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# DESIGN EDUCATION IN THE ERA OF TECHNOLOGY: CONSIDERING VISUAL PERCEPTION

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## Abstract

Over the last decade, there have been debates concerning the dominance of technology in academic disciplines such as fine arts and graphic design. In addition, advanced imaging devices, such as fMRI and PET scans, have provided researchers with visual information in the field of brain science that may influence these debates.

This paper outlines a personal study conducted with undergraduate art students to investigate levels of visual perception and creative development. The purpose was to gather preliminary information that might merit further scientific investigation.

From the students studied, the preliminary investigation concluded that artistic traits such as visual memory, perception and a critical eye for detail declined 80% compared with formal research studies conducted in 1944. This paper presents research in the fields of cognition and brain science, suggesting dominant use of technology in the arts retards intellectual and perceptual motor skills.

**Keywords**: Art, Technology, Education, Perceptual Performance

## HYPOTHESIS

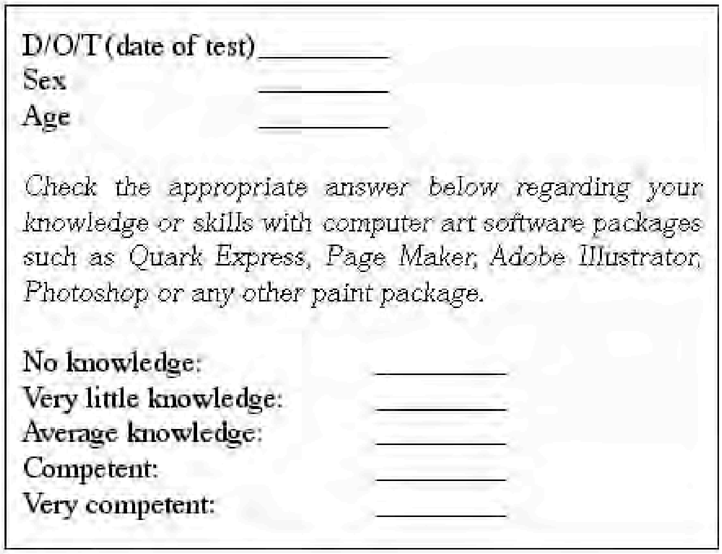
As Associate Professor of Graphic Design, I noticed a definite decline in creative performances of design students over the past several years. It was my observation that some students lacked a critical eye for detail, as well as lacking perceptual organizational skills, visual memory and evidence of conceptual development. I theorized that the use of the computer as the dominant working tool of the design student retards artistic performance and conceptual development.

## METHODS

In January 2003, I conducted an informal study to determine whether my theory merited further research. The voluntary subjects in the study consisted of three separate groups of students who declared art as their major of concentration. These students were all enrolled in a BFA program at the university of which I teach.

### Phase One: Questionnaire

Initially, each student was given a questionnaire to complete (Fig. 1) in order to gather basic information and assess familiarity with designer/painter software.



D/O/T (date of test)________
Sex ________
Age ________

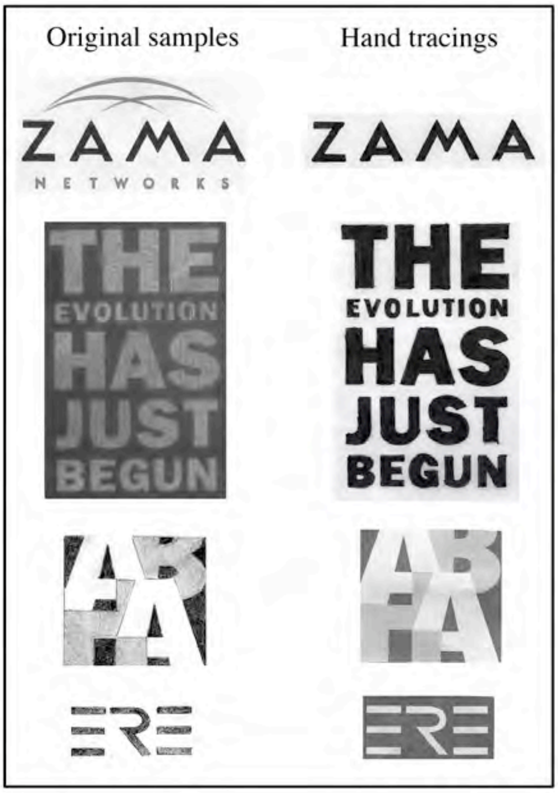
*Check the appropriate answer below regarding your knowledge or skills with computer art software packages such as Quark Express, Page Maker, Adobe Illustrator, Photoshop or any other paint package.*

