Interest and Pupil Dilation: A Print Advertising Pre-Test

Roy Douglas Adler

Western Michigan University

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INTEREST AND PUPIL DILATION:
A PRINT ADVERTISING PRE-TEST

by

Roy Douglas Adler

A Thesis
Submitted to the
Faculty of The Graduate College
in partial fulfillment
of the
Degree of Master of Arts

Western Michigan University
Kalamazoo, Michigan
April, 1971
ACKNOWLEDGEMENTS

I wish to express my appreciation to Drs. Frank Fatzinger and John Nangle whose guidance has been invaluable and whose patience has been saintly during the preparation and submission of this thesis. I would also like to thank my father who, until his death last summer, never ceased to encourage me to finish what I had begun.

Roy Douglas Adler
MASTERS THESIS

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ADVERTISING PRE-TEST.

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Psychology, industrial

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INTRODUCTION

The idea that the size of the eyes is a clue to emotions is prevalent in literature and common in everyday language. A surprised person has "eyes like saucers" or is "bug-eyed". A demoniacal person is "beady-eyed," "shifty-eyed," or has "eyes like pinpoints". A pretty girl has "bedroom eyes". Yet we commonly think of the change in pupil size only as a reflex to light; i.e., an increase in illumination will constrict the pupil.

A possible relationship between the emotional dilation described in metaphoric literature and the biological pupillary reflex to light was proposed by Dr. Eckhard H. Hess of the University of Chicago in 1960. His anecdotal explanation of the discovery is that his wife saw the extreme dilation of his pupils while he was pouring over a book of extremely beautiful photographs, and she suggested that he needed more light. The illumination seemed more than enough, so he puzzled as to why his pupils dilated.

He hypothesized that the reflex to light is a function of the parasympathetic nervous system, while reflex to emotion or interest is a function of the sympathetic nervous system. Accordingly, he has been doing pioneer research on the question of pupil size related to the interest value of visual stimuli, and to mental activity during simple problem solving. He has
christened his new science "Pupillometrics".

Hess's research has had an impact not only in the academic fields of psychology and biology, but some impact in the commercial areas of advertising and marketing as well.

A big problem in advertising and marketing research is that the individual tends to give self-conscious answers when explaining his relative interest in the different things he sees. The dilation phenomenon, of course, suggests an objective way to measure people's reactions which have always been interpreted subjectively.

To expand the point, were the pupil dilation phenomenon perfectly reliable and valid, one of the oldest problems in communications research would be solved -- the difference between what the subject sees and the interpretation of what he sees, the difference between how he is really effected and how he reports he is effected by all kinds of visual impressions including the advertising print media which served as the vehicle for this test.

Since the inception of "Pupillometrics" in 1960, a great amount of work has been done by the interdependent Marplan, Interpublic, and McCann-Erickson organizations. Hess originated his idea at the Perception Research Laboratory at McCann-Erickson, a large advertising agency in Chicago, and subsequently moved to head Interpublic's Perception Research Center in New York. Marplan is a research affiliate of the Interpublic Group of Companies. All research used essentially the same method and was oriented heavily.
toward commercial application. An outline for research either completed, in progress, or proposed is shown in Table 1.

The method and apparatus chosen to achieve these ends is fairly complicated and somewhat less than practical for a researcher of limited finances. In his most recent studies, Hess (1965) utilized infra-red lighting and infra-red camera film (neither commonly available) and obtained his incredibly sharp close-ups by the use of mirrors (which, because of their effect upon focal length, make replication very difficult). Hess's camera was an expensive and relatively rare 16mm with a special timing mechanism.

The author could not, first of all, employ this type of apparatus because of its high cost. The author would not use it, for when what would seem like a simple measurement process is open only to those with extremely sophisticated equipment, much of the practicality and utility of the process is lost.

