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MUG FILE PROJECT REPORT NUMBER UHMUG-2

An Analysis of Procedures for Generating Facial Images

K. R. Laughery, G. C. Duval, and R. H. Fowler.

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FORWARD

The work described in this report was one of the major tasks of the Mug File Project. The facial images produced in these experiments provided the data base for the pattern recognition algorithms developed during this study and for evaluation of our system. This significant data base will continue to be useful for years to come. Most of the basic data is included in four reports, UHMUG-6, 7, 8 and 9.

Generating this set of facial images required a significant investment of time and resources and required careful management. I want to thank the authors for their efforts which have supplied all of us in this type of research with such a rich source of information.

Ben T. Rhodes, Jr.
Project Director

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Many people have contributed significantly to the work reported in this document. Ben Rhodes, Jim Bargainer, Jim Townes and George Batten provided many ideas and much expertise. In addition to his efforts as an Identi-kit technician, Mike Mauldin played a key role in setting up procedures for the experiment on White male targets. Sharon Neyland was with us through most of the project as a sketch artist and general research assistant. She was primarily responsible for the transcription of tapes, reducing the time-line data, and countless other assignments. Our other artists and technicians, Verla Malik, Bob McCoy, Andy Meredith, Jan Hartgrove and Frank Duncan also provided dedicated service.

To these and others, we express our thanks.

Kenneth R. Laughery
Glen C. Duval
Richard H. Fowler

SUMMARY

This study explored the use of sketch artists and the Identi-kit as procedures for generating target images. Three separate experiments were carried out on different target populations: White males, Black males and White females.

In the study on White males, three artists and three Identi-kit technicians were employed. The study was carried out by having two witness subjects meet a target subject under controlled laboratory conditions. Most of these subjects were either university students or volunteers from the local (Houston) community. One of the witnesses then worked with the artist to generate a sketch while the other worked with the technician to produce an Identi-kit composite. A total of 182 images were generated on 97 different targets. In most (but not all) cases, a sketch and composite were obtained for each target.

The studies on Black males and White females were essentially the same, although less data was collected. Two artists and two technicians were employed for each study. Also, 20 targets and 40 witnesses were used in each study generating one sketch and one composite for each target.

In addition to the images, a variety of data was obtained about the targets, witnesses, and the image generation process itself. The target and witness information included physical characteristics as well as some ability tests such as imagery and verbal skills. Informaiton about the process of generating images was obtained by recording the verbal interaction during the session and by interviewing the witness afterward.

Many analyses have been carried out on the large volume of data obtained in these studies. An important nontrivial set of issues in this entire study concerns the manner in which one compares facial images. In comparing a sketch or composite to a photograph, what does one measure? How does one decide whether a particular image is a good, fair, or poor representation of a real face? Furthermore, how does one quantify this goodness-of-fit? The approach to this problem was twofold. First, a rating procedure was employed where a separate and independent group of people rated each image-photograph pair for goodness-of-fit on a six-point scale. The second analysis was based more on the practical aspects of the study. This procedure assessed goodness-of-fit on the basis of the degree of success of the pattern recognition algorithm (developed in this project) in identifying the target's face in a large set. The algorithm used physical measures of the facial images.

In general, the results of these studies have been consistent. Following are some of the findings:

1. Sketches are better representations than Identi-kit composites.

2. Differences exist between artists in terms of the quality of images produced, but technicians did not differ. This result implies that the limiting factor in using the Identi-kit may not be the skill of the technician, but rather the limitations of the technique itself. This conclusion is supported by another finding. In all cases, after an artist or technician finished working with the witness to generate the image, that artist or technician generated a second image while directly viewing the target person. Comparisons between the images from description and images from view showed significant differences (better from view, of course) with sketches, but negligible differences with composites. Thus, again, the nature of the Identi-kit technique may limit image quality more than technician skill or the witness' memory and/or descriptive abilities.

3. Correlations between the goodness-of-fit measures and imagery and verbal abilities of witnesses did show some relationships in expected directions. However, these relationships were not sufficiently strong to serve as a basis for characterizing different people as potentially good or bad witnesses. This latter point is made in the context of an idea that it might be possible to give a person a brief paper and pencil test that would indicate his potential utility as a witness.

4. Correlations between the two goodness-of-fit measures were generally insignificant; that is, peoples' rating of fit and the algorithm's assessment of fit based upon linear measures were not related. One possible conclusion from this result is that people may use different information than the algorithm in judging similarity. This possibility has implications for future algorithm development in the sense that one might attempt to incorporate heuristics that parallel the process used by people.

5. Comparisons between the three target populations indicated that the images tended to be best for White males and poorest for Black males. This result is not surprising since most of the witnesses in these studies were White, and a great deal of previous research has shown that memory for faces across races is poorer than within a race. This finding does, however, lend support to the reliability of the corss-racial effect, since most earlier studies used recognition procedures while this work involved recall.

6. A time-line analysis of the tape-recorded verbal interactions between the artists/technicians and witnesses showed that in generating sketches witnesses spent more total time, used a greater number of feature codes and moved around between features more frequently. Comparisons between target populations revealed similar time-line patterns for all target groups, indicating that the process of generating images with a particular technique may be independent of the target population.

A fourth experiment was carried out to explore another aspect of the image generation task; namely, whether or not the witness knew in advance of (or during) his exposure to the target that he would subsequently be asked to generate an image of that person. The issue here has an obvious parallel in the real crime situation in that witnesses may or may not know a crime

is being committed at the time it is happening. In the studies described above, the witnesses were always told in advance of seeing the target that they would subsequently be working on a sketch or composite. The results showed that only in the case of one Identi-kit technician did advance knowledge lead to better images.

The above findings and conclusions represent the important outcomes of this study. But there is another outcome that should prove equally important in the future; namely, a large data base about the process and products of generating facial images. The following list summarizes the variety of data compiled in this study. The data have been carefully documented and presented in the various project reports. The report number in which each type of data appears is indicated in parentheses after the data description.

1. Photographs of targets and witnesses (available in project files - not reproduced in reports)
2. Sketches of targets from witness descriptions (UHMUG-6)
3. Sketches of targets from direct artist viewing (UHMUG-6)
4. Identi-kit composites of targets from witness descriptions (UHMUG-6)
5. Identi-kit composites of targets from direct technician viewing (UHMUG-6)
6. Recorded protocols of verbal interactions between artists/technicians and witnesses (transcripts in UHMUG-7)
7. Informaiton on various target and witness characteristics and background (UHMUG-9)
8. Witness scores on Betts and Gordon imagery tests (UHMUG-9)

9. Witness answers to questions on Subject Comment Sheet (UHMUG-9)

10. Witness answers to questions on Interview Procedure Form (UHMUG-9)

11. Witness SAT verbal and quantitative scores (UHMUG-9)

12. Various time-line and feature code analyses from artist/technician and witness verbal interactions (UHMUG-2 and UHMUG-9)

13. Adjective descriptor dictionaries from artist/technician and witness verbal interactions (UHMUG-8)

This extensive data base will provide a rich source of information for future work on image generation.

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CHAPTER 1

INTRODUCTION

This document contains a report on a research effort that was part of a larger project to develop a man-computer interactive system for criminal identification. The specific problem addressed here concerned working with a witness to obtain an image of a target person (subject) who the witness has previously seen.

Recent years have witnessed a modest upsurge in psychological research on facial recognition. Ellis (1975) has published an excellent review of the literature dealing with this topic. Many research efforts have addressed questions and issues that have implications for the field of law enforcement.

An important factor in criminal identification concerns the memory that a witness has of a target person. A standard procedure in one type of identification is to have a witness search through a large set of photographs, a mug file, attempting to find a match for a face in his memory. The typical use of mug files actually involves the witness' memory at two stages of the process. The first memory task (the focus of this report) occurs when the witness initially encounters the identification system. This task involves an effort to recall some characteristics of the target in order to reduce the size of the file. For example, the witness may note that the target was a White male, thus permitting Black males and all females to be eliminated from the set of alternatives. The second stage involving memory is the recognition task, where the witness is looking at pictures of faces and making decisions about whether or not each face is the target person.

The man-computer identification system developed in this project places heavy emphasis upon obtaining information about the target from the witness before addressing the mug file. More specifically, an effort is made to obtain an image of the target person from the witness. This image then serves as the basis for a computerized search of the mug file in order to select "look-alikes". These look-alikes are then examined by the witness.

Law enforcement procedures in the past have included several image generation techniques. Two commonly used techniques are sketch artists and the Identi-kit. The sketch artist technique, as the term implies, involves an artist sketching the target person while getting information from a witness through conversational interaction. The Identi-kit is a set of transparent celluloid sheets, each containing a line drawing of a facial feature. There are a large number of sheets for each feature; i.e., many types of noses, eyes, etc. A trained technician constructs a composite face by interacting with a witness to select appropriate features.

Two other techniques developed more recently have also been used in law enforcement. The Photo-fit Kit was first employed in England in 1969. This technique uses photographs of real features, eyes, noses, etc., which are placed together on a specially constructed board to produce a face. The Minolta Montage Synthesizer is another example of a technique that combines features from photographs of real faces. This device, developed in Japan, is basically an optical system for filtering out parts of one face and substituting parts from another. The synthesizer is operated by a technician who interacts with the witness to select appropriate features and blend them with the

machine. While the synthesizer has been used extensively in Japan, its use in the United States to date has been limited to one or two trial installations. Development work on the synthesizer was included as part of this project and is described in Report Number UHMUG-4.

A fourth example to be mentioned here is the Facial Identification System (FIS). This technique is a very recent development that has only begun to be marketed. It consists of a special feature book in which strips containing facial features can be coordinated to produce faces. There are four sets of strips or features, each representing a different horizontal section of the face. More precisely, one set is for hair, one set for eyes, one for nose and one for mouth and chin. The witness can change any of these facial areas by simply flipping to a new strip. The advantages of the FIS are: (1) the witness can use it to generate an image without the help of a technician; (2) an image can be generated quickly; and (3) the feature books are relatively inexpensive, so it is possible for police departments to have one in every police car for rapid response to street crimes.

The work described in this report represents an effort to explore a variety of issues concerning two of the image generation techniques: the sketch artist and the Identi-kit. In a very real sense the study was exploratory in that we were hoping to discover some of the important characteristics and limitations of the techniques without having formulated all of the precise questions or issues in advance. On the other hand, a number of questions were stated at the outset, including the following:

1. What are the relative merits of the sketch artist and Identi-kit as procedures for generating facial images?
2. How much effect does the artist or technician have on the accuracy of an image?
3. What characteristics of the witness influence image accuracy and to what extent?

Overall, the purpose of the study can probably best be viewed as an effort to understand the processes involved in generating facial images and to evolve new or modified procedures for improving the outcomes.

The image generation study actually encompassed four separate experiments. Three of these experiments were similar in purpose and methodology; namely, they were concerned with the utility of the sketch artist and Identi-kit as techniques for generating facial images. The three experiments differed with regard to the target populations. Three separate target groups were White males, Black males and White females. The fourth experiment was carried out on a White male target population and was concerned with the effects of a separate task variable--whether or not the witness subject knew of the subsequent image generation assignment prior to the initial exposure to the target.

A final point concerns the use of various image generation techniques. The usual reason for attempting to obtain an accurate image of a criminal is to suggest possible suspects or to eliminate non-suspects. An experiment carried out as part of this same overall project has suggested another application. In the experiment nineteen witness subjects from the studies described in this

document returned six months to one year later to participate in a recognition task. The task consisted of attempting to identify the target person whom they had seen for a brief time and then produced a sketch or Identi-kit composite. Performance was virtually perfect. The implication of the finding is that an important use of the image generation task is to "stamp in" the target face in the witness' memory. The details of the recognition experiment are described in Report Number UHMUG-3 of this project.

CHAPTER 2

EXPERIMENT 1: IMAGE GENERATION-WHITE MALE TARGET POPULATION

As already noted in the previous section, this experiment was intended to address a number of questions and issues related to the process of generating facial images. The design and procedures of the experiment are not straightforward. In part, the design consisted of manipulating several controlled variables in a manner that falls neatly into an analysis of variance research model. For a variety of logistical reasons, however, it was not possible to obtain complete balancing across all combinations of the variables, with the result that certain statistical questions simply cannot be addressed. In addition to controlling and manipulating several variables, measures on a number of other task, target and witness dimensions were obtained. The plan was to correlate these dimensions with various performance and outcome measures in the hope of gaining further insight into the image-generating process.

Method

In this section the basic design of the image generation part of the experiment will be described. In addition, a variety of other data that were obtained will be noted in the procedure section.

Subjects. The subjects can be divided into two groups, those who served as targets and those who served as witnesses. A total of 97 target subjects (TS) were used, all White males. The TSs were drawn from several sources, including students at the University of Houston and the Houston community at large. The only

restriction placed upon the selection of these TSs, beside being White males, was that they be unknown to the witness subjects (WSs), the sketch artists and the Identi-kit technicians. There were 182 WSs. No resteictions were placed upon the selection of these subjects. Appendix A presents a variety of descriptive information about the TSs and WSs. All subjects were paid $2.00 per hour for participating.

Task. There were two phases in the basic experimental task. The first phase was the exposure of the TS to the WS. This exposure or encounter consisted of a conversational interaction between TS and WS. The interaction followed instructions to WS that he/she would subsequently be working with a sketch artist or Identi-kit technician to create the target image.

The second phase was the actual image generation activity. Following the TS-WS conversational encounter, the WS was escorted to another room where he/she worked with either a sketch artist of Identi-kit technician to create the image. Details regarding both phases of the task are presented in the procedure section below.

Design. Two variables were manipulated in the experiment. The first was the image-generation technique, consisting of the sketch artist and the Identi-kit. The second variable, to be referred to as artist-technician, consisted of three artists and three Identi-kit technicians. The artist-technician variable was nested within technique; that is, the three artists and three technicians were six different people. Because the training and ability of these six people is crucial to the study, a brief summary of their credentials is presented in Appendix B.

As stated earlier, 182 WSs and 97 TSs were used. The manner in which TSs and WSs were paired and the assignment of WSs to artists and technicians was not balanced. The actual pairing of TSs and WSs and the assignment of WSs to artist-technicians was done in the following manner. An effort was made to have each TS exposed to two WSs, one of whom would then describe him to an artist and the other to a technician. We were successful in this regard for 78 TSs, that is, there were 78 TSs each exposed to two WSs and for whom one sketch and one Identi-kit composite were generated.

For logistical reasons, it was not possible to balance the artists and technicians with respect to TSs. Table 1 shows the number of TSs shared by the different combinations of artists and technicians.

TABLE 1

Number of Targets Completed by Different Combinations of Artists and Technicians

		Sketch Artist			
		RM	SN	AM	Total
	MM	15	4	5	24
Identi-Kit	RF	5	14	9	28
Technician	JH	4	6	16	26
Total		24	24	30	78

The remaining 19 TSs and 30 WSs were paired and assigned to insure that each artist and technician constructed a minimum of 30 images. In several cases, two WSs described the same target using the same technique, but working with different artists/technicians. The number of completed sketches was 92 and Identi-kit composites was 90.

Procedure. The procedural aspects of each regular experimental session involved six people: the experimenter (E), a sketch artist, an Identi-kit technician, a TS and two WSs. Since it was necessary to carefully control the timing and manner in which different individuals encountered each other, and because a variety of data was collected from the various individuals, a relatively complex and carefully controlled procedure was carried out. The specific steps were as follows:

1. Two WSs reported to a room where they were met by E. Upon their arrival they were asked to complete a Subject Data Form which required approximately five minutes. This form asked for information about the WS, including certain physical characteristics. A copy of the form is presented as Exhibit 1 in Appendix C.
2. After the data forms were completed, photographs were taken of each WS. The photographs included bust-length front, left profile and right profile views. If the WS wore glasses, two front views were taken, one with and one without the glasses.

   The photographs were taken with a half-frame Olympus 135 mm. camera with Ektcrome film. Actually the film was made into slides, not prints. For purposes of this report, however, samples of the pictures made for a WS have been printed and are presented as Exhibit 1 in Appendix D. The physical parameters of all slides were constant (sharpness, scale, lighting, etc.).
3. After the photographs were taken, the two WSs were instructed by E as to the nature of the experiment. A sample set of

instructions is shown in Exhibit 1 of Appendix E. This is a sample in the sense that E did not read the instructions; they were presented in a conversational fashion (having been well rehearsed).

4. While the two WSs were completing the data forms and being photographed, the TS reported to an adjacent room. After E finished with the WSs, he greeted the TS and presented instructions regarding the study. These instructions are shown in Exhibit 2 in Appendix E and were also delivered in a conversational manner.
5. Following the instructions, E escorted the WSs to the room where TS was waiting. It should be noted that all three subjects at this point were aware of the nature of the experiment and the nature of the image generation task. The E, TS and WSs were seated at a table (TS across from the WSs). The E then moderated a 7 to 8 minute conversation among the subjects, which we have referred to as the exposure period. To the extent possible, the discussion focused upon TS: what was his major (if student) or job; where did he live; what were his interests; etc. A sample of Es introductory remarks in this session is presented as Exhibit 3 in Appendix E. While the setting may seem somewhat strained or artificial, in actual practice it generally proceeded quite smoothly with reasonably good conversation.
6. After the exposure period, one WS was escorted to a room to work with a sketch artist to generate an image, while the second WS was taken to a room to work with an Identi-kit technician. Upon arriving in these rooms, the WSs

initially filled out a General Description Form about the TS. This form called for information about TS that was used by the sketch artist or technician as a starting point for generating the image. The forms used in the two techniques were slightly different, and are shown as Exhibits 2 and 3 in Appendix C for the sketch and Identi-kit techniques respectively. Procedures for generating sketches and composites are described in Exhibit 1 and 2 of Appendix J.

After completing the General Information Forms, the WSs worked with the artist/technician to produce the image. The verbal interaction in each situation was tape recorded using a Stenorette Embassy dictating machine. A sample of the sketch from description, sketch from view, composite from description and composite from view are included as Exhibits 2, 3, 4 and 5 respectively in Appendix D. These images, incidentally, are of the target person whose photographs are presented in Exhibit 1 of Appendix C.

7. While the WSs were working on the image generation task, TS completed the Subject Data Form, Exhibit 1 in Appendix C.
8. After completing the Subject Data Form, TS posed for photographs. The same pictures were taken of TS as described above for the WSs.
9. After the WSs finished the image generation task, they completed three additional forms. The first was a Subject Comments Sheet. This form solicited comments from WSs regarding the manner in which they carried out the task.

The form is presented as Exhibit 4 in Appendix C.

The second and third forms consisted of the Betts and Gordon tests for imagery ability. Both are paper and pencil procedures for assessing ability to carry out imagery or verbal memory activities. Samples of the Betts and Gordon are presented as Exhibits 1 and 2 in Appendix F, respectively.

10. While the WSs were completing the three forms described above, TS reported to a room where the sketch artist and Identi-kit technician produced a sketch and composite of TS while viewing him directly.

Results

A variety of information and performance data was collected in this experiment. The following list summarizes the results available for analyses:

1. Photographs of TS and WS.
2. Sketch of TS and WS description.
3. Sketch of TS from direct artist viewing.
4. Identi-kit composite of TS from WS description.
5. Identi-kit composite of TS from direct viewing.
6. Recorded protocols of the verbal interaction between WS and artist or technician.
7. Information on TS and WS contained in Subject Data Form.
8. Scores on Betts and Gordon imagery tests.
9. WS answers to questions on Subject Comment Sheet.
10. Answers to questions on Interview Procedure Form.

11. SAT verbal and quantitative scores on subjects who were undergraduate students at the University of Houston.

The results have been analyzed in several different ways, the objective, of course, being to better understand the process of generating facial images from memory and the manner in which a variety of task and subject variables affect the outcome. This section of the report will be organized on the basis of the various analyses that were carried out. These analyses include the goodness-of-fit of the images to the target as a function of the technique and artist/technician variables, correlations of the goodness-of-fit measures with a number of TS and WS characteristics, and an exploration of the image generation process as reflected in time-line data obtained from the verbal interaction protocols.

Images and Targets--Goodness-of-Fit. An important and non-trivial set of issues in this entire study concerns the manner in which one compares facial images. What does one measure? How does one decide whether a particular image is a good, fair or poor representation of a real face? Futhermore, how does one quantify this goodness-of-fit?

Our approach to this analysis has been twofold. First, we have employed a rating procedure where a separate and independent group of subjects have rated each image-photograph pair for goodness-of-fit on a six-point scale. The second type of analysis was based upon a comparison of physical measures of the images and faces, and is based more on the practical aspects of the study. This procedure assessed goodness-of-fit on the basis of the degree of success of a computer algorithm (developed as a part of this overall study) in identifying the real face in a large set. The

algorithm uses nine physical measures obtained from the image as shown in Figure 1. These two analyses will be presented in order.

The rating procedure consisted of carrying out an actual experiment in which subjects separately rated all four images with the photograph. The four images, again, were sketches and Identi-kit composites each from description and view. The ratings were collected on a total of 71 TSs; that is, of the 97 different TSs on whom images were generated, goodness-of-fit ratings were obtained for 71 of them. The reasons why rating data was obtained on only 71 TSs were primarily design and logistical considerations. The design consideration was that ratings were needed on all four images for each TS, and, as noted earlier, such data was available for only 78 TSs. The logistical problem concerned the availability of all the stimulus materials needed for the rating experiment. For 7 TSs, some image or photograph or both was not available at the time the ratings were collected. This problem was due to the fact that it took time to get slides made of the images, and it was necessary to get on with the rating experiment in order to complete it on time. Given that 71 TSs represent a considerable amount of data, we did not feel the absence of the seven additional data sets would affect the results in any meaningful way.

The similarity ratings for this image generation experiment on White males were collected at two different times; that is, the rating experiment actually consisted of two sub experiments. The reasons for this were twofold, both logistical. First, the image generation experiment was spread over a long time period and it was desirable to complete some analyses as early as possible.

Second, each subject in the rating experiment must rate four times the number of TSs; therefore, if all 71 were introduced in one session, subjects would be required to complete 284 ratings. Such a procedure potentially introduces factors like fatigue which obviously are best avoided. An analysis of the rating task led us to conclude that about 200 ratings is a maximum to expect from subjects. As a result, ratings were obtained on 51 TSs in a first experiment (51 instead of 50 was simply a convenience due to the availability of stimulus materials). A second rating experiment obtained data for the other 20 TSs as well as the 20 White male TSs from a separate image generation experiment - to be described in a later section of this report.

The methodology of the first rating experiment was fairly straight forward, although the sequencing of the pairs may seem a little complex. The task consisted of showing the subject a total of 204 pairs of slides. Each pair consisted of a TS photograph and one of the four images for that TS. The pair was projected on to a screen in front of the subject for 10 seconds. The projected images were approximately life size. The subject looked at the images, made a decision regarding the goodness-of-fit of the image to the photograph, and then indicated his rating on a response sheet. The ratings were made on the basis of a six-point similarity scale, where the two ends of the scale were defined as "most similar" and "least similar". A sample answer sheet is presented as Exhibit 5 in Appendix C.

The subjects in the experiment were 24 undergraduate students enrolled in an introductory course at the University of Houston. They received extra course credit for their participation. None

of the subjects had previously been involved in the image generation experiments.

The stimulus materials consisted of 255 slides. These included 51 photographs of TSs, and 51 each of sketches from description, sketches from view, composites from description, and composites from view. The 204 pairs presented to the subjects consisted of each TS photograph appearing four times, once with each type of image for that TS. The sequence of pairs was arranged into four blocks of 51 each. Each TS appeared once in each block. Each block consisted of approximately an equal number of occurrences of each type of image; that is, 1/4 of the images in each block were sketches from description, 1/4 were sketches from view, and so forth. (The "approximately" was necessary simply because 51 does not divide evenly by four.) Within each block, the 51 slides were further divided into three different groups of 17 each. Given these constraints of block and group arrangement, the pairs were then randomly selected.

The purpose of this rather elaborate sequencing of the pairs was twofold. First, it was important that the slides for a particular TS not appear too close together, because each rating should be independent of how good the other images matched that target. Secondly, it was desirable to balance the sequence of pair presentations across different subjects in order to eliminate practice effects. The latter goal was accomplished by running subjects individually, and using different sequencing of the four blocks for each subject. There are exactly 24 permutations of four blocks; thus, 24 subjects. In order to further decrease the possibility of sequencing effects, the three different groups

of 17 slides within each block were randomly scrambled with the constraint that each group occurred first in the block for eight subjects.

