PERCEPTUAL FACTORS OF COMPUTERIZED TELEVISION IMAGES:
AN EXPLORATORY STUDY

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The new visual communication media imagery such as video games, digital television, and computerized pictures have captured the attention of viewers of all ages causing a revolution in imagery and stressing contemporary man's ability to comprehend and accurately recall visual information to its fullest extent. Some of the consequences of this boom in computerized video imagery are obvious while many more remain hidden.

One case of this revolution is viewers' ability to instantly accept visual displays and images, as can be attested by watching young people in a video arcade. Another cause of the rapid growth of the new media imagery is the unusual nature of their visual elements such as miniature objects, small squares, plastic boxes, contours of the actual images, etc. which many people unquestionably accept, never challenging their aesthetic value.

Yet another cause of people's fascination with the new media technology is the constant utilization of depth axis framing with objects moving rapidly towards or away from the viewer, often vanishing from the screen or blasting toward the viewer unexpectedly. Sometimes, entire frames fly away, flip over, or retreat towards the vanishing point.

This instantaneous acceptance of digital television pictures, video game images, and computerized graphic designs may not show any serious effects at a glance, but as Kuipers (1983, p.27) points out, such effects do exist. They are multi-dimensional, and the most common ones are physical and psychological. These unreal cartoon type images could be one of the reasons young people are being driven further and further away from the reality of the physical world (Gardner, 1984).
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Overuse of depth composition, unrealistic special effects, and unusually fast movement of elements in the visual space seem to have some covert effects on viewer comprehension and understanding (De Long, 1983), the most noticeable of which seems to be viewing fatigue and boredom (Levy, 1983, p.6). This study strives to isolate the perceptual factors of computerized television images and to examine their covert effects on viewers by entertaining the following four questions:

1. In the area of television composition, which research studies deal specifically with the particular constructs which identify picture depth?

2. What are the specific effects which influence viewer perception of visual space as it relates to television Z-axis staging?

3. Given that the above effects could be readily identified and controlled, what are the most suitable research measuring devices for their systematic verification and study?

4. Do the perceptual factors of shape, direction, and motion of computerized television images influence viewer comprehension and recall of such images?

Visual Space: Composition in the Depth Axis

The term visual space, in this study, refers to the opening of the two-dimensional surface of a regular television screen surrounded by the borders of the television set. It is the field in which constructors of visual elements operate (Metallinos, 1979, p. 206). Due to its small size and its condensed visual field, television picture constructors have tried to gain in depth that which they lose in horizontal framing. The small vista of the television screen necessitates the practice of favouring the placement of visual elements on the depth axis rather than the horizontal one. This is known as television Z-axis staging.

A small number of empirical studies dealing with the placement of visual elements within the depth axis are found in such fields as painting, photography, and film. A classic review and discussion on the depth variable in motionless visual space is given by Arnheim (1969). In film, the most prominent of such studies are Deregowski’s (1971, 1972) examinations of depth cues and pictorial perception of people from different countries, and Evans and Seddons’s (1978) investigation of the perception depth cues among Nigerian students.

Empirical research examining the potential physical and physiological effects of the Z-axis staging technique in television are non-existent. Research studies that would verify the Z-axis staging theory and underline its advantages and limitations are limited. Millerson (1972), for example, discusses the movement of visual elements towards or away from the foreground and states the “movement towards the camera is more striking than movement away from it...” (p.290). Zettl (1973, p. 194) asserts that motion along the Z-axis can be one of the most powerful indicators of depth in the two-dimensional field. Malik (1978) recognizes three types of movements...
within the video space which he calls "movement of the electron beam," "movement of the camera," and "inner movement" (p.11). He emphasizes that abusing and mishandling of any such movements while on the Z-axis will have negative effects on the viewer and warns that "if several domains within the picture are moved simultaneously, the possibility of information delivery diminishes arithmetically" (p. 11).

Another major construct of television Z-axis staging is the depth of field which increases or decreases with the use of the wide or narrow angle lens and the telephoto or normal zoom lens. Recognizing the flexibility offered by the manipulation of the depth of field in television composition, and its role in determining the shapes of objects, Millerson (1972) states the "deep-focus techniques may help to achieve an illusion of spaciousness and depth, when scenic planes stretch from foreground into the distance" (p. 225).

A third construct of the television Z-axis staging theory is direction within the visual space created by objects and people placed in succeeding lines, one after another, or by vectors leading the viewer's eyes towards the centre of the screen, or by people and objects moving towards or away from the foreground. Zettl discusses this variable in television composition in terms of blocking on the Z-axis vector which is defined as the visual line, the action line, created by the placement or staging of objects and people on the vertical plane within the X and Y axis (1973, p. 214).

None of the constructs or variables mentioned above have been empirically verified. The delay in dealing with these variables has been detrimental to the study of television composition and the development of the field of television aesthetics.