The differences between Hess's apparatus of 1960-1964, Hess's apparatus of 1965-1966, and the apparatus used by the author is summarized in Table 2. The materials used by the author are common and inexpensive, and the method is designed to be easily replicable. The author's apparatus and procedures have been subsequently used by Dornan (1967) in unpublished race attitude studies and by Tinio (1968) in aggressive fantasy studies, both at Western Michigan University.
Table 1: Some Applications of Pupillometrics

1. Historical practices
   a. Card tricks
   b. Bargaining

2. Sex studies
   a. Sex-different responses
   b. Development of sex interest
   c. Homosexual detection

3. Socio-cultural-political
   a. Race attitudes
   b. Attitudes on political issues
   c. Voting behavior
   d. Attitudes regarding art/ballet/etc.

4. Non-visual investigation
   a. Taste
   b. Hearing

5. The problem-solving process
   a. Tracing the decision-making process
   b. Determining decision-making abilities
   c. Evaluating decision-making methods
   d. Measuring responses to people under stress

6. Overcoming classical psychological measurement obstacles
   a. Objective measure of motivation
   b. Trace progress of psychotherapy
   c. Attitudes of nonverbal Ss
   d. Polygraph supplement/substitute
   e. Changes in perception as a result of suggestion
   f. Testing the presence of subliminal perception
   g. Testing presence of Freudian symbolism
   h. Uncovering personality functions
   i. Correlation with other existing measurement devices

7. Measuring effect of communication
   a. Information and propaganda
   b. Advertising
      Package design
      Product preference
      Media pre-testing

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Table 2: Established vs. Experimental Apparatus and Procedure

<table>
<thead>
<tr>
<th>Factors</th>
<th>Hess 1960-64</th>
<th>Hess 1965-66</th>
<th>Adler 1966</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recording</td>
<td>16mm Arriflex</td>
<td>16mm Arriflex</td>
<td>35mm Minolta SLR</td>
</tr>
<tr>
<td>Camera</td>
<td>Motion Pict.</td>
<td>Motion Pict.</td>
<td></td>
</tr>
<tr>
<td>Lens</td>
<td>150mm F/3.5 Kilfitt</td>
<td>150mm F/3.5 Kilfitt</td>
<td>55mm F/1.4 Rokkor</td>
</tr>
<tr>
<td>Film</td>
<td>Eastman Royal Pan F/8 800 ASA</td>
<td>Infra-Red</td>
<td>Kodak Tri-X 200 ASA</td>
</tr>
<tr>
<td>Exposure Rate</td>
<td>21/sec</td>
<td>21/sec</td>
<td>1/presentation</td>
</tr>
<tr>
<td>Exposure Time</td>
<td>½ sec</td>
<td>½ sec</td>
<td>1/250 sec</td>
</tr>
<tr>
<td>Illumination</td>
<td>100w</td>
<td>Infra-red</td>
<td>7½w/reading 16 footcandles at eyehole</td>
</tr>
<tr>
<td>Screen Distance</td>
<td>57 in</td>
<td>30 in</td>
<td>26 in</td>
</tr>
<tr>
<td>Image</td>
<td>16 x 25 cm</td>
<td>22 x 30 cm</td>
<td>5 x 7.5 cm</td>
</tr>
<tr>
<td>Slide Advance</td>
<td>10 sec</td>
<td>10 sec</td>
<td>6 sec</td>
</tr>
<tr>
<td>Dilation</td>
<td>0-30%</td>
<td>0-30%</td>
<td>0-36%</td>
</tr>
<tr>
<td>Enlargement</td>
<td>Variable</td>
<td>20x</td>
<td>20x</td>
</tr>
<tr>
<td>Accuracy</td>
<td>1mm</td>
<td>1/20mm</td>
<td>1mm</td>
</tr>
</tbody>
</table>

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In this study, the author intends to demonstrate that the pupil response technique can be used as a valid objective measure of the interest-arousing value of print advertising.

At present, twenty thousand dollars is the normal sum spent on the creation of a single full-color advertisement to be placed in one issue of a national magazine. The only pre-publication indication as to the interest-arousing capabilities of the proposed ad is the judgment of key agency personnel and the representative of the advertiser. It would seem reasonable that some type of objective criteria should be used to supplement the wholly subjective system now employed.

This project, therefore, involves the construction of an advertising pre-test. A number of different advertising approaches could be tested against already-existing advertisements for competing products. Upon analysis of the results, an objective scale of interest could be constructed which would rate existing and proposed advertisements in interest-arousing ability.