The procedure involved bringing subjects into a laboratory room where they sat in a classroom type desk. The viewing screen was located approximately 10 feet in front of them and the two Kodak carousel projectors above and behind them. The experimenter read the instrucions in an informal manner. The instructions for this experiment are presented as Exhibit 4 in Appendix E. The subject was given a set of response sheets with a pencil. A series of six sample pairs were then presented in order to further familiarize the subject with the task. The 204 pairs were then presented at a 10 second rate, with slightly longer pauses after each block of 51 for changing trays in the slide projector. In all pairs the photograph appeared on the left and the image on the right.

The second rating experiment was quite similar to the first. The task consisted of rating a total of 160 pairs, four images for each of 40 different White male TSs. The TSs included the remaining 20 from the White male image generation experiment and 20 from another experiment. This latter experiment dealt with the WS's knowledge of the task prior to seeing the TS, and as already mentioned, it will be described in a later section.

The stimulus materials consisted of 200 slides; the 40 photographs and 160 of the various types of images. As in the previous experiment, four blocks of 40 pairs were set up, and within each block three groups were established containing 13, 13, and 14 pairs. The instructions and procedure were

exactly the same with one exception. Instead of running subjects individually and using all 24 permutations of the block sequences, a latin-square design was employed. In this design, four different sequences of blocks are used in which each block occurs once in each of the four positions of the sequence. Subjects were run in groups, with a separate group for each sequence. There were 10 subjects per group, a total of 40. All subjects were undergraduate students enrolled in introductory psychology at the University of Houston, who received extra credit for participating.

An analysis of variance was carried out on the results of the rating experiment. There were four variables in the analysis: replication (the two sub experiments), technique (sketch artist and Identi-kit), artist/technician (the three artists and three technicians), and target presentation (witness description or direct viewing). The results of the analysis of variance is presented as Exhibit 1 and in Appendix G. The mean rating for each of the cells of the various experimental conditions is shown in Table 2.

The data underlying significant main effects of the technique, target presentation and artist/technician variables indicate that the images were better with sketches than composites, better when done from view than from description, and better with some artists or technicians than with others. The significant technique by target presentation interaction was due to a large difference in image quality between view and description in the sketch condition, but relatively little effect of target presentation in the Identi-kit condition. The target presentation by artist/technician interaction

TABLE 2

Image Generation Experiment - White Male Target Population

Mean Ratings on 1-6 Similarity Scale

Lower Scores Represent Better Images

		Sketch			Identi-kit		
		SN	BM	AM	RF	MM	JH
Replication 1 (51 TSs)	Description	3.5	3.5	3.6	3.9	3.9	3.8
	View	2.7	2.7	3.4	3.9	3.7	3.8
Replication 2 (20 TSs)	Description	3.7	3.5	3.7	4.4	4.6	4.2
	View	2.3	2.0	2.8	4.1	3.9	3.8

simply reflects larger differences between view and description for some artists/technicians than others.

The replication variable did not have a main effect in the results; in other words, the overall ratings were not higher or lower between the two rating experiments. However, replication did interact with technique and target presentation. The two interactions show that the effects of technique and target presentation were in the same direction but greater in the second replication.

The above analysis of the raw rating data was repeated using standardized Z-scores. The reason for the additional analysis concerns a potential problem in using ratings; namely, that different subjects will differentially interpret and use the six-point rating scale. For example, a rating of four may mean one level of similarity to one subject and a different level to another. By standardizing the scores, this difference is taken into account. All scores, were recomputed with respect to each individual subjects mean and standard deviation. That is, for a given subject each score was calculated with the following formula:

$$Z = \frac{X - \overline{X}}{\sigma}$$

where: X is the score being recomputed

$\overline{X}$ is that subject's mean score

σ is the standard deviation of that subject's scores.

The results of the analysis of variance on the standarized Z-scores are shown in Exhibit 2 of Appendix G. Three effects were significant in this analysis that did not reach significance in the

analysis of the raw scores: the main effect of replication; the replication by artist/technician interaction; and the replication by technique by target presentation interaction. The mean Z-scores for the different conditions are shown in Table 3. The ratings for the second replication indicate that the images were judged to be poorer than in the first replication. It is not clear why this difference exists, except that in replication 2 the ratings of the images from this study were collected with the ratings from the knowledge-no knowledge study (described later in this report). It may be that the mixing of images from the two image generation studies accounts for the difference, although it is not obvious why. It could also be due to the fact that the rating studies were run at different times with different subjects, and they may have used the scale differently.

The replication by artist/technician interaction was possibly the result of not using the same artists and technicians in the two studies (two were common to both studies and two were different). Hence, there may simply have been differences in skill levels.

The replication by technique by target presentation interaction reflects the fact that there was a larger difference between sketches done from description and view in the second replication. Again, this difference may be due to the fact that the sketch artists in the two replications differed with respect to their relative abilities to do sketches from description versus viewing.

As noted earlier, a second dependent measure used to assess the goodness-of-fit of the images was based upon physical measures of the images and faces. Ten physical measures were defined--nine linear distances and the chin angle. The definitions of these

TABLE 3

Image Generation Experiment - White Male Target Population

Similarity Rating Data, Mean Standardized Z-scores

Lower Scores Represent Better Images

	Sketch	Identi-kit
Description	.01	.38
Replication 1		
View	-.39	.61
Description	.01	.47
Replication 2		
View	-.34	.93

measures are shown in Table 4 and Figure 1. These particular measures were selected in consultation with a physiologist whose areas of specialization included the physical anthropometry of the head. They represent a set of dimensions that are meaningful in terms of defining properties of the face and obtainable in terms of the precision with which they can be measured. Also, they represent what might be regarded as "permanent measures"; that is, they are not based upon features that are readily changeable such as hair, glasses, mustaches or beards.

The nine linear measures, excluding the chin angle, served as the basis for constructing the dependent measure. In the overall identification project of which these studies were a part, a computer algorithm was developed for selecting look-alikes from a mug file. This algorithm was an integral part of the dependent measure. Before actually defining the measure, a brief overview of the manner in which the algorithm works is in order.

The algorithm requires the nine facial measurements as primary input. Each step of the algorithm performs a transformation on these measurements or ratios of these measurements. The measurements can be taken from a sketch or composite representation of from a photograph of the subject. The unit of measurement used in determining the distances is inmaterial as long as the same unit is used for all nine measurements.

In the first step of the algorithm, the measurements, which are listed in Table 4, are paired to form eight ratios. Tables 5 and 6 depict the two different sets of ratios that are used by the look-alike algorithm depending upon whether the image supplied

TABLE 4

Physical Measures of Faces

Measurement Number	Definition of Measurement
1.	Internal Biocular Distance
2.	External Biocular Distance
3.	Nose Width
4.	Mouth Width
5.	Distance Across Face Measured Directly Under Nose
6.	Distance Across Face Measured Across Mouth
7.	Nose Length from Tip of Nose to Midline of Eyes
8.	Distance from Chin to Eyes
9.	Distance from Lower Lip to Eyes
10.	Chin Angle

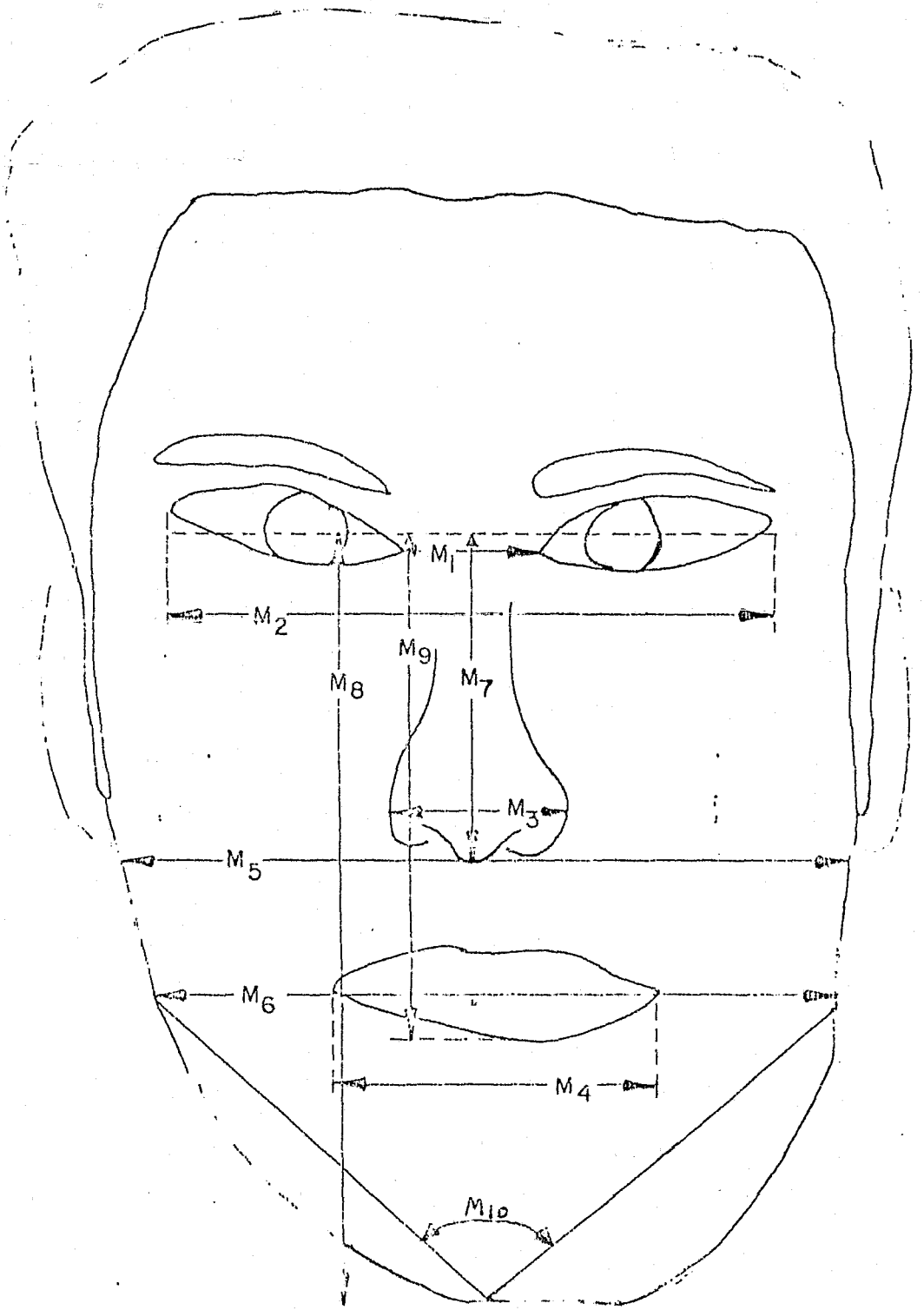


FIGURE 1

Definitions of Physical Measures

TABLE 5

Sketch Ratios

Ratio Number	Measurements Used
1.	2/8
2.*	5/8
3.*	3/8
4.	5/2
5.	6/2
6.	6/8
7.	3/6
8.	9/3

*Not used when comparing two sets of ratios.

TABLE 6

Composite Ratios

Ratio Number	Measurements Used
1.*	8/3
2.*	9/8
3.	5/3
4.	6/3
5.*	2/8
6.	2/9
7.*	3/1
8.	1/8

*Not used when comparing two sets of ratios.

is a sketch or a composite. Ratios formed from photographic measurements are standardized by dividing by the respective standard deviation. Ratios formed from a sketch or composite representation are not standardized.

The second step of the algorithm modifies the ratios generated from a sketch or composite representation. Ratios formed from photographic measurements are not processed by this phase of the algorithm. The first operation is a sixth order linear regression on each ratio. Then, a multi-linear regression is used to further modify the ratios. The value of the regression coefficients differs depending on whether a sketch or composite is used.

In the final step of the algorithm the Ecludian distance between the selected ratios of the image supplied and each mug shot is calculated. These distances are then sorted in ascending order of similarity (shortest distance) between the subject and the mug file photographs.

A complete description of the algorithms developed in the project is available in Report No. UHMUG-13. This brief overview, however, provides a flavor of the general approach and indicates the type of output provided by the algorithm. It is this output, an ordered list of look-alikes, from which the second dependent measure was the position in the list that the actual target photograph occupied.

The reason for selecting this particular measure as opposed, to the actual Ecludian distance between the image and the target photograph can be understood by noting a point made in the above algorithm description. The algorithm actually uses two different sets of ratios depending upon whether the image is a sketch or

composite. The reason for this procedure is simply that different versions give better outcomes as a function of the type of image. Thus, using the distances in comparing techniques would be analogous to comparing apples and oranges; the numbers mean different things.

We have, therefore, turned to an indirect measure; namely, how well the image fares in leading to the target person in the look-alike selection process--its position in the ordered list of alternatives. Given this definition of the dependent measure, an important issue is the set of alternatives (the mug file) through which the search is made. In the present study on White male targets, the target population itself was used as the set of alternatives. Sixty-seven data sets were available for the analyses, a data set consisted of the facial measures on the target photograph and the four images of that target. It was not possible to carry out the ranking analysis on all targets for each of the four image types, however, since there were missing data points on several images. The reason for the missing data is straightforward; some aspect of the image (glasses, beard, etc.) precluded obtaining some critical measurements. The number of data points obtained for each of the image types was:

Sketch-Description	62
Sketch-View	62
Identi-kit-Description	66
Identi-kit-View	67

There are a few more data points for composites than for sketches, as would be expected since all measures are more likely to be obtainable in the composite images. For example, in constructing a composite, accessories such as glasses and beards are superimposed on basic features, and by simply removing the accessory foil the measures can be obtained. The raw data (rankings) for each target in each image condition is presented in Exhibit 2 of Appendix H. The mean ranking for the target photograph for each of the image types is shown in Table 7.

TABLE 7

Mean Ranking of Target Photographs

	Sketch	Composite
Description	26.55	32.18
View	27.48	33.58

A series of t-tests was carried out to examine several comparisons of interest. The results of these tests are shown in Table 8. The mean rankings shown above as well as the t-tests comparing the different conditions to chance indicate that the performance of the algorithm in selecting the actual target photograph was not impressive, particularly in the case of composites where the ranking was not significantly better than chance. From Table 8 it can also be seen that no significant difference existed between the description and view conditions for either technique. This result is consistent with the outcome of the rating measure for the Identi-kit; but the ratings showed significant differences between the sketches from description and view.

TABLE 8

White Male Image Generation Experiment

Results of T-Tests on Algorithm Ranking Data

Comparison	Degree of Freedom	t value	Significance p <
Composite Description - Chance	65	.56	n.s.
Composite View - Chance	66	.14	n.s.
Sketch Description - Chance	61	2.39	0.10
Sketch View - Chance	61	2.12	0.025
Composite Description - Composite View	131	.49	n.s.
Sketch Description - Sketch View	122	.27	n.s.
Composite Description - Sketch Description	126	1.67	0.050
Composite View - Sketch View	127	1.80	0.050

For both the description and viewing situations, the sketches led to significantly better rankings than the composites. This result is consistent with the outcome of the ratings.

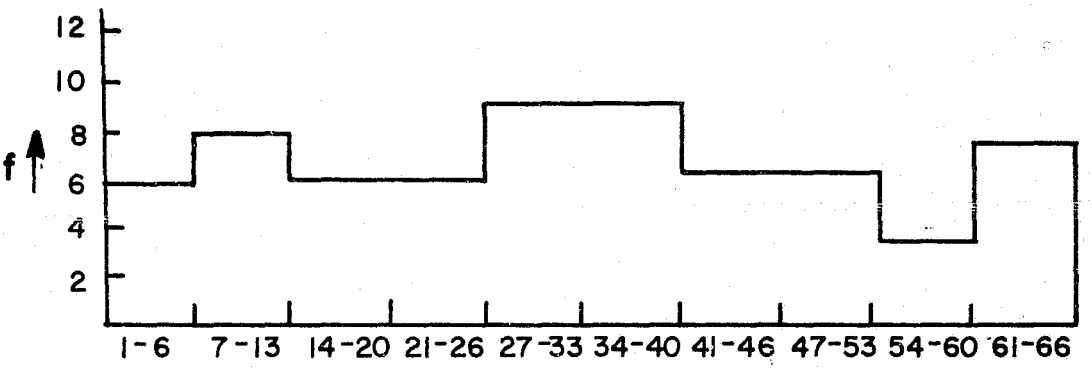
The distribution of the rankings for the sketches and composites from description are presented in Figure 2. These histograms show the frequency of ratings. The relatively level distribution for the composites reflects the chance performance of the algorithm. The distribution for the sketches, on the other hand, reflects the greater frequency with which the correct target was ranked higher (lower numbers) when the image was a sketch.

Correlations: Goodness-of-Fit and WS Characteristics. As noted earlier, a variety of information was collected in addition to the images. This information included scores on the Betts and Gordon imagery tests and SAT verbal and quantitative scores. It is reasonable to speculate about a possible relationship between these measures of imagery and verbal abilities of WSs and the quality of images produced. Obviously differences in imagery ability could result in differential memories of the target face, and different verbal abilities could lead to better or poorer descriptions.

One reason for being interested in the relationships between these WS characteristics and the quality of images produced is the possibility of distinguishing between good and poor witnesses. If reasonably straightforward and brief techniques (such as some of these measures) were available for assessing WS abilities, and if these measures correlate with image quality, one would be in a position to put more or less confidence in a particular image. Similarly, if strong correlations exist, further research might

COMPOSITE DESCRIPTION

$\bar{X}$= 32.18, N = 66



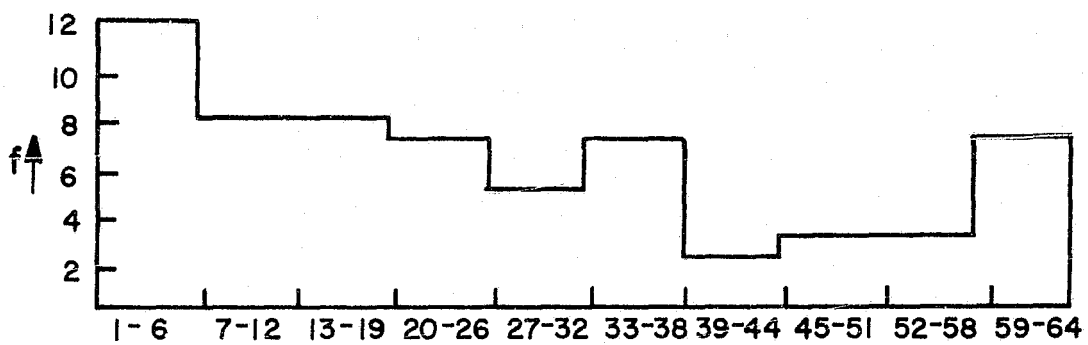
RANKS

9 12 9 9 14 14 9 9 5 11

PERCENT IN EACH 10% INTERVAL

SKETCH DESCRITION

$\bar{X}$ = 26.55, N=64



RANKS

19 13 13 11 8 11 3 5 5 11

PERCENT IN EACH 10% INTERVAL

FIGURE 2

DISTRIBUTION OF ALGORITHM RANKINGS

be appropriate for improving the quality of images produced by witnesses expected to do poorly.

Two other types of correlations were obtained. The relationship between the goodness-of-fit measures is of interest in thinking through the issues regarding facial measurement. Also, the correlation between goodness-of-fit and image production time may help understand the relationship between image quality and time and attention devoted to the generation task.

The first correlations computed dealt with the relationship between the two goodness-of-fit measures -- ratings and algorithm rankings. The correlations for each of the image generation conditions are shown in Table 9. None of the correlations was significant. This is an interesting and somewhat distressing result, since it indicates the two measures of image quality are not related to each other. One possible explanation is simply that the bases upon which people rate similarity and the information used by the algorithm in the ranking are different.

A second set of correlations examined the relationship between goodness-of-fit and the total time used to generate images. These correlations are presented in Table 10. The rating measure did not correlate with time. The algorithm measure correlated significantly with time for both sketches and composites. However, the two correlations were reversed. A negative correlation indicates that the longer the witness worked on the image the higher in the set of alternatives (a lower number) the image was selected. With composites, the correlation was -.221. With sketches, on the other hand, there was a positive correlation, .240, indicating that the algorithm performed poorer on images that had been worked on longer. It is difficult to account for this latter outcome.

TABLE 9

White Male Image Generation Experiment

Correlations Between Goodness-of-Fit Measures

Witness Image Condition	Correlation	t	N	Significance (p <)
Sketch Desc.	-.097	-.74	60	n.s.
Sketch View	.020	.15	61	n.s.
Composite Desc.	.065	.51	64	n.s.
Composite View	.038	.30	64	n.s.

TABLE 10

White Male Image Generation Study

Correlations Between Goodness-of-Fit Measures

And Total Time to Generate Image

Goodness-of-Fit Measure	Witness Image Condition	Correlaiton	t	N	Significance (p <)
Algorithm	Sketch Desc.	.240	1.76	53	.05
Algorithm	Composite Description	-.221	-1.70	58	.05
Rating	Sketch Desc.	.055	.42	60	n.s.
Rating	Composite Description	.057	.44	61	n.s.

It whould be noted that the correlations, though significant, are small and account for a relatively small portion of the variance.

Correlations between the goodness-of-fit measures and witness imagery and SAT scores are shown in Table 11. Four correlations were significant. The negative values are expected since lower scores on the goodness-of-fit measures represent better fits. In all four cases it was the Identi-kit composite that showed a significant relationship. Two of these correlations, the SAT verbal and SAT total, overlap in that the latter encompasses the former. The magnitude of the SAT verbal relationship was relatively high, -.487, accounting for about 22 percent of the variance.

Overall, the results of these correlations are not striking. The only thread of consistency was that the composite from description did correlate with several imagery and verbal abilities, indicating that a mild relationship may exist between these abilities and the quality of composite the person generates. However, the pattern was not sufficiently clear nor the magnitude of correlations sufficiently high to warrant a serious attempt to use these characteristics in assessing the potential value of a witness.

Time-Line Analyses. During the actual process of generating the images, tape recordings were made of the verbal interactions between the artists/technicians and witnesses. These interactions were subsequently transcribed, and copies of the transcripts have been combined into one of the reports from this project -- UHMUG-7.

The tapes for 62 of the verbal interactions were analyzed in detail. The first step in the analysis was to identify and define the various facial features. Twenty-three features were defined

TABLE 11

White Male Image Generation Experiment

Correlations Between Goodness-of-Fit Meausres

And Various Witness Characteristics

Goodness-of Fit Measure	Witness Characteristic	Witness Image Condition	Correlation	t	N	Significance (p <)
Algorithm	Gordons Imagery	Sketch Description	-.112	-.860	60	n.s.
Algorithm	Gordons Imagery	Composite Description	.052	.403	60	n.s.
Rating	Gordons Imagery	Sketch Description	-.102	-.837	60	n.s.
Rating	Gordons Imagery	Composite Description	-.213	-1.740	60	.05
Algorithm	Betts Total	Sketch Description	-.008	-.060	60	n.s.
Algorithm	Betts Total	Composite Description	-.237	-1.910	63	.05
Rating	Betts Total	Sketch Description	.167	1.370	68	n.s.
Rating	Betts Total	Composite Description	-.010	-.080	67	n.s.
Algorithm	SAT Verbal	Sketch Description	.024	.130	31	n.s.
Algorithm	SAT Verbal	Composite Description	-.063	-.330	29	n.s.
Rating	SAT Verbal	Sketch Description	.015	.090	34	n.s.
Rating	SAT Verbal	Composite Description	-.487	-2.95	30	.01

Table 11 (Continued)

Goodness-of Fit Measure	Witness Characteristic	Witness Image Condition	Correlation	t	N	Significance (p <)
Algorithm	SAT Quant.	Sketch Description	-.037	-.20	31	n.s.
Algorithm	SAT Quant.	Composite Description	-.143	-.75	29	n.s.
Rating	SAT Quant.	Sketch Description	.017	.09	34	n.s.
Rating	SAT Quant.	Composite Description	-.283	-1.56	30	n.s.
Algorithm	SAT Total	Sketch Description	-.007	-.04	31	n.s.
Algorithm	SAT Total	Composite Description	-.119	-.62	29	n.s.
Rating	SAT Total	Sketch Description	.017	.10	34	n.s.
Rating	SAT Total	Composite Description	-.426	-2.49	30	.01

on the basis of the contents of the tapes and the experience of the artists/technicians. The 23 features and their definitions are presented in Table 12. These features represent a fine-grained breakdown of the face. Such fine detail is appropriate in developing a first stage classification scheme, since it is a relatively simple matter to combine features later.