No knowledge: ________
Very little knowledge: ________
Average knowledge: ________
Competent: ________
Very competent: ________

[Figure 1: Student Questionnaire]

The first group of artists (Group A) consisted of 13 beginning 2-D designers; 11 females and 2 males; ages ranged between 21 and 24. This group indicated average and above average knowledge of designer/painter software. Group A was not exposed to haptic (combining tactile and kinesthetic stimulation) and visual exercises prior to using the computer for assigned projects.

The second group (Group B) consisted of 13 intermediate 2-D designers; 8 females and 5 males; ages ranged between 21 and 25. This group indicated average and above average of designer/painter software. Group B was exposed to haptic/visual exercises prior to using the computer for assigned projects (Fig. 2).



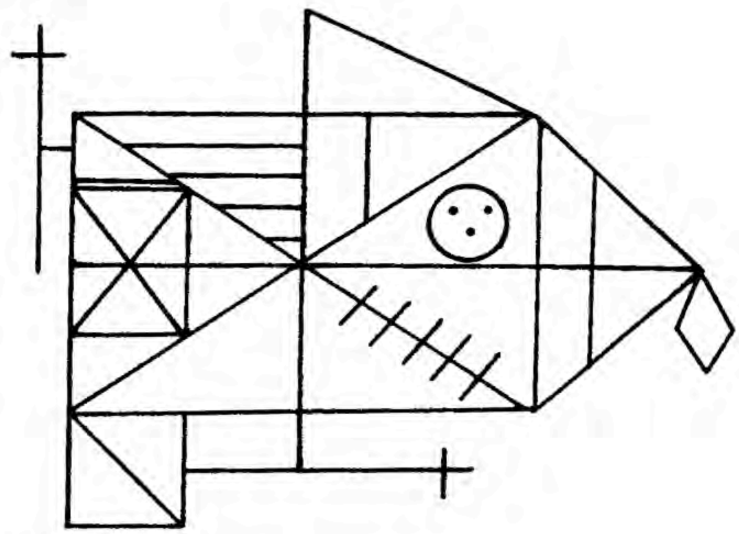

[Figure 2: Examples of students' hand-tracing (haptic) exercises]

The third group (Group C) consisted of 12 advanced artists (4 3-D artists and 8 2-D designers); 10 females and 2 males; the ages ranged from the mid-20s to 50 and above. Group C indicated a large range of experience with designer/painter software, from none to above average knowledge. Group C's use of haptic/visual exercises prior to using the computer before assigned projects was optional.

### Phase Two: The Rey Test

The second phase of the preliminary investigation referenced the Rey Test. In 1941, Rey devised a complex visual figure in order to investigate both perceptual organization and visual memory in subjects with brain damage (Lezak, 1983, p. 395). Osterrieth (Lezak, 1983, p. 395) standardized Rey's procedure in 1944 and obtained normative data. The Rey Test is currently used in neuropsychological evaluations. In this preliminary study, the Rey Test was used to investigate the level of perceptual performance in all three groups.

The subjects were instructed to view the complex figure below and then draw the figure from memory (Fig. 3).



[Figure 3: Rey Test]

Each student was given a white sheet of 8.5 x 11 paper with a copy of the figure on the reverse side. The students were told to turn over the sheet of paper and to view the figure for 1 minute. After this minute, they were instructed to turn the image over (face-down) and wait 1 minute before drawing the figure. Then, they were instructed to draw in 1 minute the figure from memory on the reverse of their individual questionnaires. It is important to note that the 1-minute interval between viewing and drawing the figure may have influenced the performance scores. The interval was purposely inserted as an attempt to challenge short-term visual memory.

The tests were collected, and evaluations were determined by the scoring system devised by E. M. Taylor in 1959 (Lezak, 1983, p. 400). The highest possible point score on the Rey Test is 36. In 1944, the average adult score was 32 points (Lezak, 1983, p. 401).

## Phase Three: Evaluation

The results in Group A (beginning 2-D designers, no haptic/visual exercises, average and above knowledge of software) revealed the following data:

Each of the 13 students scored 18 points or above.

30% scored 27 points or above (2 females, 1 male).