Validity could be checked by using Starch scores as a comparison to the pupil dilation scale. A system of call-backs could be employed supplementally to determine if interest as measured by the pupil response technique is positively correlated with recall.

1Starch scores are the result of a readership survey of advertisements. High Starch scores indicate that the advertisement is noticed and read by a great number of people.
The primary hypothesis to be tested is that a meaningful difference in pupil size can be detected by the simplified apparatus and procedure herein discussed. A secondary hypothesis is that the demonstrated difference will correlate positively with other measures of interest, such as the Starch scores of already existing advertisements, subjective professional opinion, and recall.
METHOD

Subjects

The Ss were fifty female undergraduate students between the ages of eighteen and twenty-two. Twenty-four students were from Albion College, and twenty-six were from Western Michigan University. In both groups the average age was 20. Selection was on a volunteer basis.

Apparatus

The below-listed apparatus was used in presentation and assembled as shown in Figure 1.

1. A Minolta 35mm single lens reflex camera with a 55mm F 1.4 lens. Tri-X black and white film was shot with the setting 1/250 at F 1.4.

2. A General Electric exposure meter, type PR-3

3. A Revere automatic slide projector, model P-880


5. A plywood box, size 16" x 24" x 16", providing a camera focal length of 26" and a visual focal length of 27". The interior was painted a light grey.

6. Twenty-three 35mm slide transparencies (see Figure 2) with test slides selected and paired on the basis of content and control slides on the basis of illumination.

For analysis purposes the following were required:

1. A 35mm film strip projector and screen

2. A pair of Vernier calipers
Figure 1: Viewing Apparatus

[Diagram showing a viewing apparatus with labels: 35mm camera, Screen, Path of projected image, Baffle plate, Projector, Mirror, Pinch hole, 7½ W lamp]
A - Vedra (large)  B - Vedra (small)

C - Red Aloe  D - Gold Aloe

Figure 2

Advertisement stimulus slides paired on the basis of graphic similarity

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Figure 2 Cont'd

E - Helene Curtis  F - Germaine Montiel

F. - House of Aloe  H - Francis Denney

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Figure 2 Cont'd

J - Rexall

K - Sheer Genius
Procedure

The presentations were run in a small dimly lighted room, which contained the apparatus set on a table, and a chair for the S. The S entered the room and was seated before the apparatus. The instructions read to each S were these:

"Please be seated and look through the viewing apparatus. You will see a white screen on the right side of the rear of the box. I will show you twelve advertisements on that screen and while you are looking at them, I will take photographs of your eyes. The first few are simply colored test slides. When an advertisement appears please say the word 'Ad'. Do not take your eyes from the apparatus until I instruct you to do so. Are there any questions? If any arise, please ask."

Following a final confirmation of correct focal distance, the S was instructed to look into the apparatus and the experimental trial was begun. The projector was automatically set to show each slide for six seconds with a two-second change-over period. One photograph was taken for each slide in the fourth second of its presentation. After the last slide was shown, the S was informed that the test was over and was asked to fill out an index card with identifying data. The E then recycled and reordered the slides according to a counterbalancing formula (Table 3), and changed the film, if necessary, in preparation for presentation to the next S.

Each completed roll of film was tagged immediately with a "baggage tag" which indicated the date and the subjects included on it. The exposed film was processed by the E and initially printed on matte finished paper, enlarged as much as possible
Slide Position

1 2 3 4 5 6 7 8 9 0
1 - F D G E H C A B J K
2 - A G F J E K D C B H
3 - G C D K J A B H E F
4 - B A E G D H J K F C
5 - C B J A F D H E K G
6 - K H C B G J F D A E
7 - H F B C K E G J D A
8 - J E H F C B K A G D
9 - D K A H B G E F C J
0 - E J K D A F C G H B

Key

A - Vedra (large)
B - Vedra (small)
C - Red Aloe
D - Gold Aloe
E - Helene Curtis
F - Germaine Montiel
G - House of Aloe
H - Francis Denney
J - Rexall
K - Sheer Genius

Table 3
Position Counterbalancing table
without loss of focus. This method proved inferior, however, to that of processing the film to the negative stage only, then projecting the negatives through a 35mm film-strip projector onto a smooth white wall. The latter method was used for data analysis.