Following the definition of the 23 different feature codes, the boundaries between work on each successive feature was identified on the tapes. A feature stop is defined as the continuous work on a given feature. It should be noted that the number of feature stops will exceed the number of feature codes, since witnesses typically work on a given feature-code more than once. The last step in analyzing the tapes was to note the time lapse for each successive feature stop. To summarize, the output of this analysis was the sequence in which the features were worked on the length of time spent at each.

Summaries of the time-line measures for each image generation session are presented in Exhibit 1 of Appendix I. Means for the different measures by technique and artist/technician are shown in Table 13. The technique differences are clear. In creating sketches, witnesses use a greater number of feature codes, make more feature stops, spend less time per feature stop, and use more total time.

A second analysis of the time line data focussed upon the different features. Several measures for each feature, collapsed across technique and artist/technician are presented in Exhibit 2 of Appendix I. The same measures for each technique are contained in Exhibit 3 of Appendix I. Finally, these measures by artist/technician are in Exhibit 4 of Appendix I.

TABLE 12

Definitions of Facial Features

1. Eyes
2. Nose
3. Mouth & Lips
4. Ears
5. Forehead
6. Cheeks & Cheek Bones
7. Jaw & Jawline
8. Chin
9. Hair
10. Hairline
11. Eyebrows
12. Sideburns
13. Moustache
14. Beard
15. Face Shape
16. Proportions
17. Glasses
18. Eye Color
19. Complexion
20. Wrinkles & Face Lines
21. General Expression
22. Scars & Moles
23. Neck

TABLE 13

White Male Image Generation Experiment

Means of Time Line Measures

Technique	Artist Technician	Different Feature Codes	Number of Feature Stops	Mean Time per Feature Stop (Sec.)	Total Time (Sec.)
Sketch	BM	11.6	22.0	79.5	1748.2
	AM	14.8	37.9	62.3	2361.0
Identi-kit	MM	7.7	11.3	130.7	1477.3
	JH	8.0	11.9	94.6	1126.0

The measures of interest here are the proportion of feature stops to total feature stops and the proportion of feature time to total time. These measures reflect the relative amount of time and effort devoted to the various features. Table 14 shows the five features that received the most attention for each technique. Clearly there is a great deal of consistency across techniques in how much time and effort is devoted to the various features.

It is possible, of course, to carry out many other analyses on the time line data. Several additional analyses have been completed and are contained in Report Number UHMUG-5 of this project.

Discussion

The two goodness-of-fit measures indicate that sketch artists produce better images than the Identi-kit. There are probably several factors or explanations that could account for the superiority of sketches. First, there is a limited set of alternative faces one can create with the Identi-kit, while a sketch artist can produce an essentially infinite set. Hence, with the Identi-kit there may be times (and according to technicians, there are) when "the right nose is not there." A second reason may be related to the total time difference between techniques. More time is spent generating a sketch than a composite. More time is not directly the point, however, since the time difference could be accounted for simply by the fact that the artist requires more time to produce a feature than the Identi-kit where features are simply selected. The key point is that because of the greater production time requirements of the sketch, the witness spends more time thinking about the target which may lead to a more accurate memory and description. There is a serious hitch in this

TABLE 14

White Male Image Generation Experiment

Most Attended Features in Time Line Feature Analysis

(Proportions to Totals in Parentheses)

Proportion of Feature Stops to Total Stops

Sketches		Identi-kit	
Hair	(.140)	Hair	(.151)
Eyes	(.117)	Nose	(.119)
Face Shape	(.091)	Eyes	(.113)
Chin	(.091)	Eyebrows	(.105)
Nose	(.084)	Chin	(.097)

Proportion of Feature Time to Total Time

Sketches		Identi-kit	
Eyes	(.177)	Hair	(.193)
Hair	(.174)	Eyes	(.186)
Nose	(.126)	Nose	(.149)
Mouth & Lips	(.072)	Eyebrows	(.108)
Chin	(.072)	Mouth & Lips	(.088)

explanation, however, since the correlational results showed that while total time was related to goodness-of-fit as defined by the ranking, in the case of sketches this correlation was in the wrong direction. A third possible explanation emerges from the time-line data. In generating sketches, witnesses use more codes, make more feature stops and spend less time per feature stop. These differences seem to reflect more "moving around" in generating sketches than in generating composites. The moving-around process may result in better relationships (e.g. distances) between features than a process oriented towards completing work on one feature prior to moving to another. Of course the very nature of the Identi-kit makes this latter, feature-oriented procedure more likely.

The fact that there was virtually no difference between images from description and view with the Identi-kit, has an interesting implication. It may be that a major limiting factor in the quality of composites is the Identi-kit itself, not the ability of the technicians. This idea is further supported by the fact that there was little or no difference between technicians, while there were differences between artists (see Table 2).

In general, the rankings obtained by applying the algorithm was disappointing, particularly with the Identi-kit where performance was not significantly better than chance. More will be said about this outcome in the general discussion chapter.

The correlations between image quality and witnesses' imagery abilities and SAT scores did not reflect any clearcut pattern. While the few significant correlations were in the expected direction, the overall outcome would not argue for using such

measures to assess or predict the utility of a witness.

CHAPTER 3

EXPERIMENT 2: IMAGE GENERATION-BLACK MALE TARGET POPULATION

This experiment was intended to explore the same set of questions and issues regarding the process of generating facial images as experiment 1. The target population was Black males, as compared to White males in the first experiment.

The design and procedures of experiment 2 were similar to experiment 1. In the following method section, references will be made to the appropriate section describing the first experiment where the information is the same.

Method

The basic design of the image generation part of the experiment will be described. Other measures obtained were the same as noted for the first experiment.

Subjects. Sixty subjects included 20 Black males who served as TSs and 40 who served as WSs. The WSs were selected without restriction -- race, sex, or any other criterion. Most of the subjects were students at the University of Houston, with a few drawn from the Houston community at large. Again, of course it was imperative that TSs not be known by WSs, artists or technicians. Appendix A presents a variety of information about the TSs and WSs. All Ss were either paid $2.00 per hour or given extra credit in an introductory psychology course for participating.

Task. The task was exactly the same as in the first experiment and consisted of a conversational encounter between TS and WS, followed by the image generation activity.

Design. Like experiment 1, two variables were manipulated in experiment 2. Image-generation technique consisted of sketch artist and Identi-kit. The second variable was artist/technician. In this study only two artists and two technicians were used. The artist/technician variable was nested within technique. One artist (SN) and one technician (RF) had also been employed for experiment 1. The second artist (VM) and technician (FD) were new to this part of the study. A brief summary of the credentials for VM and FD are presented in Appendix B.

Unlike experiment 1, it was possible in this experiment to have each of the 20 TSs exposed to two WSs, thus providing a sketch and a composite on every TS. Each artist and each technician generated exactly 10 images, a total of 40. In this experiment it was logistically possible to balance the assignment of TSs to artists and technicians; that is, the combination of artist and technician that worked on particular target was completely controlled. Table 15 shows this balancing of the number of TSs shared by the different combinations of artists and technicians.

TABLE 15

Number of Targets Completed by Different Combinations of Artists and Technicians

		Sketch Artist		
		SN	VM	Total
Identi-kit	RF	5	5	10
Technician	FD	5	5	10
Total		10	10	20

Procedure. The procedural aspects of experiment 2 involved the exact same ten steps as experiment 1. The same person served as the experimenter.

Results

The information and performance data collected in this experiment was the same as experiment 1 and are listed at the beginning of the results in the section describing the first experiment. Similarily, the same type of analyses were carried out on the results, including the goodness-of-fit measures, the correlations and the time-line analysis.

Images and Targets-- Goodness-of-Fit. The first goodness-of-fit analysis was based upon the results of a similarity rating experiment. This experiment consisted of having subjects rate separately all four images on a target with the photograph of that target. Ratings were obtained for 19 TSs. Actually these ratings were obtained in conjunction with ratings for 19 target images from the White female population experiment and a randomly drawn sample of 19 target images from the White male experiment. These ratings on White males were collected in addition to the ratings on these same target images described in the White male population experiment.

The rating study thus consisted of 57 different targets. Each target photograph was compared to each of the four image types on that target--a total of 228 ratings. The basic design and procedure of the rating study was the same as the first rating study on the White male population. The 228 pairs were divided into four blocks of 57 each. The rules for allocating pairs to blocks was the same as the earlier study.

Twenty-four undergraduate students enrolled in an introductory psychology course participated for extra course credit. Each subject received a different permutation of the four blocks of image-photograph pairs.

The reason for combining the different target populations into a single rating study was to be able to compare images across target populations. These comparisons will be described and discussed in a later chapter. The mean similarity rating for each Black male target is presented in Exhibit 3 of Appendix H.

An analysis of variance was carried out on the rating data. There were three variables in the analysis; technique, artist/technician and target presentation. The analysis of variance outcome is presented as Exhibit 3 in Appendix G. The mean ratings for each of the cells of the various experimental conditions is shown in Table 16. The main effects of all three variables were significant as was the technique by target presentation interaction. Again, interactions involving technique by artist/technician could not be examined due to the nesting arrangement of the variables.

From Table 16 it can be seen that sketches were better than composites, images generated from view were better than images generated from description, and there were differences between artists and between technicians. The technique by target presentation interaction reflects the fact that the difference between the images generated from view and description was greater for the sketches than for the composites.

As in the White male study, an analysis of the standardized Z-scores was carried out on the rating data. The analysis of variance table is shown in Exhibit 4 of Appendix G. The technique

TABLE 16

Image Generation Study-Black Males
Mean Ratings on 1-6 Similarity Scale
Lower Scores Represent Better Images

	Sketch		Identi-kit	
	SN	VM	RF	FD
Description	3.5	3.8	4.4	4.6
View	2.9	3.1	4.1	4.0

by target presentation interaction was not significant in this analysis, but the target presentation by artist/technician was. Mean Z-scores for the different conditions are shown in Table 17. The fact that the first interaction was not significant implies that when one takes into account individual differences in use of the rating scale, there is an effect of target presentation in both the sketch and Identi-kit procedures. The significant target presentation by artist/technician interaction simply shows that the difference between the quality of images from view and description was greater for some artists/technicians than others.

The second goodness-of-fit measure was the ranking produced by the algorithm. The same algorithm and procedure was used as described in the White male study, with the exception, of course, that in the Black male study the set of alternatives (the mug file) was different. Specifically, the set consisted of 20 Black male targets. Also, in this study, only the sketches and composites from description were analyzed.

The ranking for each of 19 different targets is shown in Exhibit 4 of Appendix H. The mean ranking for the sketches was 9.42, while for the composites the mean was 8.74. Three t-tests were carried out comparing each of the means with chance and with each other. The results of the tests are in Table 18.

TABLE 17

Image Generation Experiment-Black Male Target Population

Similarity Rating Data, Mean Standardized Z-scores

Lower Scores Represent Better Images

	Sketch		Identi-kit	
	SN	VM	RF	FD
Description	-.07	-.01	.50	.65
View	-.51	-.05	.34	.24

TABLE 18

Black Male Image Generation Experiment

Results of T-Test on Algorithm Ranking Data

Comparison	t value	Significance p<
Sketch Description - Chance	.97	n.s.
Composite Description - Chance	1.44	n.s.
Sketch Description - Composite Description	.24	n.s.

None of the differences was significant.

Correlations: Goodness-of-Fit and WS Characteristics. The relationship between the ratings and algorithm rankings for each type of image from description are presented in Table 19. Neither correlation was statistically significant, although both were close to .05 and in the expected direction.

Correlations between goodness-of-fit and total time to generate the images is shown in Table 20. Neither relationship was significant.

Several correlations were computed between the goodness-of-fit based on ratings and the imagery and SAT measures for witness subjects. The results for sketches and composites from description are presented in Table 21. None of the correlations was statistically significant.

Time-Line Analyses. Time-line data was compiled from the verbal interactions during the image generation process. The same procedures were followed as in the White male target experiment. A total of 26 sessions were analyzed. The data summaries are presented in Exhibit 5 of Appendix I. Due to a procedural problem

TABLE 19

Black Male Image Generation Experiment

Correlations Between Goodness-of-Fit Measures

Witness Image Condition	Correlation	t	N	Significance (p<)
Sketch Description	.401	1.70	17	n.s.
Composite Description	.372	1.58	17	n.s.

TABLE 20

Black Male Image Generation Experiment

Correlations Between Rating Goodness-of-Fit Measure

And Total Time to Generate Image

Witness Image Condition	Correlation	t	N	Significance (p<)
Sketch Description	-.19	-.78	19	n.s.
Composite Description	.38	1.68	19	n.s.

in the use of the tape recorder, it was not possible to derive times from the tapes for Identi-kit technician FD.

Means for the different measures by technique and artist/technician are shown in Table 22. As with the White male target population, witnesses working on sketches used more feature codes, had more feature stops, and took longer to produce the image. With the Black males, however, there was no difference between techniques with regard to mean time per feature.

In the previous chapter on White male targets, time-line results were presented that examined the time and attention devoted to different features in the different techniques. With the Black males there was not sufficient data to break down the feature analysis by technique. This feature analysis has been carried out for the overall population, however, and will be presented in a later chapter comparing target populations. The various feature measures for the Black male population are presented as Exhibit 6 in Appendix I.

Discussion

The ratings led to results similar to the White male target population. Possible explanations were advanced in the previous chapter for the superiority of sketches. The difference between images from description and view were again greater with sketch artists than with the Identi-kit, although there was a difference favoring composites from view. This interaction adds some support for the notion that the Identi-kit itself is a limiting factor in the quality of images.

The fact that the algorithm rankings were not significantly better than chance will be considered in the general discussion.

TABLE 22

Black Male Image Generation Experiment

Means of Time Line Measures

Technique	Artist or Technician	Number of Different Feature Codes	Number of Feature Stops	Mean Time Per Feature Stop (Sec.)	Total Time (Sec.)
	SN	14.0	25.0	71.7	1752.8
Sketch					
	VM	12.0	23.0	96.1	2163.4
IDK	RF	9.9	14.2	91.4	1190.2

The correlations showed no meaningful relationships between the goodness-of-fit measures and total image generation time or witness characteristics. Again, this finding indicates such measures are probably not useful for assessing the potential quality of an image or witness.

CHAPTER 4

EXPERIMENT 3: IMAGE GENERATION - WHITE FEMALE TARGET POPULATION

Experiment 3 was intended to examine the same questions and issues as experiments 1 and 2. The target population was White females. The design and procedures of experiment 3 were virtually the same as experiment 2. Indeed, experiments 2 and three were run simultaneously.

Method

In every aspect of design and procedure but one, the methodology of this experiment was exactly the same as experiment 2. The one exception, of course, was that the TSs were White females.

As in experiment 2, it was possible to balance the assignment of TSs to artist - technician combinations. Table 23 shows these assignments.

TABLE 23

Number of Targets Completed by Different Combinations of Artists and Technicians

		Sketch Artists		
		SN	VM	Total
Identi-kit	RF	5	5	10
Technicians	FD	5	5	10
Total		10	10	20

Results

The information and performance data collected in this experiment was the same as in the first two experiments. Again, the analyses included the goodness-of-fit measures, the correlations, and the time-line analyses.

Images and Targets -- Goodness-of-Fit. Similarity ratings were collected as a first goodness-of-fit measure. The similarity rating experiment on the White female images was described in the chapter on the Black male target population. Four different images were rated for each of the 19 TSs. The mean similarity rating for each White female target is presented in Exhibit 5 of Appendix H.

An analysis of variance was carried out on the rating data. The three variables in the analyses were technique, artist/technician and target presentation. The analysis of variance table is shown in Exhibit 5 in Appendix G. The mean ratings for each experimental condition are presented in Table 24.

The main effects of all three variables were significant. The images were judged to be better with sketches, better when generated from view, and better for some artists/technicians than others. The technique by target presentation interaction was significant and reflected the fact that for sketches the view condition resulted in better images while with the identi-kit no such difference existed. Finally, the target presentation by artist/technician interaction indicated that the difference between images done from description and view was greater for some artists/technicians than others.

Again, the rating scores were transformed into standardized Z-scores and an analysis of variance carried out. As with the

TABLE 24

Image Generation Study-White Females
Mean Ratings on 1-6 Similarity Scale
Lower Scores Represent Better Images

	Sketch		Identi-kit	
	SN	VM	RF	FD
Description	3.2	4.0	4.2	4.2
View	2.4	2.8	4.6	4.1

raw data, all three main effects and both interactions were significant.

The second goodness-of-fit measure was the ranking produced by the algorithm as described earlier. The set of alternatives (mug file) were 20 female targets. Only the sketches and composites from description were analyzed.

The ranking for each of 18 different targets is shown in the table in Exhibit 6 of Appendix H. The mean ranking for the sketches was 7.94 and the mean for the composites was 9.39. Three t-tests were carried out comparing each of the means with chance and with each other. Table 25 shows the t-test results:

TABLE 25

White Female Image Generation Experiment

Results of T-Tests on Algorithm Rankings Data

Comparison	t value	Significance p
Sketch Description - Chance	1.78	.05
Composite Description - Chance	.52	n.s.
Sketch Description - Composite Description	.92	n.s.

As can be seen, the sketches were better than chance while the composites were not. The difference between sketches and composites was not statistically significant.

Correlations: Goodness-of-Fit and WS Characteristics. The relationships between ratings are shown in Table 26. A high positive correlation was found for the sketches, while a modest negative correlation exists for composites. The former relationship makes sense; the latter does not.

TABLE 26

White Female Image Generation Experiment

Correlations Between Goodness-of-Fit Measures

Witness Image Condition	Correlation	t	N	Significance (p<)
Sketch Desc.	.714	3.95	17	.01
Composite Description	-.469	-2.06	17	.05

TABLE 27

White Female Image Generation Experiment

Correlations Between Rating Goodness-of-Fit Measure

And Total Time to Generate Image

Witness Image Condition	Correlation	t	N	Significance (p<)
Sketch Desc.	-.131	.53	18	n.s.
Composite Description	.06	.24	18	n.s.

Table 27 shows the correlations between ratings and image generation times. Neither relationship was significant.

The relationships between ratings and witness imagery and SAT scores are presented in Table 28. Although two correlations were statistically significant in expected directions, no meaningful pattern or relationships is evident.

Time-Line Alalyses. The time line data for the White female population consisted of 26 sessions. The Data summaries are presented in Exhibit 7 of Appendix I. Procedural problems in using the tape recorder again precluded the derivation of times from the tapes for technician FD.

Means for the different measures by artist/technician are shown in Table 29. As with the other populations, witnesses working on sketches used more feature codes, had more feature stops, and took longer to produce the image. There was a tendency for the mean time per feature stop to be longer with sketches, a finding that is opposite the outcome with White males.

The time line analyses by feature could not be broken down by technique due to data limitations. The analysis across techniques will be presented in the later chapter comparing populations. The various feature measures for the White female population are presented as Exhibit 8 in Appendix I.

Discussion

The overall pattern of results was similar to the White male and Black male populations. The ratings measure indicated sketches were better than composites. The view-description difference

TABLE 28

White Female Image Generation Experiment

Correlations Between Rating Goodness-of-Fit Measure

And Witness Characteristics

Witness Characteristic	Wintess Image Condition	Correlation	t	N	Significance (p<)
Gordon Imagery	Sketch Desc.	.23	.93	18	n.s.
Gordon Imagery	Composite Description	-.28	-1.16	18	n.s.
Betts Total	Sketch Desc.	-.11	-.45	18	n.s.
Betts Total	Composite Description	.06	.25	18	n.s.
SAT Verbal	Sketch Desc.	-.55	-2.19	13	.05
SAT Verbal	Composite Description	-.21	-.65	11	n.s.
SAT Quantitative	Sketch Desc.	.45	1.67	13	n.s.
SAT Quantitative	Composite Description	-.68	-2.75	11	.05
SAT Total	Sketch Desc.	-.06	-.18	13	n.s.
SAT Total	Composite Description	-.492	-1.69	11	n.s.

TABLE 29

White Female Image Generation Experiment

Means of Time Line Measures

Technique	Artist Technician	Number of Different Feature Codes	Number of Feature Stops	Mean Time Per Feature Stop (Sec.)	Total Time (Sec.)
	SN	10.8	22.8	92.4	2105.6
Sketch					
	VM	11.0	19.7	129.4	2510.2
IDK	RF	9.4	14.75	70.6	1014.5

was significant with sketches, but, from Table 24, there was no difference with the Identi-kit. As noted earlier, this finding may imply that the Identi-kit itself is a major limiting factor in the quality of images.

The algorithm rankings showed sketches were better than chance but composites were not. While the differences between image type was not statistically significant, it was in the direction favoring sketches. Again, however, the absolute level of performance in the rankings were disappointing.

The goodness-of-fit correlations showed no meaningful relationships (two were modestly significant) with witness characteristics. There was a strong positive correlation between ratings and rankings with sketches, which did not exist with the other populations. However, there was also a modest negative correlation between the measures in the Identi-kit technique. These inconsistancies will be considered in the general discussion chapter.

CHAPTER 5

IMAGE GENERATION: POPULATION AND ARTIST/TECHNICIAN EXPERIENCE EFFECTS

Population Effects

In the previous chapters results of the three experiments on different target populations were reported separately. It is of interest, of course, to compare the populations, since the techniques may be differentially effective on them. Direct comparisons between the populations must be made with some caution, however, because the experiments were not designed with such comparisons in mind. While the data on Black males and White females were run at the same time and with the same artists/technicians, the data on White males were obtained earlier by several months and had only one artist and one technician in common with the others. Nevertheless, population effects are of sufficient interest to warrant certain comparisons.

Goodness-of-Fit. As noted in the chapter describing the Black male target population experiment, a single rating study was carried out with population comparisons in mind. Twenty-four subjects rated the four different images for each of 57 targets. These targets consisted of 19 from each of the three target populations. The 19 White male targets rated were:

9	32	51	69
11	34	53	70
20	40	54	76
21	46	65	84
26	48	67	

The results of an analysis of variance on the rating data is shown in Exhibit 9 of Appendix G. All main effects and interactions were significant. Since primary interest here is in the population effects, only those effects involving this variable will be examined.

The main effect of target population was significant. Mean ratings for the White male, Black male and White female populations were 3.46, 3.81, and 3.68 respectively. The population by technique effect showed that the margin by which sketches were better than composites was greatest for White females and least for Black males. The data underlying the population by target presentation (description versus view) interaction indicated the greatest presentation effect for Black males and the least for White males. The third-order population by technique by target presentation was significant. The mean rating for each condition underlying this interaction is shown in Table 30. With sketches, the images from view were better than the images from description with all three target populations. With the Identi-kit, however, the viewing condition led to better images with the Black male population but not with the White male or female populations.

Time Line Analyses. As noted earlier, a number of time line measures were derived for the various facial features. Two of these measures, the proportion of feature stops to total stops and the proportion of feature time to total time, reflect the relative amounts of time and attention devoted to the various features. Table 31 shows the five features with the highest proportion of stops for each of the target populations. Similarly, Table 32 shows the five features with the highest proportions of time.

TABLE 30

Image Generation - Target Population Effects

Mean Ratings on 1-6 Similarity Scale

Lower Scores Represent Better Images

	Sketch		Identi-kit	
	Description	View	Description	View
White Males	3.33	2.59	3.89	4.02
Black Males	3.67	3.02	4.46	4.06
White Females	3.57	2.61	4.20	4.30

Table 31

Time Line Feature Analysis

Proportion of Feature Stops to Total Stops

Five Features With Highest Proportions

(Proportions in Parentheses)

White Males		Black Males		White Females	
Hair	(.143)	Eyes	(.236)	Eyes	(.126)
Eyes	(.116)	Hair	(.106)	Hair	(.120)
Nose	(.093)	Chin	(.089)	Chin	(.118)
Chin	(.093)	Nose	(.089)	Nose	(.108)
Face Shape	(.077)	Face Shape	(.088)	Mouth and Lips	(.098)

Table 32

Time Line Feature Analysis

Proportion of Feature Time to Total Time

Five Features With Highest Proportions

(Proportions in Parentheses)

White Males		Black Males		White Females	
Hair	(.181)	Eyes	(.236)	Eyes	(.221)
Eyes	(.180)	Mouth and Lips	(.151)	Hair	(.177)
Nose	(.135)	Nose	(.134)	Mouth and Lips	(.153)
Chin	(.082)	Hair	(.087)	Nose	(.129)
Mouth and Lips	(.078)	Eyebrows	(.082)	Eyebrow	(.081)

From these tables it is clear that the allocation of time and attention to specific features was similar for the different populations.

