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Enhancing medical observational skills through fine art : a randomized controlled study

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A Randomized Controlled Study

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Jacqueline Dolev
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Abstract

ENHANCING MEDICAL OBSERVATIONAL SKILLS THROUGH FINE ART

A Randomized Controlled Study

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The purpose of this study is to determine whether first year medical students can learn and enhance the observational skills necessary for medical diagnosis by studying and discussing paintings. The study was conducted at the Yale University School of Medicine and the Yale Center for British Art (YCBA) over two academic years. One hundred seventy-six (176) first year medical students participated. In 1998-1999 ninety students were randomly assigned to three groups: the YCBA group, the lecture group and the control group. The YCBA groups studied and discussed paintings with their peers and the museum Curator of Education. The control groups attended their regularly scheduled clinical tutorial session, in which they were taught clinical skills by a physician preceptor. The lecture group attended an anatomy lecture targeted at teaching students how to read x-rays. In 1999-2000, eighty-six students were randomized into the YCBA and control groups only, after the preliminary data revealed that the lecture group's observational skills were unchanged after attending the didactic lecture ($p=0.928$). All students were given a performance exam before and after their event. A predetermined key was used to grade blindly students' ability to describe the visual features necessary for medical diagnosis in a series of color photographs. Students' medical observational skills were tested along two time points, the pre-test (T_1), and post-test (T_2). Post-test scores differed between the two groups for both years [two way repeated measures ANOVA, [$F(1,144) = 8.9$, $p=0.003$]. YCBA students achieved significantly higher scores and improved more often than the control. Students also completed a word list search task after their events in 1999-2000. The YCBA group's mean scanning rate was found to be significantly faster than the control group ($p=0.035$).

Groups	YCBA (n = 81)	Control (n = 65)	Lecture (1998 only, n = 30)
Pre- Test exam	50% (± 10%)	47%(± 10%)	46%(± 14%)
Post-Test exam	57%(± 09%)	46%(± 11%)	46%(± 12%)

First year medical students can and do learn medical visual skills by studying and describing representational paintings.

Contributions and Acknowledgments

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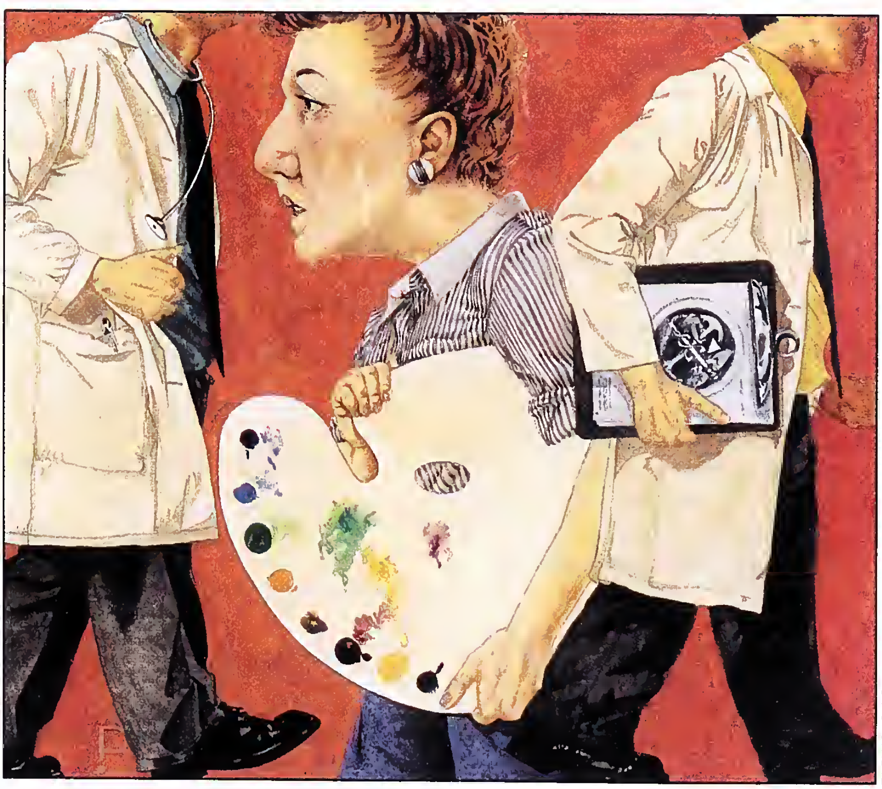

ZACHARY PULLEN

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Introduction

"With purity and with holiness I will pass my life and practice *my Art*."

From The Oath of Hippocrates

From the time of Hippocrates (c. 460 – 377 B.C.E), until the early modern age, western culture has recognized medicine as an art form as much or more than as a science. Today, the commonly coined term *the art of medicine*, is familiar to physicians, and students alike, and is often used in the media. Most frequently the term is used to describe: 1) the art-like mastery of the practice of medicine and the complexities of healing; 2) the use of art as a treatment modality within the practice of medicine, such as art therapy or music therapy; 3) humanism in medicine, or the expression of compassion by physicians; and 4) medical illustration or the artistic representations of pathology and disease. A.R Feinstein states that "Medicine is the most scientific art and the most humanistic science. The art and science are symbiotic, intermingled, and inseparable." (1) The use of art as a medium with which to *teach* clinical medicine, however, is a melding of art and medicine that is underdeveloped and, in fact, as a formal training method, is novel.

Although seldom featured in medical curricula, the connection between art and *general* education has its roots in very early philosophy. In fact, Plato (c. 428 – 348 B.C.E) stated that "art should be the basis of education." According to Read's *Education*

Through Art, this assertion was Plato's most passionate ideal. Plato's statement has not passed through history without controversy and interpretation. Read explains and defends Plato's meaning during the first chapter of his book. In reference to art and education Read states that:

> the basic mental processes involved in art and education alike – [are] perception and imagination... the integration of all biologically useful faculties in a single organic activity. In the end I do not distinguish science and art, except as methods, and I believe that the opposition created between them in the past has been due to a limited view of both activities. Art is the representation, science the explanation- of the same reality...The aim of education is therefore the creation of artists- of people efficient in the various modes of expression. (2)

The Yale Center for British Art (YCBA) project gives practical expression to the long-proposed ideals of integrating art and science in education. The project incorporates art and science both by using art as a novel training tool in which to teach medicine, and by educating and creating medical "artists."

Pappworth states that "To be described as an artist should be regarded by physicians as a great compliment but they should also be proud that their scrupulously careful examination of patients is as scientific as laboratory measurements and the interpretation of X-ray shadows.... Diagnosis is a creative art and belongs in the realm of discovery." (1) Physicians necessarily are detectives who pay close attention to their patients' body habitus, racial ethnicity, facial expressions, as well as physical clues of jaundice, anorexia, erythema or edema, in order to diagnose their pathology. Long having been emphasized throughout the history of medicine, observational skills are critical to medical diagnosis and problem solving, and thus, medical education.

Commenting on the early 20th-century, Dr. Stephen Lurie states that "…medical schools immediately began to develop unique institutional personalities….This was a stable situation until the past few decades, when a series of interrelated and universal stressors forced every institution to adapt." (3) Today, partially due to these universal stressors, pre-clinical medical education is under constant revision with many recent changes in curricula, that include new integrated learning approaches, smaller group sessions, and less didactic lecture time. Much of this widespread reform has been based on published findings that promote superior teaching methods. It has been noted, for example, that rote memorization or surface learning is an inferior teaching style. "Surface learning merely encourages students to reproduce what has been learnt…. Deep learning, as opposed to surface learning, is an active search for understanding…. Research has identified the student's approach to learning - surface or deep - as the crucial factor in determining the quality of learning outcomes." (4) Although there has been a general trend in medical curricula to move away from didactic teaching and rote memorization and towards student centered approaches to learning, visual skills remain very difficult to teach at a "deep" level.

Spencer identifies student centered approaches to learning as the means to achieving deep learning. They include both self directed and problem based learning, and have the advantage of: the achievement of deep learning, the enhancement of self directed skills, a stimulating learning environment, the promotion of interactions between

students and staff, increased collaboration between disciplines, and an improvement in student motivation and enjoyment. (4) A new teaching design using a student centered approach to observational learning will be outlined later.

The difficult task of teaching observational skills can be illustrated in the pre-clinical years by the visually oriented studies of histology or pathology. A student may inspect a slide under the microscope that has previously been identified to them during a lecture as the adrenal gland. The student memorizes that particular image or pattern, but may not be able to identify the underlying features that define each and every cross section of that gland. Thus, the student begins the task of memorizing all the possible views of the adrenal gland so that they may be recognized when encountered in the future. However, if a variant occurs that does not match one of the already memorized patterns, the student may not be able to identify the tissue with certainty. Pattern recognition without necessary understanding or sufficient inspection of the details that compose the overall pattern is the surface learning that makes teaching observational skills problematic.

Observational skills are transmitted to senior medical students much like many aspects of clinical medicine, by the old adage "see one, do one, teach one", that is, by emulating others. Students with clinical responsibilities begin to learn clinical and visual skills by mimicking the interns, residents and attendings physicians with whom they come into contact. Papadakis writes that "most of the socialization of what trainees will

internalize in terms of values, attitudes, and behaviors takes place as part of the hidden curriculum." (5) Observational skills lay unseen within the hidden curriculum, as they are impossible to emulate simply by watching others. Students may improve their observational skills solely if they are in the audience of a great teacher. As Sir William Osler (1849 – 1919) stated, "No bubble is so iridescent or floats longer than that blown by the successful teacher." (6) The challenge of this teaching method for the teacher is to both emphasize the visual skills important for diagnosis, and to also describe to students *how* he or she "sees".

Milton Charles Winternitz (1885 – 1959) by many historical accounts a truly great teacher and pathologist, was Dean of the Yale School of Medicine from 1920 to 1935, during which time he elevated the school's academic status enormously. "Who could forget this compact, intense fountainhead of energy; this inexhaustible generator of ideas and constant stimulator of the imagination;...this sensitive, perceptive, and, in his own way, tender human being who inspired adulation?" (7) His style of teaching was gregarious and memorable to many. One account depicts Winternitz holding up an object he had constructed. He asked one of the students to state what he saw. Winternitz was looking for a description, not an identification of the object. He wanted the student to state that the object "was a glass cylinder filled with fluid of a yellow hue containing several glass spheres of varying colors", and not "a test tube with marbles and colored

water."[1] He was hoping to teach his students to observe in an unbiased fashion, and to resist the urge to jump to a diagnosis without observing details. As a teacher, Winternitz believed in the importance of emphasizing observational skills in the students' learning of pathology.

Published studies regarding undergraduate medical education reform include the following topics: the effectiveness of the history and physical examinations, the significance of medical boards scores, teaching communication skills, critical care management, professionalism, compassion, novel curriculum designs and teaching styles. (8, 9,10) There have been, however, no published studies exploring how to teach medical students to be better observers. Furthermore, there have been virtually no published studies on how physicians in general "see". The *only* study in the medical literature investigating observational skills in physicians is titled "Aspects of visual perception in radiography" published by Adrian–Harris in *Radiography*. (11) The study utilizes the findings of Ulrich Neisser, an American psychologist, who introduced the term "parallel processing" in the 1960s.

Parallel processing is the ability of an observer to scan lists of words or phone numbers and quickly disregard irrelevant information while simultaneously searching for target symbols. Neisser found that humans can identify up to ten target symbols with the

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[1] Personal Communication: Dr. John S. Strauss. YSM Class of 1950. Professor of Dermatology. University of Iowa School of Medicine.

same speed and accuracy as one symbol after a period of visual training. (12) He introduced the visual exercise Adrian-Harris utilizes in which subjects are shown a list composed of 50 rows of 5-10 letters single spaced in columns. Subjects are asked to find a single item with an assigned target property that is present in each column, and their speed is timed.

In Adrian–Harris's study, the subjects are radiologists and the word list exercise described above is used as a training tool. Adrian-Harris demonstrated that after the subset of radiologists in the study assigned to the intervention group underwent 15 days of practicing with this visual tool, their accuracy at reading radiological films increased from 56% to 76%. The radiologists in the control group, who did not undergo training, showed no improvement. Radiologists were also found to be 89 percent faster at the word list task than the general population. The word list task, as well as other visual training methods, were proposed by the author to be useful as a measurement with which to test prospective students applying for a job. "...recruitment of only the elite is not suggested, but rather the weeding out of the visual equivalent of tone deaf applicants." (11) Although the author illustrates that non-medical visual training is directly correlated with increased radiological accuracy, visual training methods have not in a consistent fashion, been formally adopted into medical curricula or used as a screening tool over the course of the last 22 years.

The lack of systematic training in medical observational skills caught the attention of Dr. Irwin Braverman, who noted that the observational skills of residents beginning their Dermatology training were no better than those of medical students. He also noted that, in general, housestaff lose (not gain) observational skills during their internship training due to workload, inadequate time spent with and observing their patients, and an increasing reliance on imaging techniques and laboratory data for clinical diagnosis. After 3 years of practice and personal experience, Dermatology residents become better observers, and after residency, it often takes 5 to10 years of practical experience for practitioners to have an "experiential epiphany" in diagnosis.

In October of 1997, Dermatology residents were taken to the YCBA to determine whether describing representational paintings would improve their clinical skills. Their observational improvements in the following weeks, became the impetus to extend the exercise to first year medical students, in a deliberate attempt to teach and reinforce visual skills early in medical education. Dr. Bob Gifford, formerly Dean of Student Affairs, was extremely enthusiastic, and encouraged medical students to attend during the 1997-1998 academic year. The study was then formalized the following years, after the pilot students' informal visual descriptions of medical photographs revealed improvement. Thus, the intent of the YCBA project was to discover if the *experiential* process of learning to "see" can be taught through systematic visual training.

Hypothesis

First year medical students can learn and enhance the observational skills necessary for medical diagnosis by studying and discussing paintings. The study design to be outlined is an attempt to verify whether non-medical visual training translates into improvements in medical visual skill. This thesis describes the results and implications of The Yale Center for British Art Project, and also serves as an "instructional manual". It contains the framework for building a curriculum to optimize the teaching of observational skills.

Methods

Study Design

First year medical students began attending the Yale Center for British Art (YCBA) during the academic year of 1997-1998. This initial group of students was a pilot program, and although the students were not formally evaluated for improvements in observational skills, the preliminary impression was that their skills had improved based on their informal descriptions of photographs of medical disorders unknown to them. The study design was conducted during the academic years of1998-1999 and 1999-2000. In 1998-1999, all first year medical students at the Yale University School of Medicine were randomly assigned, by clinical tutorial group[2], into three groups: the control group, the intervention group (YCBA group), and the Lecture group. In 1999-2000, all first year medical students were randomly assigned into either the control or the YCBA groups only. All students were tested using a performance exam.

Pre- test performance exam	1.5 – 2 hour event	Post – test performance exam
√	clinical tutorial session	√
√	YCBA intervention	√
√	Radiology lecture	√

Table 1.1 Study Design

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[2]Clinical tutorial groups are assignments given to all first year medical students by the Office of Education. Groups of four students attend weekly sessions at Yale-New Haven Hospital or the West Haven VA.

The Control Group:

Students in the control group attended their regularly scheduled clinical tutorial sessions, in which they were taught clinical skills by their physician preceptor. Preceptors emphasize history taking and physical exam skills, through discussion and demonstration, as well as the fundamentals of patient care and medical diagnosis. Students may interview patients or perform physical examinations.

The Intervention Group:

Students in the intervention group attended the Yale Center for British Art with their assigned clinical tutorial groups. Each student was asked to examine one pre-selected representational oil painting individually. Students were given a clipboard with a blank piece of paper and a pencil for any notes they wanted to write down. Students were asked not to look at the posted labels containing descriptions and titles of the paintings. After studying the paintings for approximately 10 minutes, students were asked to describe their painting to their peers with the museum Curator of Education in attendance. Their discussion format and topics will be outlined later.

The Lecture Group:

Students in this group attended a regularly scheduled Anatomy lecture as part of the first year curriculum. This particular lecture emphasized teaching students how to read abdominal x-rays, in relation to that week's dissection.

Group Sizes

Year	Control	Intervention	Lecture	Totals
1999	30	30	30	**90**
2000	35	51	—	**86**
Totals	**65**	**81**		

Table 1.2 Number of participants in each group by year.

Participants

1. All participants were first year medical students enrolled at the Yale University School of Medicine.
2. First year medical students were introduced to the YCBA project during the first month of their Doctor-Patient Encounter course in a lecture given by Dr. Irwin Braverman discussing the importance of observational skills. Students were invited and encouraged to participate in the study.
3. Students were then randomly assigned to one of the three groups.
4. Participant characteristics were not significantly different among groups or years.

As part of the medical school curriculum for both years, all first year students attended the Yale Center for British Art experience by the end of their academic year regardless of group assignment or participation in visual skills testing.