Since the measure used in evaluation was the relative measure of pupil-iris ratio, the absolute magnification achieved was of secondary importance, although higher magnification would logically yield more precise readings. Iris diameter, of course, was assumed to remain constant while pupil diameter varied. The E measured each projected image with a Vernier calipers and recorded the absolute measurements. These were later reduced to ratios and averaged for each slide. A small ratio indicated constriction, while a larger ratio indicated dilation and presumably interest. The projected image yielded an average iris diameter of 30cm and a pupil diameter of between 7 and 18 centimeters.

Spoilage of pictures ranged between 10% and 38% for different slides and averaged about 16%. The most common reason was that the S blinked, but any picture which, for any reason, involved the possibility of inaccurate measurement was listed as spoiled and not included in results. This accounts for the differing number of Ss in the last column of Table 4.

The right eye was the one primarily measured for pupil change, but for those Ss involved in spoiled pictures, the eye yielding the most data was used. All measurements for a given S, however,
were taken for the same eye.

Each S received a questionnaire (see Appendix A) between four and six weeks after the experimental session. Rank orderings by advertising professionals were solicited and correlated with test results. It was assumed that this professional opinion would correlate positively with test results. Starch scores were sought for the purpose of correlation with pupillometric scores.

As a reliability check, each advertisement was paired with a graphically similar advertisement. It was assumed that advertisements similar in graphics would be ranked similar in appeal on the basis of pupil-iris ratios.

As a validity check against amount of illumination from the slide becoming a major influencing factor, the illumination of each slide was measured and the rankings on the basis of illumination were correlated with experimental results.

An additional investigation regarding the position variable was made, to confirm that the counterbalancing formula employed in positioning slides was necessary.
RESULTS

Numerical results were obtained by using the average of the ratios between pupil diameter and iris diameter for each slide for all Ss. Each slide was then ranked on the basis of this average pupil-iris ratio. Table 4 presents these results.

These results were then to be correlated to recall generated by questionnaires, Starch scores, and professional opinion rankings. Response to the questionnaire (Appendix A) was an unexpectedly high 72%, but recall was so slight as to provide no basis for correlation with test results. Starch scores were unobtainable for all but two advertisements, presumably because of the limited geographical areas in which most advertisements appeared.

A ranking of advertisements on the basis of interest determined by professional opinion was made by interviewing five female members of the advertising profession whose products were oriented toward the female market, but whose products were noncompetitive with those products advertised in the test slides. The correlation coefficient was computed to test the degree of agreement between the rankings of the professionals and the rankings by pupillary response. The coefficient of rank correlation was .81, which demonstrates that the slides scoring highest were also judged most interesting by professional opinion. A table demonstrating this ranking is included as Appendix B.
Table 4: Rankings of stimulus slides based upon pupil-iris ratio

<table>
<thead>
<tr>
<th>KEY</th>
<th>STIMULUS SLIDE</th>
<th>AVERAGE PUPIL-IRIS RATIO</th>
<th>NUMBER OF SLIDES RATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Yellow Test</td>
<td>.3396</td>
<td>40</td>
</tr>
<tr>
<td>Y</td>
<td>White Test</td>
<td>.3376</td>
<td>43</td>
</tr>
<tr>
<td>F</td>
<td>Germaine Montiel</td>
<td>.3190</td>
<td>43</td>
</tr>
<tr>
<td>D</td>
<td>Gold Aloe</td>
<td>.3168</td>
<td>40</td>
</tr>
<tr>
<td>K</td>
<td>Sheer Genius</td>
<td>.3161</td>
<td>40</td>
</tr>
<tr>
<td>C</td>
<td>Red Aloe</td>
<td>.3130</td>
<td>44</td>
</tr>
<tr>
<td>E</td>
<td>Helene Curtis</td>
<td>.3128</td>
<td>45</td>
</tr>
<tr>
<td>B</td>
<td>Vedra (small)</td>
<td>.3124</td>
<td>44</td>
</tr>
<tr>
<td>H</td>
<td>Francis Denney</td>
<td>.3106</td>
<td>45</td>
</tr>
<tr>
<td>J</td>
<td>Rexall</td>
<td>.3093</td>
<td>43</td>
</tr>
<tr>
<td>A</td>
<td>Vedra (large)</td>
<td>.3086</td>
<td>45</td>
</tr>
<tr>
<td>G</td>
<td>House of Aloe</td>
<td>.3007</td>
<td>31</td>
</tr>
</tbody>
</table>
In retrospect, it would seem advisable to have also asked the Ss themselves to rank the slides on the basis of interest after having seen them, so that the same correlation could have been made between the pupillary and verbal responses of the Ss.