Artist/Technician Experience Effects

A factor of potential importance in generating facial images is the experience of the artists/technicians. A brief description of the training and experience of each artist/technician prior to participating in this study is contained in Appendix B. The three image generation experiments present an opportunity to examine the effects of experience gained by the artists/technicians during the study.

Each artist/technician generated a number of images. The rating measure on each of these images can be analyzed in terms of the number of prior images generated. In short, we can look at the learning curve for each artist/technician. Table 33 presents the mean rating for consecutive blocks of five images for each artist/technician for each target population.

One or two artists/technicians seemed to show improvement over sessions -- FD with Black males and VM with White females. The overall pattern is clear, however; there is little indication of any systematic change in image quality as a function of the number of images generated.

Discussion

The ratings indicate that images were best for White males, second best for White females, and poorest for Black males. These results are consistent with previous work showing that intra-racial facial recognition is better than inter-racial identification (Ellis,

Table 33

Mean Ratings - Blocks of 5 Images

Image Generation Experiments

White Males

Block of 5 Images	Sketch Artists				Identi-kit Technicians			
	SN	BM	AM	Total	MM	JH	RF	Total
1	3.11	3.37	3.31	3.26	4.55	4.13	4.07	4.25
2	3.54	3.65	3.96	3.72	4.17	3.78	3.90	3.95
3	3.90	3.85	3.78	3.84	4.43	4.22	4.29	4.31
4	3.78	3.14	3.94	3.62	3.27	3.31	4.02	3.53

Black Males

Block of 5 Images	Sketch Artist			Identi-kit Technicians		
	SN	VM	Total	RF	FD	Total
1	3.42	3.68	3.55	4.21	4.59	4.40
2	3.67	3.68	3.68	4.62	3.60	4.11

White Females

Block of 5 Images	Sketch Artist			Identi-kit Technicians		
	SN	VM	Total	RF	FD	Total
1	3.29	4.30	3.79	4.57	4.04	4.31
2	3.16	3.72	3.44	4.03	4.39	4.21

CONTINUED

1 OF 3

1975). Since most of the witness subjects and all of the artists/technicians were White, the explanation is probably related to a familiarity factor.

The population by technique by presentation interaction reflects a pattern that was described in the earlier chapters. The view-description difference existed for all three populations with sketches, but only in the case of Black males was there a presentation effect with the Identi-kit. As already noted, this outcome may imply limitations of the Identi-kit technique. The view-description difference in the case of Black males may be due to the poor quality of images in the description condition, where witnesses' inability to describe Blacks may be a factor.

The time-line analyses showed essentially no differences in the allocation of time and attention to features as a function of population. An analysis of Table 31 indicates that in one sense this outcome is not surprising; the most attended features are the major features -- eyes, hair, nose, etc. Nevertheless, the results do suggest that the manner in which faces are perceived, remembered and images produced are not a function of race or sex.

The lack of any learning effect with artist/technician experience may reflect a couple of possible explanations. First, it may be that the initial, pre-experimental training resulted in asymptotic performance. Second, it could be that twenty images was not a sufficiently long period to examine improvement. This explanation seems unlikely, since learning effects in such tasks usually show up in the early phases of training. Whatever the explanation, it seems clear that improvement in the ability of an artist or technician is less than significant in the early stages of practice.

CHAPTER 6

EXPERIMENT 4: IMAGE GENERATION - ADVANCE TASK KNOWLEDGE EFFECTS

The fourth image generation experiment had a purpose different from the other three. Specifically, this experiment explored the effects of a separate task variable; namely, whether or not the witness knew in advance of seeing the target that he/she would subsequently be asked to generate an image of the target.

This question is interesting in the context of law enforcement procedures, since it may have implications regarding the confidence one might have in the accuracy of an image produced by a witness. The somewhat parallel situation in the real world would be a person observing a crime and knowing or not knowning a crime is being committed at the time. The prediction one would probably make is that in the knowing situation the witness will produce a better image since he/she will "pay more attention" to the criminal. However, there may be situations where the witness' reaction to the knowing situation could be sufficiently distracting to result in a poorer memory. The real world trauma cannot realistically be created in the laboratory, so the second effect is not considered to be a part of the conditions of this experiment. The attention effect, however, might operate and produce better images when WS knows of the subsequent generation task.

Method

The design and procedure for this experiment were the same as in experiments 2 and 3, except, of course, half (20) of the WSs received instructions for the know condition and half (20) for the not-know condition. The (know-not, know) variable was balanced

across the other variables. Half the sketches/composites done by each artist/technician were done with WSs in the knowing condition and the remaining half with WSs who did not know.

The artists and technicians who participated in this experiment were the same as in experiments 2 and 3. All TSs were White males.

An important issue in an experiment like this is the manner in which one creates the know-not know conditions. Our approach was instructional; that is, when the WSs were instructed as to the nature of the experiment, different instructions were given for the two conditions. Instructions given for the knowing condition were the same as in the earlier studies and are shown in Exhibit 1 of Appendix E. The instructions for the not-know condition are shown in Exhibit 5 of Appendix E and warrant some additional comment. In an experiment such as this where one is going to test a subject's memory but doe not want him/her to know about the test until after the information exposure, it is often necessary to provide an alternative reason to the subject so as to get him/her to give some amount of attention to the information (target in this case). The reason is straightforward. If some such instruction is not given, the WS might never look at the TS. Under such circumstances there would be no memory of TS at all - which is not the issue in this experiment. So the goal of the instruction is to get the WS to look at the TS but without knowing of the subsequent task. As the instructions in Exhibit 5 of Appendix E indicate, WSs were led to believe that they would subsequently be asked to rate the TS with regard to various personality characteristics.

After the exposure period the WSs worked with either an artist or technician to produce an image. However, before starting work on the image, all WSs who had received not-know (personality rating) instructions were given a short Personality Rating Form to be completed. The form is presented as Exhibit 6 of Appendix C. The purpose in doing this was to maintain the WS's confidence and cooperation in the experiment. The personality rating were not used.

Results

The information and performance data collected in this experiment was the same as in the first three experiments. Since the primary concern of this experiment was the effect of the advance task knowledge on the quality of the image, only a goodness-of-fit analysis was done. The measure of fit was similarity ratings.

The similarity rating experiment consisted of ratings on four different images for each of the 20 TSs. Actually, this rating study consisted of a total of 40 TSs, the 20 from experiment 4 and 20 from experiment 1. Details of the design and procedures were described in the section of this report dealing with experiment 1.

An analysis of variance was carried out on the ratings. The table for the analysis is shown in Exhibit 7 of Appendix G. The mean rating for each of the 16 conditions is presented in Table 34. The analysis of variance table shows the main effects of all variables were significant as were the second order interactions. As in the other experiments, performance was better with sketches and from view, and there were quality differences in the images

TABLE 34

Image Generation Study-White Males
Know/Not Know Conditions
Mean Ratings on 1-6 Similarity Scale
Lower Scores Represent Better Images

	Description				View			
	Sketch		Identi-kit		Sketch		Identi-kit	
	SN	VM	RF	FD	SN	VM	RF	FD
Know	4.2	3.8	4.5	3.8	2.7	2.3	4.2	3.1
Not Know	4.0	4.1	4.4	4.9	2.2	2.5	4.1	3.6

produced by different artist/technicians. The interactions of these variables were also as before.

The knowledge variable produced a significant main effect and interacted with the other variables. The main effect reflects better performance when WSs knew of the subsequent image generation task. It should be noted, however, that while the difference is statistically significant, it is not large. The mean ratings were 3.57 and 3.73 for the know and not know conditions respectively. The knowledge by technique interaction indicates that there is an effect of knowledge with the Identi-kit, but not with sketches. The knowledge by presentation (description versus view) interaction indicates that the knowledge had an effect when the image was produced from description but not when it was produced from view. Certainly this result is expected since the knowledge variable should not be a factor in the view condition. The knowledge by artist/technician interaction reflected differential effects of the knowledge condition as a function of the artist/technician. Specifically, the knowledge condition led to better images with VM and FD, poorer images with SN, and had no effect with RF. The third order knowledge by presentation by artist/technician interaction was also significant and reflects the same differential knowledge effects for different artists/technicians.

As in the other experiments, the ratings were transformed into standardized Z-scores and an analysis of variance carried out. The results of the analysis, presented in Exhibit 8 of Appendix G, show the same pattern as the analysis based upon raw ratings.

Discusssion

While the knowledge variable had an effect on image quality, the effect was limited primarily to the Identi-kit technique, and furthermore to one technician -- FD. It is not clear why in only this one condition should knowing versus not knowing have an effect. Possibly, the experimenter bias notion applies in the sense that this one technician is influenced to "try harder" by his awareness that a subject is in the know condition. It is virtually impossible, incidentally, to preclude this awareness, because witness subjects frequently make comments in the early phases of the image generation task that indicate the knowledge condition.

Perhaps the emphasis in the outcome of this experiment should be on the fact that in most technique and artist/technician conditions the knowledge variable did not have an effect on image quality. The explanation for this lack of effect could be due to the difficulty of simulating a true not-know situation in the laboratory.

In any case, the outcome of this experiment does not appear to negate earlier findings simply because witness subjects were aware of the task.

CHAPTER 7

GENERAL DISCUSSION

In the introduction of this report several questions were stated which were intended to provide a context for the study. Essentially, the questions addressed the three major factors in generating facial images; the technique, the artist/technician and the witness.

It should be noted that the experiments were not designed to separate completely the effects of these three factors. Rather, the purpose of this work was more molar, more applied; it was oriented towards the production system as a whole - including technique, artist/technician and witness. Yet, a number of comparisons and analyses have been carried out which reflect on the three factors and their influence on image quality. This discussion is organized around these questions as well as some other issues, such as target population effects.

Technique

The two most widely used image generation techniques in law enforcement are the sketch artist and Identi-kit. These experiments show rather clearly that sketches are better representations than composites. Some possible reasons for the superiority of sketches were discussed in Chapter 2. While comparisons between techniques are important, it is also interesting and useful to consider the absolute quality of the images. The algorithm rankings provide an indirect assessment in that they represent the outcome of a decision process for selecting the target face on the basis of the image. The results were not encourageing, especially for the

Identi-kit technique and Black male target population. It is impossible at this point, however, to know to what extent the rankings were the result of the procedures used by the algorithm or the quality of the image. Another experiment carried out as part of this overall project dealt with this same issue. Subjects were shown either sketches or composites and asked to select that target's photograph from a large set. Subjects were moderately successful in the identification indicating that the images were representative at least to some extent. This later experiment is reported in Report Number UHMUG-3 from this project.

One implication of the ranking results is that the algorithm probably requires further development. This development might involve modifications in the use of the linear measures or it might involve more basic changes in the decision process, such as using different facial information.

A point that was made earlier concerns the goodness-of-fit measures themselves. As noted, the development of appropriate measures in dealing with complex patterns such as faces is not a trivial problem. Move sophisticated measures would probably reveal a great deal about the relative and absolute value of the techniques. For example, an analysis of fit at the level of features would probably lead to a better understanding of specific strengths and weakness of the techniques. We are planning to carry out such comparisons in the future.

Artists/Technicians

The modest differences between sketch artists indicates that skill and experience may be a factor in the quality of sketches. The fact that BM, the best trained protrait artist (see Appendix B),

produced the best images added some validity to this outcome.

With the Identi-kit there were no technician differences. As noted in the earlier chapters, this outcome in conjunction with minimum differences between the description and view conditions suggests that the Identi-kit itself may be a major limiting factor. Another possible explanation for the lack of any technician differences, however, may be the similar background training and experience of the people involved. In short, the technician variable may not have represented a sufficient spread in ability to show up in these experiments.

The lack of any learning effect across the first twenty images is somewhat puzzling. The pre-experiment training and experience was not particularly extensive for either the artists or technicians, and one would expect them to improve with experience. It may be that the measures were not sufficiently sensitive to detect such changes, or that meaningful improvement does not occur until more images have been generated. Of course, it may be that the technicians achieve maximum skills quickly as do trained artists (such as those in these experiments).

In general, as the above comments imply, the nature and importance of the artist/technician as a factor in generating sketches and composites is not clear.

Witnesses

Obviously there will be individual differences in witnesses' abilities to remember and describe a target. The correlations carried out were intended to explore witness characteristics and abilities that might be related to performance in generating images. Certainly imagery and verbal abilities might be regarded as relevant factors.

While some correlations were significant in the expected direction, there was no basis for suggesting these particular measures for screening witnesses or assessing the quality of images.

The lack of more clearcut relationships in these correlations, however, is not a reason to abandon the idea of finding measures that will be useful for assessing witnesses. The imagery and verbal measures were crude, and from the outset were a secondary purpose of the study. While these particular measures are not sufficient to fulfill the purpose, the fact that several correlations were significant is encouraging for future developments on this issue.

Another factor that can be viewed as a witness variable is whether or not the person knows in advance that he/she will subsequently be working on an image of the target. As noted in Chapter 6, advance knowledge helped but only in the case of one technician. Hence, it would appear that information regarding the person's awareness of the situation is also not a particularly useful predictor of his/her utility as a witness.

Target Population

The population differences in these experiments are consistent with earlier facial recognition research indicating memory for faces of the same race is better than for faces of another race. The reasons are probably related to familiarity or experience in making appropriate discriminations. The implications for law enforcement are, or course, noteworthy. The quality of an image is likely to be better if generated by a witness of the same race as the target. This conclusion must be tempered in this report, however, since most of the witness subjects were White. On the other hand it

seems reasonable to speculate that Balck witnessses will generate better images of Black targets than White targets.

Another speculation that may be worth pursuing in future research concerns the artist/technician race. These results along with earlier recognition studies would argue for using artists/technicians of the same race as the target.

Image Generation Processes

The time-line data contain a great deal of information about the process of generating images. In this report, only a few summary measures were examined. Several additional analyses have been carried out on these data, and the results are presented and discussed in Report Number UHMUG-5 of this project.

Conclusions

The problem of obtaining a facial image from a person's memory is difficult at best. This research on sketch artist and Identi-kit technicians indicates that these procedures are considerably short of perfect. But they are useful. It is important to keep in mind that the images produced by these techniques are intended primarily to eliminate non-suspects and to suggest potential suspects. The computerized system developed in this project employs the sketches and composites in this fashion. Hence, even though these images are not expected to lead directly to a criminal, they are potentially of great importance. Any improvement in image quality may represent a significant contribution to law enforcement.

The Identi-kit composites were not regarded as good fits in the ratings and did not lead to success in the computerized rankings. Improvements could probably be achieved by increasing the number

and content of feature foils and developing better procedures for selecting the foils. Also, more technician experience might help, although we tend to doubt the importance of this factor for reasons stated earlier.

It may well be that there are limits to the quality and utility of images produced by sketch artists and the Identi-kit. They are line drawings and cannot be an exact match to a photograph. This latter point suggests that another image generation procedure might have additional utility, since it generates "photographic" images. The Minolta Montage Synthesizer developed in Japan produces images that look like a photograph of a face. As part of the current project, extensive development work has been done on the Montage. This work is reported in UHMUG-4.

Finally, a point about the application of these techniques. There is room in the law enforcement bag of tools for all of the procedures. While sketch artists may produce better images than the Identi-kit, they are not nearly so cheap, portable, or available. The point is that each has its time and place.

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3. Laughery, K. R., Fessler, P. K., Lenorovitz, D. R. and Yoblick, D. A. "Time delay and similarity effects in facial recognition." Journal of Applied Psychology, 1974, 59, 490-496.

APPENDICIES

EXHIBIT 1

Appendix A

Target and Witness Descriptive Information

(See Key in Exhibit 2)

	Col. 1	Col. 35	Col. 46		Col. 60		Col. 74
1	1002 0150020400194709	1451234	31	00010	212	002	0021003
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5	1004 01300204	1224	22	10000	12	004	0041007
6	2004 0620403130161	3712 3	12	10000	12	004	0041008
7	100514912174910750150021407194867	1501235	21	00100	211	005	0051009
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9	006 022949823970420027400244060	10021 3	13	00000	152	006	0061012
10	100723177374113090270623401264471	1501222	41	100112	311	007	0071013
11	2007 22302010510620400255467	1201223	13	11000	121	007	0071014
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13	2006294031921451207307014111124066	1421123	12	10000	15 1	008	0081016
14	20032033373673252403707014	1323	314	00000	211	009	0091017
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19	1010295944723427002007024101105 70	1491224	21	100011	212	013	0101022
20	2012237134772509410137024062 5765	1302425	314	10000	311	012	0101023
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23	201417913950022340110702400305072	1051325	21	01100	21 3	014	0111026
24	2015232583323333903007024	1333	21	010101	211	015	0111027
25	1012214421502924920150702400244771	1551114	324	10001	2122	017016	0121028
26	201623638772342671110703411245565	1202225	41	00000	21 2	016	0121029
27	201729837952416871 0 0703406045465	1182104	11	10000	112	017	0121030
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EXHIBIT 1

Appendix A

(Continued)

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34	101517539574923210150703405144576	2351323	22	10000	21 2	022	0151037
35	202229430852469551310700403075465	1192324	21	000023	11 2	022	0151038
36	101622275106520710150712405214672	1781213	12	10001	21 3	023	0161039
37	2023 7475040 0712401235568	1391225	214	010002	11 3	023	0161040
38	101720281358153201640713400174671	1751213	41	01000	21	024025	0171041
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40	202522702577445220340715401125368	13012231	215	01100	21 2	025	0171043
41	101827653794450313130716410094970	1751223	21	11011	21 3	026	0181044
42	2026 74750401740716411245063	1202435	21	10000	21 3	026	0181045
43	101922403846143070130717406104669	1801213	12	11101	2112	027026	0191046
44	2026 5243037 0717409084364	1102225	214	00000	21 2	026	0191047
45	202724340145202151830717404305468	1452223	21	00000	211	027	0191048
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51	2031 0718408310167	1201224	21	00000	11 2	031	0211054
52	102223580274913702230718412205274	1701324	21	01001	2133	032033	0221055
53	203221097768640501830718407025164	2052123	11	10000	313	032	0221056
54	203329339343730632330718409256471	2225	214	10010	31 3	033	0221057
55	102326594240346092410719409164676	2101123	42	10001	313	034	0231058
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Appendix A

(Continued)

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66	102729354874739731120723410115470	1551215	22	00000	212	041	0271069
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69	2042 7492121 20723406155560	1292315	21	00000	21 2	042	0281072
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74	103023485843753431220725411155472	15512 5	114	000002	2113	046047	0301077
75	204626805946262750130725406173966	17022 4	31	00000	311	046	0301078
76	204722437932357243003725410014762	13322 5	11	00000	11 3	047	0301079
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78	204815319172359880140725404184070	16512 3	12	00000	21 2	048	0311081
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129	20842628115243451092080741209556 1	1122235	21	00000	21 2 084	0471132
130	10432933244731623037080740416497 0	1701234	41	01000	2132 087088	0481133
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184	212224675374808755940915404175363			13024 4	314	10000	113	122	0651187
185	212129465752300023730916411085363			11022 3	31	10000	21 1	121	0651188
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187	212330392646562301110917404305662			1152224	21	10000	21 2	123	0661190
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206	213630879074932474020933401136471	15022 3	11	00000	22 3	136	0721209
207	10673611126 10000 4581106222100000000	257				126125	0672061
208	10683521137 00001 5561104321000010000	357				127128	0682062
209	10692222136 11001 3061101122110000000	209				130129	0692063
210	10701322117 10000 6051102222100000000	356				132131	0702064
211	10712222417 01001 3081102232000000000	308				134133	0712065
212	1072233212 01001 0081102332010000000	306				135136	0722066
213	2133120636112114321112311211314232111213						8139
214	21340622414334442322311211476233635711422						8140
215	107331485292340694121001408145370	1501224	22	11101	2132	137138	0731210
216	213722167345873552721001407155371	2151213	215	11001	313	137	0731211
217	2138 7494486 1001408124964	1122223	42	00000	11 2	138	0731212
218	107413914304665110111002403065375	1751424	414	00002	2132	139140	0741213
219	213921831892367084231002406225273	1651223	21	00001	213	139	0741214
220	214023277290629031341002404054966	1152224	11	00000	11 2	140	0741215
221	107522401872972411111004405315268	2001224	12	00000	3121	141142	0751216
222	21412791549233132 21004411115353	1062224	114	000002	152	141	0751217
223	214231324078195654111004412224163	1052125	41	00000	11 1	142	0751218
224	107630279478235361111005406055672	1701224	124	10010	2121	144143	0761219
225	214330865449770953111006409145564	12522 4	21	10000	21 1	143	0761220
226	214433360974949240531006411085363	13022 3	42	00000	212	144	0761221
227	107724485692604611331007406055472	1501313	21	00000	1132	145146	0771222
228	21452613329335790221007403225371	15022 4	424	1110123	113	145	0771223
229	214630378074912371111007411145672	1052134	12	0001012	22 2	146	0771224
230	107833285853655011111003406155669	1451224	21	00000	2132	148147	0781225
231	214727586074927971421006401135567	1282224	42	000002	21 2	147	0781226

EXHIBIT 1

Appendix A

(Continued)

232	214833042056977453011100841105556	1122225	12	00000	153	148	0781227
233	1079 86486161111009403305572	1401223	2	000002	1121	150149	0791228
234	214930337365422931011003407085565	1202235	42	00000	21 1	149	0791229
235	2150281031892150341911003405145464	1052134	11	00000	252	150	0791230
236	1080300227801071905 1014406045671	1601223	31	00000	2132	151152	0801231
237	2151 77234601341014410074268	22812141	12	111013	313	151	0801232
238	2152 772346043 1014406224266	1272324	21	000002	21 2	152	0801233
239	1081. 7723.4501341014410074258	22712141	17	111013	3121	154153	0811234
240	215330300574942600111014412195562	1172325	31	100002	11 1	153	0811235
241	2134123129748460310171014409234504	1252223	32	00000	212	154	0811236
242	1082 47707811111016405015670	1451213	11	00000	2121	155156	0821237
243	215532275050100361111010407125657	13521242	1	00000	222	155	0821238
244	2156 52301000911016402025664	1502123	13	000002	32 1	156	0821239
245	103028637464532260211017412315467	1451123	21	000002	2132	158157	0831240
246	215713204577273734441017411294670	1501213	21	000101	21 2	157	0831241
247	215831119046596532321017402275365	1062224	11	00000	113	158	0831242
248	103430318374941301111018412165572	1651225	124	00000	2133	159160	0841243
249	215930484660876351011016402025664	1202225	1145	0000012	213	159	0841244
250	2160 0141018409144966	1352124	11	00000	21 3	160	0841245
251	108530988574244650721023406095070	1501224	22	01101	2121	161162	0851246
252	216130343452391081111023403255655	1202224	12	000002	222	161	0851247
253	216230703774931971111023407285664	1202123	13	00000	22 1	162	0851248
254	1036303906373229371111021400125670	1401325	14	00001	2132	164163	0851249
255	216324388472111880431021404145463	1252223	21	00000	21 2	163	0801250
256	216425802274754601131021405075363	1052123	11	00000	133	164	0861251
257	108726063872907750721025411225473	1451234	21	00000	2132	167165	0871252
258	108726063872907750721025411225473	1451234	21	00000	2131	167166	0871253
259	216530462792656762711025406155660	1102223	314	00000	21 2	165	0871254
260	216630366774937931811025411175565	1402324	1	00000	31 1	166	0871255

EXHIBIT 1

Appendix A

(Continued)

