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ABSTRACT

This paper discusses several considerations and techniques in doing research which attempts to measure the effects of visual images on viewers. For example, to describe precisely the effects of some element of a visual image or series of images, researchers must be able to specify the institutional context in which the image is presented and describe the contents of the visual image in unambiguous fashion. If they fail to do those things, they will not know if the response is really to the environment instead of the image or know which element to credit with impact on the viewer. They may have to take into account other sources of variance as well. A research design which successfully reduces restraints on audience response can also include magnitude estimation scaling, Cloze procedure, or scales which indicate emotional response. Researchers might also use tachistoscopes--instruments with shutters that allow the researcher to control how long a viewer is exposed to an image--or even eye-tracking equipment and electrodermal recording. (Contains 17 references.) (BEW)

ASSESSMENT OF THE VISUAL IMAGE IN FILM TELEVISION AND THE NEW VISUAL MEDIA: RESEARCH DESIGN

by
James E. Fletcher

The *visual image*, whether a part of the new visual communication media technologies or of education in general, poses particular challenges for quantitative research.

The new media and education differ in the context provided for the image. In education the image is controlled by an instructor or by the designer of instructional environment. An institution--the college or the school system--binds student and teacher into a common fabric. When speaking of visual media scholars tend to understand and explain images from the perspective of the institutions which prepare and market image-bearing media. This distinction affects the conduct of research into the nature of the image as well.

For purposes of this essay *image* will be defined as a presentation which is not part of the here and now of its audience: It represents a discontinuity in time and space from the immediate visual experience of the viewer (Fletcher, 1979). To describe precisely the effects of some element of a visual image or series of images the researcher must be able to specify (a) the institutional context in which the image is presented, (b) the distance in time and space from the image, to the time and space represented by the context of the viewer, and (c) the relative prominence of the image as a proportion of the total visual field of the viewer; (d) in addition, the researcher must be able to describe the contents of the vi.u.l image in unambiguous fashion.

If the environment of the viewer cannot be specified, then the researcher will not know whether the responses to an image in that environment is really a response to the environment rather than to the image. Likewise, if the content of the image cannot be described unambiguously, the researcher will not know which visual element should be credited with the effect measured in the viewer.

Experiments--
Sacred Cows or Bum Steers

The experiment as a tool of scientific inquiry presumes a relatively well defined domain of investigation in which scholars have strong expectations as to the relevance of the measures employed. The logic of the experiment is that a number of variables relevant to the phenomenon under study are held constant or controlled while one or more other variables are systematically manipulated and still others measured for effect. Those variables which are systematically manipulated are called *independent*, while those measured are called *dependent* (Fletcher, 1978).

One of the first steps in assessing the validity of an experiment is to assume that the independent (manipulated) variables have been systematically changed across the experimental images to be presented to study participants so that these changes--and these only--may be taken as the reason that viewers respond differently to the images.

Consider an example from the study of image asymmetry. Asymmetry is specified with relative ea if right half of image is not the mirror of left half, then an image is asymmetric. Zettl (1973) identifies a series of factors which may make an asymmetric image *right asymmetric* or *left asymmetric*. They include *focus of attention*, *pictorial weight*, *magnetism of the frame, index vectors.* Most of these factors are difficult to apply unambiguously to images. Asymmetry and opposite asymmetry, on the other hand, are relatively easy to specify and affirm. As a consequence, validating two images as asymmetric and *mirror asymmetric* may be a relatively simple matter: a photographic slide projected as it came from the camera and reversed left to right in a slide projector represent an unambiguous manipulation of asymmetry (Metallinos, 1985). A manipulation much more difficult to validate would be that of images which must difier from 30 percent to 60 percent left asymmetric.

Experiments may not be particularly effective in studying visual images until there is a more complete catalog of dimensions along which a visual image can be unambiguously described. At the same time, however, there are good reasons to employ some of the techniques of experimentation in designs for the study of visual images.