As a reliability check, each advertisement was paired with a graphically similar advertisement. The results of these pairings are shown in Figure 3, with rank order identified by the numbers one through twelve, and advertisements identified by letter keys. Chi-square analysis yields $P < .005$ which lends support to the contention that analogous advertisements achieved similar test scores.

The effect of the slight differences in the illumination of each slide was evaluated by ranking the slides on the basis of illumination and computing the correlation coefficient between illumination and experimental results. The coefficient of rank correlation was .05, suggesting that illumination was not a factor. A table presenting these rankings is shown as Appendix C.

The position variable was a valid concern in that the dilation in response to all slides generally decreased during the course of each trial as shown in Figure 4. This probably accounted for the high relative dilation measured for the pre-trial slides which were always presented first. Since the presentation order of all actual test slides was counterbalanced, the problem of position was thought to be effectively neutralized.

After results had been tabulated and summarized in the manner outlined above, an alternate method of statistically treating data
Average pupil-iris ratio

Note: Numbers indicate rank order

Stimulus slides identified by letter "key"

Scores of stimulus slides paired on the basis of graphic similarity

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Figure 4

Average scores based upon presentation order
and summarizing results was proposed. Using this alternate method, numerical results were obtained by indexing the decimal equivalent of the pupil-iris ratio for each test slide against the average of two pre-test control slides for each S.

Rankings obtained by the alternate method of analysis provided a correlation coefficient of .71 with the primary method. While the alternate method is somewhat more statistically sophisticated, the primary method was judged more appropriate in that it provided a level of treatment more in keeping with the level of methodology. Results obtained by the alternate method are shown in Appendix D.
DISCUSSION

The analysis of the data supported the primary hypothesis that a difference in pupil size can be detected by the simplified apparatus employed in this investigation. Pupil-iris ratios of between 25 and 59 percent were recorded across all Ss, and a pupil size change of up to 36% was recorded in consecutive measurements of a single S.

The data also tended to support the hypothesis that the pupil dilation will correlate positively with some independent measure of the interest-arousing capability of print advertising, although this conclusion is more tenuous.

Two of the three measures designed to establish interest-arousing capability were not available for reasons described previously. The third measure, that of professional opinion, correlated positively but is in itself a highly subjective measure.

Perhaps the best indicator of positive results in this test is the lack of intervening variables. A validity check of the illumination variable was performed and it was found to be non-contributory. The effect of position, which could have been a significant intervening variable, was neutralized by experimental design.

The positive reliability evaluation regarding the pairing of graphically similar advertisements is encouraging. This check demonstrates that similar advertisements were ranked
similarly in interest and suggested that the content of the advertisement was truly the major contributor to pupillary dilation.

Subsequent to the tabulation of results, an additional reliability test was run that showed a range of error in measuring individual pupil-iris ratios of between zero and 1.82%. The average error over twenty-five re-ratioed eyes was .67%. This average represents about one-sixth the distance between the score achieved by the highest and the lowest slide and, while no error is desirable, this seems to be an acceptable average error range.

While the ability to support hypotheses is encouraging, there were two problems encountered in methodology which speak for further development of the technique.

The largest problem was that of measuring the pupil-iris ratio. Not only did this require an unexpectedly inordinate amount of time, but the E found that a certain discriminatory skill in measuring the somewhat irregularly shaped circles that the pupils and irises become under high magnification was developed over time. While the reliability check described previously indicated that the E was consistent in his measurements, efforts should be directed toward the development of apparatus to more quickly and accurately measure pupil-iris ratio.