Year	1998-1999			1999- 2000	
Characteristics	control (n=30)	intervention (n=30)	lecture (n=30)	control (n=35)	intervention (n=51)
Female	14	16	13	17	24
Male	16	14	17	18	27
Color Blindness	0	0	1	N/A‡	N/A
Annual Museum Visits	3.4	3.0	3.2	N/A	N/A
Art Experience*	7	6	3	9	15

Table 1.3 Participant characteristics by group assignment and year.

* Art experience is defined as: courses or proficiency in art history, and courses or aptitude in the arts and visual arts (including photography, pottery, and music).

‡ These characteristics were not assessed for the 1999-2000 year.

Training Technique

Each student in the intervention group was asked to study one painting for ten minutes before presenting it to their peers and the museum Curator of Education. Students were instructed to present their painting to the small group in such a way, that if an individual listening to them had their eyes closed, they would be able to "see" what the student was describing. Students were asked to base what they said solely on visual observations. A student could not simply state that in a portrait of a woman, the woman's face looks melancholic, but rather they must direct the viewers attention to her gaze, to a specific wrinkle, or to the colors the artist uses to paint her. The discussion moderated by

the Curator of Education encouraged students to systematically describe the entire painting, including the frame, the size of the picture, the figures on the canvas and all of the elements that compose the painted scene. The discussions were structured with open-ended questioning, rather than didactic teaching. Often, students were asked to elaborate on or explain a comment they had made. Direct questioning was used if a specific visual point had not been addressed. Other students were encouraged to voice their opinion or ask questions once the student presenter had finished their initial descriptions.

The paintings are used as a medium to teach both physical diagnosis and the construction of the differential diagnosis. To best illustrate the teaching format and content used, the discussion points and observations expected to be addressed by the students for this painting, *The Death of Chatterton,* by Henry Wallis (1856), follow[3]:

[3] All other paintings utilized for the visual training may be found in Appendix A.

1. Is the gentleman in the painting sleeping, dead or unconscious? Visual clues include his skin color of a bluish hue (cyanotic) and his abnormal posture (not sleeping posture) that lead to the conclusion that he is dead.
2. Where in the house does this scene take place? There is a darkness in the painting like that expected in a basement, and even though there is a view of the city from above through the window, it could be a basement on a hilltop. The window's construction reveals a slanting roof and, therefore, the location is in the attic.
3. What is the time of day/how long has he been in this condition? Both the smoke still rising from the candle that has burned out after being lit all night, and the yellowish/ pink sky indicate it is dawn (not dusk). The angle of the light shining on him provides another clue.
4. How old is the figure? His smooth skin and lean physique indicate he is an adolescent man (Chatterton was 17 years old in his death).
5. Is his arm resting comfortably on his chest or was he clutching his chest before his death? Perhaps he was experiencing chest pain related to his death.
6. What was his cause of death? The empty vial fallen to the floor may indicate that his death was not accidental. The crumbled paper in his right hand and the torn manuscript on the floor may provide his motivation (Chatterton used arsenic to poison himself).

Photograph Performance Measure

All participating students were given a performance exam as a pre-test (or baseline), and then as a post-test after a 1.5 to 2 hour time lapse, during which the interventions took place. Two sets of the performance exam were developed for each year. Students were randomly assigned to set A or B each year. If a student received set A as the pre-test, then set B was given as the post-test, and vice versa. This was done to ensure that the pre-test and post-test were of equal difficulty, and that no inherent bias towards either improvement or degradation existed in the testing. In the1998-1999 year, the pre-test and post-tests contained two clinical medical photographs each. In the1999-2000 year, the tests contained three clinical medical photographs each.

Year	Control Group	YCBA Group	Lecture Group
1998-1999	11A (then B) 19B (then A)	11A (then B) 19B (then A)	20A (then B) 10B (then A)
1999-2000	16A(then B) 19B (then A)	27A(then B) 24B (then A)	

Table 1.4 Set A and B Assignments

Photographs

Students were asked to describe in words what they saw in the photographs given to them. The instructions were open-ended, in the sense that students were not asked to write down a diagnosis or to look for a specific pathology. They were instructed to think

of the photographs as paintings in a frame. Students were given three minutes per photograph.

The photographs were images of patients with dermatological and medical pathology reselected by the author and Dr. Irwin Braverman. Some of the images were full figures, while others were either portraits or close-ups of a specific body part. The images depicted both genders, as well as individuals varying in body habitus, and age. Grading keys were developed in advance that included ten points of characteristic features necessary for diagnosis in each photograph. [1] The following is an example of one photograph used and its grading criteria:

[1]All of the photographs used and sample grading sheets may be found in Appendix B.

Visual features used for grading this photograph include:

1) Back of the arm, 2) Lesions extend to the shoulder, 3) Hair seen on arm and in the axilla, 4) Gender / Age, 5) Lesions found in clusters, 6) Description of individual lesions 7)Varying sizes of the clusters, 8)Varying sizes of lesions within clusters, 9)Dermatomal / linear distribution, 10) Other Observation[5]. (eg. five major clusters of lesions, low muscle mass of triceps, lesions are in differing stages of development)

Examples of Student Descriptions:

The following are three sample student descriptions for the above photograph (pg. 19):

1)Scored "below average":

-The picture is of a person's forearm and upper arm. -light complexion -groupings of dermatological lesions, perhaps pustules -the lesions are raised above the surface of the skin and are brown to grey in color, apparently filled with fluid - each lesion is bordered by red, apparently inflamed skin.

- The picture is of a person's forearm and upper arm.
- light complexion.
- groupings of dermatological lesions, perhaps pustules
- the lesions are raised above the surface of the skin and are brown to grey in color, apparently filled with fluid
- each lesion is bordered by red, apparently inflamed skin

[5] Students were given credit for "other observation" when a keen observation was made not previously thought of by the graders (the author and Dr. Irwin Braverman).

2) Scored "average":

Picture of upper arm on the back side. Arm is slightly hairy, has swellings on the skin that are in patches and seem to contain fluid. They are brownish in color. They extend from the back of [the] shoulder to almost the elbow region. Arm is slightly spread out. The person is white; has hair in armpit.

Picture of upper arm on the back side
Arm is ~~hav~~ slightly hairy, has swealings
on the skin that are in patches & seem to contain
fluid. They are brownish in color. They extend
from the back of shoulder to almost the elbow
region. Arm is slightly ~~[illegible]~~ spread out
The person is white ~~and~~, has hair in armpit

3) Scored "above average":

Left back side and proximal arm of a Caucasian male (not old- no wrinkles or usual old age skin discolorations). Axillary hair is evident. Shows signs of a clear/milky white raised blisters scattered about [the] arm surrounded by/bordered [by] a bright red skin. Large clusters of the blisters on [the] middle arm and running linearly to several other clusters- up to shoulder. Some of the rash/lesions do not show same blistering or [are] in such groups-- more like bright red dots.

Picture #2 left back side + ~~upper~~ proximal arm

- of a caucasian male (prob not old - no wrinkles or usual old age skin discolorations)
- axillary hair is evident
- shows signs of a clear/milky white raised blisters scattered about arm surrounded by/bordered a bright red skin
- large clusters of these blisters on middle arm and - running linearly to several other clusters up to shoulder
- some of the rash/lesion does not show such blistering or in such groups -- more just like bright red dots

Computer Testing

As part of the performance exam, a computerized visual task was used during the testing of students participating in the1998-1999 year only. Again, both an A and B set was developed, and student assignment corresponded to the student's A or B designation in the color photograph task. The computerized test is based on a visual training modality called "change blindness." "Change-blindness occurs when large changes are missed under natural viewing conditions because they occur simultaneously with a brief visual disruption, perhaps caused by an eye movement, a flicker, a blink, or a camera cut." (13) In the computerized program used, the viewer's natural viewing condition is interrupted by a one second screen flicker.

Subjects were asked to direct their attention to a computer monitor. The computerized program began by displaying a color image or scene. The image flashed on and off the screen in one second intervals alternating between the entire scene and the scene with one item removed from it. A digital clock remained on the monitor while the images flashed, allowing students to record the speed with which they found the missing item. A paper packet containing each computerized image was given to every student to circle the missing item in order to ensure accuracy.[6] Six natural scenes and five medical images were used in each version of the computer test. An example of each type of scene or image used with the missing item intact and removed can be seen in Figure 3 and

Figure 4. Natural scenes were supplied by Dr. Marvin Chun, formerly Associate Professor of Psychology at Yale University, who used this training modality for human visual research. The medical images included x-rays (online access to x-rays provided by Dr. Bruce McClennan, Department of Radiology), and electron micrographs (provided by Dr. Irwin Braverman). All medical images were doctored by the author, who removed a single element in each image for the change blindness task using the Photoshop 5.5 software application.

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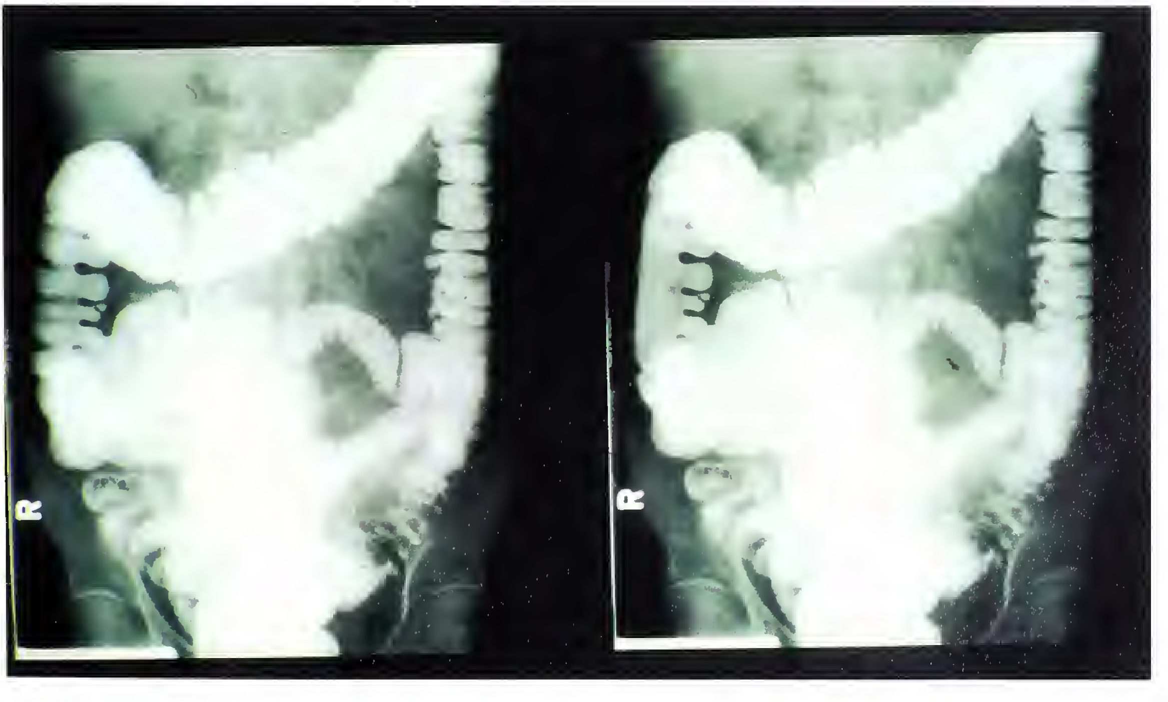
[6] An example packet containing the medical and natural scenes utilized may be found in Appendix C

Figure 3

Figure 4



Word Lists

The word list task, introduced by Uric Neisser, was utilized in this study as post-testing accompanying the photographs in the1999-2000 year only. Students were tested for their ability to scan columns of consonants and locate the one vowel (a,e,i,o,u) in each column. Subjects were shown three pages with five columns on each page. Each column contains 250 single spaced consonants in 50 rows, five letters wide. [7] All consonants and the one vowel present in each column, at a random row and letter position, were computer generated. Each student was given a stop watch and asked to self-time and record their speed at finding the vowel in seconds. Fifteen speeds were recorded per participant.

Statistical Methods

Data was gathered and entered into Microsoft Excel databases, where all graphs were produced. Descriptive statistics (including means and standard deviations), Independent variable t-tests, paired t-tests, and repeated measures ANOVAs were performed using either the Microsoft Excel program or the SPSS10.0 program, on a Macintosh computer.

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[7]The Word List task columns used may be found in Appendix D.

Results

Year 1998-1999

Students' medical observational skills were tested along two time points, the pre-test (T_1), and post-test (T_2). Observational scores differed between the three groups: [two way repeated measures ANOVA, [$F(1,90) = 6.4$, $p=0.003$]. Post-hoc analysis demonstrated that the three groups did not have significantly differing pre-test scores ($p=0.214$). Independent variable (student's) t-test revealed that the YCBA group had significantly higher post-test scores, when compared to both the control group's post-test scores ($p=0.001$) and the Lecture group's post-test scores ($p=0.009$).

1998-1999	Pre-test percent correct	Post-test percent correct	Pre-test raw score (out of 19)	Post-test raw score (out of 19)
YCBA group (n = 30)	**52%** (±13%)	**56%** (±14%)	**10.0** (±0.46)	**10.9** (±0.48)
Control group (n = 30)	**46%** (±09%)	**44%** (±14%)	**8.9** (±0.30)	**8.5** (±0.34)
Lecture group (n = 30)	**46%** (±14%)	**46%** (±12%)	**9.0** (±0.51)	**8.8** (±0.42)

Table 2.1 Pre-test and post-test percent correct and mean raw scores (± S.E.M) by group.

Lecture Group

After evaluating preliminary data which revealed an improvement in observational scores for the YCBA group and no change in observational performance for the Lecture group, only two groups were used in 1999-2000, the control and the

YCBA groups. This was done in order to maximize the number of students in the YCBA group. The mean pre-test percentage correct for the Lecture group was 46% (± 0.14), and the mean post-test percent correct was 46%(± 0.12). A paired t-test was also performed, revealing no significant difference in the pre-test and post-test scores for the Lecture group (p= 0.928).

Year 1999-2000

Students' medical observational skills were again tested along two time points, the pre-test (T_1), and post-test (T_2). Observational scores differed between the YCBA group and the control group [two way repeated measures ANOVA, [$F(1,84) = 11.68$, $p=0.001$]. Independent variable t-test demonstrated that the intervention group had significantly higher post-test scores, as compared to the control group's post-test scores($p=0.001$), but not at the pre-test point ($p=0.557$).

1999- 2000	Pre-test percent correct	Post-test percent correct	Pre-test raw score (out of 30)	Post-test raw score (out of 30)
YCBA Group (n = 51)	**48%** (±10%)	**57%** (±11%)	**14.5** (±2.42)	**16.94** (±2.49)
Control Group (n = 35)	**47%** (±10%)	**47%** (±09%)	**14.1** (±2.75)	**13.96** (±2.55)

Table 2.2 Pre-test and post-test percent correct (± S.E.M) and mean raw scores by group

Students in the YCBA group achieved higher scores than the control group in each of the photographs used during the post-test exam, but had similar scores in each of the

photographs used in the pre-test exam (see Figure 5 and 6). In addition to the differences in global scores, students' individual observations for each of the six photographs were analyzed utilizing the ten criteria used for scoring. Histograms comparing the percentage of students who made individual scored observations by YCBA and control group assignment are seen in Figures 7 - 12.