261	216730446366414664511025405215667	1202224	11	00000	213	167	0871256
262	1088305576604366971111025411255566	1351223	224	00000	1121	168169	0881257
263	216824450764319232131025410265357	1302314	21	10000	212	168	0881258
264	2169 498036211 1025411204268	1701223	31	11001	31 1	169	0881259
265	108930686772114551111023405135668	1401224	31	00000	1122	170171	0891260
266	108930686772114551111028405135668	1401224	31	00000	1121	170172	0891261
267	217024332378135061131028402265468	16313 4	214	00000	212	170	0891262
268	217130003476277091111028411205670	15322 3	21	00000	21 2	171	0891263
269	217227750548729612611028406115565	12523 5	21	000002	21 1	172	0891264
270	109030635568162930911028406295570	18512 5	12	11101	2131	174173	0901265
271	217323980472343410021023403255460	14524 4	21	00000	21 1	173	0901266
272	217428302452423411121028410103371	17112 4	12	01001	253	174	0901267
273	109130344846531061121023408145167	1701223	12	11101	2132	175176	0911268
274	217527566206278621221029407055572	1401234	42	111111	213	175	0911269
275	217630381285107081111023403235668	1302224	11	00000	21 2	176	0911270
276	109214665166709680141030406174769	1651213	41	11100	2121	178177	0921271
277	217730514273373250911030406305659	1502323	21	00000	21 1	177	0921272
278	2178 72329960611030402086372	1851234	22	100101	212	178	0921273
279	109331117355650771111101403275473	1551324	32	00000	21 1	179	0931274
280	217930580752990491421101401075660	10722 4	12	00000	22 1	179	0931275
281	109430389674941371111101404125573	1701223	22	00000	2121	181180	0941276
282	109430389674941371111101404125573	1701223	22	00000	2123	181182	0941277
283	218024501262139370931101403305471	1441224	12	01001	15 1	180	0941278
284	2181304121664865271111101405225665	1302225	114	00000	212	181	0941279
285	218230390574836411111101405175667	1202224	21	00000	21 3	182	0941280
286	109530524686214840721104410275066	1451223	11	10000	1121	184183	0951281
287	218323270847242290911104412295574	21012 4	44	110111	31 1	183	0951282
288	21843040546211647 11104409225574	18512 4	14	100012	212	184	0951283
289	109629538574935562611104411275572	1551224	22	01100	2111	185186	0961284

EXHIBIT 1

Appendix A

(Continued)

290	2185304433064393401111C4412295565 1C32224	21	CCCCC	111	185	C961285
291	2196253633465677501211044C6085252 1022224	32	0000012	21 1	186	0961286
292	1097303461665EC4811111C64C2065670 1501224	12	CCCCC	2121	189186	0971287
293	1097333461665C4811111C34C2065670 1501224	12	00000	2122	189187	0971283
294	2187300916772245311211C64C5055568 1681223	21	CCC1C1	21 2	187	0971289
295	2138289102C4941392C111C3411237469 1432224	31	000002	21 1	188	0971293
296	21893034C9946382911111CC4C5255662 1042324	21	CCCCC	112	189	0971291

EXHIBIT 2

APPENDIX A

Key to Target and Witness Descriptive Information Listing
(Codes on Following Pages)

Information	Columns
Target or Witness Subject (see Code)	1
Subject number	2-4
University of Houston student number	5-10
Telephone number	11-17
University major (see code)	18-19
University classification (see code)	20
Date of photo (month, day, second digit of year in '70s)	21-25
Date of birth (month, day, year)	26-31
Height (inches)	32-33
Weight (pounds)	34-37
Sex (see code)	38
Hair color (see code)	39
Hair thickness " "	40
Hair length " "	41
Eye color " "	46
Complexion " "	47-49
Accessories " "	50-54
Peculiarities " "	55-59
Build " "	60
Race " "	61
Artist " "	62
Identi-kit technician " "	63
Artist Witness number (if target)	65-67
Identi-kit technician witness number (if target)	68-70
Target number (if witness)	74-76
Card number	77
Sequence number	78-80

CODE

Target or Witness Subject

1 = Target subject
2 = Witness subject

University Major

1 = Psychology
2 = Engineering
3 = History
4 = Home Economics
5 = Accounting
6 = Music
7 = Optometry
8 = Political Science
9 = Biology
10 = Gen. Arts and Science
11 = Business
12 = Chemistry
13 = English
14 = Speech Path./Aud.
15 = Mexican-American Studies
16 = Special Education
17 = Elementary Education
18 = Journalism
19 = Art Education
20 = Math
21 = Sociology
22 = Nursing
23 = Behavioral Sciences & Technology
24 = Philosophy
25 = Art
26 = German
27 = Curriculum and Instruction
28 = Chemical Engineering
29 = Guidance and Counseling
30 = Hotel and Restaurant Management
31 = Geology
32 = Radio and Television
33 = Pharmacy
34 = Electronics
35 = Economics
36 = Social Rehabilitation
37 = Geography
38 = Organizational Behavior & Management
39 = Pre-Med
40 = Spanish
41 = Russian Studies
42 = French
43 = Archeology
44 = Pre-Dentistry

45 = Fashion Merchandising
46 = Computer Science
47 = Law
48 = Architecture
49 = P.E.
50 = Communications
51 = Drafting Tech.

University Classification

1 = Freshman
2 = Sophomore
3 = Junior
4 = Senior
5 = Graduate
6 = Postbaccalaureate
7 = Non-student

Sex

1 = Male
2 = Female

Hair Color

1 = Black
2 = Brown
3 = Blonde
4 = Red
5 = Grey/white

Hair Thickness

1 = Thin
2 = Medium
3 = Thick

Hair Length

1 = Bald
2 = Thin
3 = Short
4 = Medium
5 = Long

Eye Color

1 = Brown
2 = Blue
3 = Green
4 = Hazel
5 = Other

APPENDIX B

Credentials of Sketch Artists and Identi-Kit Technicians

The image generation studies employed four sketch artists and four Identi-kit technicians, eight different people. Their names (and the initials used to refer to them) are:

Sketch Artists	Identi-kit Technicians
Sharon Neyland (SN)	Michael Mauldin (MM)
Robert McCoy (BM)	Richard Fowler (RF)
Andrew Meredith (AM)	Janice Hartgrove (JH)
Verla Malik (VM)	Franklin Duncan (FD)

Following is a description of the credentials of the various artists and technicians.

Artists

All four artists were recruited from the local Houston area and had similar credentials.

Sharon Neyland was a 24 year old white female who had recently graduated from the University of Houston with a B.F.A. degree in art. She had a good deal of training, experience and skill in portrait work. On one previous occasion she had worked for the University of Houston Security Office in preparing a sketch from a witness' description. She produced several practice images from description in the laboratory before starting the actual experiments. Also during the course of the image generation experiments she consulted on several occasions with the Houston Police and the University Security Office to prepare sketches from witnesses descriptions.

Robert McCoy was a 27 year old white male who had recently graduated from the University of Houston with a B.F.A. in art. He had a great deal of training, experience and skill in portrait work - a speciality area in his art. He produced several images from description in the laboratory before starting the actual experiment.

Andrew Meredith was a 23 year old white male who had recently graduated from the University of Houston with a B.F.A. degree in art. He had a good deal of training, experience and skill in portrait work and had worked for the University of Houston Security Office in preparing sketches from witnesses. He produced several images from description in the laboratory before starting the actual experiment.

Verla Malik was a 23 year old white female who had recently graduated from the University of Houston with a B.F.A. degree in

art. She had a good deal of training experience and skill in portrait work. She produced several images from description in the laboratory before starting the actual experiment.

Identi-kit Technicians

Three of the technicians were graduate students working towards a Ph.D. in psychology at the University of Houston. The fourth (FD) was recruited to work on the development of the Minolta Montage Synthesizer, but also served as a technician.

Michael Mauldin was a 26 year old white male enrolled in the psychology Ph.D. program at the University of Houston. During the early phase of the project, he attended a 2 1/2 day course on Identi-kit procedures. This course was sponsored by the Identi-kit Company for the purpose of training law enforcement people in the use of the technique. Following the training course, he practiced extensively by constructing composites of faces from photographs, and he produced several composites from description before starting the experiment.

Richard Fowler was a 23 year old white male enrolled in the psychology Ph.D. program at the University of Houston. He received instruction and training in Identi-kit procedures from Michael Mauldin and by studying instructional materials prepared by the Identi-kit Company. He practiced extensively by constructing composites of faces from photographs. Also, he produced several composites from description before starting the experiment.

Janice Hartgrove was a 25 year old white female enrolled in the psychology Ph.D. program at the University of Houston. She received instruction and training in Identi-kit procedures from Michael Mauldin and by studying instructional materials prepared by the Identi-kit Company. She practiced extensively by constructing composites of faces from photographs. Also, she produced several composites from view and then from description before starting the experiment.

Franklin Duncan was a 22 year old white male who had recently received a B.A. degree in psychology from the University of Oklahoma. He was recruited to work on the development of the Minolta Montage Synthesizer. As part of his overall involvement in the project, however, he also served as an Identi-kit technician in the Black male, White female and know-not-know image generations. He received instruction and training in Identi-kit procedures from Fichard Fowler and by studying instructional materials produced by the Identi-kit Company. He practiced extensively by constructing composites of faces from photographs. Also, he produced several composites from description before starting the experiment.

EXHIBIT 1
APPENDIX C

SUBJECT DATA FORM

DATE _____

NAME _____ Student# _____

Target Number _____ Subject Number _____

Permanent Address _____ Phone # _____

Major _____ Classification: FR SO JR SR

Birth date _____ Height _____ Weight _____

Sex: M F

Hair Color: Black Brown Blonde Red Gray/white

Hair Length: Bald Thin Short Medium Long

Eye Color: Brown Blue Green Hazel Other

Complexion: Light, fair Tan Dark/black Freckles, splotchy Pockmarked

Accessories: Glasses _____ Moustache _____ Beard _____ Sideburns _____

Visible scar on face _____ None _____

Peculiarities on face: Visible scars _____ Moles _____ Birthmarks _____

Build: Light Medium Heavy

Race: White Black Chicano Oriental Other

Image Photographs _____ Witness Description: _____ Portrait _____

Image Production Technique: Sketch _____ Identa-kit _____ Minolta _____

Color Photographs: Front Bust W/Sign _____ W/Glasses _____

WO/Sign _____ WO/Glasses _____

Profile Bust _____

EXHIBIT 2
APPENDIX C

SUGGESTIVE INTERVIEW PROCEDURE
SKETCH ARTIST INFORMATION

DATE: _____

TIME: Start _____ Stop _____

Target No. name _____

Witness No. name _____

Target Information:

Age: _____

Build: Slender Medium Heavy

Color of Hair: Blonde, Brown, Black, Red, Gray

Color of Eyes: Blue, Green, Hazel, Brown

Light, Medium, Dark

Complexion: Fair, Tan, Dark

Smooth, Rough, Wrinkled, Facial scars

Accessories: Glasses, moustache, beard, side burns, head gear.

Drawing with target present _____

Sketch Artist Technician _____

Signature

Date:

TIME — SUGGESTED INTERROGATION PROCEDURE — Subject No. _____

Start: — IDENTI-KIT - IDMO INFORMATION — Target No. _____

Stop:

RACE	SEX
White	Male
Black	Female
Other	

AGE GROUP

UNDER 34	BETWEEN 35 - 45	OVER 46
A up to 20	E 35 - 40	G 46 - 50
B 21 - 25	F 41 - 45	H 51 - 55
C 26 - 30		I 56 - 60
D 31 - 34		J 61 - 65
		K over 65

HEIGHT	BUILD
TALL - 6' and Over	Slender
MEDIUM - 5'7" - 5' 11"	Square
SHORT - Under 5' 6"	Medium
	Heavy

COLOR OF HAIR	ODDITY (If any)
Blond or Red	Note: _____
Brown	_____
Black	_____
Grey	_____
Bald	
Greying	

SUPPLEMENTAL INFORMATION

Glasses	Hat or Cap	Wrinkles
Mustache	Mask	Acne
Beard	Tattoo	Cripple
Side Burns (large	Freckles	Facial Scars

Other:
Confidence Level

IMPORTANT: Record Identi-Kit Code for Future Construction:

Identi-Kit Code: _____

IDMO "324" Jacket No. _____

Identi-Kit Technician _____
Name

Portrait Identi-Kit Code:

EXHIBIT 4
APPENDIX C

SUBJECT COMMENT SHEET

1. When you viewed the target, what did you do to help you remember his face.

2. What parts of the face were easiest to remember?

3. What parts of the face were difficult to remember?

4. What parts of the face were hard to describe?

5. What parts of the face were easiest to describe?

6. Have you ever had to describe a persons face before? If yes, why?

7. If you have any additional comments or thoughts about your experience in this experiment which you feel to be important, describe them below.

RESPONSE SHEET

SIMILARITY RATING EXPERIMENTS

	MOST SIMILAR					LEAST SIMILAR
1.	____	____	____	____	____	____
2.	____	____	____	____	____	____
3.	____	____	____	____	____	____
4.	____	____	____	____	____	____
5.	____	____	____	____	____	____
6.	____	____	____	____	____	____
7.	____	____	____	____	____	____
8.	____	____	____	____	____	____
9.	____	____	____	____	____	____
10.	____	____	____	____	____	____
11.	____	____	____	____	____	____
12.	____	____	____	____	____	____
13.	____	____	____	____	____	____
14.	____	____	____	____	____	____
15.	____	____	____	____	____	____
16.	____	____	____	____	____	____
17.	____	____	____	____	____	____
18.	____	____	____	____	____	____
19.	____	____	____	____	____	____

EXHIBIT 6

APPENDIX C

PERSON
PERCEPTION RATING FORM

Rate the person you have just viewed by circling the number which corresponds to the appropriate level on the following attribute scales:

a. Friendliness

1	2	3	4	5
Extremely Friendly				Extremely Unfriendly

b. Motivation

1	2	3	4	5
Highly Motivated				Not Motivated

c. Self-confidence

1	2	3	4	5
Extremely Self-confident				Extremely Self-conscious

d. Aggressiveness

1	2	3	4	5
Extremely Aggressive				Non-Aggressive

e. Patience

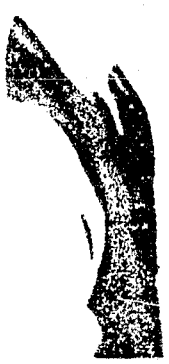
1	2	3	4	5
Extremely Patient				Extremely Quick-tempered

f. Compatibility

1	2	3	4	5
Extremely Compatible				Extremely Incompatible

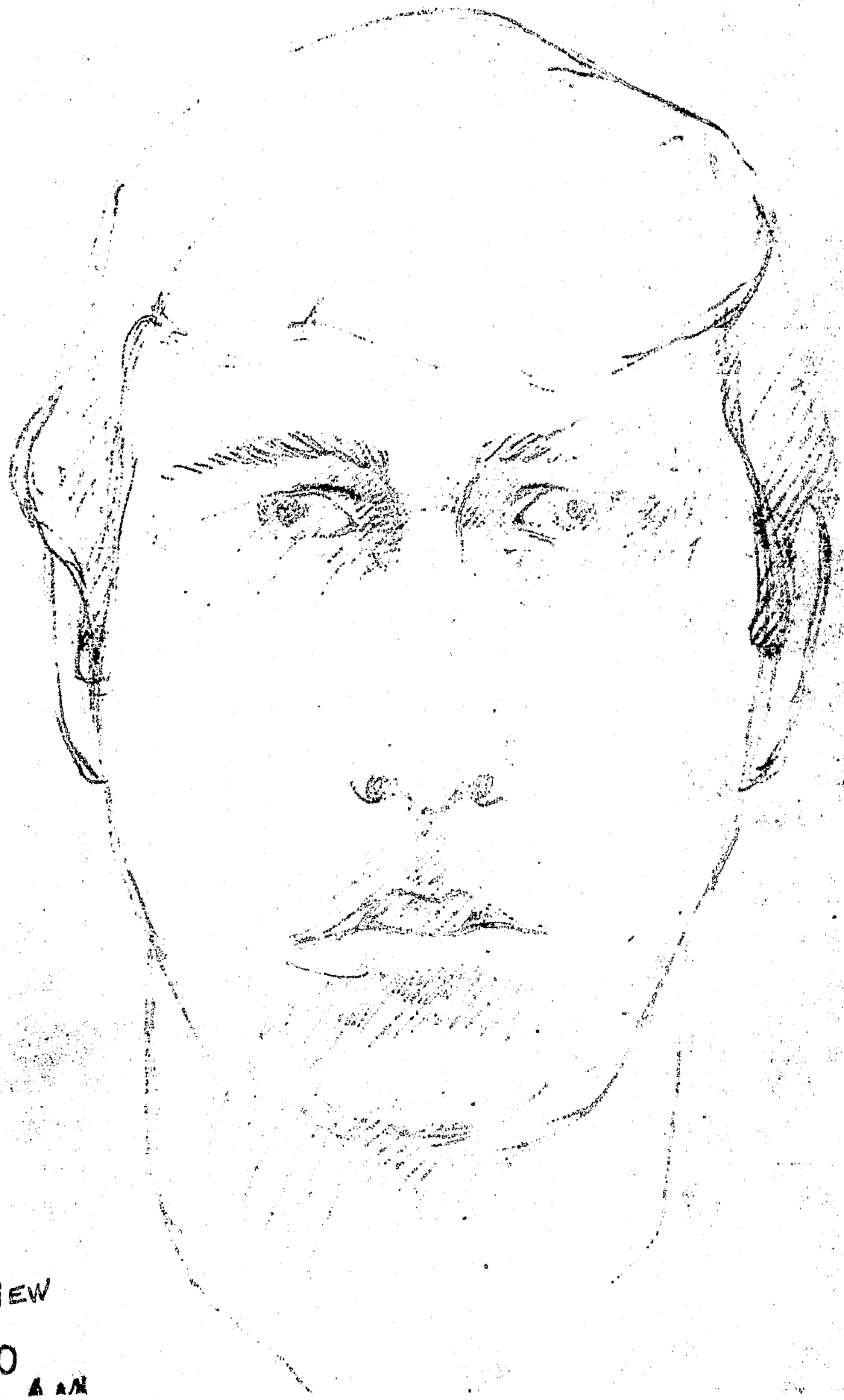
EXHIBIT 1

Appendix D
Examples of Images and Photographs



Appendix D
Examples of Images and Photographs

DESCRIPTION
W 151
T80
AM

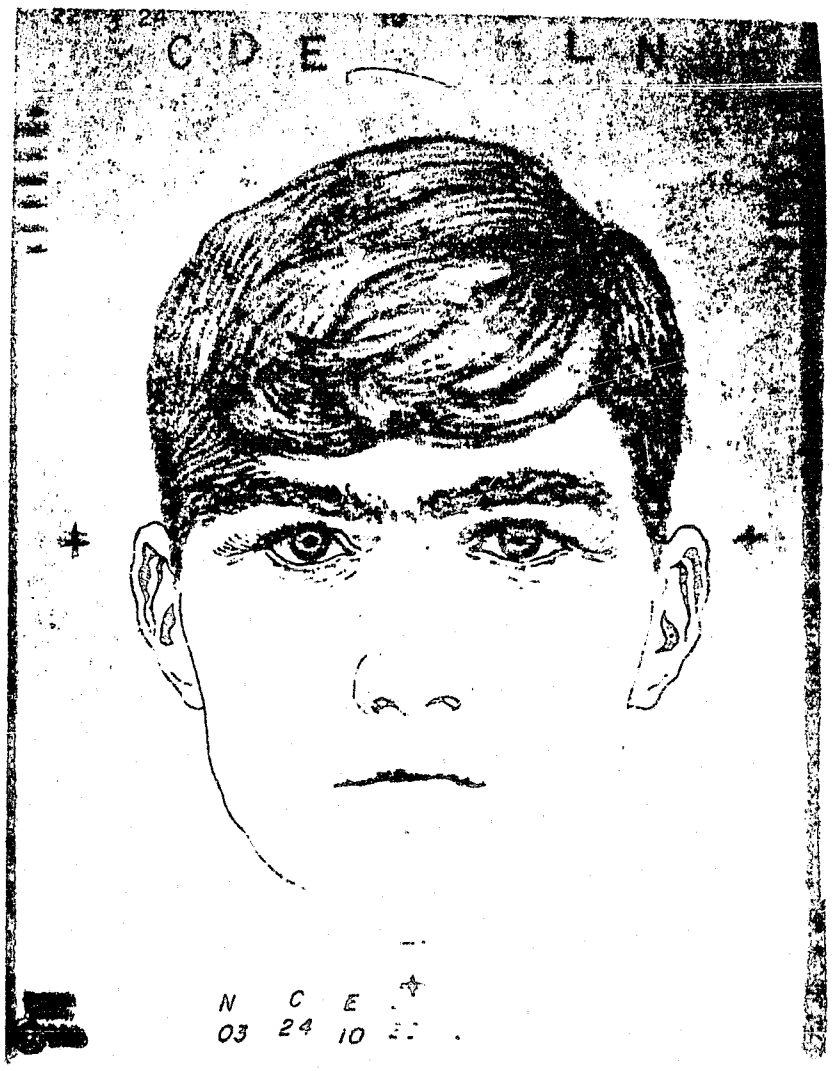


P-VIEW
T80 A AN

EXHIBIT 4

Appendix D

Examples of Images and Photographs



T-80
W-152
DESCRIPTION

EXHIBIT 5

Appendix D

Examples of Images and Photographs

T-80
VIEW

EXHIBIT 1

APPENDIX E

Prototype Instructions to Witness Subjects
(In the following instructions WS1 and WS2
are substituted for the subjects' names)

WS1 and WS2, now that I've finished taking the photographs, we are going to go to the room next door where I will introduce you to another participant in this study. The person you meet is someone you will later attempt to describe for purposes of producing an image of him. The experiment is set up so that you and the person will spend about seven to ten minutes talking with each other. Following this conversation, one of you will work with a sketch artist and the other with an identi-kit technician. Your task will be to describe from memory the target person you have seen in order to produce a likeness of him.

EXHIBIT 2

APPENDIX E

Prototype Instructions to Target Subjects
(In the following instructions TS is substituted for the subject's name)

TS, in a few minutes I will bring two other subjects into this room to meet you. We will spend about seven to ten minutes talking with each other. We use this conversation to give the other subjects an opportunity to see you so they can then describe you from memory. This is the purpose of the study, to see how successfully people can participate in producing an image of someone they have seen. It will help the interaction process go smoothly if you and they can get an easy conversation going.

EXHIBIT 3

APPENDIX E

Prototype Introductory Remarks for Witness-Target Conversational Interaction

(In the following statement WS1, WS2 and TS are substituted for the subjects' names)

"WS1 and WS2, I would like you to meet TS. WS1 and WS2, if you will sit opposite TS and me we will take a few minutes for you to get acquainted with TS. As you know (looking at WS1 and WS2), you are going to be working with either a sketch artist or identi-kit technician to develop a facial image of TS. TS, while WS1 and WS2 are giving their descriptions, we will go next door where you can fill out a data form and I will take some pictures of you. We will use one of the photographs as the standard against which we will compare WS1's and WS2's images. In addition to the photographs, TS, we will ask you to pose while our sketch artist and identi-kit technician prepare an image while viewing you."

The above statement was made by E primarily because it created a feeling of mutual participation between the subjects. Following the statement, E would attempt to get a conversation started around the witnesses' and target's activities and interests.

EXHIBIT 4

APPENDIX E

Instruction to Subjects in Rating Studies

During the past year we have been doing a good deal of research on human memory. Recently, we conducted a study in which two individuals looked at another person, and then described that person to either a sketch artist or Identi-kit operator. The sketch artist or IDK operator, working with the individual attempted to produce an accurate image of the person being described.

The next step in this particular project is to determine how good these images are, that is, how good is the match between the sketch or Identi-kit composite and a photograph of the person. This evaluation phase of the study is the part in which you are participating.

Your task will be to tell us how similar each of the images is to a photograph of the person. We will show you a series of pairs of slides. One slide contains a photograph of the person and the other slide shows either a sketch or Identi-kit composite. The photograph will be shown on the left side of the screen and the image on the right. We simply want you to make a judgment about how well they match.

