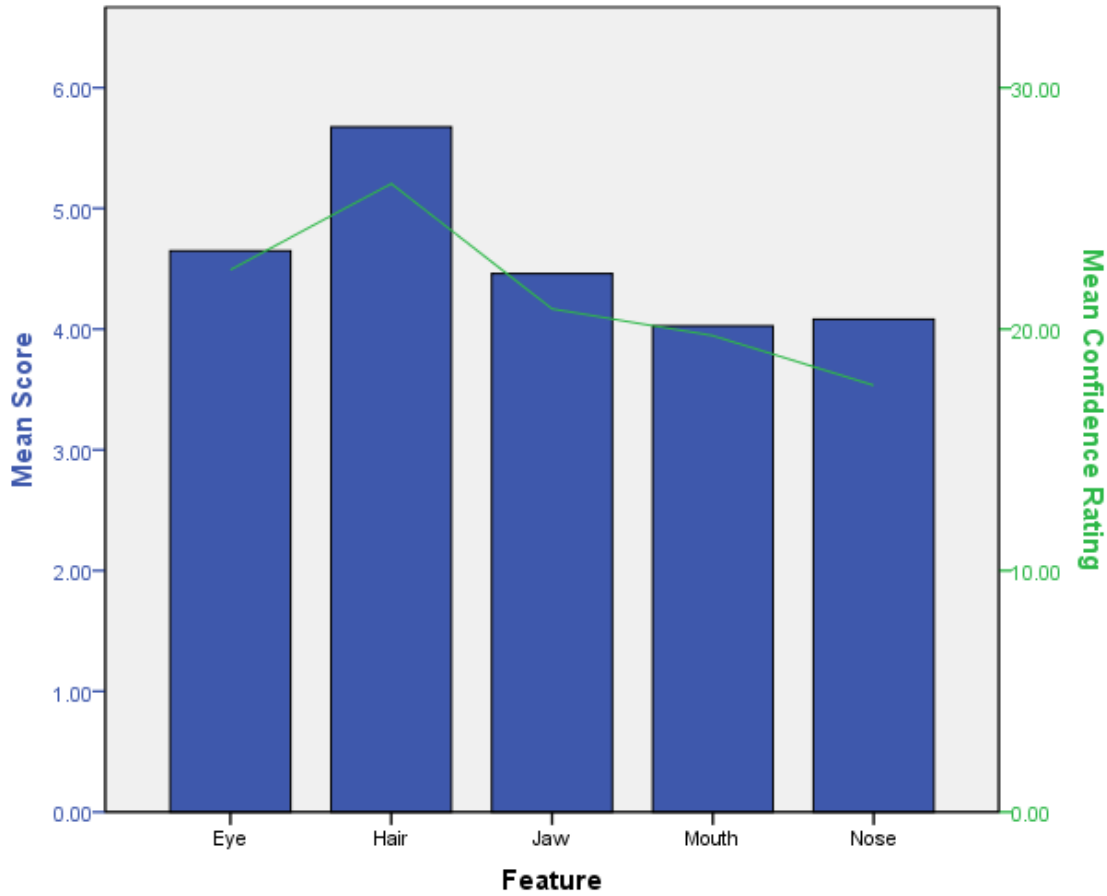


Figure 4. Women's scores in each of the five feature conditions and their average confidence rating for each response; scores are represented by the blue bars, and the average confidence rating is represented by the green line.



Figure 5. Men's mean correct responses in each figure condition vs. mean confidence ratings