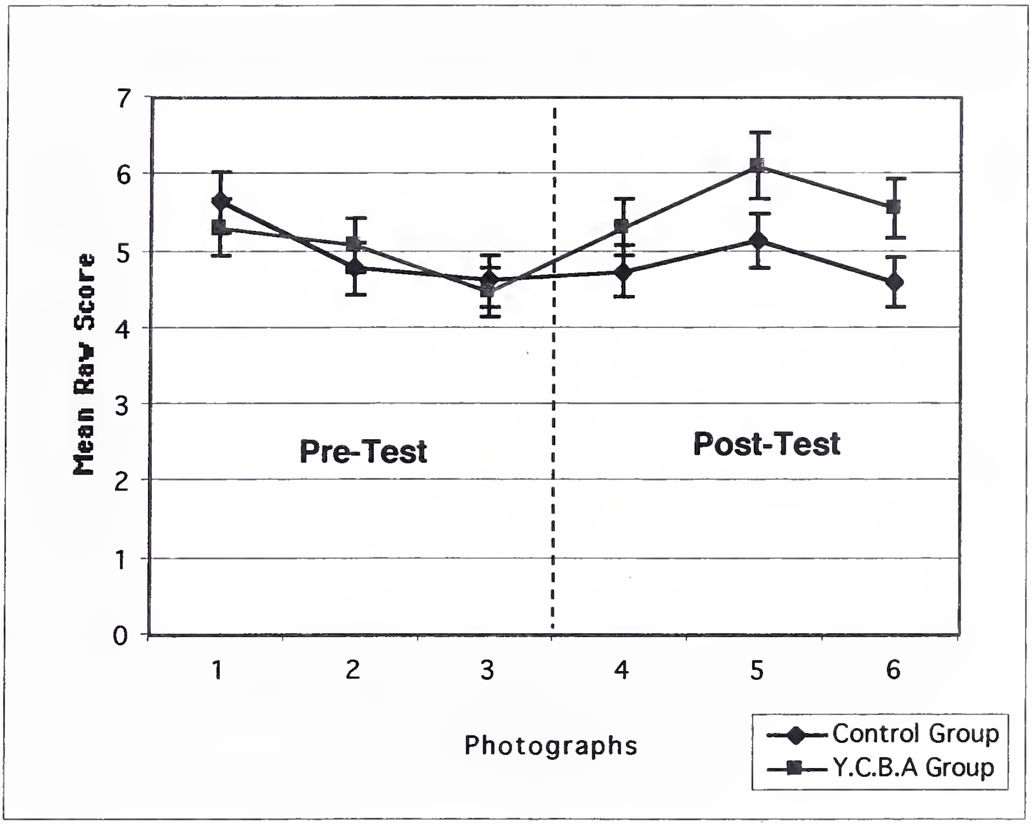


Figure 5. Subjects assigned to set A: Figure shows the mean raw score of each photograph for subjects receiving set A assigned to the control group and YCBA group. Photographs 1, 2, 3 were used as the pre-test and photographs 4, 5, 6 as the post-test for students assigned to set A. Figure shows that subjects in the YCBA group have a significant improvement in their post-test scores.

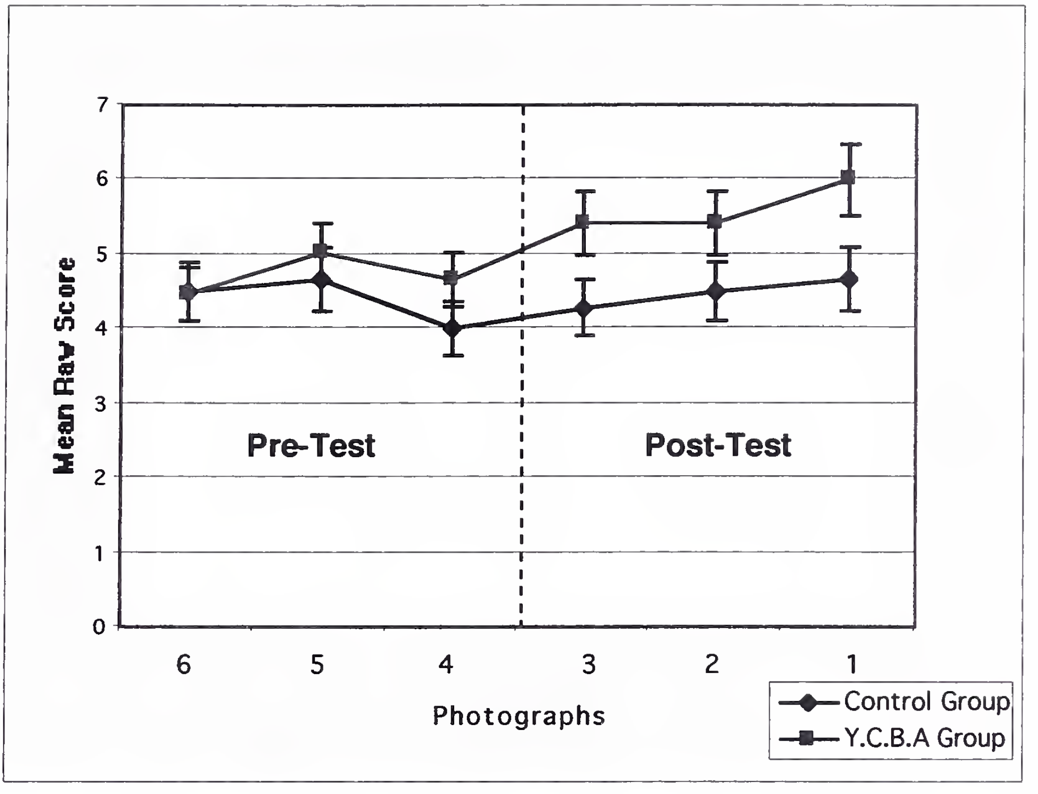


Figure 6. Subjects assigned to set B: Figure shows the mean raw score of each photograph for subjects receiving set B assigned to the control group and YCBA group. Photographs 4, 5, 6 were used as the pre-test and photographs 1, 2, 3 as the post-test for students assigned to set B. Figure shows that subjects in the YCBA group have a significant improvement in their post-test scores.

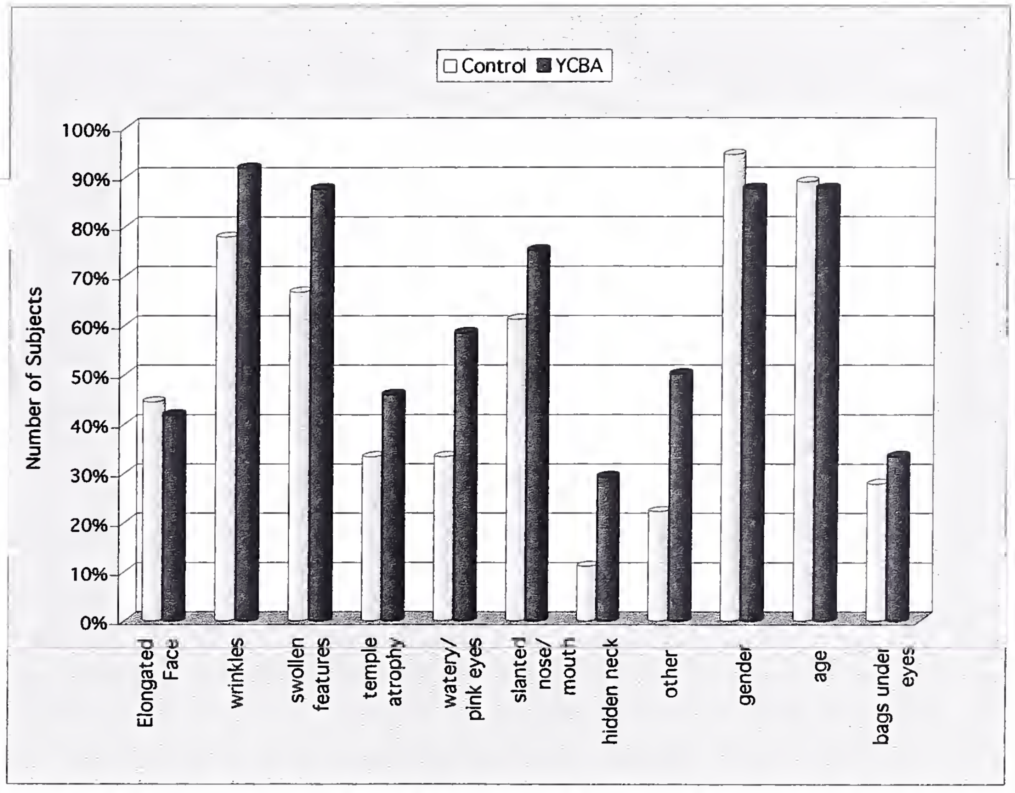


Figure 7. Photograph 1: Figure depicts the differences in percentage of scored observations made in the post-test exam by subjects in the control group and by subjects after the YCBA intervention.

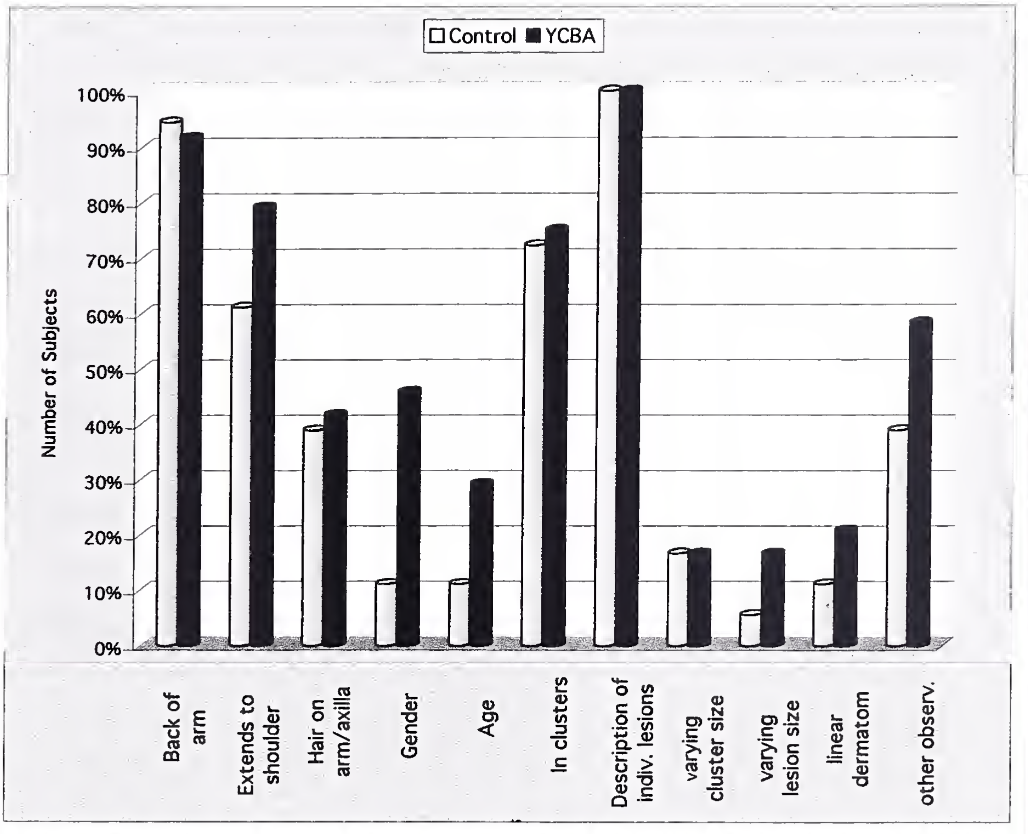


Figure 8. Photograph 2: Figure depicts the differences in percentage of scored observations made in the post-test exam by subjects in the control group and by subjects after the YCBA intervention.

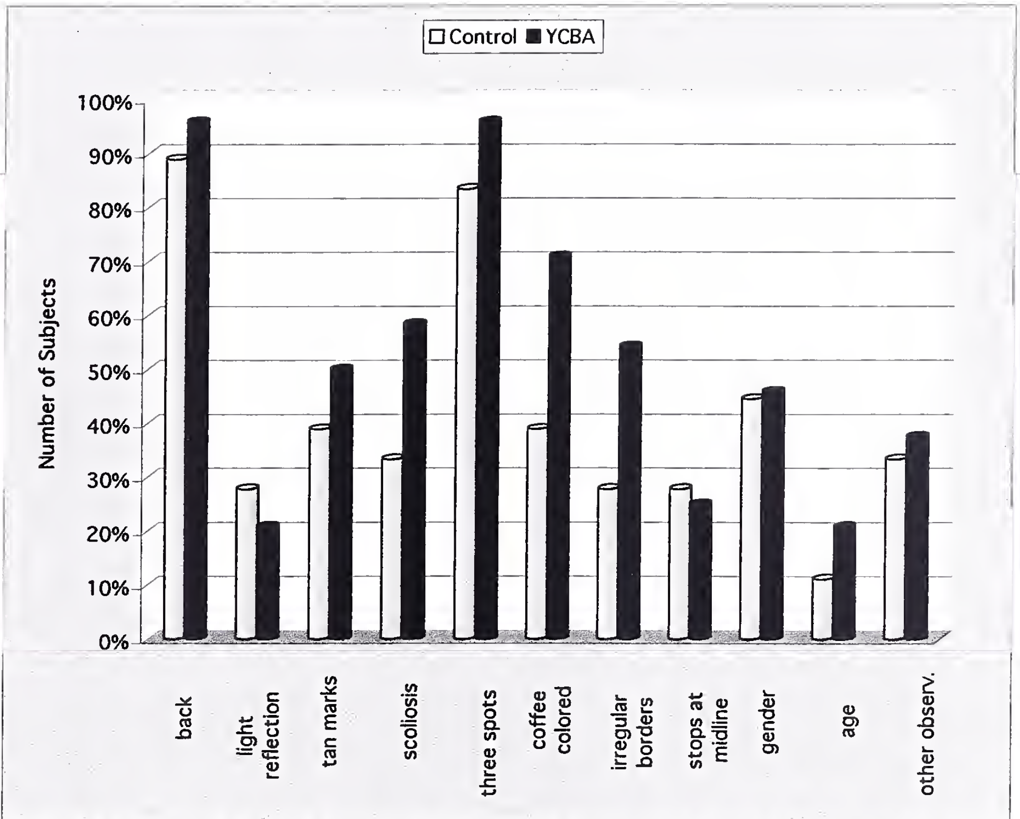


Figure 9. Photograph 3: Figure depicts the differences in percentage of scored observations made in the post-test exam by subjects in the control group and by subjects after the YCBA intervention.

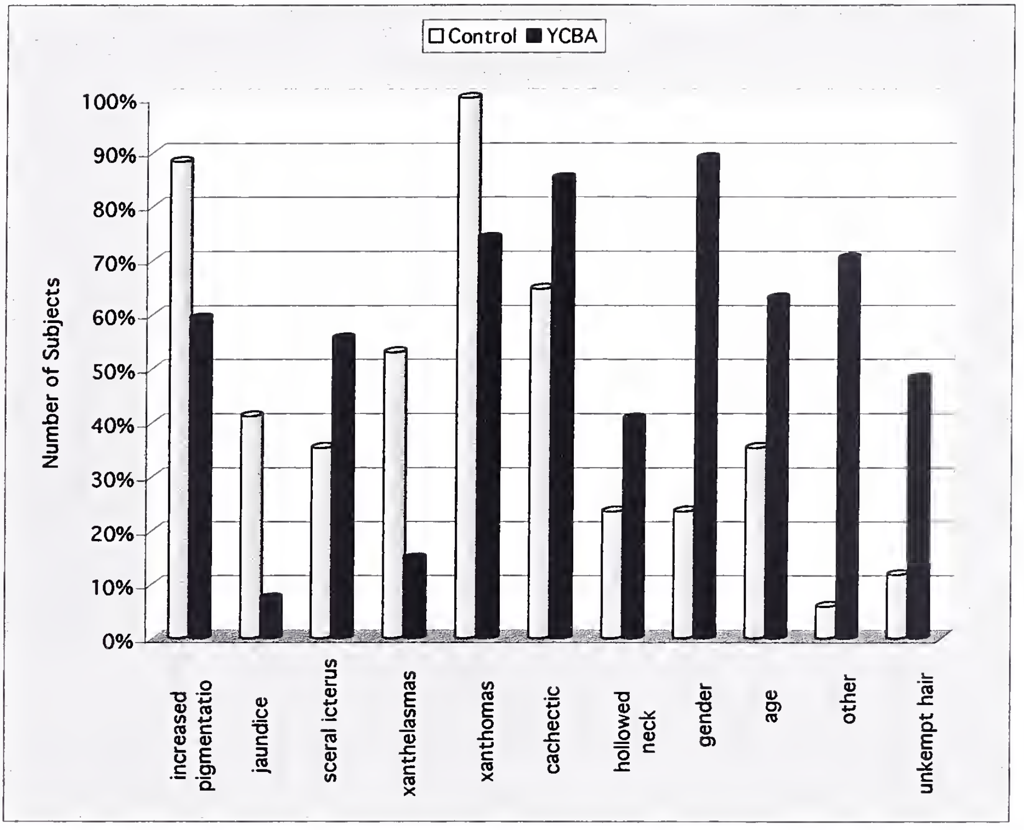


Figure 10. Photograph 4: Figure depicts the differences in percentage of scored observations made in the post-test exam by subjects in the control group and by subjects after the YCBA intervention.