We have provided you with forms to record your similarity judgment. Each row on the sheet corresponds to a pair that you will judge. Note that there are six spaces in each row. We want you to use a scale of 6 to classify your similarity judgments. The left of the scale is for pairs that are most similar and the right end is for least similar pairs. Which of these 6 spaces

you mark should reflect how good a match you feel the image is to the photograph. For images that are the best match to the photograph mark the left end of the row. For images that match the photograph least well, mark the right end of the scale. For images that are intermediate as to how well they match the photograph mark an appropriate space between the extremes, keeping in mind the meaning of the end points. Note that there are 14 rows on the sheets. When you finish one sheet, simply go on to the next.

We will now show you several practice pairs to enable you to become familiar with the types of pictures and to develop some idea about good and poor matches.

Any questions?

EXHIBIT 5

APPENDIX E

Prototype Instruction to Witness Subject
In The Don't Know Situation.
(In the Following Instruction WDK is
substituted for the Subject's Name)

WDK, now that I have finished taking the photographs, we are going to go to the room next door where I will introduce you to another participant in this study. The person you meet is someone whose personality you will attempt to rate. The experiment is set up so that you and the person will spend about seven to ten minutes talking with each other. Following this conversation we will ask you to give us some information on particular character traits.

Appendix F

THE BETTS CMI VIVIDNESS OF IMAGERY SCALE

Instructions for doing test.

The aim of this test is to determine the vividness of your imagery. The items of the test will bring certain images to your mind. You are to rate the vividness of each image by reference to the accompanying rating scale, which is shown at the bottom of the page. For example, if your image is 'vague and dim' you give it a rating of 5. Record your answer in the brackets provided after each item. Just write the appropriate number after each item. Before you turn to the items on the next page, familiarize yourself with the different categories on the rating scale. Throughout the test, refer to the rating scale when judging the vividness of each image. A copy of the rating scale will be printed on each page. Please do not turn to the next page until you have completed the items on the page you are doing, and do not turn back to check on other items you have done. Complete each page before moving on to the next page. Try to do each item separately independent of how you may have done other items.

The image aroused by an item of this test may be:

Perfectly clear and as vivid as the actual experience	Rating 1.
Very clear and comparable in vividness to the actual experience	Rating 2
Moderately clear and vivid	Rating 3
Not clear or vivid, but recognizable	Rating 4
Vague and dim	Rating 5
So vague and dim as to be hardly discernible	Rating 6
No image present at all, you only 'knowing' that you are thinking of the object	Rating 7

An example of an item on the test would be one which asked you to consider an image which comes to your mind's eye of a red apple. If your visual image was moderately clear and vivid you would check the rating scale and mark '3' in the brackets as follows:

Item	Rating
5. A red apple	(3)

Now turn to the next page when you have understood these instructions and begin the test.

Think of some relative or friend whom you frequently see, considering carefully the picture that rises before your mind's eye. Classify the images suggested by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

Item	Rating
1. The exact contour of face, head, shoulders and body	( )
2. Characteristic poses of head, attitudes of body, etc.	( )
3. The precise carriage, length of step, etc. in walking	( )
4. The different colours worn in some familiar costume	( )

Think of seeing the following, considering carefully the picture which comes before your mind's eye; and classify the image suggested by the following question as indicated by the degree of clearness and vividness specified on the Rating Scale.

5. The sun as it is sinking below the horizon	( )

Rating Scale

The image aroused by an item of this test may be:

Perfectly clear and as vivid as the actual experience	Rating 1
Very clear and comparable in vividness to the actual experience	Rating 2
Moderately clear and vivid	Rating 3
Not clear or vivid, but recognizable	Rating 4
Vague and dim	Rating 5
So vague and dim as to be hardly discernible	Rating 6
No image present at all, you only 'knowing' that you are thinking of the object	Rating 7

Think of each of the following sounds, considering carefully the image which comes to your mind's ear, and classify the images suggested by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

Item	Rating
6. The whistle of a locomotive	( )
7. The honk of an automobile	( )
8. The mewing of a cat	( )
9. The sound of escaping steam	( )
10. The clapping of hands in applause	( )

Rating Scale

The image aroused by an item of this test may be:

Perfectly clear and as vivid as the actual experience	Rating 1
Very clear and comparable in vividness to the actual experience	Rating 2
Moderately clear and vivid	Rating 3

Not clear or vivid, but recognizable — Rating 4

Vague and dim — Rating 5

So vague and dim as to be hardly discernible — Rating 6

No image present at all, you only 'knowing' that you are thinking of the object — Rating 7

Think of 'feeling' or touching each of the following, considering carefully the image which comes to your mind's touch, and classify the images suggested by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

Item	Rating
11. Sand	( )
12. Linen	( )
13. Fur	( )
14. The prick of a pin	( )
15. The warmth of a tepid bath	( )

Rating Scale

The image aroused by an item of this test may be:

Perfectly clear and as vivid as the actual experience — Rating 1

Very clear and comparable in vividness to the actual experience — Rating 2

Moderately clear and vivid — Rating 3

Not clear or vivid, but recognizable — Rating 4

Vague and dim — Rating 5

So vague and dim as to be hardly discernible — Rating 6

No image present at all, you only 'knowing' that you are thinking of the object — Rating 7

Think of performing each of the following acts, considering carefully the image which comes to your mind's arms, legs, lips, etc., and classify the images suggested as indicated by the degree of clearness and vividness specified on the Rating Scale.

Item	Rating
16. Running upstairs	( )
17. Springing across a gutter	( )
18. Drawing a circle on paper	( )

19. Reaching up to a high shelf ( )
20. Kicking something out of your way ( )

Rating Scale

The image aroused by an item of this test may be:

Perfectly clear and as vivid as the actual experience Rating 1
Very clear and comparable in vividness to the actual experience Rating 2
Moderately clear and vivid Rating 3
Not clear or vivid, but recognizable Rating 4
Vague and dim Rating 5
So vague and dim as to be hardly discernible Rating 6
No image present at all, you only 'knowing' that you are thinking of the object Rating 7

Think of tasting each of the following considering carefully the image which comes to your mind's mouth, and classify the images suggested by each of the following by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

Item Rating

21. Salt ( )
22. Granulated (white) sugar ( )
23. Oranges ( )
24. Jelly ( )
25. Your favourite food ( )

Rating Scale

The image aroused by an item of this test may be:

Perfectly clear and as vivid as the actual experience Rating 1
Very clear and comparable in vividness to the actual experience Rating 2
Moderately clear and vivid Rating 3
Not clear or vivid, but recognizable Rating 4
Vague and dim Rating 5
So vague and dim as to be hardly discernible Rating 6
No image present at all, you only 'knowing' that you are thinking of the object Rating 7

Think of smelling each of the following, considering carefully the image which comes to your mind's nose and classify the images suggested by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

Item	Rating
26. An ill-ventilated room	( )
27. Cooking cabbage	( )
28. Roast beef	( )
29. Fresh paint	( )
30. New leather	( )

Rating Scale

The image aroused by an item of this test may be:

Perfectly clear and as vivid as the actual experience	Rating 1
Very clear and compareble in vividness to the actual experience	Rating 2
Moderately clear and vivid	Rating 3
Not clear or vivid, but recognizable	Rating 4
Vague and dim	Rating 5
So vague and dim as to be hardly discernible	Rating 6
No image present at all, you only 'knowing' that you are thinking of the object	Rating 7

Think of each of the following sensations, considering carefully the image which comes before your mind, and classify the images suggested as indicated by the degrees of clearness and vividness specified on the Rating Scale.

Item	Rating
31. Fatigue	( )
32. Hunger	( )
33. A sore throat	( )
34. Drowsiness	( )
35. Repletion as from a very full meal	( )

The image aroused by an item of this test may be:

Perfectly clear and as vivid as the actual experience	Rating 1
Very clear and comparable in vividness to the actual experience	Rating 2
Moderately clear and vivid	Rating 3

Not clear or vivid, but recognizable	Rating 4
Vague and dim	Rating 5
So vague and dim as to be hardly discernible	Rating 6
No image present at all, you only 'knowing' that you are thinking of the object	Rating 7

Appendix F

THE GORDON TEST OF VISUAL IMAGERY CONTROL

You have just completed a questionnaire that was designed to measure the vividness of different kinds of imagery. In this present questionnaire some additional aspects of your imagery are being studied.

The questions are concerned with the ease with which you can control or manipulate visual images. For some people this task is relatively easy and for others relatively hard. One subject who could not manipulate his imagery easily gave this illustration. He visualized a table, one of whose legs suddenly began to collapse. He then tried to visualize another table with four solid legs, but found it impossible. The image of the first table with its collapsing leg persisted. Another subject reported that when he visualized a table the image was rather vague and dim. He could visualize it briefly but it was difficult to retain by any voluntary effort. In both these illustrations the subjects had difficulty in controlling or manipulating their visual imagery. It is perhaps important to emphasize that these experiences are in no way abnormal and are as often reported as the controllable type of image.

Read each question, then close your eyes while you try to visualize the scene described. Record your answer by underlining 'Yes' 'No' or 'Unsure', whichever is the most appropriate. Remember that your accurate and honest answer to these questions is most important for the validity of this study. If you have any doubts at all regarding the answer to a question, underline 'Unsure'. Please be certain that you answer each of the twelve questions.

1.	Can you see a car standing in the road in front of a house?	Yes	No	Unsure
2.	Can you see it in colour?	Yes	No	Unsure
3.	Can you now see it in a different colour?	Yes	No	Unsure
4.	Can you now see the same car lying upside down?	Yes	No	Unsure
5.	Can you now see the same car back on its four wheels again?	Yes	No	Unsure
6.	Can you see the car running along the road?	Yes	No	Unsure
7.	Can you see it climb up a very steep hill?	Yes	No	Unsure
8.	Can you see it climb over the top?	Yes	No	Unsure
9.	Can you see it get out of control and crash through a house?	Yes	No	Unsure
10.	Can you now see the same car running along the road with a handsome couple inside?	Yes	No	Unsure
11.	Can you see the car cross a bridge and fall over the side into the stream below?	Yes	No	Unsure
12.	Can you see the car all old and dismantled in a car-cemetery?	Yes	No	Unsure

EXHIBIT 1

APPENDIX G

Analysis of Variance Table

Similarity Rating Data - White Male Image Generation Experiment

Source	SS	df	MS	F	p <
Replication (R)	.47	1	.47	<1	n.s.
Technique (T)	109.27	1	109.27	134.24	.01
Target Presentation (TP)	54.18	1	54.18	174.23	.01
Artist/Technician (A/T)	13.68	4	3.42	19.54	.01
RxT	12.37	1	12.37	15.19	.01
RxTP	8.84	1	8.84	28.43	.01
RxA/T	1.49	4	.37	2.12	n.s.
TxTP	15.57	1	15.57	68.59	.01
TPxA/T	6.10	4	1.52	13.85	.01
RxTxTP	.60	1	.60	2.64	n.s
RxTPxA/T	.27	4	.07	<1	n.s
Subjects (Ss) within R	142.58	46	3.10		
T x Ss within R	37.04	46	.81		
TP x Ss within R	14.58	46	.31		
A/T x Ss within R,T	33.87	184	.18		
T x TP x Ss within R	10.08	46	.22		
TP x A/T x Ss within R,T	20.72	184	.11		

EXHIBIT 2

APPENDIX G

Analysis of Variance Table

Similarity Rating Data, Standarized Z Scores

White Male Image Generation Experiment

Source	SS	df	MS	F	p
Replication (R)	49.66	1	49.66	198.20	.01
Technique (T)	20.15	1	20.15	164.52	.01
Target Presentation (TP)	33.27	1	33.27	114.02	.01
Artist/Technician (A/T)	46.97	4	11.74	97.28	.01
RxT	17.78	1	17.78	145.17	.01
RxTP	1.54	1	1.54	5.28	.05
RxA/T	68.83	4	17.21	142.61	.01
TxTP	3.29	1	3.29	90.98	.01
TPxA/T	3.38	4	.85	50.19	.01
RxTxTP	2.26	1	2.26	62.50	.01
RxTPxA/T	.27	4	.07	1.02	n.s
Subjects (S) within R	11.52	46	.25		
TxS within R	5.63	46	.12		
TPxS within R	13.42	46	.29		
A/TxS within R,T	22.20	184	.12		
TxTPxS within R	1.66	46	.04		
TPxA.TxS within R,T	12.39	184	.07		

EXHIBIT 3

APPENDIX G

Analysis of Variance Table

Similarity Rating Data - Black Male Image Generation Experiment

Source	SS	df	MS	F	p<
Technique (T)	40.16	1	40.16	167.33	.01
Target Presentation(TP)	13.35	1	13.35	52.36	.01
Artist/Technician (A/T)	1.24	2	.62	3.66	.05
TxTP	.76	1	.76	7.13	.05
TP x A/T	.72	2	.36	1.65	n.s.
Subjects (S) x T	5.52	23	.24		
SxTP	5.87	23	.26		
SxA/T	9.01	46	.20		
SxTxTP	2.46	23	.11		
SxTPxA/T	9.96	46	.22		

EXHIBIT 4

APPENDIX G

Analysis of Variance Table

Similarity Rating Data, Standarized Z Scores

Black Male Image Generation Experiment

Source	SS	df	MS	F	p
Technique (T)	16.70	1	16.70	165.70	.01
Target Presentation (TP)	3.27	1	3.27	30.18	.01
Artist/Technician (A/T)	1.63	2	.81	13.69	.01
TxTP	.02	1	.02	<1	n.s.
TPxA/T	1.29	2	.64	11.67	.01
Subjects (S) x T	2.32	23	.10		
SxTP	2.50	23	.11		
SxA/T	2.75	46	.06		
SxTxTP	1.35	23	.06		
SxTPxA/T	2.54	23	.06		

EXHIBIT 5

APPENDIX G

Analysis of Variance Table

Similarity Rating Data - White Female Image Generation Experiment

Source	SS	df	MS	F	p <
Technique (T)	61.50	1	61.50	99.84	.01
Target Presentation (TP)	9.07	1	9.07	34.36	.01
Artist/Technician (A/T)	9.71	2	4.86	40.12	.01
TxTP	13.98	1	13.98	110.04	.01
TP x A/T	1.99	2	1.00	6.76	.01
Subjects (S) x T	14.17	23	.62		
SxTP	6.07	23	.26		
SxA/T	5.56	46	.12		
SxTxTP	2.92	23	.13		
SxTPxA/T	6.78	46	.15		

EXHIBIT 6

APPENDIX G

Analysis of Variance Table

Similarity Rating Data, Standarized Z Scores

White Female Image Generation Experiment

Source	SS	df	MS	F	p
Technique (T)	29.97	1	29.97	107.03	.01
Target Presentation (TP)	4.13	1	4.13	37.54	.01
Artist/Technician (A/T)	4.60	2	2.30	38.33	.01
TxTP	6.79	1	6.79	135.80	.01
TPxA/T	1.11	2	.56	7.22	.01
Subjects (S) x T	6.33	23	.28		
SxTP	2.45	23	.11		
SxA/T	2.61	46	.06		
SxTxTP	1.08	23	.05		
SxTPxA/T	3.57	46	.08		

EXHIBIT 7

APPENDIX G

Analysis of Variance Table

Similarity Rating Data - Image Generation Study on Advance Task Knowledge Effects

Source	SS	df	MS	F	p
Knowledge (K)	5.01	1	5.01	31.31	.01
Technique (T)	116.79	1	116.79	171.75	.01
Target Presentation (TP)	204.08	1	204.08	485.90	.01
Artist/Technician (A/T)	18.17	2	9.09	56.78	.01
KxT	6.20	1	6.20	21.38	.01
KxTP	3.94	1	3.94	24.63	.01
KxA/T	21.03	2	10.52	31.88	.01
TxTP	36.20	1	36.20	139.23	.01
TPxA/T	10.47	2	5.24	26.20	.01
KxTxTP	.07	1	.07	< 1	n.s.
KxTPxA/T	1.69	2	.85	3.26	.05
K x Subjects (S)	.16	39	.16		
TxS	26.35	39	.68		
TPxS	16.49	39	.42		
A/TxS	24.90	78	.32		
KxTxS	11.15	39	.29		
KxTPxS	6.43	39	.16		
KxA/TxS	25.76	78	.33		
TxTPxS	10.00	39	.26		
TPxA/TxS	15.26	78	.20		
KxTxTPxS	9.15	39	.23		
KxTPxA/TxS	20.00	78	.26		

Analysis of Variance Table

Similarity Rating Data, Standarized Z Scores

Image Generation Study on Advance Task Knowledge Effects

Source	SS	df	MS	F	p
Knowledge (K)	2.51	1	2.51	25.92	.01
Technique (T)	55.25	1	55.25	238.14	.01
Target Presentation (TP)	96.92	1	96.92	927.46	.01
Artist/Technician (A/T)	8.57	2	4.28	29.06	01
KxT	2.86	1	2.86	20.31	.01
KxTP	1.85	1	1.85	23.01	.01
KxA/T	9.05	2	4.52	32.52	.01
TxTP	17.20	1	17.20	144.78	.01
TPxA/T	4.79	2	2.39	26.03	.01
KxTxTP	.08	1	.08	<1	n.s.
KxTPxA/T	.84	2	.42	3.39	.05
K x Subjects (S)	3.10	39	.08		
TxS	9.07	39	.23		
TPxS	4.08	39	.10		
A/TxS	11.50	78	.14		
KxTxS	5.50	39	.14		
KxTPxS	3.13	39	.08		
KxA/TxS	10.85	78	.14		
TxTPxS	4.63	39	.12		
TPxA/TxS	7.18	78	.09		
KxTxTPxS	4.02	39	.10		
KxTPxA/TxS	9.64	78	.12		

Analysis of Variance Table

Similarity Rating Data - Target Population

Effects in Image Generation Studies

Source	SS	df	MS	F	P<
Target Population (P)	5.78	2	2.89	10.09	.01
Technique (T)	150.56	1	150.56	238.60	.01
Target Presentation (TP)	25.37	1	25.37	82.11	.01
Artist/Technician (A/T)	1.79	6	.30	11.27	.01
Px T	.761	2	.38	3.51	.05
Px TP	.626	2	.31	4.17	.05
Tx TP	19.37	1	19.37	116.00	.01
TP x A/T	.46	6	.08	2.75	.05
P x T x TP	2.20	2	1.10	21.00	.01
S x P	.57	23			
Sx T	.63	23			
Sx TP	.31	23			
Sx A/T	.16	138			
Sx P x T	.22	46			
Sx P x TP	.15	46			
Sx T x TP	.17	23			
Sx TP x A/T	.17	138			
Sx Px Tx TP	.11	46			

Exhibit 1

Appendix H

Mean Similarity Rating for each Target by Image Type

White Male Image Generation Experiment

Target #	# Ratings (N)	Sketch Description	Sketch View	Identi-kit Description	Identi-kit View
8	24	2.79	2.67	4.08	3.58
11	24	3.37	2.08	3.54	3.00
13	24	2.87	2.12	4.17	3.91
14	40	3.20	2.90	4.30	3.73
17	40	3.22	3.40	4.30	4.32
19	24	4.04	2.92	3.70	3.87
20	24	2.49	2.45	3.46	3.79
21	24	3.04	2.17	4.07	3.62
22	40	3.57	3.00	4.77	3.85
24	24	3.13	2.83	4.21	3.50
25	40	3.70	2.15	4.43	4.35
26	24	3.42	3.17	4.29	3.71
28	40	3.25	2.20	4.22	3.07
29	40	3.37	1.90	4.17	4.22
32	24	2.79	2.87	4.75	3.75
33	40	4.35	3.45	4.12	4.25
34	24	3.67	3.04	3.75	3.87
35	40	4.02	2.75	3.60	3.35
36	24	3.12	2.21	3.88	3.58
37	24	3.75	3.08	3.88	4.00
38	24	4.71	3.08	3.83	3.87
39	24	3.71	2.42	3.12	2.83

EXHIBIT 1

Appendix H (Continued)

Mean Similarity Rating for each Target by Image Type

White Male Image Generation Experiment

Target #	# Ratings (N)	Sketch Description	Sketch View	Identi-kit Description	Identi-kit View
40	24	2.62	2.29	4.00	3.50
41	40	5.00	2.70	4.65	3.10
42	40	3.35	2.05	4.50	4.45
43	24	4.08	2.83	4.50	4.54
45	40	3.35	2.05	4.50	4.45
46	24	4.58	3.50	3.79	4.54
48	24	3.71	2.92	2.91	2.79
49	40	3.65	1.59	4.45	4.30
50	24	4.67	2.58	4.83	4.50
51	24	4.13	2.21	3.96	4.87
52	24	3.29	3.00	3.92	3.75
53	24	3.54	2.54	3.96	3.83
54	24	3.92	3.50	4.25	4.41
55	24	4.12	3.38	3.75	4.21
56	24	4.46	3.04	4.79	3.46
57	40	3.55	1.32	5.22	3.62
58	40	3.80	2.45	4.95	5.10
59	40	3.27	1.92	3.80	3.60
60	40	4.80	3.72	4.17	3.80
61	24	3.70	3.17	3.83	3.87
62	24	3.67	2.83	3.71	4.41
63	24	3.08	2.79	3.96	3.08
64	40	3.47	1.62	4.10	4.55

Appendix H (Continued)

Mean Similarity Rating for each Target by Image Type

White Male Image Generation Experiment

Target #	# Ratings(N)	Sketch Description	Sketch View	Identi-kit Description	Identi-kit View
65	24	3.33	4.62	4.00	3.62
67	24	3.87	3.41	4.46	4.67
68	24	4.00	4.08	5.33	3.96
69	24	2.96	2.25	3.46	3.87
70	24	3.92	3.00	4.04	4.25
71	40	4.80	1.90	5.27	3.57
72	24	3.79	3.83	3.91	3.37
73	24	4.67	4.25	4.12	3.83
76	24	3.58	3.50	3.92	4.37
77	24	3.12	2.21	3.87	3.58
78	24	3.67	3.80	3.96	4.04
79	24	4.04	3.21	4.17	4.75
80	24	3.17	3.83	2.71	3.25
81	24	2.33	2.25	4.25	2.84
82	24	3.25	2.25	2.58	3.37
83	40	3.35	2.87	3.07	4.02
84	24	3.21	2.71	3.29	3.79
85	24	4.42	2.12	3.12	3.67
88	24	2.37	2.33	2.71	3.25
89	24	3.33	2.29	3.12	3.46
91	40	2.67	3.20	4.22	2.95
92	40	2.07	1.27	3.70	3.17

EXHIBIT 1

Appendix H (Continued)

Mean Similarity Rating for each Target by Image Type

White Male Image Generation Experiment

Target #	# Ratings(N)	Sketch Description	Sketch View	Identi-kit Description	Identi-kit View
94	24	3.67	2.54	3.67	4.12
95	24	3.71	2.96	3.54	2.79
96	24	2.67	2.87	3.58	2.67

EXHIBIT 2

APPENDIX H

ALGORITHM RANKING FOR EACH TARGET BY IMAGE TYPE

WHITE MALE IMAGE GENERATION EXPERIMENT

TARGET #	SKETCH DESCRIPTION	SKETCH VIEW	IDK DESCRIPTION	IDK VIEW
10	22	62		54
11			11	5
13	13	11	34	22
14	38	47	47	42
16	10	16	62	59
17	35	43	18	44
19			21	27
20			42	40
21	67	66	67	67
22	10	23	25	22
24	45	57	63	54
25	5	28	30	30
26	31	18	38	37
28	6	31	58	60
29	36	32	28	28
32	20	23	38	31
33	31	23	47	37
34		52	27	16
35			44	39
36	64		15	16
37	62	31	28	28
38	20	11	35	24
39	10	41	36	56
41	18	38	64	64
42	64	39	67	66
43	26	27	16	11
45		64	45	46

EXHIBIT 2 CONT.

TARGET #	SKETCH DESCRIPTION	SKETCH VIEW	IDK DESCRIPTION	IDK VIEW
46	7	21	9	7
48	34	34	6	9
49	18	39	38	39
50	34	19	10	19
51	12	1	3	63
52	21	9	24	41
53	7	7	13	13
54	43	13	34	60
55	19	4	5	6
56	51	50	51	55
57	2	3	1	1
58	5	19	33	30
59	52	26	65	66
60	16	22	18	19
61	54	53	63	58
62	1	1	8	8
63	33	28	44	40
64	6	6	29	56
65	17	11	34	33
67	26	29	22	42
68	1	56	24	25
69	5	49	48	58
70	16	5	31	32
71	59	19	53	21
72	5	17	13	15
73	56	46	54	50
76	6	5	12	13
77	9	19	14	13
78	39	53	45	57
79	46	40	37	44
80	3	2	6	5
81	3	3	12	9
88	34	52	51	35
89	30	10	18	18

EXHIBIT 2 CONT.