A secondary methodological problem involved the construction of the presentation device. A mirror was used to
deflect the stimulus image in the presentation device, because a straight projection would have placed the S directly in the path of the projector's hot exhaust. The use of the mirror caused the margins of the stimulus slides to be out of focus and may have contributed to the lack of recall of specific advertisements. Further development of the presentation device seems to be indicated.

Since the beginning of this paper in 1967, there have been interesting developments regarding both the technique described herein and the total science of "Pupillometrics". The E has provided assistance to others investigating the pupil dilation phenomenon, and his technique and apparatus were successfully employed by Tinio (1968) in her thesis relating aggressive fantasy to change in pupil size.

The "Pupillograph", an instrument designed to simultaneously measure and record pupil size, has been developed and produced by Bausch and Lomb. This device operates by scanning the eye with a spot of infrared light which is reflected everywhere but in the pupil area. If available at a reasonable cost, it should be very helpful to those pursuing pupillometrics research.

The field of advertising has evidenced a trend away from the objective measures so intensively pursued in the mid-1960's. Those in the field now generally believe that creativity, developed subjectively, should be evaluated subjectively. Accordingly, those who had been working in pupillometrics research have rechanneled their efforts into other areas. The

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current emphasis on subjectivity, however, appears to be only part of the cyclical trend in a field in which novel concepts, methods, and executions are prized. It is hoped that this paper may provide part of the basis of renewed pupillometrics investigation in the future.
SUMMARY

The possibilities for "Pupillometrics" in communications research are extensive, but previous studies have employed complicated and sophisticated equipment. This study attempted to perform an advertising pre-test retaining the principles of pupillometrics but using far simpler equipment than had been used previously.

It was hypothesized that a meaningful change in pupil size could be measured using less sophisticated equipment and that this change would be correlated to other measures of the interest-arousing value of graphic advertising.

To test the hypotheses, 50 female college students were shown 12 slides of different cosmetic advertisements while pictures were taken of their eyes. The average pupil-iris ratio for all subjects viewing a given advertisement was tabulated and all advertisements were ranked in order of this ratio.

A definite change in pupil size was recorded, but only one other measure of interest was available. Pairing on the basis of content matching revealed remarkable similarity in response to similar advertisements, and the effects of illumination and position were found to be noncontributory.

The simplified apparatus and procedure was judged to be effective, but the need for a scale against which to measure experimental results was apparent.
REFERENCES


Hicks, Clifford B. Your eyes tell your secrets. *Family Weekly*, 1966, 27:33, 4-5.


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**FOLLOW-UP QUESTIONNAIRE**

Name: ________________________________  Address: ________________________________

1. Which ads do you remember?
   (Even if you can't think of any send the questionnaire in anyhow.)

<table>
<thead>
<tr>
<th>Brand of ad</th>
<th>Brief description</th>
<th>What did you think of it?</th>
<th>In color?</th>
<th>How much of the person was visible?</th>
<th>Was there a similar ad?</th>
<th>Brand of it</th>
<th>How was it different?</th>
</tr>
</thead>
</table>

a. 

b. 

(for additional ads remembered please use back of questionnaire)

2. Had you seen any of these ads before?
   Which?  Where?

   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________

3. Which specific products in the ads have you used?

   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________

Return to:  Roy Douglas Adler, 2024 Yuma Trail, Okemos, Michigan 48864
APPENDIX B

Subjective ranking of advertisements by professional opinion compared with ranking by pupil-iris ratio

<table>
<thead>
<tr>
<th>ADVERTISEMENT</th>
<th>(KEY)</th>
<th>BY PUPIL-IRIS RATIO</th>
<th>BY PROFESSIONAL OPINION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germain Montiel</td>
<td>(F)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Gold Aloe</td>
<td>(D)</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Sheer Genius</td>
<td>(K)</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Red Aloe</td>
<td>(C)</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Helene Curtis</td>
<td>(E)</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Vedra (small)</td>
<td>(B)</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Francis Denney</td>
<td>(H)</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Rexall</td>
<td>(J)</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Vedra (large)</td>
<td>(A)</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>House of Aloe</td>
<td>(G)</td>
<td>10</td>
<td>9</td>
</tr>
</tbody>
</table>