**Visual Space: Psychophysiological Effects of the New Imagery**

The imagery explosion created by new technology in visual communication media has had its effects on multiple levels (psychological, physiological, neurological, sociological, etc.) and has generated a plethora of literary sources on their impact upon users of these media. Here, the psychophysiological effects that these media exert on heavy users will be underlined insofar as they relate to the constructs of *movement, depth of field, and direction* in the theory of television Z-axis staging.

**Rapid Inward-Outward Movement**

Perceptual psychologists have pointed out that rapid inward and outward movement of visual elements in the visual field decrease the viewer's ability to receive, process, and recall detailed information. The span of time required to make a judgement about the structure of the perceived visual image is analogous to the speed at which such images move in and out of the visual space. This is confirmed by the split-second theory developed by Sturm (1987, pp. 37-44).
The problems pertinent to the perception of motion and the limitations imposed by our eidetic apparatus have been examined by such prominent perceptual psychologists as, Goldstein (1980, pp. 40-87), and Marr (1982, pp. 159-215). What these and similar studies confirm is that, neurophysiologically speaking, man’s ability to receive (see), process (recognize), and recall (remember) visual information in motion is limited. Furthermore, viewer’s ability to instantaneously perceive and comprehend images moving rapidly towards or away from the foreground of the visual space depends greatly on several external and internal parameters which must be correlated and controlled. Externally, the shapes, sizes, and structures of objects in the environment must be perceived and internally, the total synthesis of such images must be comprehended. Imbalance can cause “perceptual and emotional numbing” (Edmundson, 1984, p. 52) in heavy users.

**Distorted Depth of Field**

Painters, photographers, and film-makers always recognized the need to create the illusion of depth in the visual space. They have employed such techniques as overlapping planes, relative size, height in plane, linear perspective, aerial perspective, tonal manipulation of the light and shade of the pictures (Dondis, 1973), etc. Film-makers and photographers were also able to make use of different lenses to create depth such as (a) the wide-angle lens to produce a long, narrow depth of field, (b) the narrow-angle lens to produce a short, wide depth of field, and (c) the normal lens. The invention of the moving camera gradually changed these fixed focal length lenses into zoom and telephoto lenses which have the capacity to enormously exaggerate or diminish the depth of field. However, the abuse of such technology has caused considerable concern among constructors of visual images.

Some theorists have warned us that distorted depth of field caused by the combined application of depth cues and extreme variance in focal length produces forced and unnatural perspective. It shrinks space, or as Dondis (1973) puts it, “collapses space like an accordion...” (p. 61). The technology has overlooked subtle principles of visual perception and neurophysiological limitations. The depth of field in a picture is the reference point, the establishing shot, the home base which viewers use to perceive shapes and to comprehend representations of the real world. When such fields rapidly and unexpectedly shrink or expand, shifting the convergence in depth perspective and de-stabilizing the observer’s point of view, they cause a considerable breakdown in the viewer’s ability to distinguish optical reality from perceptual reality.

**Forceful Direction of Z-Axis Vectors**

Visual communication researchers have underlined the strength, power and dynamism exerted by directional lines found in Z-axis vectors. When television images represent the real world on the vertical axis of the visual field they enhance the perception of depth because of the forced directional lines which are created by blocking of visual elements. One such effect is known to perceptual psychologists...
as "convergence error" (McKim, 1980), a principle which states that the directional lines in the depth axis cause image distortion and viewer discomfort.

Another effect caused by strong directional lines and forceful vectors is referred to as a "reinforced or focusing perspective" (Arnheim, 1969). Strong directional indicators on the Z-axis vector forces our visual attention on certain objects at the expense of other objects in the field which remain totally unnoticed. Recognizing how powerful such a force is as a means of representation and expression, Arnheim (1969) warns that "focusing produces a powerful dynamic effect. Since the distortions of the receding shapes are compensated only in part, all objects appear compressed in the third dimension" (p. 284).

When we consider the psychophysiological effects caused by rapid inward and outward movement, distorted depth of field, and forceful directional lines, we can understand the degree to which these effects influence heavy viewers and persistent users.

**Visual Space: Research Instruments**

The necessity to apply more advanced diverse and precise measuring devices to communication media research topics has been the concern of several scholars in the fields of communication, neurophysiology, and psychophysiology. The most effective measuring devices for the study of visual images have been found to be the psychophysiological measuring instruments developed in the fields of neurophysiology and psychology, both visual and experimental. In addition to their accuracy, these measuring devices are less biased because the subject's responses are not opinions or attitudes, but chemical or electrothermal spontaneous reactions to visual stimuli. Data gathered from such instruments is directly fed to computers which eliminate errors and offers greater flexibility and speed of analysis (Behnke, 1970; Martin & Venables, 1980; Fletcher, 1985).

Psychophysiological measuring techniques concern themselves with the covert of hidden responses to communication stimuli such as detection of eye movement and dilation of the pupils, increase in brain activity, changes in heart rate, variations in skin resistance and changes in pulse, pressure and frequency, etc. These covert responses are accompanied by measurable sensoric reactions or releases of energy which are considered indications of the level of activation or the state of arousal of the individual. The ultimate purpose of communication media research that utilizes psychophysiological instruments is to correlate physiological activation levels with various types of behavioral measures.