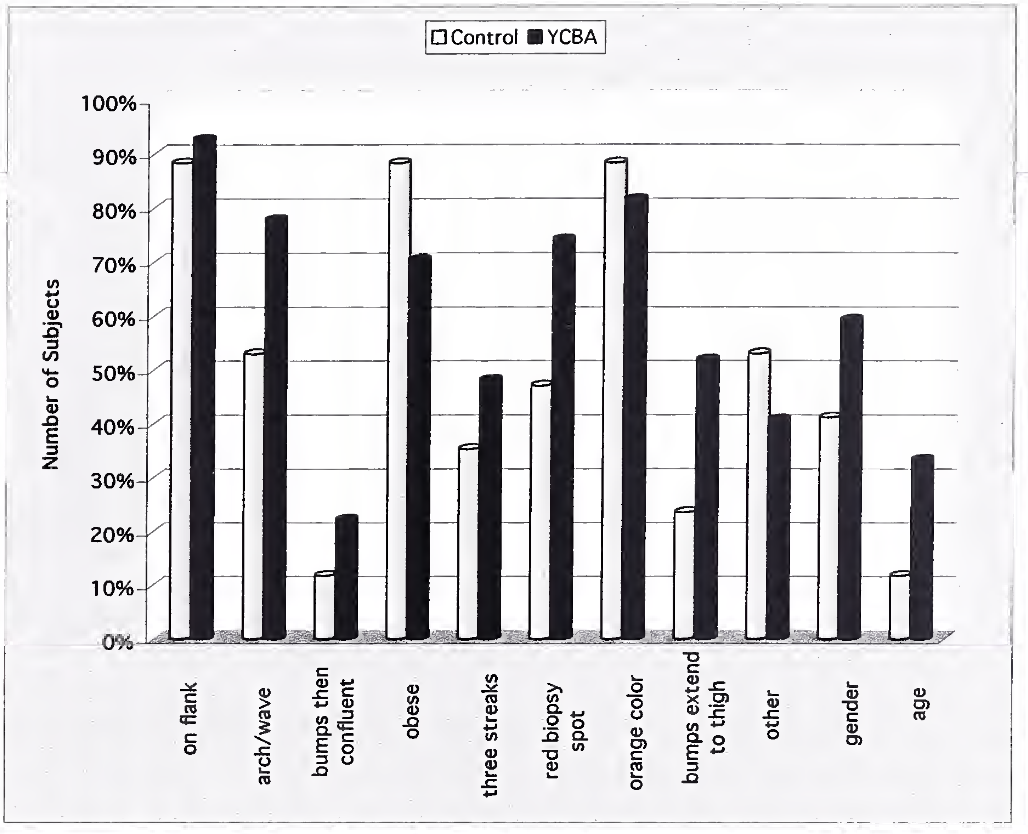


Figure 11. Photograph 5: Figure depicts the differences in percentage of scored observations made in the post-test exam by subjects in the control group and by subjects after the YCBA intervention.

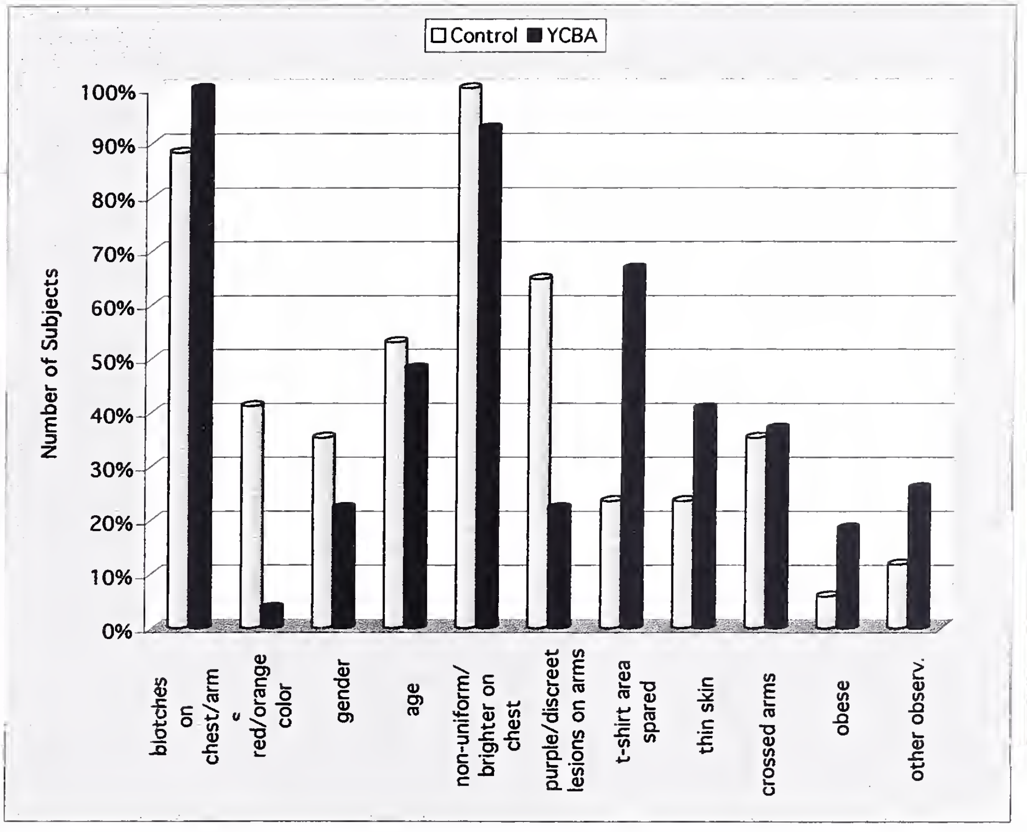


Figure 12. Photograph 6: Figure depicts the differences in percentage of scored observations made in the post-test exam by subjects in the control group and by subjects after the YCBA intervention.

Observational Mistakes

Students' descriptions included the observations in the predetermined grading criteria, additional keen observations of visual features that were scored as "other observations", and, occasionally, an observational mistake. Mistakes were found in two of the six photographs. Four students identified the posterior aspect of the left arm seen in photograph 2 (Appendix B) as the anterior arm, forearm, or "front" of the right upper arm. One student identified the anatomical part as a close-up of a thumb. Students who misidentified the posterior arm and shoulder region, ignored visual cues including: the shadow outlining the inferior margin of the triceps muscle, the shadows demarcating the elbow joint, the hair pattern on the arm, and the hair in the axilla. Six students could not identify photograph 6 (Appendix B) as a woman. Three students wrote that they could not identify the gender, and three students stated the patient was male. These students ignored the visual cues that identify the patient as female including: typical female fat distribution in both arms, lack of hair on the chest, arms, and hands, and the outline of breast tissue seen above and below the folded arms.

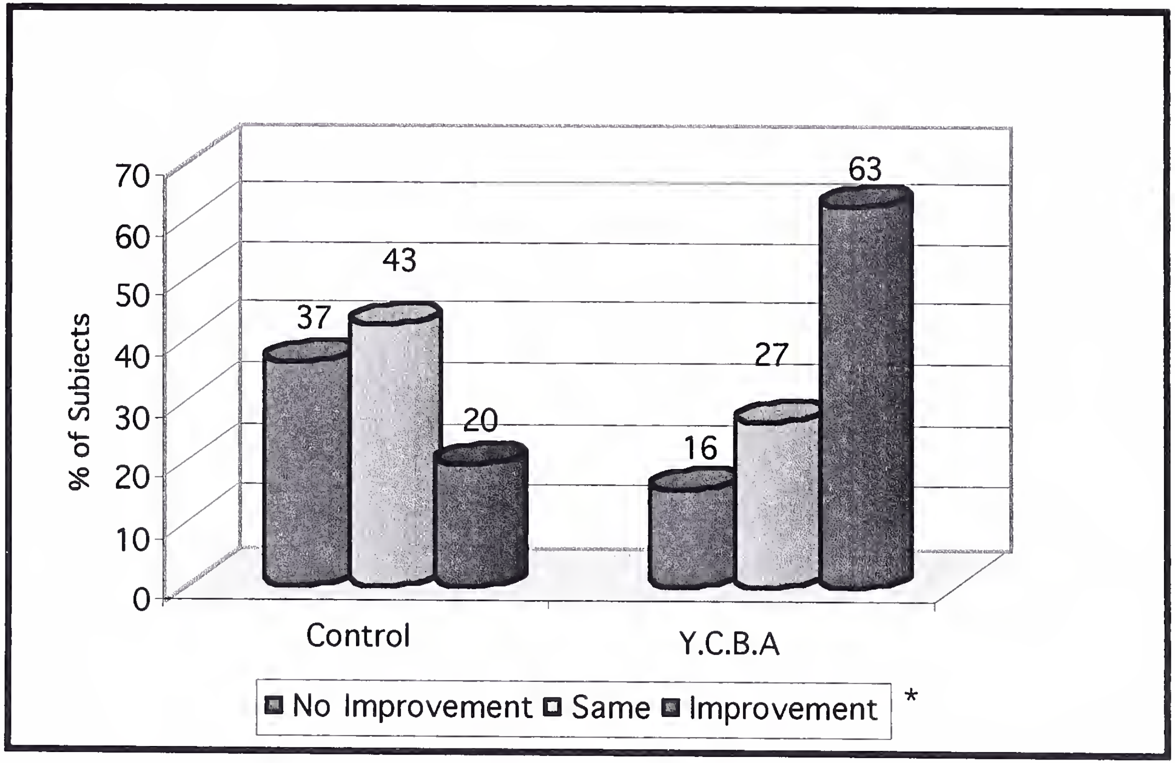
Combined Results

Students' medical observational skills were evaluated along two time points, the pre-test (T_1), and post-test (T_2), for the YCBA groups and the control groups in both years. Observational scores differed between the YCBA group and the control group [two way repeated measures ANOVA, [$F(1,144) = 8.9$, $p=0.003$]. Also, there was a significant Time by Group interaction ($p=0.0001$). Post-hoc independent variables t-test demonstrated that the total intervention group had significantly higher post-test scores, as compared to the total control group's post-test scores($p=0.0001$) but not at the pre-test point ($p=0.200$). The baseline pre-test scores of the students between the two years were not significantly different from each other ($p= 0.80$). Thus, the sets of photographs utilized in each of the two years were of similar difficulty.

All Years	Pre-test percent correct	Post-test percent correct	Significance
YCBA Group (n = 81)	**50%** (± 0.10)	**57%** (± 0.09)	p = **0.0001**
Control Group (n = 65)	**47%** (± 0.10)	**46%** (± 0.11)	p = **0.200**

Table 2.3 Pre-test and Post-test percentage scores.

A higher percentage of students in the YCBA group improved, than in the control group Improvement is defined as an increase of 5% or more in score between pre-test and post-test exams (see Figure 13).



* Improvement = Pre-test and Post-test score difference ≥ + 5%, Same = Score difference > - 5% and < + 5%, No Improvement = Score Difference ≤ - 5%

Figure 13. Percentage of subjects by control and YCBA group assignments whose scores improved, remained the same, or did not improve between their pre-test and post-test examinations.

Word lists results

Scanning rates per individual were calculated using: total seconds per column / vowel row position. The individual's rate (or their average speed per row) for each of the 15 columns was averaged to calculate an overall mean rate per individual. Using a student's t-test, mean rates were found to be significantly different between the two groups (p=0.035). The YCBA group was faster on average at the word list task than the control group. Individuals in the YCBA group had a faster rate than the control group in 13 out of 15 columns (See Figure 14). For both groups, the greatest differences in scanning rates occurred when the vowel was located in the uppermost portion of the column.

Group	N	Mean Scanning Rates
YCBA	**45**	**0.98** (± 0.43)
Control	**28**	**1.37** (± 1.07)

Table 2.4 Mean scanning rates (± S.E.M) by group

Although the YCBA group had a faster word list scanning rate and scored higher in the photograph task, the scan rate for each individual was not correlated with their post-test score in the photograph task, or with their percent change in score between the pre-test and post-test photographs.

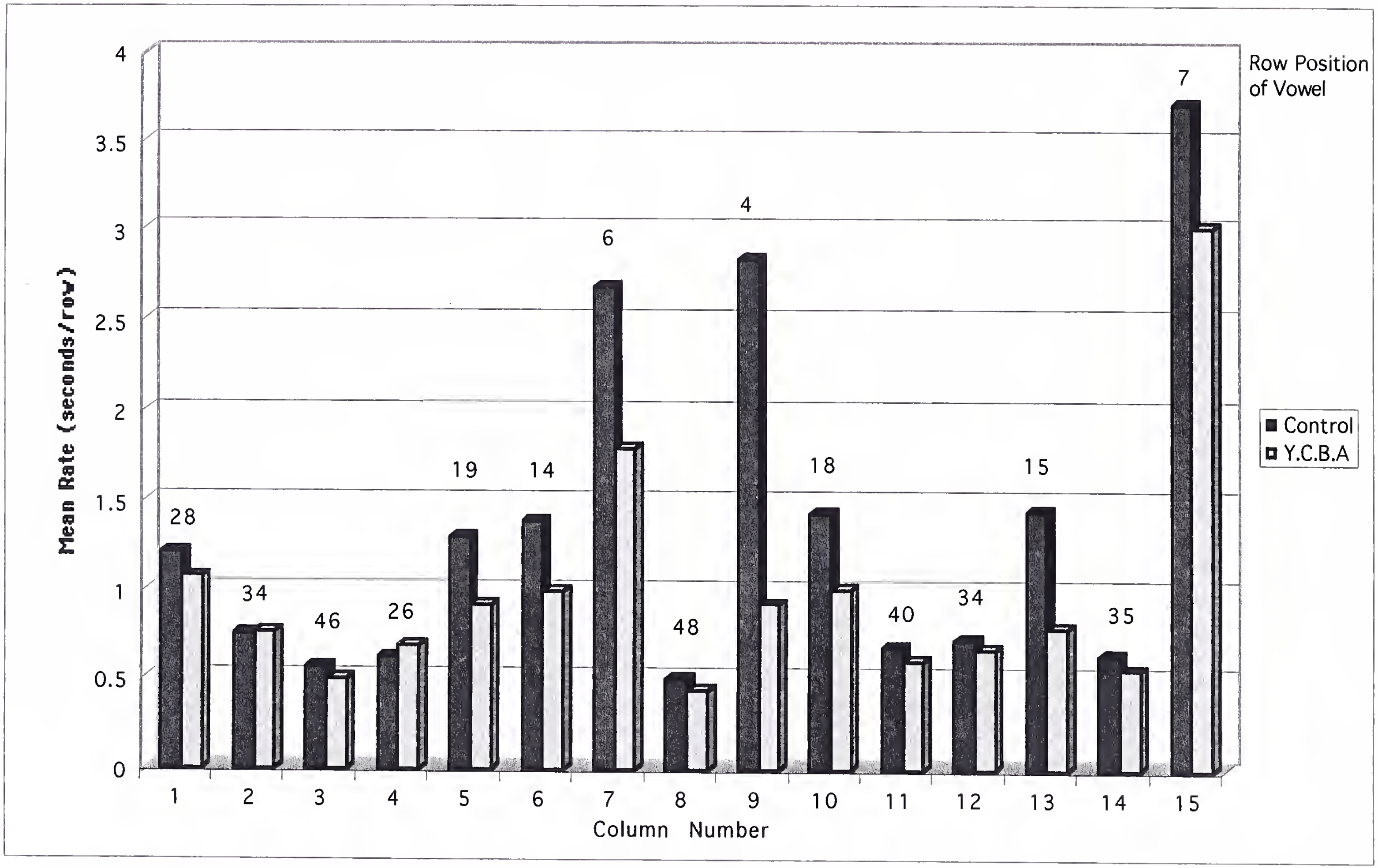


Figure 14. Figure shows mean scan rates for each word list column by YCBA and control group assignment. Columns nine and thirteen are significantly different between groups to $p < 0.05$.

Change-Blindness Computer Testing Results

The first two images introduced the students to the manner in which the task was performed. The times to complete the remaining flashing images were calculated for the final results, excluding the first two images. The differences in individual reaction time and accuracy scores in the change-blindness task among the Lecture, YCBA, and control groups were not statistically significant. However, on average, students in all groups did improve between the pre-test and post-test in both speed and accuracy. Thus, the computer task itself is a training method, and accounts for the overall average improvement in both accuracy and speed over time. The interventions themselves did not significantly alter the students' changes in scores.

Group	Pre-test reaction time	Post-test reaction time	Pre-test accuracy	Post-test accuracy
YCBA	13.72	13.01	0.713	0.763
Control	13.55	11.43	0.675	0.736
Lecture	14.31	12.31	0.669	0.751

Table 2.5 Mean reaction time and accuracy by group.

Discussion

Student Centered Painting-based Learning

The open-ended questioning used to teach observational skills in the intervention group is analogous to the problem-based learning Spencer writes about. The painting-based learning fulfils the characteristic advantages of deep learning, of a stimulating environment, intense student/teacher interaction and student/student interactions and a collaboration between the disciplines of art and science.

The small group training construct encourages student participation. Since students are in a familiar small group, they are comfortable discussing a subject in which most of them have no prior training. The discussion format is also a training session in communication, as well as, visual skills. Students were expected to verbalize what they were observing and, in turn, enhanced their communication skills; an extremely important ability in sharing diagnostic information about a patient with other health care workers.