(r=.81)

Five female members of the advertising profession were separately interviewed, shown pictures of the tested advertisements, and asked to rank them from most interesting to least interesting. Individual rankings were combined to yield the above ranking.
APPENDIX C

Rankings of advertisements based upon illumination compared with ranking by pupil-iris ratio

<table>
<thead>
<tr>
<th>ADVERTISEMENT (KEY)</th>
<th>RANKINGS</th>
<th>BY RATIO</th>
<th>BY DARKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow Test (X)</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>White Test (Y)</td>
<td>2</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Germaine Montiel (F)</td>
<td>3</td>
<td>9(\frac{1}{2})</td>
<td></td>
</tr>
<tr>
<td>Gold Aloe (D)</td>
<td>4</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Sheer Genius (K)</td>
<td>5</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Red Aloe (C)</td>
<td>6</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Helene Curtis (E)</td>
<td>7</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Vedra (small) (B)</td>
<td>8</td>
<td>11(\frac{1}{2})</td>
<td></td>
</tr>
<tr>
<td>Francis Denney (H)</td>
<td>9</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Rexall (J)</td>
<td>10</td>
<td>9(\frac{1}{2})</td>
<td></td>
</tr>
<tr>
<td>Vedra (large) (A)</td>
<td>11</td>
<td>11(\frac{1}{2})</td>
<td></td>
</tr>
<tr>
<td>House of Aloe (G)</td>
<td>12</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

(r=.05)

Pupil dilation is a response both to interest and absence of light. If pupillary response had correlated highly with absence of light, a case could be made that it was an intervening variable significantly affecting results. Measured results correlated only r=.05 with darkness, however, suggesting that illumination was not a factor.
APPENDIX D

For the alternate method of treating data, numerical results were obtained by indexing the decimal equivalent of the pupil-iris ratio for each test slide against the average of two pre-test control slides for each $S$. The indexing of ratios of test slides to control slides was done in an attempt to establish some sort of base level of performance for each $S$, thereby providing a relative performance indicator for the test slides.

Even though slide presentation position was counterbalanced, additional statistical adjustments were made for both time and position order before the scores for each slide were combined. These adjustments (additions or subtractions) were made to correct any bias on individual slides that time or position would have on an individual $S$ score.

A correlation analysis was then conducted to determine the relationship of the means of the pupil-iris values for each test slide to the mean of its pre-test control slides. The results were used to determine the extent of difference between slides so that the validity of the primary hypothesis (i.e., "that a meaningful difference in pupil size can be detected by the simplified apparatus and procedure.") could be shown.

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1This modified analysis of covarience program was authored by Linda Harman of Procter & Gamble's Marketing Systems & Services section. The program was run on an IBM 360 computer, as were other statistical operations involved in the alternate method.
The significance of the differences between each pair of slides was determined by a t-test. Values were extracted from a table by Fisher-Yates. These results indicated that there is a .92 probability that the differences observed between the highest and lowest scoring slide were due to a factor other than chance. Relationships between other pairs of test slides are shown in Figure D1.

The correlation coefficient between this method of analysis and the primary method is .71. Correlation between this alternate method and the professional opinion ranking is .50, not as strong as the primary method's correlation of .81 but not contraindicative.

Correlation with illumination was -.59, while the correlation of the primary method with illumination was .05. Both provide strong support to the conclusion that illumination was not a major factor influencing results. The degree of inverse correlation of the secondary method with illumination was surprisingly large, and further suggests that interest can be a strongly dominant factor over illumination.

The alternate method was able to provide further information regarding the pairing of similar advertisements. The assumption was that both members of the pair would be similar in interest, and, if ranked similarly by the experimental results, these pairings could serve as a reliability check. Analysis by the alternate method indicated that there was an average .60 probability that true differences did not exist within the members of each pair.
Probability of true differences between pairs (x .01)

Figure D1

Relationships between pairs