Elements of Study Design

One useful way of examining study design is to consider sources of the variance evident in the dependent measures (measures of effect upon an audience member or consumer) employed in the study. Consider a study in which grade school students are asked to report on a five step like/dislike scale their liking of various images presented by slide projector. The resulting judgments of liking provide a range of values for each image. The variance in this measure (X) for any one of the slides presented in the study could be described by this model:

$$var_I = var_X - var_S - var_V - var$$

where var_I - variance due to image manipulation
var_X - variance evident in measure X
var_S - variance due to unique qualities of the study participant
var_V - variance due to study environment
var_E - variance due to error in measure X

The part of the variance in the dependent measure which is due to the study manipulation must be isolated in the study. Each participant is responding with her or his own peculiarities, for example. The effects of individual differences may be removed from the liking measure by using a large sample of participants where differences will be less confounding. Or a study design such as the *repeated measures design* may be employed to remove this source of variance statistically. Or the sample may be recruited from persons expected to have the same inherent biases in responding to asymmetric images (such as elderly left handed portrait painters from Poughkeepsie).

The study design may remove the influence of variance due to environment by *holding constant* the environment in which the image is presented. This is commonly done by conducting the studies in laboratory settings. One consideration among others is that the image occupies the same segment of the visual field of each study participant.

Variance due to error in the dependent measure is reduced to a minimum by selecting measures which are highly reliable, as indexed by a reliability coefficient. The newer or more complex the dependent measure, the more important it is that the research report include an estimate of its reliability.

If in a study of visual images it has been possible to control or account for variance due to individual differences in study participants, variance due to the study environment and variance due to measurement error, the design is said to be *sensitive*, permitting the researcher to equate a measured difference in response to difference in images.

Measures and Measurement Techniques

An explosion in interest in quantitative measures appropriate to study of visual images has occurred in the past two decades. Some of the new measures are the consequence of greater interest in visual images as a subject for study. Others are a byproduct of technology developed for other uses. Measures and measurement techniques will be represented in this discussion by (a) magnitude estimation scaling, (b) Cloze procedure, (c) multivariate measures of feelings, (d) tachistoscope, (e) eye-tracking, and (f) electrodermal recording.

Magnitude Estimation Scaling

Magnitude estimation scaling is a method of soliciting audience judgments while keeping restraints upon those judgments to a minimum (Meeland & Kaplan, 1967). The study participant is asked to employ an interior standard for a quality--attractiveness, for example. The participant may use any number system which comes to mind, so long as numbers increase as perceived attractiveness increases and to the same extent. Thus one subject may see Picture A as having an attractiveness equal to 1/4; Picture B as 10. Another subject may judge Picture A to have an attractiveness equal to 10, Picture B to have an attractiveness equal to 3500. The result is a set of numerical judgments from participants that go far beyond the three to seven steps of common perceptual scales--at least in terms of power to discriminate.

When the responses are analyzed, the researcher puts each score in ratio to the first judgment offered--yielding a ratio scale of attractiveness. In a study of the attractiveness of landscape photographs presented in opposite asymmetries the measure was used to estimate whether "indexing vector" or position of midline with respect to mass of object of interest (Dondis, 1973, pp. 92-93), is the better predictor of more attractive asymmetry. Results (Fletcher, 1979) indicated that direction of perceived asymmetry interacts with experience of the viewer, but that position of midline with respect to mass is a useful predictor of more attractive asymmetry.

Magnitude estimation scaling works best when participants are able to think about their judgments before recording them and when a series of judgments are required in the same study session. It is appropriate to study of still images likely to differ in subtle ways as judged by participants. It is not appropriate to such complex visual presentations as television or motion picture dramas.

Cloze Procedure

The early development of Cloze procedure was as a measure of readability (Wimmer & Dominick, 1991). When employed as a measure of memory or recall, Cloze procedure is well suited to television or film presentations in which specific memory of a rule or of an argument are desirable goals for the visual presentation studied.

The instrument for Cloze procedure is a copy of the verbal text of the presentation in which one out of every five words is removed. The study participant is asked to write in the missing words. The frequency with which blanks appear in the copy can be varied by the investigator to make the task easier or harder.

The strength of Cloze procedure as a measure of recall or memory is that it has high reliability. It works well in combination with other measures when the analysis will involve such multivariate routines as factor analysis, multiple regression, discriminant analysis, or canonical correlation.

Measures of Feeling

Few areas in the behavioral studies have occasioned more literature or controversy than that of human emotion. In many studies emotion is taken as a generalized state; in others, it is conceived as a state of arousal with a cognitive label (Schachter & Singer, 1962). One of the difficulties is that for study participants to identify which emotion they are experiencing, they must use language, and the use of language may change the emotion either as it is experienced or as it is remembered.