The students' descriptions in the intervention groups were longer on average than either the control or the lecture groups, even though all students were given the same amount of time to look at the photographs and write their observations. The increased length in descriptions of the intervention groups indicates that these students were more engaged at the YCBA. In order to effectively emphasize visual skills, students should have access to museum paintings or high quality reproductions. The core effect of the

YCBA training is an increased awareness of visual details. Thus, the level of visual detail found in slides or projections would not be sufficient.

The use of representational paintings in the teaching design of the YCBA project capitalizes on the artworks as being unfamiliar objects to the students. The viewers attend to all of the paintings' details, since they have not formed a predetermined observational bias that gives weight to those details they have subconsciously deemed "important" to look at. This observational bias occurs when someone recognizes a familiar object, like a person's face, and filters out the details unimportant for recognition. We only notice and look at the details when, as Gombrich states, "... our attention is aroused by some dysequilibrium, a difference between the expectation and the incoming messages." (14) However, students who underwent visual training in the YCBA were trained to look at all details, as well as the global scene. They achieved higher scores on the post-test performance exam, and improved their scores more often (63%) than students who did not have the intervention (20%). Students with the highest marks were able to scan the overall scene and zoom in on the details. Students with lower scores either concentrated on only the global visual attributes of the photos, haphazardly mentioned details, or made observational mistakes ignoring visual cues (Please refer to the example students' descriptions).

From the data gathered, three types of observers can be identified: global, detailed, and those who are "observationally impaired". The YCBA visual exercise trains

"lookers" who are oriented towards one type of observation, to incorporate both detail and global observation together. Approximately 6% of all students graded were poor at describing what they saw (scored less than 30% correct). These students were either not engaged in the task or were truly poor observers. This project serves to identify students who may need remedial help. Repeated visual training sessions every six months to one year, would benefit all students, but would especially help students with the poorest observational skills. It is very likely that repeated visual training would yield even better results for all students; more students would improve and at a larger magnitude. It is unclear whether the improvement shown by students in this study is transient or sustained. An interesting follow-up study, would be to repeat student testing after a period of rest and after additional repeated training.

An informal e-mail was sent in the Fall of 2001 to all students (regardless of group or year) who participated in the YCBA project, asking whether they felt the experience was worthwhile or positive, if it was an effective training tool for observational skills, and any suggestions for the future. The e-mail was meant to casually gauge student satisfaction, rather than provide an analytical study. Only 19 out of the 176 students who participated replied. Interestingly only 50% of the19 students believed that the YCBA experience enhanced their medical observational skills. Students indicated that they believe increased visual training is necessary and they feel the need for more visual training to be taught in the hospital setting.

Students (n=19)	Responses
18	Worthwhile Experience
9	Effective Training
1	Not positive Experience
7	Not Effective Training
8	One time training is not enough
	Future Suggestions
8	Optional second and/or follow-up session
12	Would like more emphasis of observational with clinical tutors and patients
12	Mentioned small group as an advantageous model
1	Use of different types of art as follow-up (eg. abstract art)
1	Alternation of art and medical images with increasing obscurity during each session

Table 3.1 Student Survey Responses

Students were offered a follow-up evening session in the Spring of 2000 which specifically addressed the important details meant to be observed in the photographs used during testing, as well as offered visual training exercises emphasizing patterns. Unfortunately, only 25% of the 80 potential participants attended, due to other academic conflicts. Follow-up training on the computer network may prove to be a more effective method of reaching the students who participate, and others. Future plans for computerized visual training include: mystery images to increase motivation, advanced pattern recognition and remedial training of observational skills.

Change Blindness Testing

It may be concluded that the "change blindness" task is either not an appropriate paradigm or not a sensitive enough measure with which to test medical observational skills. Although the computer training method was not the best fit for this type of visual testing or training, a possibly fruitful application lies in the challenge of teaching histology discussed in the introduction. A computer software program could be developed using histological images, instead of natural scenes or x-rays. Within the images, characteristic visual features, like basement membranes, cells, etc., would be removed from the image. The removal of the relevant item would emphasize the item's visual characteristics to the viewer, and it's importance in the tissue itself. Students could also be timed as in the computer training method, using a relevant subject matter for the images.

Word List Task

Scanning time is a function of the position of the critical item (vowel) in the column. It takes a subject a longer overall time to find a vowel that is positioned in a lower row. Neisser stated that before a subject, "'decides' that the letter Z, for example, is present in the input, he must make prior 'decisions' about subordinate features such as parallel lines and angles; these in turn are probably based on processes of a still lower order. We should expect such processing times to depend on the depth of the hierarchy

required by the problem." (15) Thus, scanning rates take into account the ability of the individual to process visual data and details on many levels.

In both Neisser's and Adrian-Harris's studies, subjects were given the word list training task to practice over a period of time. In this study, the word list task is used as an observational measure rather than as a training tool. The difference in mean rates between the control and intervention groups indicates that the painting discussions, by increasing the student's awareness of details, were acting as a training tool for the detail oriented word list task. The YCBA students' ability to see details was most profound as soon as they looked at the columns, since the greatest rate difference between the two groups was found when the position of the vowel has highest in the column.

Curriculum Reform

This study was designed to quantify the benefit of the YCBA experience, as well as provide a framework to continue and formalize observational skills teaching. As Sir Dominic Corrigan, a cardiologist from the 1850's, stated 'The trouble with many doctors is not that they do not know enough but that they do not see enough." (1) The following are the goals and important principles of visual observation, and then the practical tools with which to improve observational skills:

As Sir William Osler stated "Learn to see, learn to hear, learn to feel, learn to smell, and know that by practice alone you can become expert." (1)

℘ Continuation of student-centered learning

I. Continued sessions at the YCBA as part of the curriculum (or at another museum/ institution) with small groups. The use of representational paintings or high quality reproductions capture important visual details, and, as unfamiliar objects, prevent observational bias.

II. Repeated voluntary sessions for upkeep of visual skills every six months to one year. These sessions should continue to emphasize visual details, but should also emphasize exercises in pattern recognition with increasing levels of difficulty.

III. The use of the change-blindness task, with natural and medical scenes, as a training modality or teaching tool within the medical sciences.

"Inspection (seeing) should always be an active search for evidence and never just a hurried glance or blank stare." (1)

℘ Provide motivation

I. Monthly mystery medical images (eg. histology, x-rays, patients) online through the internet or an internal computer network. Images may have varying levels of difficulty: clinical images requiring descriptions with differential diagnosis answers for senior medical students and faculty, and images requiring descriptions with optional differential diagnosis answers for pre-clinical students.

II. Images could be part of a monthly contest with medical books as prizes.

III. Monthly images may increase interest among students <u>and</u> faculty, in light of the massive interest the New England Journal of Medicine receives when they publish their images of medical mystery cases.

"Distinction should be made between what we really see and what we intellectually infer." (1)

℘ Reinforce observational skills in students on the medical wards

I. Clinical tutors could have dedicated teaching sessions for clinical observations found in ward patients. Clinical tutors may also incorporate mystery images as examples and use them to make teaching points

Leonardo DaVinci wrote "sapere vedere" or learn to see things. (1)

℘ Evaluation of students

I. Observational testing of students, like that proposed by Adrian-Harris for radiology residents, using the photograph performance exam or the word list testing modalities could identify those students in need of remedial visual exercises.

II. The use of these testing modalities would also serve as visual training methods in and of themselves.

Conclusion

In writing about medicine in the nineteenth century, Dr. Sherwin Nuland states in *Doctors*:

> As the decades of that century went by, this entire developmental process of the art of healing became more and more dependent on the objective study of organs, tissues, and cells, and therefore more and more dependent on the ways of science. The result was that doctors necessarily focusing down in a way that historians call reductionist, sometimes lost sight of the whole patient who had come to be healed. As much as the best of the healers always strove to keep in perspective the entire reality of a patient's life, the demands of science made it ever more difficult to be a "whole-ist." (17)

The same may be said for the closing of the twentieth century, as more detailed information emerged from the fields of genetics, immunobiology, and others. The physician must maintain the reductionist mind-set in order to heal patients effectively. This has become especially evident with the changes and trends in medical economics. Ultimately, the ability to treat patients accurately and quickly very much relies on observing the entire medical visual scene. The scene includes the patient, like a figure in a painting, the patient's context, like the background of a painting, and the details of their pathology, like the content depicted by the artists' strokes.

The quotes of Leonardo DaVinci, Sir Dominic Corrigan, and Sir William Osler attest that the notion of aptitude and expertise in observation as a critical talent is not novel. The physician, Sir Arthur Conan Doyle, who developed the character Sherlock Holmes wrote, "... on meeting a fellow mortal, learn at a glance...the history of the man and the trade or profession to which he belongs...it sharpens the faculties of observation...by a

man's fingernails...coat-sleeve...boots...callosities of forefinger and thumb... expression...a man's calling is plainly revealed." (16) The proposal to formalize visual training within medicine is simply the manifestation of ideals expressed beginning centuries ago.

The Yale Center for British Art Project has become more than an exercise in how to teach medical students to become better observers. The journey has evolved into a commentary of medicine today. Amid the realities of reliance on technological imaging and impositions of managed care, the physician's diagnostic skills are being under utilized at the same time they are being taxed. By adopting a curriculum that strengthens medical observational skills in students and physicians, alike, there will be more opportunity for more effective and efficient diagnosis and treatment, and more chances to move towards "whole-istic" medicine in this new century.

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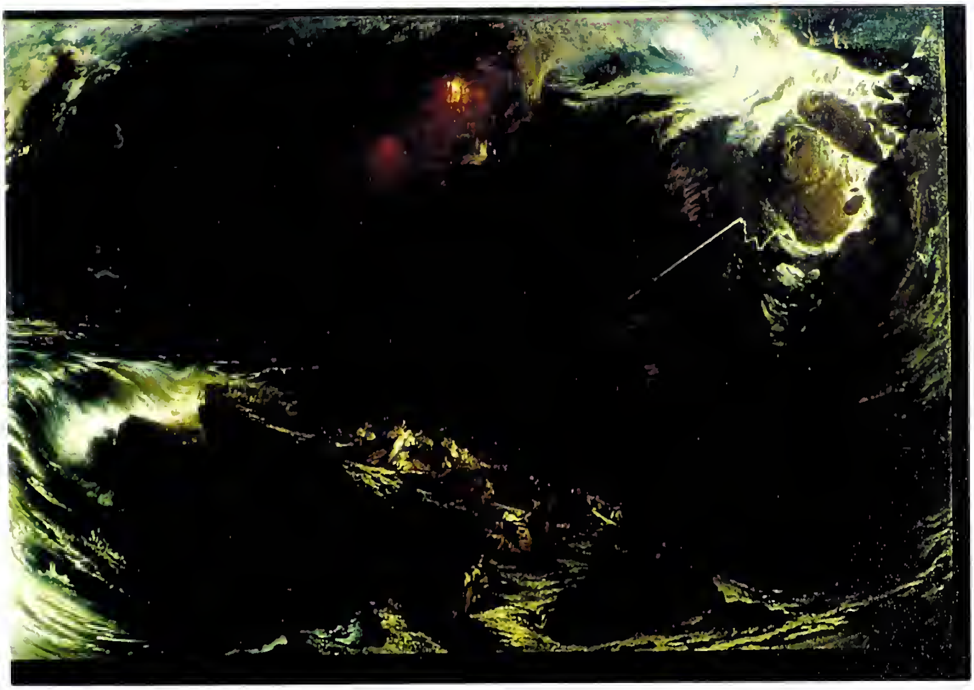
Appendix A

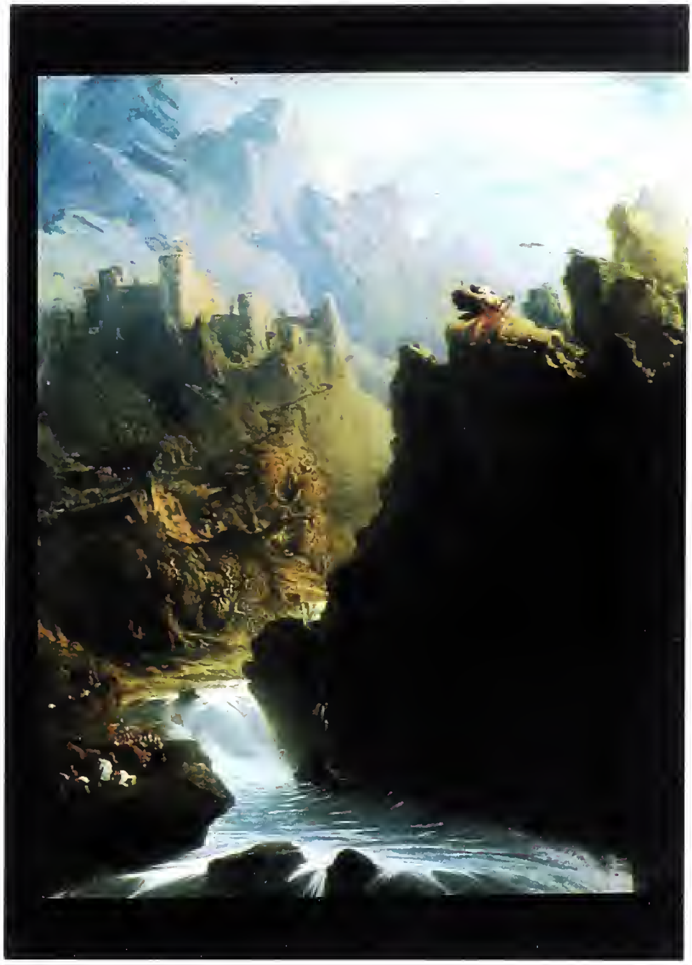
Paintings used

1. The Gore Family by Johann Zoffany. 1769.

2. The Deluge by John Martin. 1834.



3. The Bard by John Martin. 1817.



4. Mrs. James Guthrie by Frederic Leighton. 1864-65.

5. A Roman Amateur by Lawrence Alma-Tadema. 1868.

6. Allegory of the Tudor Succession by Unknown Artist. 1590.

7. L'Enfant du Régiment by John Millais. 1854-1855.

8. The Death of Chatterton by Henry Wallis. 1856.

9. The Life and Death of Buckingham by Augustus Leopold Egg. 1853-1855.

10. The Drummond Family by Johann Zoffany. 1769.

11. Bifron's Park, near Canterbury,Kent by British School. 1705-10.

Appendix B (1999-2000 Photograph Grading Criteria)

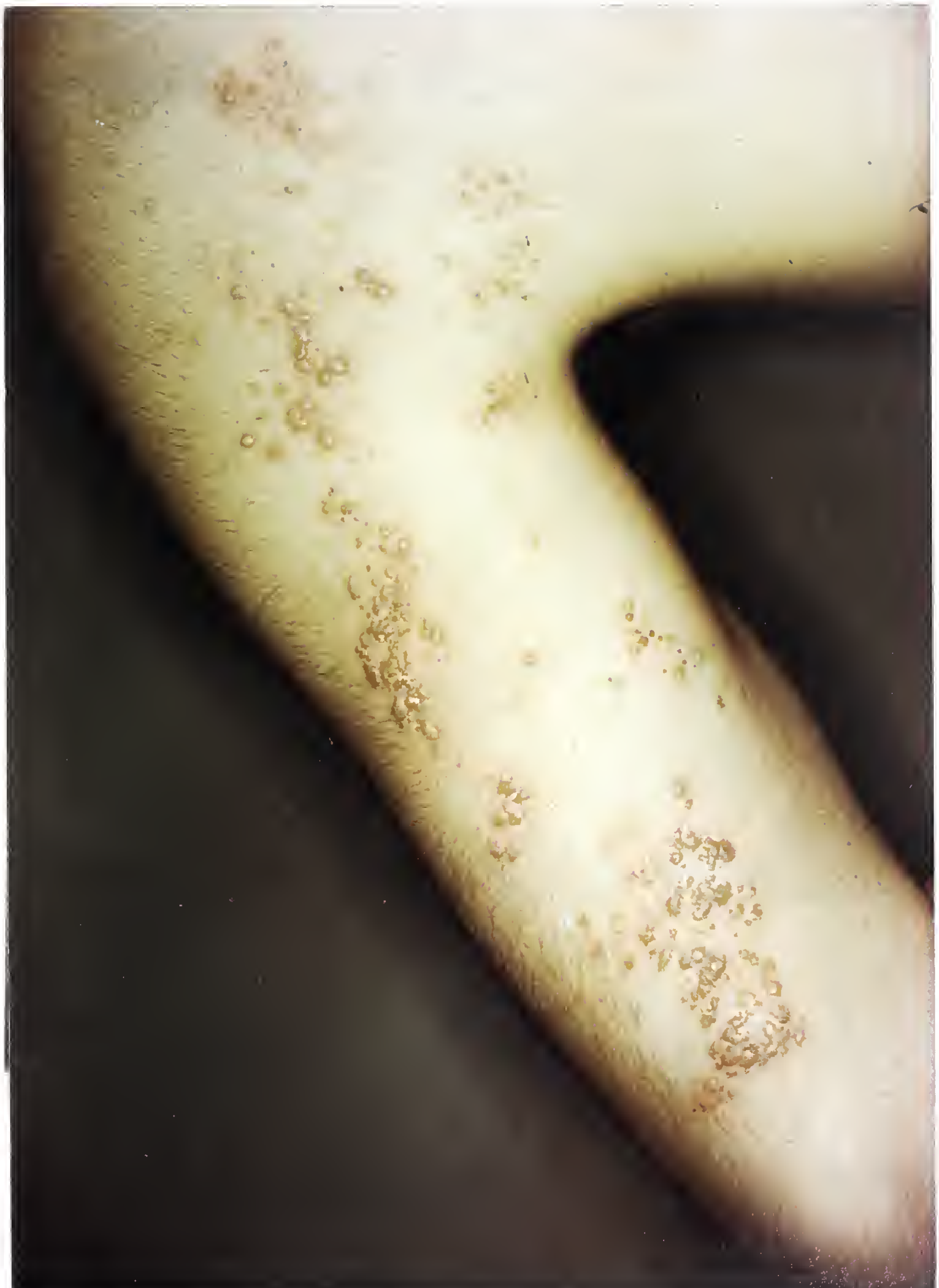
photo #1															
Elongated face															
Thickened skin/wrinkles															
Swollen Features															
Temple Atrophy															
Watery/pink eyes															
Slanted nose/asymm. Mouth															
Neck not visible															
Gender/Age															
Bags under eyes															
Other Observation															
Photo #2															
Back of arm															
Lesions extend to shoulder															
Hair on arm/in axilla															
Lesions in clusters															
Desrip. Of indiv. Lesion															
Varying size of clusters															
Varying size of lesions in cl.															
Linear dermatome															
Gender/Age															
Other Observation															
Photo #3															
Back															
Light reflection															
Tan marks															
Scioliosis															
Three spots															
Coffee colored															
Irregular Border															
Stops at midline															
Gender/Age															
Other Observation															
Photo #4															
Increased Pigmentation															
Jaundice/yellowish skin															
Scleral icterus															
Xanthelasmas															
Xanthomas on elbows															
Cachectic															
Hollowed neck															
Gender/Age															
Unkempt hair															
Other Obsrv															