Psychophysiological instruments measuring energy changes of the body, due to informational stimulation, are divided into five major areas each of which has generated several devices. Physiological instruments that detect and record electrical activity of the brain are the EEG (Electro-Encephalograph) and the BWA (Brain Wave Analyzer). Instruments that detect and record skin resistance or response are
the GSR (Galvanic Skin Resistance) and the GSP (Galvanic Skin Potential). The most commonly used heartbeat rate devices are the EKG (Electrocardiograph) which records the electrical activity of the heart muscle, the Sphygmograph which records the arterial pulse contraction, systolic and diastolic, and the Stethograph which detects and measures heart rate. The most frequently used apparatus recording changes in muscle tension is the EMG (Electromyograph). The devices that detect and record changes in volume in various parts of the body are the Electrical Impedance Plethysmograph (EIPG), the Rheoplethysmograph (RPG), the Girth Plethysmograph (GPG), and the Photo Plethysmograph (PPG).

Several scholars in the field of communication studies are using such psychophysiological measuring devices in their media related research with considerable success.

Visual Space: Effect on Comprehension and Recall of Information

In order to determine whether the factors of shape, direction, and motion of visuals in computerized television pictures influence viewer comprehension and recall of information, an exploratory study was conducted using the EKG, GSR, Eye-Track, and a multiple-choice questionnaire.

The stimulus materials were nine segments of a computerized television sequence taken from a demonstration videotape called MIRAGE. The segments were edited for the study into 2, 3, 4, and 5 second segments. The shapes, direction, and motion of visual elements within the screen were altered in each of the segments while the content of the scenes, including sound, remained constant. The total duration of the videotape was three minutes and 13 seconds.

The subjects were selected from a variety of students between the ages of 14 and 30 years old and were pretested. The pretest recorded the subject's reactions at a zero point of activity which is the key for the diagnosis of the actual test. A random sample of nine students was retained and tested and only seven tests were maintained for analysis. After they were briefed on the test procedure and the instruments, they were individually hooked-up to two EKGS, one GSR, and to the Eye-Track apparatus. While they viewed the videotape, their physical reactions were recorded. As soon as they saw the videotape they were given a multiple-choice questionnaire which diagnosed the degree of their comprehension and recall of the information contained in the tape.

The examination of the data gathered from the combined data-grams recorded by the EKG, GSR, and Eye-Track revealed that strong physical activity takes place when all three factors—shape, direction, and motion—change. This was interpreted as discontent or discomfort caused by multiple visual activity in the visual space. When motion and direction of an object not readily distinguishable occurred at a high speed in a length of time shorter than five seconds, strong physiological reactions were recorded which were caused by the subjects inability to follow the action.
The preliminary analysis of the data obtained by the multiple-choice questionnaire was based on the mean score of all subjects’ responses (ΣX) since the number of subjects (N=7) was very small. The examination revealed that a little more than half (54%) of the subjects were able to correctly identify the overall elements presented, such as the shape of objects, their direction, and their motion. A little less than half of the subjects (47%) were able to correctly recall the shapes of objects. Although the directions of the motions within the Z-axis were correctly recalled by more than half (66%) of the subjects, accurate estimation of the speed at which the objects were moving was minimal (18%).

A time-coded comparison between the data gathered by the EKG, GSR, and Eye-Track and that of the questionnaire revealed that the strongest of the three factors—direction—attracts the viewer’s attention and is more readily recalled and comprehended. However, when motion and direction occur at high speed, recall and description of shapes is minimal. This finding coincides with previous empirical studies concluding that limited exposure to imagery influences viewer comprehension and recall (Biron & McKelvie, 1986, pp. 159-166).

Due to the small number of subjects used, further analysis of the data was not necessary. This was only a diagnostic experiment which seems to suggest that understanding and recall of computerized television images that are placed within the depth axis of the visual space are influenced by the factors of motion, direction, and shape which are constructs related to the Z-axis theory in television composition.

Summary and Conclusions

It has been observed that technological advances in television images resulted in an increase of media imagery. It has also been speculated that viewer exposure to these images has increased. It was hypothesized that such developments are bound to have numerous psychophysiological effects on heavy viewers.

Specifically, this study argued that empirical research in the composition of the depth axis in television images would be the most appropriate route to follow for the examination of the psychophysiological effects of these images on heavy viewers. Examination of such effects should be centered on the constructs of the theory of Z-axis staging—motion, depth of field, and direction. Scientific study of the psychophysiological effects should be based on advanced, precise, and unbiased psychophysiological measuring devices. Viewer comprehension and recall of visual information seems to be influenced by the placement of visual elements within the visual field at acceptable inner-outer speed, considerable clarity of shape, and predictable direction.

The broader implication of the research suggested in this study is to alert communication scholars to the need to utilize technology to overcome the challenge imposed by technology. The influence of computerized television imagery on the field of study known as television aesthetics can only be adequately challenged by the use of more vigorous and advanced research methods and measuring techniques.
REFERENCES