An attractive alternative for capturing the affective reactions of viewers of images is the measurement of *feelings*. Recent work at Duke University has developed a series of reliable scales which reflect feelings as participants are able to share them. Unlike some other measures these scales differentiate weak and moderately experienced feelings as well as those that are intense (Goodstein, Edell, & Moore, 1989). The scales look like this:

Upbeat Feelings

Amused
Agree 5 4 3 2 1 Disagree
Carefree
Agree 5 4 3 2 1 Disagree
Cheerful
Agree 5 4 3 2 1 Disagree
Happy
Agree 5 4 3 2 1 Disagree
Playful
Agree 5 4 3 2 1 Disagree
Silly
Agree 5 4 3 2 1 Disagree

Warm Feelings

Affectionate
Agree 5 4 3 2 1 Disagree
Hopeful
Agree 5 4 3 2 1 Disagree
Kind
Agree 5 4 3 2 1 Disagree
Peaceful
Agree 5 4 3 2 1 Disagree
Warm
Agree 5 4 3 2 1 Disagree

Skeptical Feelings

Critical
Agree 5 4 3 2 1 Disagree
Disinterested
Agree 5 4 3 2 1 Disagree
Offended
Agree 5 4 3 2 1 Disagree
Suspicious
Agree 5 4 3 2 1 Disagree
Skeptical
Agree 5 4 3 2 1 Disagree

Uneasy Feelings

Sad
Agree 5 4 3 2 1 Disagree
Uneasy
Agree 5 4 3 2 1 Disagree
Lonely
Agree 5 4 3 2 1 Disagree
Anxious
Agree 5 4 3 2 1 Disagree
Regretful
Agree 5 4 3 2 1 Disagree
Concerned
Agree 5 4 3 2 1 Disagree

Scores on these scales are not only reliable; they are relatively independent of other measures. In studies of image composition they will provide good discriminators of the overall effect of changes in the relative position or perspective of objects in the image.

Tachistoscope

The tachistoscope--a device for controlled exposure to visual experience--is widely used in psychology and in reading research. A common form of tachistoscope appropriate for studies of visual communication is a slide projector equipped with a shutter which when activated allows a slide to be projected for a study participant. The activation mechanism permits the shutter to open for a precisely measured period of time.

The idea is that the tachistoscope allows the image to be seen in too little time for the viewer to rationalize or plan an exploration of its parts. Thus the first exposure of an image might be .1 second. After the exposure the participant is asked to report whatever she saw of the image. Then a second, longer exposure of the image is presented and the participant asked, "What additional things have you now seen in the image?" (Dunn, Barban, Krugman, & Reid, 1990, p. 489; Zikmund, 1989, p. 282).

The data produced by this tachistoscope procedure are the mean accumulated length of exposure required for a particular visual element to be reported as seen. The sooner that element is reported by study participants, the more *prominent* that element is considered to be in the image.

The tachistoscope is useful in comparing images which are equivalent in purpose but different in the relative prominence the designer intends to give some feature of the composition. The steps from one period of exposure to another are necessarily rough. Investigators bothered by this limitation of tachistoscopes will want to investigate eye-tracking.

Eye-Tracking

Eye-tracking equipment is extremely expensive--so expensive, in fact, that most investigators rent the equipment from the Applied Sciences Laboratories of Waltham, Massachusetts--a part of MIT.

Eye-tracking devices record the movement of the eye as it scans an image. Most such devices do this by reflecting a small light source off the flat spot of the corneum. This fine point of light is then superimposed upon a video representation of the visual image viewed by the study participant.

In the early days of eye-tracking studies the study participant's head was held in a sort of vice, or the participant was asked to bite into a wax mouthpiece to hold her head in a fixed position.

The eye-tracking apparatus of today is much less demanding of the participant. A television camera and light source to record the direction of gaze during exposure to the visual image is located several feet away from the participant. The record of the participant's exposure to the image is a videotape showing the location of the point of gaze as a cross. Figures near the margin of the frame show the relative diameter of the pupil of the eye at each moment. A cross representing the point of gaze and other information are shown superimposed over the visual image being studied.