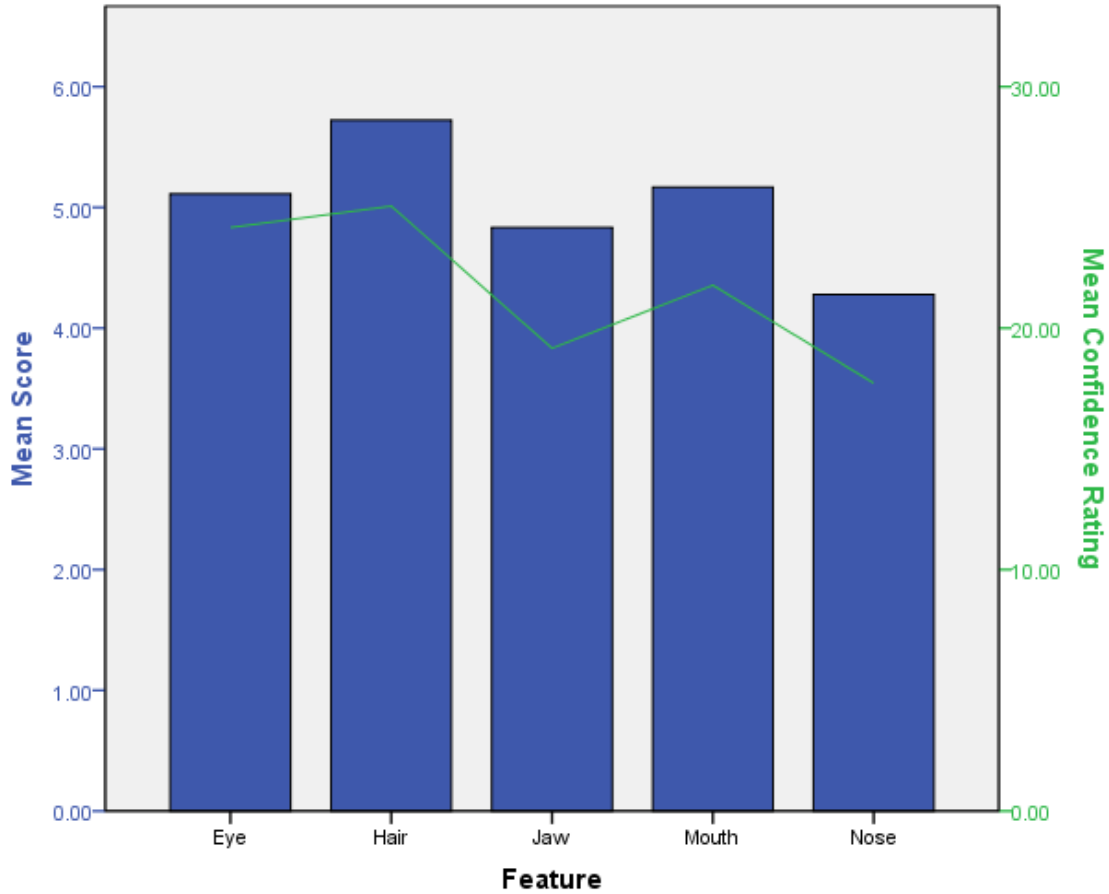


Figure 6. Men's scores in each of the five feature conditions and their average confidence rating for each response; scores are represented by the blue bars, and the average confidence rating is represented by the green line.

Figure 6. Comparison of men and women's FA and CR responses during recognition task

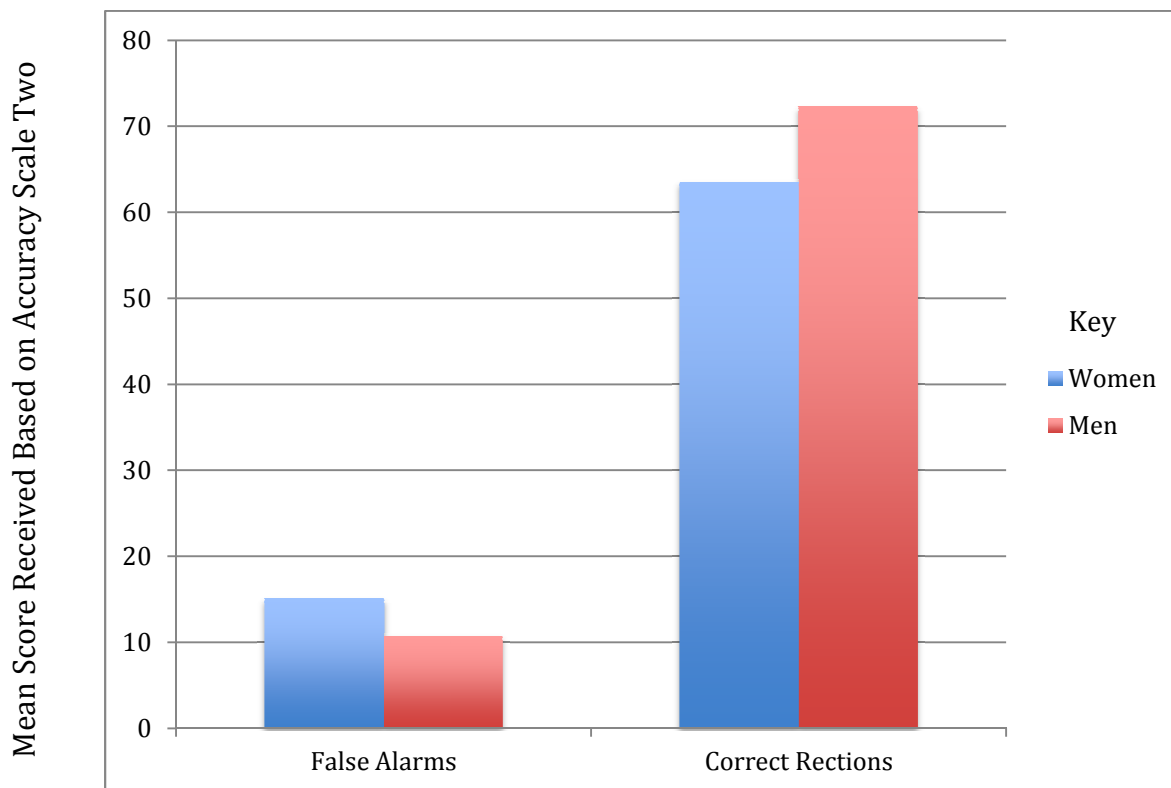


Figure 6. Comparison of men and women's average number of false alarms and correct rejections within the recognition test; FAs are represented on the left, women in blue and men in red, and CRs are represented on the right.