I Never Forget a Face!

You have an appointment to meet a friend at a busy street corner. You arrive a few minutes early and observe the faces of hundreds of people passing by. Ten minutes later you smile when you recognize the face of your friend as he or she comes down the crowded street. Out of these hundreds of faces, how is it that you are able to recognize that one face so readily?

The capacity to remember faces has fascinated many people. Carl Sagan (Cornell University) in his popular book *The dragons of eden* commented on the mystery of face recognition, observing, "No one is born with a repertoire of faces implanted in his brain."[1]

Along with our ability to recognize family and friends, there is another phenomenon that is equally interesting: Why we "recognize" a stranger as looking like someone we know. Quite recently, I saw an old Dutch painting of a man who bore a remarkable resemblance to American cinema star Robert Mitchum. About 25 years ago, I saw a painting of a boy in Hausner's Restaurant in Baltimore which could have been my seven-year-old son Stefan. I tried to buy the painting a few years back, but was refused. I had to settle for a photograph of it.

How we remember and classify faces so that we may note the similarities between them is a particularly fascinating puzzle to me, probably because I've devoted half my life to the study of non-traditional classification systems such as numerical taxonomy and citation indexing. My need to classify is so compulsive I sometimes feel like a fetishist. One of my classification fantasies is to figure out a way to categorize the portraits in the world's art galleries. If you combine this with the usually innate compulsion of a librarian or information scientist to make information accessible, you find yourself imagining an index that would tell people where in the great art collections they could find a portrait of someone whose looks were remarkably similar to their own.

While my desire to categorize portraits may not be the most pressing problem facing humanity, there are a lot of other reasons why face recognition is an area of research.

One of the most obvious applications of face recognition studies is in police work. By developing our knowledge about the face recogni-

tion mechanism it may be possible to help victims and police officers correctly identify criminals and thereby help prevent innocent people's arrests.

Another practical application of face recognition research involves the field of security. In a large corporation, government facility, or even an apartment house, only certain individuals are authorized to be admitted to some areas. Scientists are trying to develop computers which will be able to recognize automatically these "authorized" faces. Computerized identification of faces could also prevent a lot of phony checks from being cashed. The possibilities for this application were discussed in a 1973 *Scientific American* article, and have since been refined.[2]

Face recognition studies also help social scientists investigate people's attitudes toward other races—why members of one race may "all look alike" to those of another race. Learning how we might overcome this form of stereotyping could have important social implications.

Not surprising then, that the recognition of faces has received some attention over the years. A quick check of the *Social Sciences Citation Index* ™ indicates there are a considerable number of papers on the subject and several approaches to studying face recognition. Some studies focus on the viewer of faces, while others deal with the face being viewed. Papers may concentrate on eye movement, brain activity, memory processes, or attitudes and motivation. One thing is

clear—researchers do not necessarily agree on any one unified theory of face recognition. In this essay, I have included a cross-section of the recent work on the subject. The bibliography following the essay will probably be criticized as incomplete. But there is so vast a literature on face recognition, and the larger topic of pattern recognition, that it would be beyond the scope of this essay to try to discuss it all.

From my reading, it became clear that two of the primary questions in face recogniton were, "Are faces different from other things people recognize?" and the other side of that coin, "Do people process and store faces differently from other stimuli?"

In his 1975 review, Hadyn Ellis (University of Aberdeen) concludes that the processing of the face stimulus may not be any different from the processing of other complex geometrical patterns. "Faces obviously constitute a rather specialized class of visual input because of their complexity, the familiarity with which we experience them, the motivation which we have to remember them and the ways they convey nonverbal information. But as yet there is no reason to suppose that the recognition and storage of faces basically differs from that involved when other visual information is presented."[3]

In his soon to be published chapter on the origins of facial pattern recognition, Joseph Fagan III (Case Western Reserve University) supports this view. "While faces

are, by definition, a unique class of objects, the processes underlying face recognition do not appear to be unique."[4]

However, in 1975 Alvin G. Goldstein (University of Missouri) cautioned against this generalization: "The human face may be a totally unique stimulus inasmuch as it represents the sum of a host of rarely occurring interacting factors. It is difficult to think of another perceptual configuration which is as important to the human as is the face: it is a reinforcer, it also punishes, and gives several other kinds of information which affect behavior; it is the primary means of identifying all other humans in one's environment; it is the perceived source of speech...."[5] Goldstein advised future researchers not to use data from face recognition studies to build a model of the perceptual storage system as faces may not be stored in the same way as other stimuli.