Appendix B (1999-2000 Photograph Grading Criteria)

Photo #5															
Flank															
Arch or wave form															
Bumpy then confluent															
Obese															
3 waves/streaks															
Red spot															
Orange/red color															
Lesions extend to leg															
Gender/Age															
Other Obsrv															
Photo #6															
Blotches on chest/forearms															
Red/orange color															
Non-uniform/brighter chest															
Discreet/darker on arms															
T-shirt dist. Spared															
Thin skin/veins on arms															
Folded/crossed arms															
Obese															
Gender/Age															
Other Obsrv															

Photograph #1

Photograph #2



Photograph #3

Photograph #4

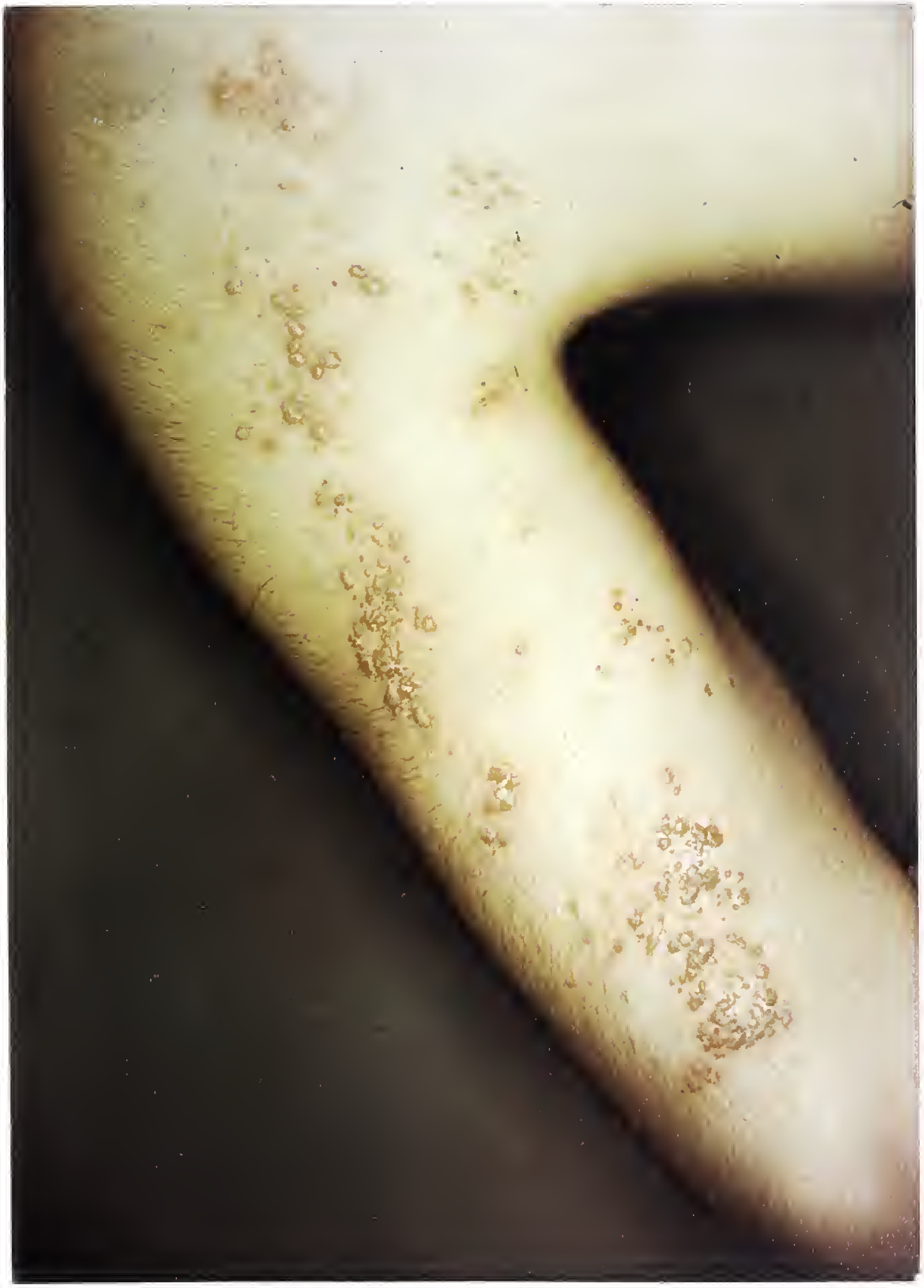
Photograph #5 and #6

Appendix B

(1998-1999 Grading Criteria)

photo #1															
Back of arm															
Lesions extend to shoulder															
Hair on arm/in axilla															
Lesions in clusters															
Desrip. Of indiv. Lesion															
Varying size of clusters															
Varying size of lesions in cl.															
Linear dermatome															
Gender/Age															
Other Observation															
Photo #2															
Right side of face															
From upper lip to forehead															
Involves sclera															
Hyperpigmented															
Border not defined well															
Stippled border															
Upper lid involvement															
Gender/ Age															
To level of lower lip/chin															
Other Observ.															
Photo #3															
Lateral to eye/temple area															
Patch/spot of pigment															
Sharp irregular border															
Not uniform pigmentation															
Intense dark spot															
Droopy lid/ eye half open															
Arcus (white ring)															
Telangectasia on upper lid															
Wrinkles															
Other Observ.															
Photo #4															
Hypopigmentation															
Around eyes and mouth															
Beneath nose															
On neck															
Sharp margins															
around eyes unifm/around mouth patchy															
Ring around irises															
Gender/Age															
Other Obsrv															