The videotape is then subjected to analysis by computer. Important areas of the visual image being studied are designated as boxes. The computer summarizes the entire exposure of the participant to an image by accumulating such numerical indices as the length of time before point of gaze reaches a particular box, dwell time or the cumulative time during which the point of gaze rests in each box, the number and length of fixations in each box, the number and degrees of movement for each saccade in each box, the number and duration of all fixations in each box, and the average pupil dilation in each box.

This is a large volume of information on the behavior of the eye during exposure to a visual image. Unfortunately, science falls short of the capacities of technology. We are not entirely sure, for instance, how the ratio of number of saccades to degrees of arc movement in saccades are related--nor what such relationships imply about learning or perception of visual images (see Groner, Menz, Fisher, & Monty, 1983).

At the same time, for an investigator these detailed records mean that differences can be measured between visual images that differ in relatively small ways. It is also true that dwell time typically enjoys a moderate to high correlation to reports of recall and affect related to the image. While eye-tracking studies have a history of nearly a half century, relatively few have been published. Most of these have been studies involving small samples. Large studies with many images in the analysis are now being undertaken, and the technique is one that should interest students of visual images in the future.

Electrodermal Recording

Electrodermal recording--measuring electrical changes in the skin--began more than a century ago (Neumann & Blanton, 1970). The preferred electrodermal measurement method today is continuous recording of skin conductance (SC).

In SC measurement two electrodes are placed in a palm of the study participant. The electrodes are made of a silver/silver chloride mix; they contact the skin through a low concentration saline gel (.5 % N NaCl). A tiny voltage (.2 volts) is applied to the skin, and the ease with which the current passes is recorded digitally in a computer.

The skin of the palm is made a better or worse conductor by action of the sympathetic nervous system in response to central nervous processing of stimulation from the environment of the study participant. The mechanisms in the skin which respond to information processing are the walls of the sweat glands which become more or less permeable to the potassium ion--more permeable and more conductive as the individual takes in more information from surroundings (Fletcher, 1985).

So far as studies in the information processing of visual images is concerned, the most promising construct associated with SC is that of the *orienting response (OR)*. This system of ideas was born in Russian neurophysiology (Sokolov, 1963) and has been influential in the rest of the world in the past two decades. Various indices based on the OR have been related to common notions of *attention* and to *involvement* or *allocation of information processing resources*. The conditions in the perceptual environment of an individual which give rise to changes in SC have been summarized (Fletcher, 1985):

> (1) message features that to the individual are unpredictable (because they are novel, incongruous, inherently uncertain, or greater or smaller than expected in some respect); (2) message features that imply an obligation to act, either mentally or physically (because the receiver's name is called; a reference group norm is invoked; other previous experience involving threat or action is evoked); and (3) message features that are directly at odds with the policies or states then governing the receiver's behavior. (p. 99)

Allocation of information processing resources is indexed by the moment-by-moment average of SC levels by the research of a number of psychophysiologists (Dawson, Filion, & Schell, 1989; Filion, Dawson, Schell, Hazlett, 1991). This notion fits at least one definition of communication involvement: "Commitment of the central nervous system to devote attention to a message" (Fletcher & Shimell, 1989).

When mean SC is measured as an individual views the images of television or film, it represents the capacity of the images to dominate the experience of the viewer. When this average increases during viewing, the images are having greater influence upon the viewer, and vice versa.

The prospect of SC measures applied to studies of the imagery of new media promises new understandings of the time and persuasive vectors created by the visual components of multimedia presentations, enhanced television and virtual reality. The measures are highly reliable (reliability coefficients typically above .9) and extremely sensitive. Their application to the study of static images has not been extensive to this point, but in the few studies available the measures have performed well when time of exposure was controlled across the sample.

Summary

While the objectives of quantitative research on visual images do not at the moment warrant the experiment as principal study design, the techniques and rigor of experimentation have great appeal. Gradually the body of information about visual causes and human effects will justify a science in this area.

Fifteen years ago an earlier paper on this topic ended with these words, repeated here as a coda to this discussion:

But more important than new measures and new procedures, new curious eyes and ears need to scan the exotic terrain of visual communication, finding in it not only a Shangri-La for mystic contemplation and scholarly rapture--but a rational encyclopedia of inductively based generalizations which, when mastered, offer new views of human capacity to share both personal insight and collective dream. . .how we got to be this way. . .how we are shaping the visual universe. . .for our posterity. . .and for our own maturity (Fletcher, 1978).

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