Over the years several theories about how the eye scans the face in order to recognize it have been advanced. In the serial self-terminating theory, the eye is said to encode one feature after another until a decision can be reached as to whether the face is in the person's memory. The theory states that processing time tends towards a linear function of the number of features that must be encoded before a person can make that decision. Another theory, the parallel processing theory, says, "all features are processed more or less simultaneously." In the serial-exhaustive theory, all features are said to be encoded irrespective of whether a decision about the face can be reached beforehand.[6]

Recently, several UK researchers proposed yet another theory of eye movement. According to Gail Walker-Smith (University of Oxford), Alastair Gale (Loughborough University of Technology) and John Findlay (University of Durham), "Successive glances function to allow details of facial features to be entered into a general 'face' framework."[7]

For many researchers, the critical issue in face recognition is determining what part of the brain is responsible for processsing the stimulus.

In 1975, H.S. Levin (University of Iowa), K. de S. Hamsher (University of Texas Medical Branch, Galveston), and A.L. Benton (University Hospitals, Iowa City) reported they had devised a short form of a facial recognition test used to separate brain-diseased patients from psychologically impaired patients. "Application of these tests to patients with brain disease has shown that impairment in facial recognition is particularly closely associated with disease of the right hemisphere."[8]

M. Moscovitch, D. Scullion, and D. Christie (University of Toronto) also studied this aspect of face recognition. They pointed out that past research had shown "normal people usually recognize faces more quickly...when faces are presented to the left visual field, which projects directly to the right hemisphere than when they are presented to the right field, whose

projections to the right hemisphere are more indirect."[9] They found, "Only higher order processes, such as are needed to maintain a relatively permanent memory representation or to compare caricatures with photographs, require the specialized functions peculiar to the right hemisphere. Lower order, pre-categorical processes seem to be common to both hemispheres."[9]

We all know that we can remember a face we haven't seen in twenty years or so. This ability has been scientifically confirmed. In fact, the ability to recognize faces declines very little over the years, according to a 1975 study by H. P. Bahrich, P. O. Bahrich, and R. P. Wittlinger (Ohio Wesleyan University). They tested almost 400 high school graduates who had been out of school from two to 57 years to see if they remembered names and pictures of their former classmates. "Identification and matching of names and faces remain approximately 90 percent correct for at least 15 years," the researchers pointed out. "Subjects can recognize and match names and faces for several hundred classmates" even after many years, "but recall the names of only a few."[10]

Scientists are also interested in finding out why some people recognize faces more accurately than others. Their studies of "field-dependent" and "field-independent" individuals reflect this concern.

Field-dependent people are likely to rely on other people in their environment for self-definition so they pay particular attention to the people and things around them. Field-independent people, on the other hand, rely less on their environment and more on some internal mechanism to set their values and standards. Psychologists had thought that field-dependent people, with their acute awareness of others in the environment, would be better at face recognition than field-independent people. However, according to several recent studies, this is not so. Not only do field-independent people apparently process faces in the right hemisphere of the brain more often than field-dependent people,[11] but, "The evidence is now reasonably clear that field-independent individuals are more accurate in the recognition of human faces."[12]

A particularly practical aspect of face-recognition research involves the study of techniques to help people improve their recognition of faces.

Evidence presented in a 1976 study by S. J. McKelvie (Bishop's University, Lennoxville, Quebec) revealed that using verbal labels might help people recognize faces. For example, a face presented to a viewer might be labelled "scheming" or "innocent." "A verbal label functions mainly to direct attention to specific features during viewing," he said. Labels guide the "subject's examination and encoding of the stimulus during viewing and serve as mediators in the memory representation."[13]

In a 1977 paper, Bruce N. Strnad and John H. Mueller (University of Missouri) investigated levels of pro-

cessing in facial recognition memory.[14] They found that subjects asked to make judgments requiring "deep processing," such as judgments about the honesty in a face, recognized faces better when they were later presented to them than persons asked to perform "shallow processing," such as determining the sex of the person in the picture. Mueller points out that this finding is curious because common sense would indicate that concentrating on the physical features would lead to better facial memory. But instead, studying the non-physical attributes does.[15]

According to another article by Alvin Goldstein and his colleagues Blair Stephenson and June Chance (University of Missouri), some faces are easier to remember than others because they have unique features.[16] Two faces are sometimes mistaken for each other because they have one or more features in common, or because they have several features in common with many other people.