TARGET#	SKETCH DESCRIPTION	SKETCH VIEW	IDK DESCRIPTION	IDK VIEW
90	27	14	43	58
91	36	27	27	26
92	12	1	4	4
94	25	40	30	11
95	18	8	21	10
96	64	60	55	56

Exhibit 3

Appendix H

Mean Similarity Rating for Each Target by Image Type

Black Male Image Generation Experiment

Target #	# Ratings (N)	Sketch Description	Sketch View	Identi-kit Description	Identi-kit View
103	24	4.25	2.96	4.00	3.71
118	24	3.04	2.83	4.29	3.54
120	24	3.75	2.71	3.92	3.71
123	24	4.50	3.00	4.42	4.42
125	24	3.38	2.08	5.08	2.67
126	24	2.38	2.96	3.83	3.25
128	24	2.79	2.13	4.54	4.79
129	24	3.13	2.21	4.63	3.17
130	24	3.54	3.29	4.42	4.33
132	24	4.08	3.25	4.50	3.92
133	24	4.75	3.46	4.33	4.50
135	24	4.38	3.88	4.88	4.88
136	24	4.58	3.33	4.33	4.58
137	24	2.79	2.13	4.54	4.79
138	24	3.79	3.00	3.96	3.75
139	24	3.71	2.25	4.75	4.29
140	24	3.33	2.46	5.17	4.08
141	24	3.50	3.42	4.17	4.13
144	24	2.38	4.67	4.83	4.75

EXHIBIT 4

APPENDIX H

Algorithm Ranking for Each Target by Image Type
Black Male Image Generation Experiment

Target #	Sketch Description	IDK Description
103	15	12
118	20	12
120	2	1
123	14	8
125	17	14
128	9	4
129	3	4
130	9	1
132	7	9
133	14	12
134	11	1
135	12	7
136	12	12
137	9	8
138	1	12
139	6	6
140	2	18
141	10	19
142	6	6

Exhibit 5

Appendix H

Mean Similarity Rating for Each Target by Image Type

White Female Image Generation Experiment

Target #	# Ratings (N)	Sketch Description	Sketch View	Identi-kit Description	Identi-kit View
105	24	3.38	2.58	3.71	3.67
106	24	2.92	2.67	4.25	4.79
107	24	3.17	2.17	4.88	4.33
108	24	3.42	2.46	4.71	4.42
109	24	3.67	2.88	3.50	3.08
110	24	3.58	2.13	3.75	4.67
111	24	4.46	3.13	3.71	3.88
112	24	4.96	2.50	3.75	4.46
113	24	4.54	3.04	4.38	4.13
114	24	3.88	2.88	5.38	5.33
115	24	3.46	2.21	4.42	3.38
116	24	3.33	2.54	4.08	4.54
117	24	3.42	2.88	5.04	4.67
119	24	4.08	3.62	4.67	4.79
122	24	3.17	2.83	3.71	4.25
124	24	2.58	1.92	3.75	4.58
127	24	4.29	2.83	4.50	4.75
131	24	2.71	2.54	4.17	4.33
143	24	4.17	3.46	3.75	4.08

Algorithm Ranking for Each Target by Image Type
White Female Image Generation Experiment

Target #	Sketch Description	IDK Description
105	8	12
106	2	4
107	8	2
108	6	10
109	2	17
110	5	14
111	6	1
112	14	9
113	15	7
114	13	12
115	3	5
116	4	4
117	10	10
119	10	6
122	13	16
124	17	16
127	[illegible]	11
131	5	13

EXHIBIT 1
APPENDIX I

Time-Line Measures for Each Image Generation Session

White Male Image Generation Experiment

Technique	Artist Technician	Target Number	Witness Number	Total Time	Number Different Feature Codes	# Feature Stops	Mean Time Per Feature	Standard Dev. of Mean Time Per Feature	Ratio # Feature Stops # Feature Codes
Sketch	BM	33	53	1346	12	20	67.3	55.5	1.67
Sketch	BM	64	120	2594	10	26	99.8	92.3	2.60
Sketch	BM	66	124	1443	13	26	55.5	45.2	2.00
Sketch	BM	67	126	2348	14	29	81	80.9	2.07
Sketch	BM	71	134	1688	14	22	76.7	49.4	1.57
Sketch	BM	75	141	1344	11	16	84.0	80.6	1.46
Sketch	BM	76	144	1645	10	19	86.6	80.1	1.90
Sketch	BM	69	130	1570	11	16	98.1	85.8	1.46
Sketch	BM	79	150	1064	10	16	66.5	48.7	1.60
Sketch	BM	81	154	2284	13	29	78.8	85.7	2.23
Sketch	BM	82	155	1092	10	13	84.0	76.1	1.30
Sketch	BM	88	168	2618	12	34	77.0	64.1	2.83
Sketch	BM	89	170	1342	9	16	83.9	59.0	1.78
Sketch	BM	95	184	2034	13	19	107.1	116.9	1.46
Sketch	BM	94	181	1967	12	32	61.5	72.4	2.67
Sketch	BM	92	178	1592	12	19	83.8	70.4	1.58

EXHIBIT 1
APPENDIX I

Time-Line Measures for Each Image Generation Session

White Male Image Generation Experiment

Technique	Artist Technician	Target Number	Witness Number	Total Time	Number Different Feature Codes	# Feature Stops	Mean Time Per Feature	Standard Dev. of Mean Time Per Feature	Ratio # Feature Stops #Feature Codes
Sketch	AM	14	20	2592	14	49	52.9	40.3	3.5
Sketch	AM	23	34	1482	9	21	70.6	36.6	2.33
Sketch	AM	60	111	2768	14	26	106.5	82.2	1.86
Sketch	AM	17	24	2144	16	45	47.6	39.1	2.81
Sketch	AM	86	164	2661	17	32	83.2	70.4	1.88
Sketch	AM	83	158	2432	16	41	59.3	58.5	2.56
Sketch	AM	68	127	2453	17	39	62.9	57.0	2.94
Sketch	AM	87	167	2583	13	40	64.6	53.0	3.08
Sketch	AM	72	135	2310	16	29	79.7	59.4	1.81
Sketch	AM	74	139	2574	16	47	54.8	54.3	2.94
Sketch	AM	84	159	1400	11	21	66.7	72.2	1.91
Sketch	AM	78	148	2431	16	36	67.5	47.4	2.25
Sketch	AM	77	145	2039	16	37	55.1	53.4	2.31
Sketch	AM	80	151	2464	15	43	57.3	52.3	2.87
Sketch	AM	65	122	2608	14	37	70.5	82.1	2.64
Sketch	AM	22	32	2261	15	59	38.3	27.1	3.93
Sketch	AM	90	174	2771	18	48	57.7	70.7	2.67
Sketch	AM	70	132	2525	14	32	78.9	72.8	2.29

EXHIBIT 1
APPENDIX I

Time-Line Measures for Each Image Generation Session

White Male Image Generation Experiment

Technique	Artist Technician	Target Number	Witness Number	Total Time	Number Different Feature Codes	# Feature Stops	Mean Time Per Feature	Standard Dev. of Mean Time Per Feature	Ratio # Feature Stops # Feature Codes
IDK	MM	76	143	875	6	6	145.8	159.9	1.00
IDK	MM	69	129	905	6	9	100.6	57.0	1.50
IDK	MM	71	133	1289	5	6	214.8	233.5	1.20
IDK	MM	81	153	478	5	7	68.3	39.4	1.40
IDK	MM	85	162	2180	6	9	242.2	230.6	1.50
IDK	MM	88	169	607	8	12	50.6	50.8	1.50
IDK	MM	90	173	1550	8	8	193.8	92.7	1.00
IDK	MM	93	179	1002	5	5	200.4	71.0	1.00
IDK	MM	92	177	2289	10	17	134.7	126.2	1.70
IDK	MM	64	119	1697	10	20	84.9	86.3	2.00
IDK	MM	75	142	2919	8	16	182.4	154.3	2.00
IDK	MM	67	125	1076	9	13	82.8	56.1	1.44
IDK	MM	95	183	1509	8	10	150.9	130.3	1.25
IDK	MM	82	156	1690	10	15	112.7	141.1	1.50
IDK	MM	65	121	2094	11	16	130.9	155.8	1.46

EXHIBIT 1
APPENDIX I

Time-Line Measures for Each Image Generation Session

White Male Image Generation Experiment

Technique	Artist Technician	Target Number	Witness Number	Total Time	Number Different Feature Codes	# Feature Stops	Mean Time Per Feature	Standard Dev. of Mean Time Per Feature	Ratio # Feature Stops # Featrue Codes
IDK	JH	73	138	770	8	8	96.2	55.7	1.00
IDK	JH	74	140	768	8	13	59.1	42.6	1.63
IDK	JH	70	131	993	7	8	124.1	77.7	1.14
IDK	JH	83	157	1855	6	9	206.1	207.5	1.50
IDK	JH	86	163	488	6	7	69.7	46.7	1.17
IDK	JH	87	165	470	8	9	52.2	42.9	1.13
IDK	JH	89	171	700	4	6	116.7	24.6	1.50
IDK	JH	77	146	1495	13	22	68.0	75.4	1.69
IDK	JH	78	147	1451	10	16	90.7	115.7	1.60
IDK	JH	19	26	2235	11	22	101.6	108.2	2.00
IDK	JH	66	123	1161	7	11	105.6	82.2	1.57

CONTINUED

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EXHIBIT 1
APPENDIX I

Time-Line Measures for Each Image Generation Session

White Male Image Generation Experiment

Technique	Artist Technician	Target Number	Witness Number	Total Time	Number Different Feature Codes	# Feature Stops	Mean Time Per Feature	Standard Dev. of Mean Time Per Feature	Ratio # Feature Stops # Feature Codes
IDK	RF	16	23	2579	10	15	171.9	115.1	1.50
IDK	RF	33	54	1172	8	12	97.7	58.6	1.50
IDK	RF	84	160	1477	11	21	70.3	103.1	1.91
IDK	RF	72	136	1294	11	22	58.8	39.0	2.00

EXHIBIT 2
APPENDIX I

Time-Line Measures for Each Facial Feature

Totals Across Technique and Artist/Technician

White Male Image Generation Experiment

Feature Code	Feature Description	Number Stops on Feature	Feature Stops to Total Stops	Total Time on Feature	Mean Time Per Feature Stop	Ratio Feature Time Total Time
1	Eyes	163	.116	20,118.9	123.4	.180
2	Nose	131	.093	15,006.1	114.5	.135
3	Mouth & Lips	106	.075	8,719.0	82.2	.078
4	Ears	38	.027	1,435.0	37.8	.013
5	Forehead	57	.041	1,970.0	34.6	.018
6	Cheeks and Cheekbones	68	.048	3,092.9	45.5	.028
7	Jaw & Jawline	29	.021	1,225.0	42.2	.011
8	Chin	130	.093	9,135.0	70.3	.082
9	Hair	201	.143	20,246.1	100.7	.181
10	Hairline	19	.014	668.0	35.1	.006
11	Eyebrows	101	.072	8,349.8	82.7	.075
12	Sideburns	36	.026	1,504.0	41.8	.013
13	Moustache	52	.037	3,238.0	62.3	.029
14	Beard	25	.018	2,917.2	116.7	.026
15	Face Shape	108	.077	4,389.9	40.6	.039
16	Proportions	21	.015	882.0	42.0	.008
17	Glasses	25	.018	3,593.0	143.7	.032

EXHIBIT 2
APPENDIX I

Time-Line Measures for Each Facial Feature

Totals Across Technique and Artist/Technician

White Male Image Generation Experiment

Feature Code	Feature Description	Number Stops on Feature	Feature Stops to Total Stops	Total Time on Feature	Mean Time Per Feature Stop	Ratio Feature Time Total Time
18	Eye Color	2	.001	87.0	43.5	.001
19	Complexion	11	.008	473.0	43.0	.004
20	Wrinkles	33	.024	2,189.9	66.4	.020
21	General Expression	20	.014	773.0	38.6	.007
22	Scars & Moles	8	.006	383.0	47.9	.003
23	Neck	20	.014	1,141.1	57.0	.010

EXHIBIT 3

APPENDIX I

Time Line Measures for Each Facial Feature

Totals for Each Technique

White Male Image Generation Experiment

Sketches

Feature Code	Feature Description	Number Stops on Feature	Feature Stops to Total Stops	Total Time on Feature	Mean Time Per Feature Stop	Ratio Feature Time Total Time
1	Eyes	121	.117	12,460.9	103.0	.177
2	Nose	87	.084	8,885.1	102.1	.126
3	Mouth & Lips	74	.071	5,113.1	69.1	.072
4	Ears	26	.025	913.0	35.1	.013
5	Forehead	52	.050	1,892.0	36.4	.027
6	Cheeks & Cheekbones	69	.067	3,087.9	44.7	.044
7	Jaw & Jaw-Line	27	.026	1,035.0	38.3	.015
8	Chin	94	.091	5,071.0	53.9	.072
9	Hair	145	.140	12,300.3	84.8	.174
10	Hairline	10	.010	276.0	27.6	.004
11	Eyebrows	62	.060	3,894.8	62.8	.055
12	Sideburns	28	.027	1,076.0	38.4	.015
13	Moustache	36	.035	1,857.0	51.6	.026
14	Beard	12	.011	1,442.0	120.2	.020
15	Face Shape	94	.091	4,022.9	42.8	.057
16	Proportions	12	.011	410.0	34.2	.006
17	Glasses	13	.012	2,719.0	209.1	.038

EXHIBIT 3
APPENDIX I

Time Line Measures for Each Facial Feature
Totals for Each Technique
White Male Image Generation Experiment

Sketches

Feature Code	Feature Description	Number Stops on Feature	Feature Stops to Total Stops	Total Time on Feature	Mean Time Per Feature Stop	Ratio Feature Time Total Time
18	Eye Color	2	.002	87.0	43.5	.001
19	Complexion	7	.007	410.0	58.6	.006
20	Wrinkles	25	.024	1,469.9	58.8	.021
21	General Expression	14	.013	564.0	40.3	.008
22	Scars & Moles	7	.007	353.0	50.4	.005
23	Neck	19	.018	1,129.1	59.4	.016

EXHIBIT 3
APPENDIX I

Time Line Measures for Each Facial Feature

Totals for Each Technique

White Male Image Generation Experiment

Identi-kit Composites

Feature Code	Feature Description	Number Stops on Feature	Feature Stops to Total Stops	Total Time on Feature	Mean Time Per Feature Stop	Ratio Feature Time Total Time
1	Eyes & Lashes	42	.113	7,658.0	182.3	.186
2	Nose	44	.119	6,121.0	139.1	.149
3	Mouth & Lips	32	.086	3,605.9	112.7	.088
4	Ears	12	.032	522.0	43.5	.013
5	Forehead	5	.013	78.0	15.6	.002
6	Cheeks & Cheekbones	1	.003	5.0	5.0	.000
7	Jaw & Jaw-line	2	.005	190.0	95.0	.002
8	Chin	36	.097	4,064.0	112.9	.003
9	Hair	56	.151	7,945.8	141.9	.193
10	Hairline	9	.024	392.0	43.5	.009
11	Eyebrows	39	.105	4,455.0	114.2	.108
12	Sideburns	8	.022	428.0	53.5	.010
13	Moustache	16	.043	1,381.0	86.3	.034
14	Beard	13	.035	1,475.2	113.5	.036
15	Face Shape	14	.038	367.0	26.2	.009
16	Proportions	9	.024	472.0	52.4	.011

EXHIBIT 3

APPENDIX I

Time Line Measures for Each Facial Feature

Totals for Each Technique

White Male Image Generation Experiment

Identi-kit Composites

Feature Code	Feature Description	Number Stops on Feature	Feature Stops to Total Stops	Total Time on Feature	Mean Time Per Feature Stop	Ratio Feature Time Total Time
17	Glasses	12	.032	874.0	72.8	.021
18	Eye Color	0	0	0	0	.0
19	Complexion	4	.011	63.0	15.7	.001
20	Wrinkles	8	.022	720.0	90.0	.017
21	General Expression	6	.016	209.0	34.8	.005
22	Scars & Moles	1	.003	30.0	30.0	.001
23	Neck	1	.003	12.0	12.0	.000

EXHIBIT 4

APPENDIX I

Time Line Measures for Each Facial Feature
Totals for Each Artist/Technician
White Male Image Generation Experiment

Sketches-Robert McCoy

Feature Code	Feature Description	Number Stops on Feature	Feature Stops to Total Stops	Total Time on Feature	Mean Time Per Feature Stop	Ratio Feature Time Total Time
1	Eyes & Lashes	46	.131	5377.9	116.9	.192
2	Nose	26	.074	2768.0	106.5	.099
3	Mouth & Lips	27	.077	1517.1	56.2	.054
4	Ears	10	.028	256.0	25.6	.009
5	Forehead	6	.017	299.0	49.8	.011
6	Cheeks & Cheekbones	23	.065	975.9	42.4	.035
7	Jaw & Jawline	4	.011	153.0	38.2	.005
8	Chin	28	.079	1695.1	60.5	.061
9	Hair	55	.156	5940.0	108.0	.212
10	Hairline	1	.003	30.0	30.0	.001
11	Eyebrows	31	.088	2130.9	68.7	.076
12	Sideburns	5	.014	196.0	39.2	.007
13	Moustache	11	.031	585.0	53.2	.021
14	Beard	9	.025	922.0	102.4	.033

EXHIBIT 4

APPENDIX I

Time Line Measures for Each Facial Feature
Totals for Each Artist/Technician
White Male Image Generation Experiment

Sketches-Robert McCoy

Feature Code	Feature Description	Number Stops on Feature	Feature Stops to Total Stops	Total Time on Feature	Mean Time Per Feature Stop	Ratio Feature Time Total Time
15	Face Shape	32	.091	1391.0	43.5	.050
16	Proportions	1	.003	18.0	18.0	.006
17	Glasses	9	.025	2202.0	244.7	.079
18	Eye Color	2	.006	87.0	43.5	.001
19	Complexion	7	.020	410.0	58.6	.015
20	Wrinkles	11	.031	585.0	53.2	.021
21	General Expression	3	.008	151.0	50.3	.005
22	Scars & Moles	3	.008	175.0	58.3	.006
23	Neck	2	.006	106.0	53.0	.004

EXHIBIT 4

APPENDIX I

Time Line Measures for Each Facial Feature
Totals for Each Artist/Technician
White Male Image Generation Experiment

Sketches-Andrew Meredith

Feature Code	Feature Description	Number Stops on Feature	Feature Stops to Total Stops	Total Time on Feature	Mean Time Per Feature Stop	Ratio Feature Time Total Time
1	Eyes & Lashes	75	.110	7083.0	94.4	.167
2	Nose	61	.089	6117.1	100.3	.144
3	Mouth & Lips	47	.069	3596.0	76.5	.085
4	Ears	16	.023	657.0	41.1	.015
5	Forehead	46	.067	1593.0	34.6	.037
6	Cheeks & Cheekbones	44	.064	2112.0	48.0	.050
7	Jaw & Jawline	23	.034	882.0	38.3	.021
8	Chin	66	.097	3375.9	51.1	.079
9	Hair	90	.132	6360.3	70.7	.150
10	Hairline	9	.013	246.0	27.3	.006
11	Eyebrows	31	.045	1763.9	56.9	.041
12	Sideburns	23	.034	880.0	38.3	.021
13	Moustache	25	.037	1272.0	50.9	.030
14	Beard	3	.004	520.0	173.3	.012
15	Face Shape	62	.091	2631.9	42.4	.062
16	Proportions	11	.016	517.0	129.2	.012

EXHIBIT 4

APPENDIX I

Time Line Measure for EAch Facial Feature

Totals for Each Artist/Technician

White Male Image Generation Experiment

Sketches-Andrew Meredith

Feature Code	Feature Description	Number Stops on Feature	Feature Stops to Total Stops	Total Time on Feature	Mean Time Per Feature Stop	Ratio Feature Time Total Time
17	Glasses	4	.006	517.0	129.2	.012
18	Eye Color	0				
19	Complexion	0				
20	Wrinkles	14	.020	884.9	63.2	.021
21	General Expression	11	.016	413.0	37.5	.010
22	Scars & Moles	4	.006	178.0	44.5	.004
23	Neck	17	.025	1023.1	60.2	.024

EXHIBIT 4

APPENDIX I

Time Line Measures for Each Facial Feature

Totals for Each Artist/Technician

White Male Image Generation Experiment

Identi-kit Composites-Michael Mauldin

Feature Code	Feature Description	Number Stops on Feature	Feature Stops to Total Stops	Total Time on Feature	Mean Time Per Feature Stop	Ratio Feature Time Total Time
1	Eyes & Lashes	19	.112	4963.0	261.2	.224
2	Nose.	20	.118	3193.0	159.6	.144
3	Mouth & Lips	17	.100	2103.9	123.8	.095
4	Ears	6	.035	420.0	70.0	.019
5	Forehead					
6	Cheeks & Cheekbones					
7	Jaw & Jawline					
8	Chin	15	.089	1969.0	131.3	.089
9	Hair	26	.154	4221.9	162.4	.191
10	Hairline	3	.018	139.0	46.3	.006
11	Eyebrows	16	.095	1781.0	111.3	.080
12	Sideburns	1	.006	73.0	73.0	.003
13	Moustache	8	.047	821.0	102.6	.037
14	Beard	9	.053	1168.0	129.8	.053
15	Face Shape	7	.041	157.0	22.4	.007

EXHIBIT 4

APPENDIX I

Time Line Measures for Each Facial Feature

Totals for Each Artist/Technician

White Male Image Generation Experiment

Identi-kit Composites-Michael Mauldin

Feature Code	Feature Description	Number Stops on Feature	Feature Stops to Total Stops	Total Time on Feature	Mean Time Per Feature Stop	Ratio Feature Time Total Time
16	Proportions					
17	Glasses	9	.053	509.0	56.6	.023
18	Eye Color					
19	Complexion	1	.006	10.0	10.0	.000
20	Wrinkles	6	.035	407.0	67.83	.018
21	General Expression	5	.029	194.0	38.8	.009
22	Scars & Moles	1	.006	30.0	30.0	.001
23	Neck					

EXHIBIT 4

APPENDIX I

Time Line Measures for Each Facial Feature

Totals for Each Artist/Technician

White Male Image Generation Experiment

Identi-kit Composites-Janice Hartgrove

Feature Code	Feature Description	Number Stops on Feature	Feature Stops to Total Stops	Total Time on Feature	Mean Time Per Feature Stop	Ratio Feature Time Total Time
1	Eyes & Lashes	15	.114	1707.0	113.8	.138
2	Nose	15	.114	1840.0	122.67	.149
3	Mouth & Lips	10	.076	822.0	82.2	.066
4	Ears	5	.038	88.0	17.6	.007
5	Forehead	2	.015	17.0	8.5	.001
6	Cheeks & Cheekbones	1	.008	5.0	5.0	.000
7	Jaw & Jawline	1	.008	180.0	180.0	.015
8	Chin	11	.084	1251.0	113.7	.101
9	Hair	21	.160	2807.9	133.7	.227
10	Hairline	6	.046	253.0	42.2	.020
11	Eyebrows	15	.114	1632.0	108.8	.132
12	Sideburns	6	.046	235.0	39.2	.019
13	Moustache	5	.038	335.0	67.0	.027
14	Beard	4	.030	307.0	76.7	.025
15	Face Shape	3	.023	74.0	24.7	.006

EXHIBIT 4

APPENDIX I

Time Line Measure for Each Facial Feature

Totals for Each Artist/Technician

White Male Image Generation Experiment

Identi-kit Composites-Janice Hartgrove

Feature Code	Feature Description	Number Stops on Feature	Feature Stops to Total Stops	Total Time on Feature	Mean Time Per Feature Stop	Ratio Feature Time Total Time
16	Proportions	6	.046	299.0	49.8	.024
17	Glasses	1	.008	197.0	197.0	.016
18	Eye Color					
19	Complexion	2	.015	23.0	11.5	.002
20	Wrinkles	2	.015	313.0	156.5	.025
21	General Expression					
22	Scars & Moles					
23	Neck					