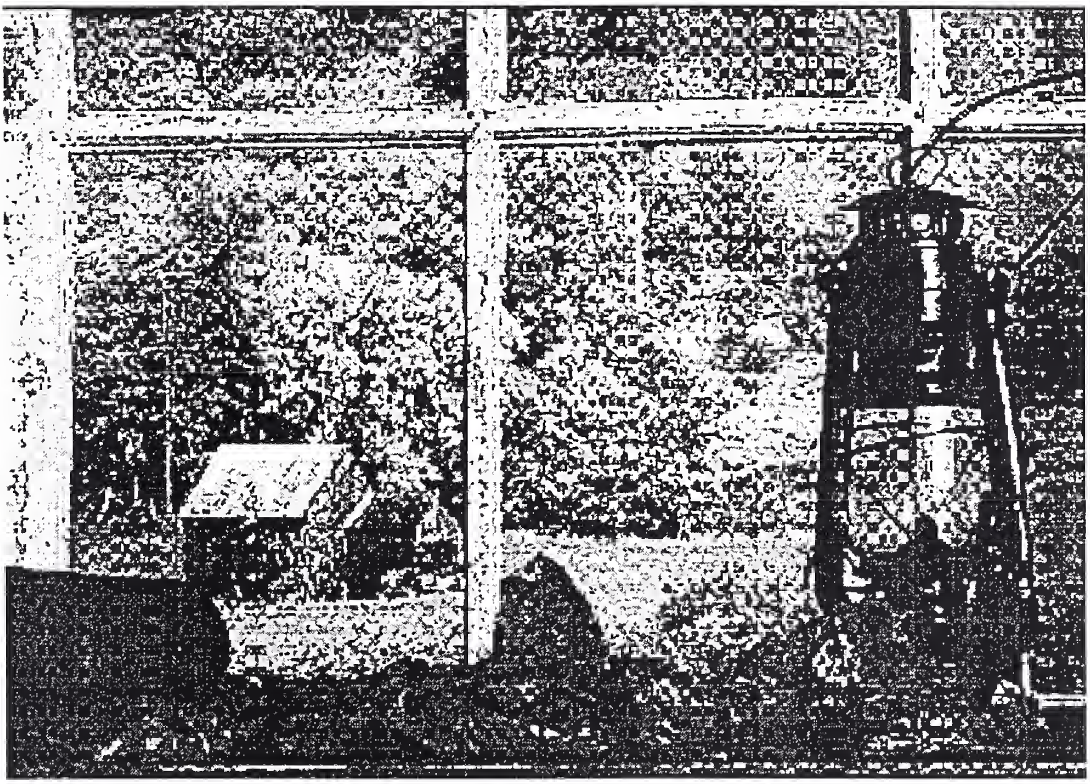
Photograph #1

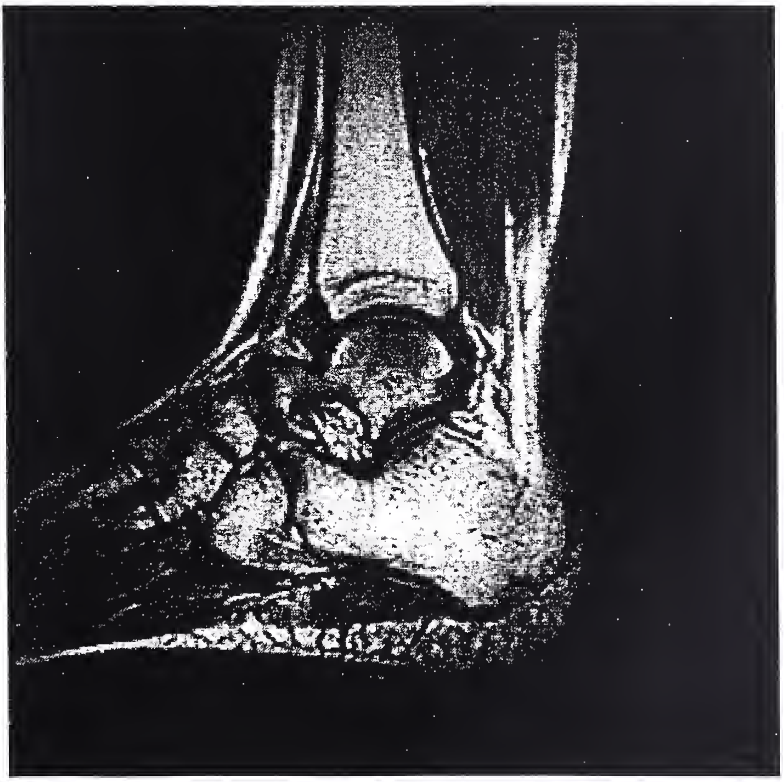


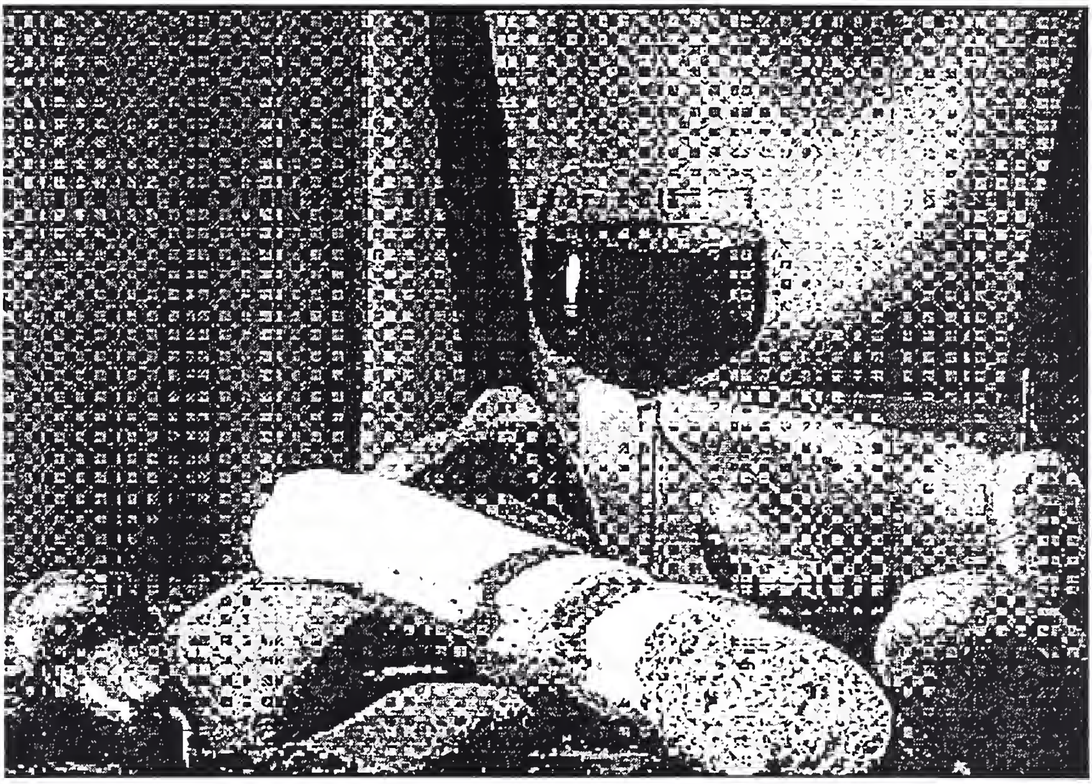
Photograph #2

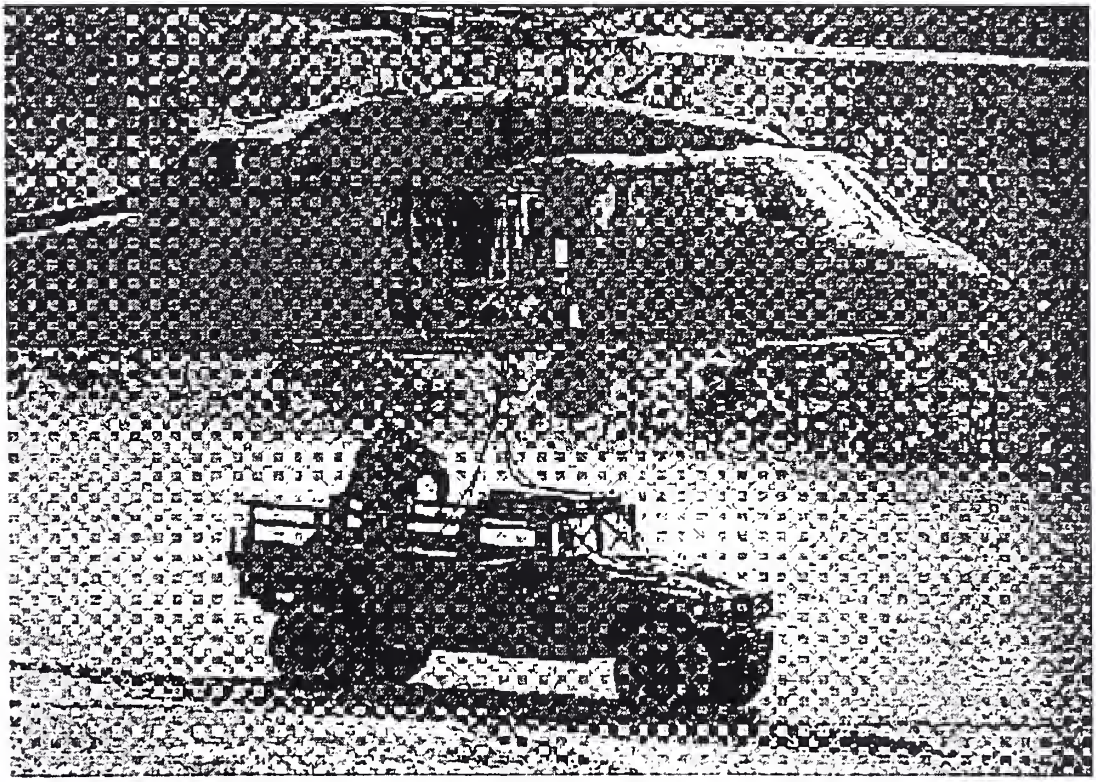
Photograph #3 and #4

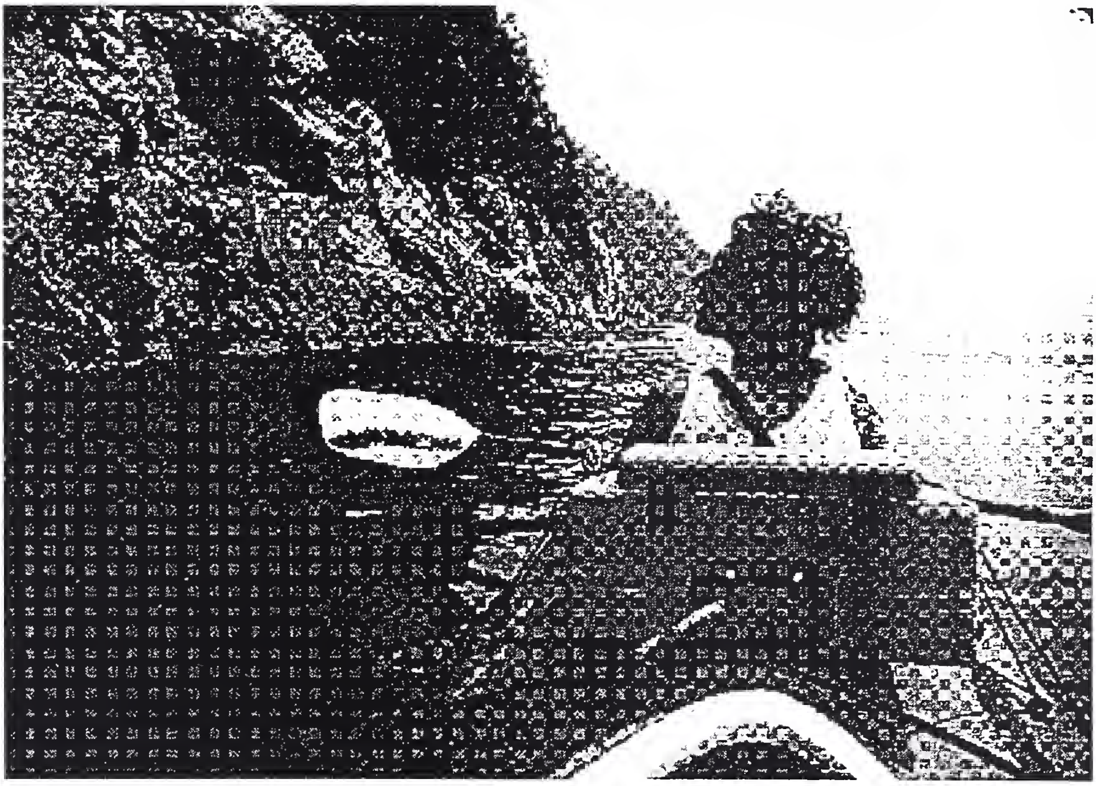
Appendix C (Computer Training Images)