Some of the studies have concentrated on the development of face recognition capabilities in children. Louise Hainline (Brooklyn College), for example, wrote a paper in 1978 in which she presented data to support a conclusion "that it is probably not until 7 weeks or so that the human infant begins to encode salient aspects of the face (probably the eyes initially) and begins to form associations with the face based on experience with it."[17]

In 1976, Joseph Fagan III demonstrated the ability of infants of 7 months to discriminate among photos of adult male faces and among poses of the same man's face. "...The study of infant face recognition may...have practical application. Samples of infants who are likely to differ in measured intelligence later in life also differ in their ability to recognize familiar visual stimuli within the first year of life.... Empirical determination of what kinds of faces are... difficult to discriminate over the early months of life would be useful for two reasons. The first would be to provide items to be included in the measurement of individual differences in early cognitive functioning, and the second would be to provide data for theoretical accounts of infant face perception which would, hopefully, specify the processes relating to such individual differences."[18]

Children's ability to recognize faces of other-race individuals was investigated in a 1976 paper by Saul Feinman (University of Wyoming) and Doris Entwisle (Johns Hopkins). They came up with some interesting conclusions. "The data suggest that facial recognition ability improves markedly from age 6 to 8 and may improve very little from age 11 to adulthood. There is a clear tendency for female faces to be remembered better.... Black children are significantly better than white children at recognizing faces.... Blacks are significantly better at recognizing white faces than whites...are at recognizing black faces...."[19] The researchers say this may be attributed to blacks having more experiences with white

faces, for example, through watching television.

Feinman and Entwisle analyzed the significance of their findings for integration. "Contrary to what one might expect, children who attend segregated schools get higher overall scores [on face recognition tests] than children who attend" integrated schools. "The findings are that differences between own-race and other-race recognition scores are significant for all children except when the preponderance of the people in the child's neighborhood are of the other race....If, as these data suggest, facial recognition does not improve after elementary school, perhaps integration at the junior high or later grades would not affect this ability."[19]

The capacity of adult subjects to recognize other-race faces has also been studied. "Being white and actually having black friends was found to be more positively related to recognition of black faces than merely having grown up in a neighborhood or having gone to school with blacks."[20] The authors, Paul Lavrakas, John R. Buri, and Mark S. Mayzner (Loyola University of Chicago) also said in the same 1976 paper, "Field-independent white subjects are superior to field-dependent white subjects in the recognition of black faces.... The implication here is that a field-independent white policeman working in a black community may have an advantage in performing patrol duties over his field-dependent counterpart who works in the same community but who may be more likely to feel that 'they all look alike to me.' " The researchers also noted that training "significantly improved immediate recognition performances."

Roy Malpass (SUNY College of Arts & Sciences, Plattsburgh, NY) also studied other-race face recognition, or in his terminology, "differential face recognition." He attempted to derive a theoretical basis for understanding the phenomenon. However, his work has been hampered by the lack of agreed upon face recognition theory. "I believe that before we can begin to develop knowledge about exactly how recognition differentiation is created in society, whether it is a phenomenon of racism, a political phenomenon...or an accident of social experience and naive ethnocentrism, we must first have a better idea of how recognition of faces proceeds."[21]

Work on face recognition has many legal applications. For example, Helen Dent (University of Nottingham) pointed out, "Face recognition experiments have in general omitted to take into consideration the effects of the situation in which recall takes place.... The police report cases of witnesses who are too frightened to identify a person, and even adult subjects in a simulated situation report nervousness and embarrassment at having to stare at a line-up of nine men."[22] Dent performed an experiment with children, showing a live "line-up" to some and color slides to others. She found, "Those who went in front of the live parade sometimes seemed nervous, embar-

rassed and even frightened.... The children in the slides condition, on the other hand, showed no signs of nervousness....The percent of correct identifications was much greater in the color slides condition."

Goldstein's group at the University of Missouri, in the article previously mentioned, pointed out that people shown a large number of faces can usually recall many of them. Nevertheless, there are always "misidentifications" which are troublesome, especially in criminal investigations.[16]

Facial recognition tests used by the police can be biased, producing inaccurate identifications, according to Robert Buckhout (Brooklyn College, CUNY) Daryl Figueroa, and Ethan Hoff (California State University, Hayward). In their research they asked students who had witnessed an assault to pick out the culprit from photographs. One set of photos contained a picture that appeared to have been "hastily" inserted into the set. A large number of witnesses selected the "biased" photo from the set. From these findings, the researchers urged that tests used by the police be examined "for possible bias before they are admitted into evidence in court."[23]

In a lengthy 1977 article, F.D. Woocher addressed the question of the reliability of eyewitness identifications. The author explained, "In order to make an accurate identification, the eyewitness must observe or perceive the offender's face correctly, retain that complete perception without distortion in memory, and retrieve a faithful version of the remembered image when called upon to identify a suspect at some later time. The term 'eyewitness' identification refers to this entire process." The author recommends that courts allow expert psychologists to testify in cases in which conviction depends on the accuracy of eyewitness identification because they "can now point to a large number of cognitive and social factors that subtly but powerfully distort a witness' perception, memory and recall..."[24]

At the University of Houston, Ken Laughery is working on a way to use a computer to match police mug shots with sketches made using identification kits. The identification kits allow crime victims to pick from an array of features (eyes, noses, mouths), those that most closely match the criminal's features. A composite sketch is then made. If a computer could match the sketch with the mug shot photo, a probable identification could be made much more quickly than is now possible.[25]

"There are many applications where it is desirable that no human be directly involved with the recognition of the face. Industrial security and credit-card verification are two examples," Gerald Kaufman, Jr. (Hewlett Packard) and Kenneth Breeding (Ohio State University, Columbus) point out.[26] In 1976, they described a computerized facial recognition system which is "completely automatic from image acquisition through recognition." They also described

experiments to test their pattern recognition system and found that the computer "performed no worse" than human observers.