EXHIBIT 4

APPENDIX I

Time Line Measures for Each Facial Feature

Totals for Each Artist/Technician

White Male Image Generation Experiment

Identi-kit Composites-Richard Fowler

Feature Code	Feature Description	Number Stops on Feature	Feature Stops to Total Stops	Total Time on Feature	Mean Time Per Feature Stop	Ratio Feature Time Total Time
1	Eyes & Lashes	8	.114	988.0	123.5	.151
2	Nose	9	.128	1088.0	120.9	.167
3	Mouth & Lips	5	.071	680.0	136.0	.104
4	Ears	1	.014	14.0	14.0	.002
5	Forehead	3	.043	61.0	20.3	.009
6	Cheeks & Cheekbones					
7	Jaw & Jawline	1	.014	10.0	10.0	.002
8	Chin	10	.143	844.0	84.4	.129
9	Hair	9	.128	916.0	101.8	.140
10	Hairline					
11	Eyebrows	8	.114	1042.0	130.2	.160
12	Sideburns	1	.014	130.0	120.0	.018
13	Moustache	3	.043	225.0	75.0	.034
14	Beard					
15	Face Shape	4	.057	136.0	34.0	.021
16	Proportions	3	.043	173.0	57.7	.027

EXHIBIT 4

APPENDIX I

Time Line Measures for Each Facial Feature

Totals for Each Artist/Technician

White Male Image Generation Experiment

Identi-kit Composites-Richard Fowler

Feature Code	Feature Description	Number Stops on Feature	Feature Stops to Total Stops	Total Time on Feature	Mean Time Per Feature Stop	Ratio Feature Time Total Time
17	Glasses	2	.028	168.0	84.0	.026
18	Eye Color					
19	Complexion	1	.014	30.0	30.0	.005
20	Wrinkles					
21	General Expression	1	.014	15.0	15.0	.002
22	Scars & Moles					
23	Neck	1	.014	12.0	12.0	.002

EXHIBIT 5

APPENDIX I

Time Line Measures for Each Image Generation Session

Black Male Image Generation Experiment

Technique	Artist Technician	Target Number	Witness Number	Total Time	Number Different Feature Codes	# Feature Stops	Mean Time Per Feature	Standard Dev. of Mean Time Per Feature	# Feature Stops # Feature Codes
Sketch	SN	118	237	1800	11	27	66.67	71.58	2.45
Sketch	SN	125	251	1960	14	22	89.09	80.31	1.57
Sketch	SN	128	256	1765	13	31	56.94	48.77	2.38
Sketch	SN	129	258	1590	15	20	79.50	104.97	1.33
Sketch	SN	133	266	1340	13	23	58.26	58.34	1.77
Sketch	SN	136	273	1340	15	21	63.81	51.45	1.40
Sketch	SN	141	282	2035	17	36	56.53	56.00	2.12
Sketch	SN	142	285	2430	17	27	90.00	109.65	1.59
Sketch	SN	144	289	1515	11	18	84.17	88.26	1.64

EXHIBIT 5

APPENDIX I

Time Line Measures for Each Image Generation Session

Black Male Image Generation Experiment

Technique	Artist Technician	Target Number	Witness Number	Total Time	Number Different Feature Codes	# Feature Stops	Mean Time Per Feature	Standard Dev. of Mean Time Per Feature	# Feature Stops # Feature Codes
Sketch	VM	120	241	2430	13	28	86.79	100.42	2.15
Sketch	VM	123	246	2555	14	33	77.42	99.58	2.36
Sketch	VM	130	261	2657	14	24	110.71	110.06	1.71
Sketch	VM	132	264	2425	11	27	89.91	76.31	2.45
Sketch	VM	134	268	1635	12	19	86.05	93.70	1.58
Sketch	VM	135	271	1255	9	12	104.58	124.32	1.33
Sketch	VM	137	275	1680	11	21	80.00	71.45	1.91
Sketch	VM	140	281	2670	12	20	133.50	154.14	1.67

EXHIBIT 5

APPENDIX I

Time Line Measures for Each Image Generation Session

Black Male Image Generation Experiment

Technique	Artist Technician	Target Number	Witness Number	Total Time	Number Different Feature Codes	# Feature Stops	Mean Time Per Feature	Standard Dev. of Mean Time Per Feature	# Feature Stops # Feature Codes
IDK	RF	118	236	960	11	19	50.53	31.33	1.73
IDK	RF	120	240	1272	12	15	84.80	69.85	1.25
IDK	RF	123	247	1270	9	15	84.67	96.44	1.67
IDK	RF	130	260	1090	9	11	99.09	79.51	1.22
IDK	RF	132	265	910	10	13	70.00	64.99	1.30
IDK	RF	133	267	1115	9	21	53.10	39.05	2.33
IDK	RF	139	278	1090	7	7	155.71	104.55	1.00
IDK	RF	141	283	1545	12	15	103.00	75.69	1.25
IDK	RF	144	288	1460	10	12	121.67	90.60	1.20

EXHIBIT 6

APPENDIX I

Time-Line Measures for Each Facial Feature

Black Male Image Generation Experiment

Feature Code	Feature Description	Number Stops on Feature	Feature Stops Total Stops	Total Time on Feature	Mean Time Per Feature Stop	Ratio Feature Time Total Time
1	Eyes	61	.114	10,339.5	169.5	.236
2	Nose	48	.089	5,865.6	122.2	.134
3	Mouth & Lips	44	.082	6,626.4	150.6	.151
4	Ears	14	.026	334.6	23.9	.008
5	Forehead	32	.060	1,456.0	45.5	.033
6	Cheeks & Cheekbones	23	.043	1,074.1	46.7	.024
7	Jaw & Jawline	9	.017	295.2	32.8	.007
8	Chin	48	.089	2,529.6		
9	Hair	57	.106	3,801.9	66.7	.087
10	Hairline	20	.037	646.0	32.3	.015
11	Eyebrows	30	.056	3,612.0	120.4	.082
12	Sideburns	19	.035	864.5	45.5	.020
13	Moustache	27	.050	1,900.8	70.4	.043
14	Beard	19	.035	1,259.7	66.3	.029
15	Face Shape	47	.088	1,795.4	38.2	.041
16	Proportions	10	.019	339.0	33.9	.008
17	Glasses	1	.002	405.0	405.0	.009

EXHIBIT 6

APPENDIX I

Time-Line Measures for Each Facial Feature

Black Male Image Generation Experiment

Feature Code	Feature Description	Number Stops on Feature	Feature Stops Total Stops	Total Time on Feature	Mean Time Per Feature Stop	Ratio Feature Time Total Time
18	Eye color	0	.0	0	0	0
19	Complexion	3	.006	35.1	11.7	.001
20	Wrinkles	8	.015	235.2	29.4	.005
21	General Expression	4	.007	34.8	8.7	.001
22	Scars & Moles	1	.002	35.0	35.0	.001
23	Neck	12	.022	320.4	26.7	.007

EXHIBIT 7
APPENDIX I

Time Line Measures for Each Image Generation Session

White Female Image Generation Experiment

Technique	Artist Technician	Target Number	Witness Number	Total Time	Number Different Feature Codes	# Feature Stops	Mean Time Per Feature	Standard Dev. of Mean Time Per Feature	# Feature Stops # Feature Codes
Sketch	SN	100	201	2582	11	25	103.28	79.25	2.27
Sketch	SN	105	211	2597	10	26	99.88	90.00	2.60
Sketch	SN	107	215	2108	11	22	95.82	101.68	2.00
Sketch	SN	108	217	2385	9	25	95.40	71.06	2.78
Sketch	SN	115	231	1535	11	16	95.94	86.32	1.45
Sketch	SN	117	235	2030	12	21	96.67	79.14	1.75
Sketch	SN	122	244	1375	10	18	76.39	78.56	1.80
Sketch	SN	124	249	2203	12	29	75.97	69.57	2.42

EXHIBIT 7

APPENDIX I

Time Line Measures for Each Image Generation Session

White Female Image Generation Experiment

Technique	Artist Technician	Target Number	Witness Number	Total Time	Number Different Feature Codes	# Feature Stops	Mean Time Per Feature	Standard Dev. of Mean Time Per Feature	# Feature Stops # Feature Codes
Sketch	VM	104	209	1656	10	14	118.29	109.27	1.40
Sketch	VM	109	219	2687	12	18	149.28	1[illegible]	1.50
Sketch	VM	111	222	3274	12	20	163.70	166.74	1.67
Sketch	VM	113	227	2510	13	21	119.52	142.73	1.61
Sketch	VM	114	228	2620	10	24	109.17	84.30	2.40
Sketch	VM	116	233	2325	10	18	129.17	132.15	1.80
Sketch	VM	119	239	2390	12	26	91.92	81.35	2.17
Sketch	VM	127	255	2520	10	21	120.00	122.36	2.10
Sketch	VM	131	263	2630	11	17	154.71	189.98	1.54
Sketch	VM	143	286	2490	10	18	138.33	165.63	1.80

EXHIBIT 7

APPENDIX I

Time Line Measures for Each Image Generation Session

White Female Image Generation Experiment

Technique	Artist Technician	Target Number	Witness Number	Total Time	Number Different Feature Codes	# Feature Stops	Mean Time Per Feature	Standard Dev. of Mean Time Per Feature	# Feature Stops / # Feature Codes
IDK	RF	100	200	975	8	16	60.94	57.32	2.00
IDK	RF	106	212	1346	8	14	96.14	60.35	1.75
IDK	RF	108	216	855	9	13	65.77	66.96	1.44
IDK	RF	110	220	765	10	13	58.85	42.21	1.30
IDK	RF	112	224	1090	9	12	90.83	68.76	1.33
IDK	RF	114	229	1290	11	14	92.14	67.74	1.27
IDK	RF	127	254	895	10	19	47.11	56.90	1.90
IDK	RF	131	262	900	10	17	52.94	37.42	1.70

EXHIBIT 8

APPENDIX I

Time-Line Measures for Each Facial Feature

White Female Image Generation Experiment

Feature Code	Feature Description	Number Stops on Feature	Feature Stops to Total Stops	Total Time on Feature	Mean Time Per Feature Stop	Ratio Feature Time Total Time
1	Eyes	64	.126	11,333.76	177.09	.221
2	Nose	55	.108	6,640.15	120.73	.129
3	Mouth & Lips	50	.098	7,834.00	156.68	.153
4	Ears	4	.008	80.00	20.00	.001
5	Forehead	27	.053	936.36	34.68	.018
6	Cheeks & Cheekbones	40	.078	2,218.00	55.45	.043
7	Jaw & Jawline	9	.018	420.03	46.67	.008
8	Chin	60	.118	3,958.2	65.97	.077
9	Hair	61	.120	9,079.24	148.84	.177
10	Hairline	6	.012	154.98	25.83	.003
11	Eyebrows	38	.075	4,167.08	109.66	.081
12	Sideburns	—	—	—	—	—
13	Moustache	—	—	—	—	—
14	Beard	—	—	—	—	—
15	Face Shape	39	.077	1,731.99	44.41	.034
16	Proportions	32	.063	1,041.92	32.56	.020
17	Glasses	4	.008	263.00	65.75	.005

EXHIBIT 8

APPENDIX I

Time-Line Measures for Each Facial Feature

White Female Image Generation Experiment

Feature Code	Feature Description	Number Stops on Feature	Feature Stops to Total Stops	Total Time on Feature	Mean Time Per Feature Stop	Ratio Feature Time Total Time
18	Eye Color	1	.002	80.00	80.00	.001
19	Complexion	1	.002	463.00	463.00	.009
20	Wrinkles	5	.010	385.00	77.00	.007
21	General Expression	1	.002	15.00	15.00	.000
22	Scars & Moles	2	.004	140.00	70.00	.003
23	Neck	9	.018	300.96	33.44	.006

EXHIBIT 1
APPENDIX J

PROCEDURES FOR GENERATING SKETCHES

The interview with the witness begins with the witness' initial description of the target on the Sketch Artist Information Form (see Exhibit 2, Appendix C). Questions asked on this sheet are direct and received direct answers. The completed form is used as a referral sheet during the interview.

Two particular techniques are used to obtain an initial image from a subject. One approach is direct. Guided by the artists' questions, the subject describes his image of the target. The artist begins sketching a likeness concurrently with this verbalization. The subject, observing the emerging drawing, is asked to change, at any time, any portion of the drawing which he feels is not correct. He is made to feel relaxed about expressing any changes in the drawing. Also, subjects are given small writing pads and asked to draw (no matter how crude) anything they feel is not being expressed well verbally. Throughout this procedure, other drawings of different faces are used as examples for comparison.

The second approach involves less interaction with the image initially. The witness is asked to look at the blank wall and to concentrate only on the image of the target. With the guidance of the artists' questions, the witness describes his image. Only after the initial features are sketched, does the witness view the drawing. At this time, he describes whatever alterations should be made. With this method, the image which the witness retains is perhaps less disturbed during the initial exchange between artist and witness.

Although these initial methods of procedure are different, the outline of questions and drawing techniques used by the artist to create a face are the same. Before the witness arrives, a layout is placed on the drawing paper. It consists of an oval with a central vertical line and three division lines placed horizontally at one-third segments to designate eyes, nose, and mouth locations. This outline is based upon an average face and provides a starting point for any alterations. The first area of the face that the witness is asked to concentrate on is facial shape. He/she is asked to describe the chinline and the jawline, possibly in terms of long, short, pointed, squared, oval, high cheekbones, sunken cheekbones, etc. A neck and shirt collar are quickly sketched in. At this point work began on the hairstyle and type of hair. At all times, the witness is asked to describe any distinctive characteristics or perculiarities he may have noticed about the target. Once this initial facial shape is completed, focus is placed on the actual features. The nose is drawn first, again with the artist supplying descriptive adjectives in the questioning to help the witness make comparisons and to give the artist a starting point. Attention is placed on the nose positioning first, for it is used in locating the other features. For example, the eyes and mouth could be located more accurately within the face in relation to the nose, rather than in a top to bottom placement of eyes, nose, and finally mouth. With positioning of the nose, the mouth is then drawn. At this point, it could be placed into the drawing in relation to the nose and the chinline. Moustaches and beards are drawn next. The final features are the eyes and eyebrows. These features are plotted in relation to the distance from the nose and the hairline.

At no time, is the witness guided so strongly in the questioning that he can not add his own input independent of the outline described. The outline is used as a guide during the interview.

PROCEDURES FOR GENERATING IDENTI-KIT COMPOSITES

Construction of Identi-kit composite begins by asking the witness four basic questions and recording specific responses on a standard form (see Exhibit 3, Appendix C). The questions and response categories include the following:

(a) Approximate height of the suspect? Response categories are: tall, medium, and short. Classification is based on the following table.

	Men	Women
Tall	6'	5'6"+
Medium	5'7"-5'11"	5'1"-5'5"
Short	5'6"-	5'-

(b) Build of the suspect? Response categories are heavy, medium, slender, and square.

(c) Age of the suspect? Response categories consist of age groups starting at age 15 and ascending in groups of ten years (15-25, 25-35, 35-45, 45-55, 55- and up).

(d) Hair of the suspect? This question is divided into three parts. The first calls for a description of the hairline across the forehead, the second asks about the color of the hair, and the third about the thickness of the hair. The witness is then asked to look at the card in the Identi-kit which contains a large selection of hair styles and select one that is most like the suspect.

The answers to the above four questions guide the technician in producing a basic composite. Each response category for the questions is mapped to a

basic composite. Each response category for the questions is mapped to a corresponding facial feature or set of facial features in the Identi-kit. A card in the Identi-kit contains the mappings. The feature associated with each description following the questions is selected so that the resulting facial composite is plausible given all responsed to the questions.

The resulting composite is shown to the witness and the construction of the face proceeds in an interactive fashion. The witness indicates which features are not correct and the manner in which they should be changed. The selection is facilitated by the technician providing structured alternatives to the witness. Alternative values of the feature are selected which are closer to the witness' description. Generally the technician should exaggerate in the selection features. Feature selection is made from a book containing all the features in Identi-kit. The technician avoids showing the features in isolation to the witness. The technician selects the feature based on the witness discription. The witness works primarily from the composite. Exceptions include hair selection.

Certain aspects of the face can be influenced during the construction period through the use of the following procedures:

(a) Expression - raise or lower eyebrows,
raise or lower lips

(b) Age - raise or lower chin

(c) For females

eyes - E14 others are E15 and E16

nose - N9, N24

younger nose - N 35

Older nose - N 03

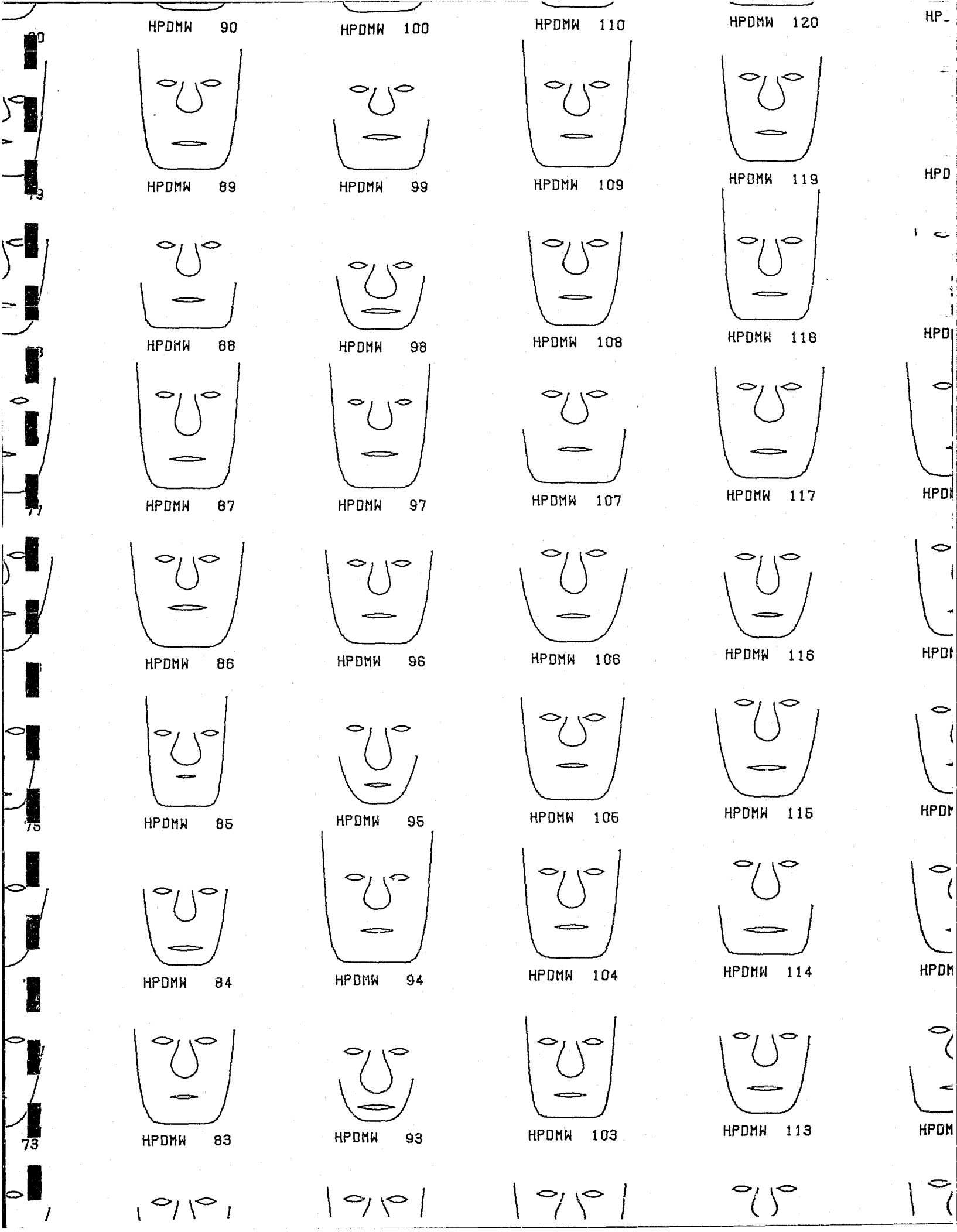
Older lips -L 30

Smiling lips - L08

other female lips - L03, L28, L29

Other female eyebrows - D 02, D21

When the composite is finished, the witness is asked to rate how closely the composite matches person.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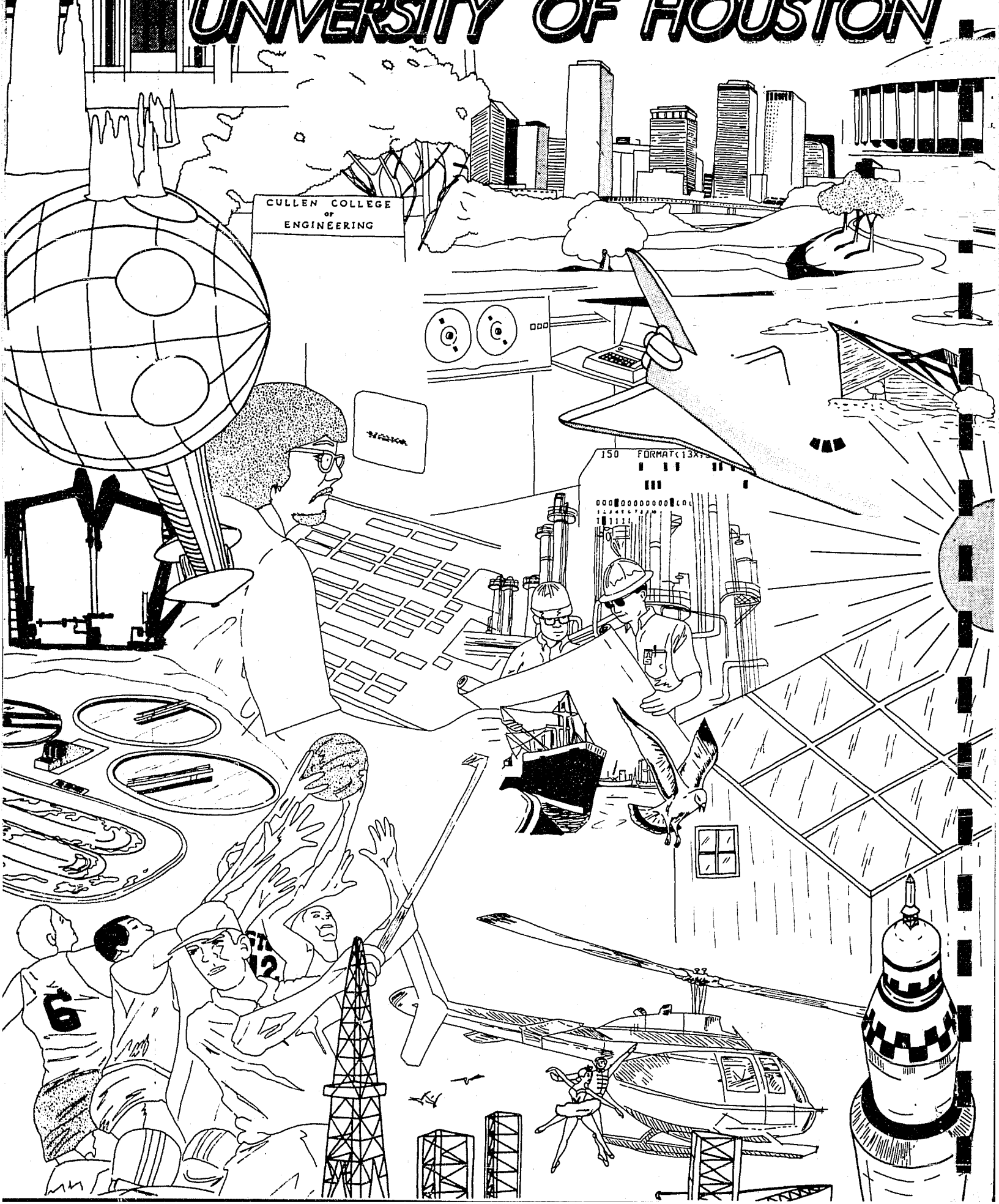
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