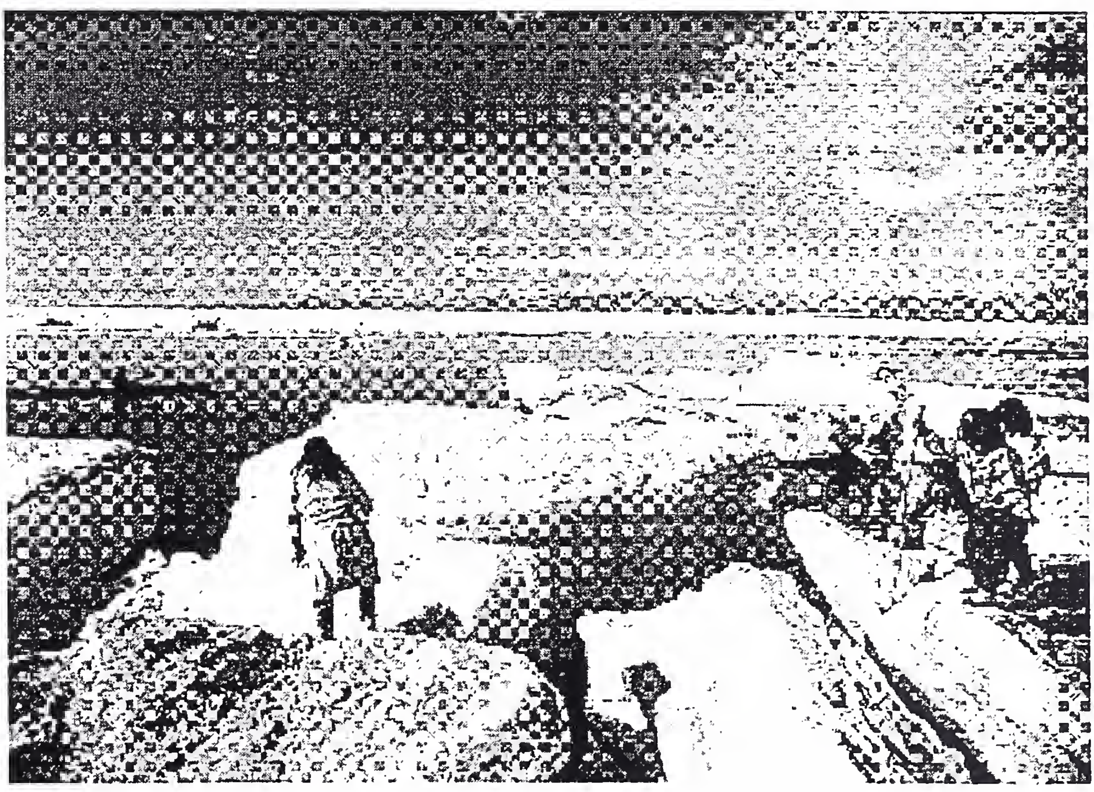


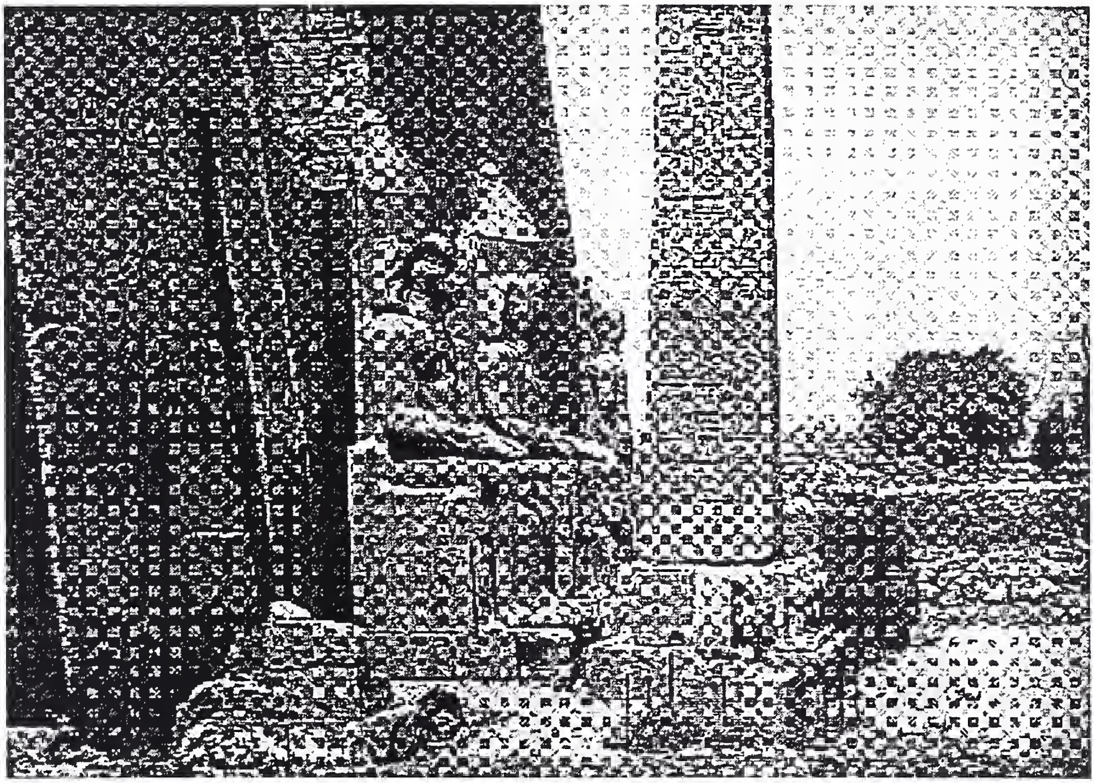


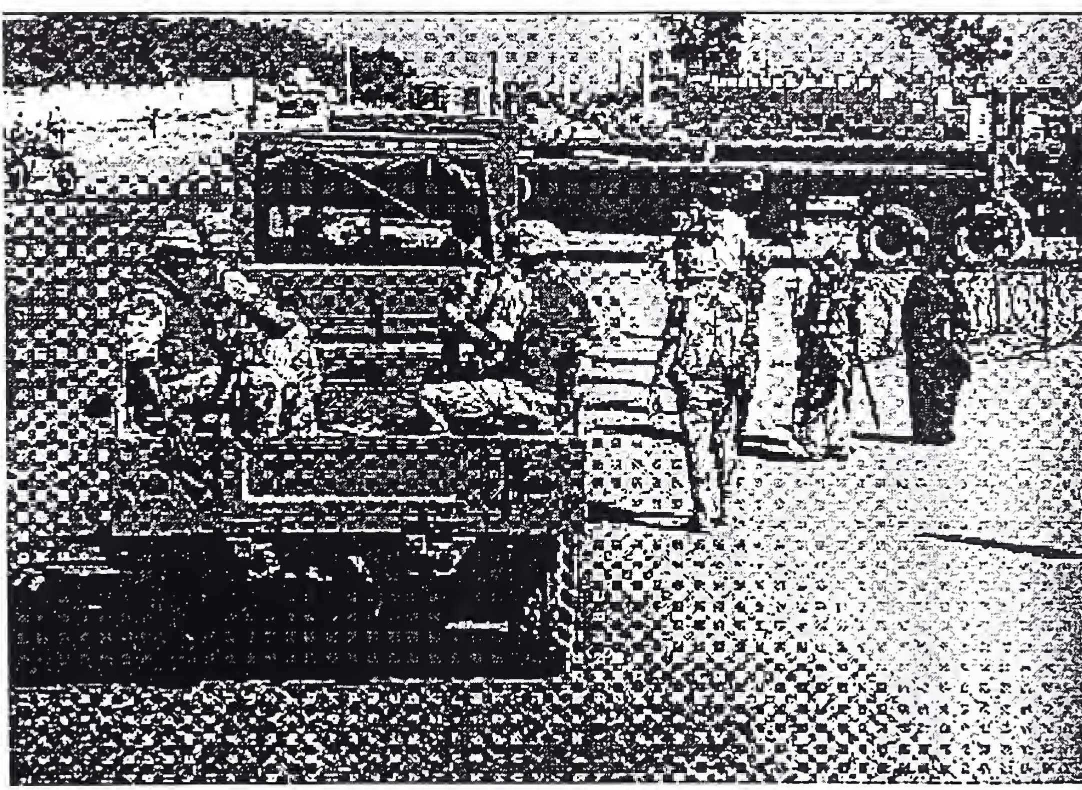


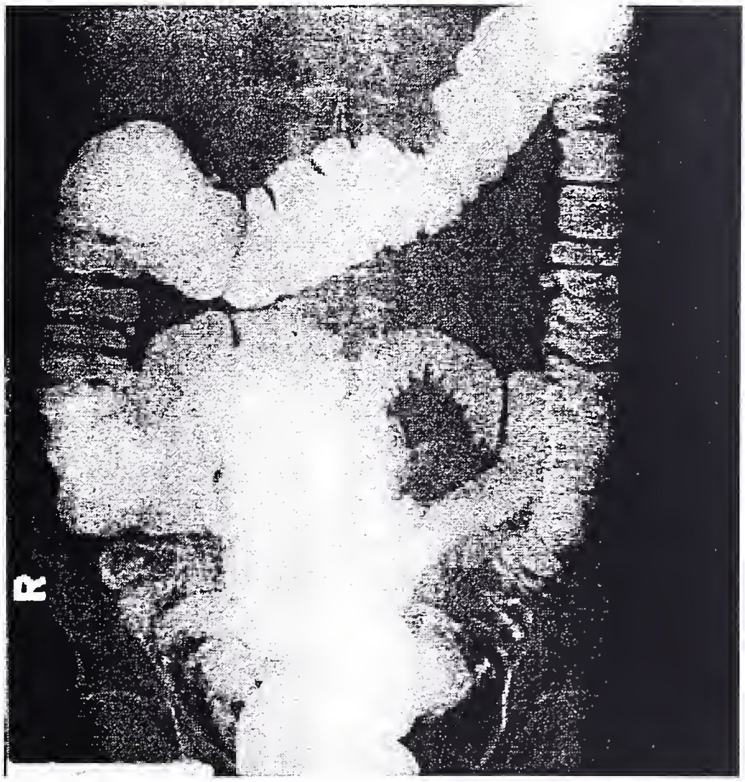


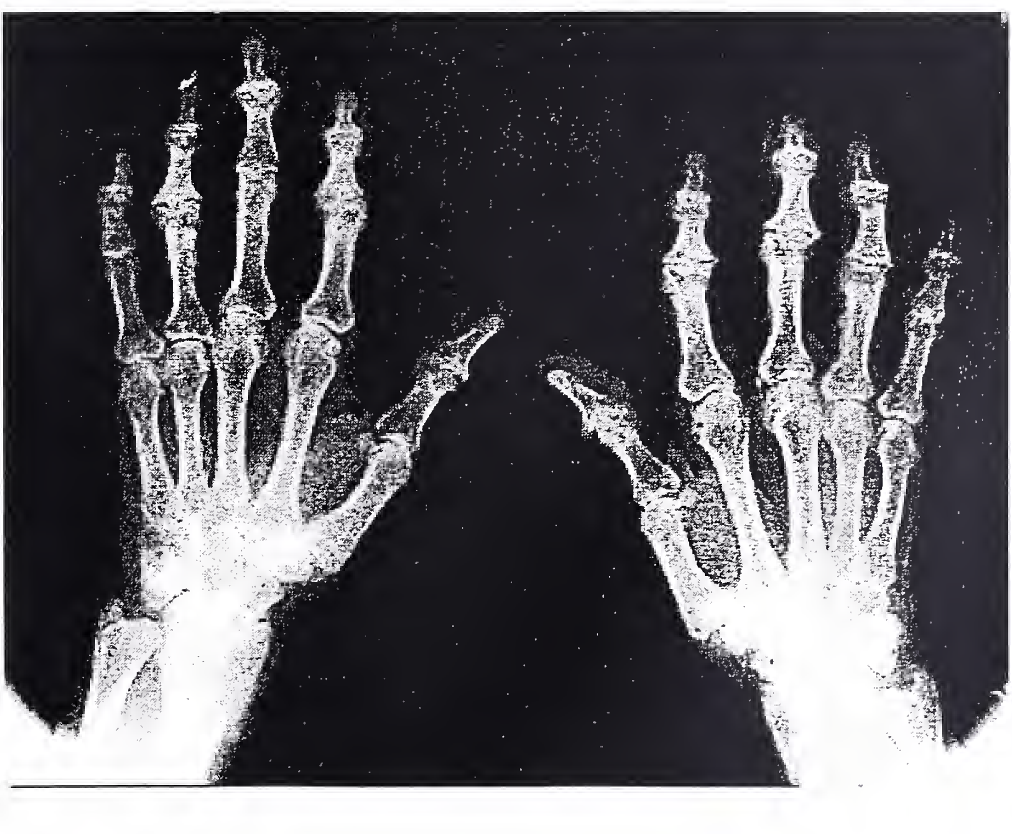


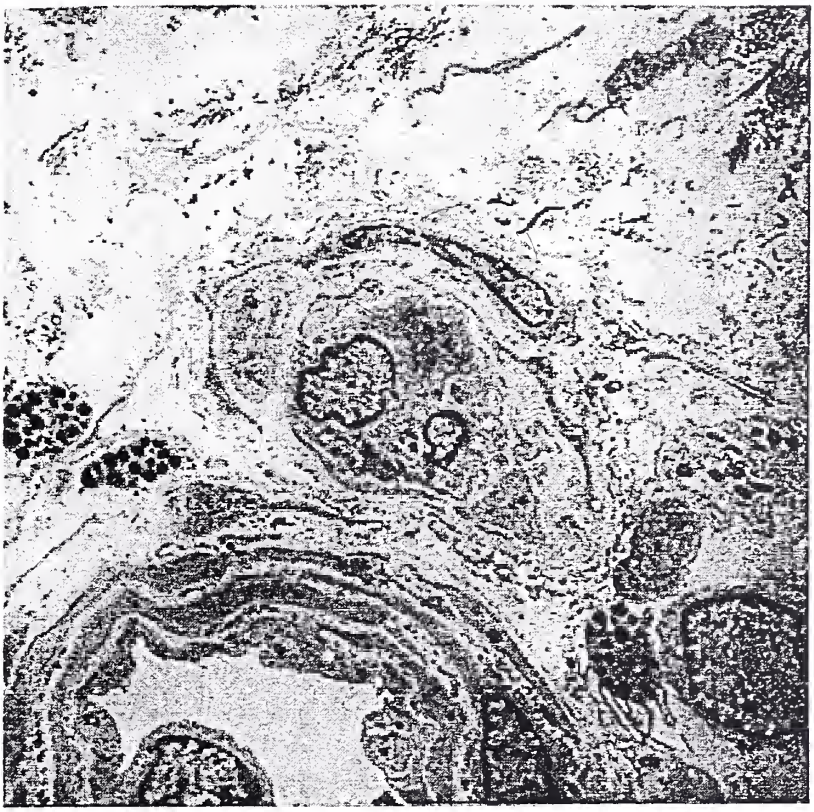


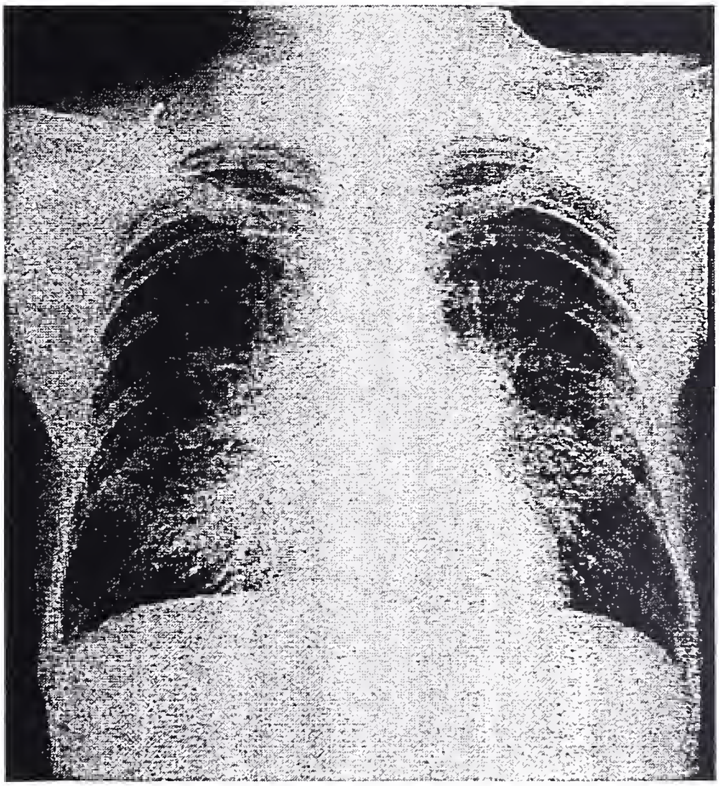


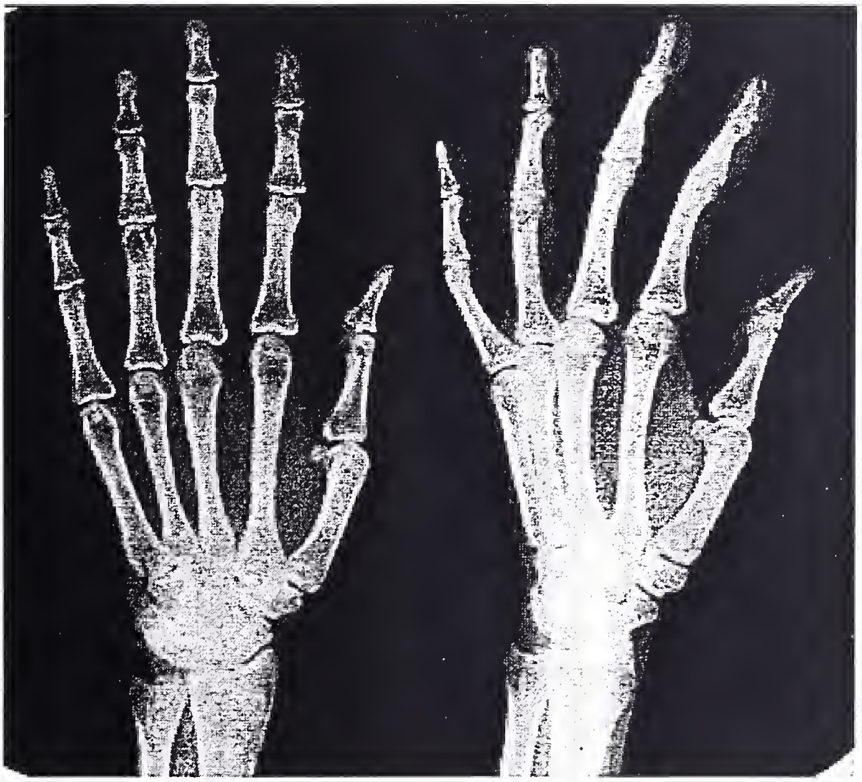



R









Appendix D

(Word List Task)

1	2	3	4	5
kpgrg	jptlg	zlrzp	hrypt	tywdl
tsdtl	ttlps	ntfsv	sgxsy	jgdnd
zmwdl	pzwtk	nywmv	gcmvk	zclhj
pzzng	khlxs	tbtnf	wpcvl	stlwp
swzvz	rszqh	yddhr	djpwq	yppxy
kznvv	xzyfz	zdlgf	lhwxp	fpgqd
syscw	yyzpx	ghdsk	thcqd	vvdpn
dndkj	qszzz	qmcms	ltscm	jkpzd
qtblx	fxqsd	vncxy	nhnsz	hykzn
txjqw	fnhjm	ctsxp	zytwx	tgcvw
rsrpk	bjkdt	qrflm	grkwh	gpcxg
xtjmt	czxdj	vtjnl	zqnyx	rylth
xhhzd	yjxcc	fftvw	jyrsx	hzwjv
sqhph	ftdzw	zzkhb	chzbf	vxftp
bktkf	xrtln	btqct	cgyxg	qtzwy
zydyz	lcqmq	hqhsm	mkpzz	hjhgf
xxckl	dxqwn	wprnh	sjzwb	ypbbx
dkcqg	qfvtd	kltzz	ncztj	lnzcc
qmxqn	kjrvw	jrlgd	xmlst	plmzi
mvtpk	zhgkz	gfhcr	bnwsf	xngwg
gbysd	sbdjz	htydb	mqyjm	wnwnh
sslts	vfdfl	nkrwz	ktzfq	pcksv
wrbwr	sqgwx	dldcm	tjzfx	ccytm
kyrgn	pslsg	mqpkx	mylhj	lzxpq
tzzhm	mlnzw	xkhcr	knvnj	vnnpv
pprwl	rljdw	tcrgy	gzsev	byqmp
zsxpl	gdvzq	rzhvl	ckcnt	jpcrt
rrytu	hylyv	yfynk	hmnrs	wlmjf
dslvl	vqcts	zzzfl	mwvrc	mhzfs
zjmvd	stcvs	kzzcr	vtnzt	vnrcs
whnpk	ptgxg	vhgtw	vdqgh	ltqxj
dczqp	flfmy	vswmt	wnkbc	wvhhs
ltczt	hngnz	zppxg	zlqkn	nmdpf
jwsyw	wuswp	ssxcg	clqdf	kdwvp
lrvns	kppvd	dhkmr	scmmv	xjgpy
bypzq	zrghj	wfvjx	lnyxh	krntm
qyhzl	dxvjm	ccjdd	rhvhz	fdvsz
pwhdk	kldzj	xfzgz	qkrxt	dpvvb
wmcgl	fpyvg	mmstt	nxppl	nxmpn
thszq	jnbxc	gydyy	cmqwd	ghskm
pvdjr	zmyvz	ckcnx	zpjdz	lgtzg
mwcyy	dfygj	nfqqs	ljzmz	qsdwl
nxzny	qvxxn	fxwgp	fyyzq	fslcc
dwcjv	zddcc	rdfss	jstxs	fmzym
vynhz	nfwwz	cnnnt	mmpkq	trnpf
zpqks	pvyyx	mgohh	fmbcg	dqzgc
rkfpt	kjmbz	plhhd	jprgz	rrwvf
zxsvl	kyyms	ttywt	vqytd	mkqyg
wpwmz	fdhvh	svhwb	xrpwt	mwdvc
yklsy	pbywh	yfcjs	slgmn	ghkjk
Time	Time	Time	Time	Time
Sec	Sec	Sec	Sec	Sec

6	7	8	9	10
nlxdg	qrwzq	hmyhm	tlkxs	ngqrn
cxffh	zfnwq	jnhlt	kgqfc	dbtrp
hvhmj	ypqqg	vzvrg	zllmt	mmgrs
cyssm	gjlmj	vfmtw	zrxje	glppd
zcytz	nppzf	bppsx	jgcnc	jsyyd
pnmjz	yexlb	rjmkm	nvzmr	rktmv
wtqjh	byggl	tlffz	xpcwr	spjcp
spvdx	rjvwz	mywlg	tfrvn	zpxlb
dbnjc	nddlz	msxmw	cmpnz	wyvsp
mtcsz	jbyjp	krgtx	ltzjy	wkpts
wxpwc	clyzf	tvnrw	gqmkk	dqhff
jcqfv	gfkyc	vvznc	lddrc	kcfvb
nlhdj	dxswr	pkrys	rxxfj	pwfzt
ksnge	gfzpy	qpxkf	lrvww	yspcb
jhxnm	pqkqh	qdzlm	gzbpc	rwprt
ckyzr	vsxnl	jvqtj	gpggq	zlkgj
dnmlp	jkglt	vwzrb	gsxkx	kmyhs
tyyff	rjyzp	nzqln	fnjnw	qoxym
gfxvq	jprnz	ymrss	szqsd	khcrv
xddpg	tyzvm	nqswp	scvgz	fsgyn
ccrxj	vthqc	wyxrl	pgvcm	lcxzc
rkyhb	rjyyg	qzhvd	tszsd	xpbkt
fyqmq	lbypq	xrmqx	pkthf	jbtzg
flqxc	vtztt	fzvrq	qzctq	kjwzb
rcpyc	cmhqd	wgmpt	wdzzb	twvqw
mjdrg	czhkb	zhqqv	qmchn	gfvzr
hqzdt	nvwvq	kztyk	zhqzc	zgxmq
flrjf	tzsff	qstgq	bwgsc	qnlfw
hrlqk	ypsxc	vnhrw	ryjtg	tqlkd
fcblp	lqvqj	wzzfb	nvysq	gskng
khrjm	rspgr	nrfzv	wmxxr	bvwzz
ttcgl	hftxh	xgltj	crzkl	sklzf
wqpqw	bwkmx	tqjvm	jdhjm	nkfjj
xynrk	cqrqz	zpymk	hkjmr	ltzpz
zqzvs	rpxxt	mwcxl	tvpgl	cgtxy
fymfz	gkcrz	ltmjc	qbtvm	qnjks
mhngl	zjjzd	yndds	vlnxc	fsyzq
ydbry	hsjwj	hvytv	jmgzy	zmfrj
dxsmj	hdgyz	wdzlz	xrpnb	lhchf
vnsjr	fnlxc	lvrqt	tdjjx	ftdcq
cmgxv	ywsxb	njmrt	xkqgl	zcjvc
bwzsn	skdsf	zmsvl	llvvq	zbvzh
xmpkj	mplzh	fkxyv	dxcvw	slifm
rfzkq	pyytp	zqlkn	mnxgl	hgkpl
jggyl	jhplt	qxfzw	mqdcm	jfmxw
hzyzp	zpczh	qhqfk	rllzc	zgjhp
dgqjd	jkjfx	ytjbm	nwhmx	ffgfp
vpzxs	xrbdq	drzem	swzgj	phzbj
vskvv	dfmch	wltnc	vfqks	qrxyw
wsjdl	rgbyh	qgsmc	dvyng	zmfyk

IME TIME TIME TIME TIME

Sec Sec Sec Sec Sec

11	12	13	14	15
tjpsp	zczwh	mqzky	ndpqj	bjtxt
tqbdk	rpyqw	yyjmk	pfgzj	qpgvz
lwtyp	ydgzp	kphmq	ppjmh	fkftx
qplwj	rlsky	fkmsw	kdytj	ghffd
zkvrr	zscwg	hcrwg	hvhph	txmxd
zjvzr	rlwss	ykgmh	zlczt	wtdnn
mswfr	fqtql	qfgcv	vfgyw	ulmng
tylhf	hllrx	rqfcn	lnlvt	dtwmh
xsnfx	xxnvk	ysctw	fqnzy	msjhy
cjkvg	qdnvl	zdgjp	ntpxz	lrrbx
nyyxz	dzwjx	hzgjy	njzqx	qwpfs
jsszn	jtpyt	ldrmy	bsvpr	nzvcm
fsydf	xnfhs	dpxfj	bqcgt	wlqwt
snzcc	lzsqq	wqmqs	dykcl	gjfpk
kchgg	cprty	wsehz	prjqs	cflfn
bpfwv	cwhqt	cbkjv	tysjj	wqwkc
ybtdp	dfdjw	kydzw	wzjhy	rmnnf
msspp	pywwb	cmvfp	flmmf	kpghm
hsfgl	prwjt	wzfxd	gkmrs	lxrxc
jscrm	tqvyz	hmqmh	dqnyc	pjwjz
lctjh	wfrlj	fcjlt	nqjrj	qfctc
xpvvk	dtmzh	dpjnf	wmzcy	ymthf
jzlfy	vqttw	zqdsz	qytlv	xzfcq
xcpnf	sspgz	zznjh	pyybm	zgwhg
hnzpp	czgtg	hqmfp	lsfcw	htppd
wyhpm	trqzz	gfyjd	gtnxn	psrpl
xvhmf	drhnt	lpbcw	ncswh	fvvkg
qsycd	ylvly	wslgd	slljp	ppkrq
ytztv	nzqgg	kzwwz	xkyth	lfdzz
qmzqn	sqcvn	frxxz	kfrwq	xyhxs
sxyqq	ymrxx	dflwp	fhznv	pfpkg
bvzqc	mtfzj	mjhkp	zgqrp	qcjjc
pktrw	cphpy	ctvlw	jstzd	yqknf
rpzrn	ddiqc	cdckk	clhqz	wvhkj
csbyf	ybkhc	chgcf	dkikc	rdpcx
rnvck	gcpqw	lvsvd	xnnfh	hphyj
hyqhs	jsjvz	nkjvr	lhqdk	sdklf
vxjwh	yrzhy	sdbtg	vjvnf	ccszx
ppclx	tvlbz	sngsx	wtgzv	lzlqp
jcuwt	hxgjr	jppfz	gjqdg	zstms
spbgf	vxwhs	yqncp	kzvzd	kdzfk
rzylp	fctlj	fgjzq	bcwxh	tmlhj
bdnwd	dfzpn	mlryn	zzpcs	xmfjh
jfmqz	mmfyg	qrlld	zwstx	jprvn
gjpww	hhjyz	gdxnn	nfypz	yszch
lqqzk	jsymh	xxfwt	ftsqg	xnzdz
hfznc	gsqrd	dtcqv	brgkq	lqpkm
nxtww	nxlpf	krxlw	rzbsq	zfyhy
ynvmq	zlxyh	fksvw	hkyfn	lpsvt
fbjhz	lsynq	chpnr	lwqms	vyfnn
Time	Time	Time	Time	Time
Sec	Sec	Sec.	Sec	Sec

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