Our review of the recent literature on face recognition reveals that this field is ripe for further study. There are still many unanswered questions about how we recognize faces. Social scientists are approaching this subject from every conceivable point of view.

Some day soon their studies may converge into a single theory of facial recognition. Social scientists will have helped develop better methods of police training and more accurate security devices. Society may be able to make some of its important integration experiments more successful. And I will finally satisfy my curiosity about why I can spot a familiar face in a crowd.

REFERENCES

1. Sagan C. *The dragons of eden*. New York: Ballantine, 1977. 271 p.
2. Harmon L D. The recognition of faces. *Scientific Amer.* 299:71-82, 1973.
3. Ellis H D. Recognizing faces. *Brit. J. Psychol.* 66:409-26, 1975.
4. Fagan J F. The origins of facial pattern recognition. (Bornstein M & Kessen W, eds.) *Psychological development from infancy.*
   Hillsdale, NJ: Lawrence Erlbaum Associates, in press.
5. Goldstein A G. Recognition of inverted photographs of faces by children and adults. *J. Genet. Psychol.* 127:109-23, 1975.
6. Bradshaw J L & Wallace G. Models for the processing and identification of faces. *Percept. Psychophys.* 9:433-8, 1971.
7. Walker-Smith G J, Gale A G & Findlay J M. Eye movement strategies involved in face perception. *Perception* 6:313-26, 1977.
8. Levin H S, Hamsher K deS. & Benton A L. A short form of the test of facial recognition for clinical use. *J. Psychol.* 91:223-8, 1975.
9. Moscovitch M, Scullion D & Cristie D. Early versus late stages of processing and their relation to functional hemispheric asymmetries in face recognition. *J. Exp. Psychol.-Hum. Percep. Perf.* 2:401-16, 1976.
10. Bahrick H P, Bahrick P O & Wittlinger R P. Fifty years of memory for names and faces: a cross-sectional approach. *J. Exp. Psychol. Gen.* 104:54-75, 1975.
11. Oltman P, Ehrlichman H & Cox P. Field independence and laterality in the perception of faces. *Percept. Mot. Skills* 45:255-60, 1977.
12. Hoffman C & Kagan S. Field dependence and facial recognition. *Percept. Mot. Skills* 44:119-24, 1977.
13. McKelvie S J. The effects of verbal labelling on recognition memory for schematic faces. *Quart. J. Exp. Psychol.* 28:459-74, 1976.
14. Strnad B N & Mueller J H. Levels of processing in facial recognition memory. *Bull. Psychonomic Soc.* 9:17-8, 1977.
15. Mueller J H. Personal communication. 5 January 1979.

REFERENCES (continued)

16. **Goldstein A G, Stephenson B & Chance J.** Face recognition memory: distribution of false alarms. *Bull. Psychonomic Soc.* 9:416-8, 1977.
17. **Hainline L.** Developmental changes in visual scanning of face and nonface patterns by infants. *J. Exp. Child. Psychol.* 25:90-115, 1978.
18. **Fagan J F.** Infant's recognition of invariant features of face. *Child Develop.* 47:627-38, 1977.
19. **Feinman S & Entwisle D R.** Children's ability to recognize other children's faces. *Child Develop.* 47:506-10, 1976.
20. **Lavrakas P J, Buri J R & Mayzner M S.** A perspective on the recognition of other-race faces. *Percept. Psychophys. Phys.* 20:475-81, 1976.
21. **Malpass R S.** *Towards a theoretical basis for understanding differential face recognition.* Paper presented at: Midwestern Psychological Assn. Meeting. Chicago, IL, 1 May 1975.
22. **Dent H R.** Stress as a factor influencing person recognition in identification parades. *Bull. Brit. Psychol. Soc.* 30:339-40, 1977.
23. **Buckhout R, Figueroa D & Hoff E.** Eyewitness identification: effects of suggestion and bias in identification from photographs. *Bull. Psychonomic Soc.* 6:71-4, 1975.
24. **Woocher F D.** Did your eyes deceive you? Expert psychological testimony on the unreliability of eyewitness identification. *Stanford Law Rev.* 26:969-1030, 1977.
25. **Laughery K.** Personal communication. 11 January 1979.
26. **Kaufman G & Breeding K.** The automatic recognition of human faces from profile silhouettes. *IEEE Trans. Syst. Man. Cybern.* 6(2):113-20, 1976.