The highest score was obtained by a female, age 26, who indicated average knowledge of designer software.

The results in Group B (intermediate 2-D designers, with haptic/visual exercises, average and above knowledge of software) revealed the following data:

Each of the 13 students scored 18 points or above.

45% scored 27 points or above (5 females, 1 male).

The highest score was obtained by a female, age 21, who indicated average knowledge of designer software.

The results in Group C (advanced 2-D and 3-D artists, haptic/visual exercises optional, ranging from none to above average knowledge of software) revealed the following data:

One student scored 36 points--perfect score (female sculptor, age 22, very little knowledge of software).

40% scored 27 points or above (5 females, 1 male; 3 3-D artists, 3 2-D designers).

30% scored 18 points or above.

20% scored below 18 points (2 females, age 50 and above; 1 indicating average and above knowledge of software; 1 indicating no knowledge).

In summary, the highest scores were obtained by 3 students with very little knowledge of designers software and 2 with average knowledge. The lowest score was obtained by 1 student with average knowledge of designer software.

## DISCUSSION

Group B scored 15% higher than Group A. I credit this increased performance to the haptic/visual exercises required of Group B. Students in all three groups who indicated very little knowledge of designer/painter software scored the highest on the Rey Test. These students' ages ranged from early to mid-20s. It was also noted that the 3-D artists outperformed the 2-D designers. The scores suggested signs of visual memory loss beginning at age 40. This may be due to the effects of aging and/or sight degeneration that is typical between the ages of 40 and 45.

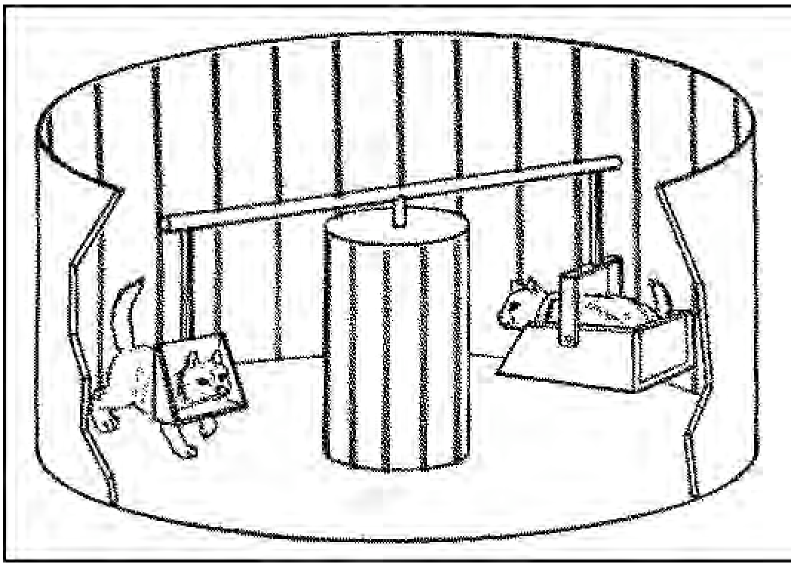
In 1944, the standard norm was 32 points compared with the norm of 18 points in this investigation. This study indicated that 80% scored below the standard norm (32 points) reported in 1944. This apparently massive decline in perceptual organization and visual memory may be due to the fact that in 1944 computers and televisions were not available to the general public. Is it not logical that the scores of art students, due to the nature of their field, would excel in a visual performance test? Is it possible that modern technology is affecting our perceptual intelligence?

Another observation made from this preliminary investigation was that female artists scored higher than male artists. This seems to go along with research conducted that indicated more females provide directions based on visual landmarks (visual memory) than males, who identify directions by street names and the number of left and right turns.

As stated, there are several factors and variables to consider in this preliminary investigation that may have influenced the performance scores; however, the study provided indicators that deserve serious attention.

### Perceptual Development

The findings of this study reflect the 1963 experiment of Richard Held and Alan Hein (Bourne and Ekstrand, 1976, p. 92). Held and Hein raised kittens in darkness to prevent them from having any visual experiences until they were old enough to walk. Then the kittens were placed in a research apparatus (Fig. 4).



[Figure 4: The kitten carousel]

The device was designed to force one kitten to initiate all movement while the the other kitten became the rider. The experiment revealed that the active kitten developed extensive perceptual abilities, while the passive kitten became perceptually retarded. Held and Hein suggested that "the crucial kind of experience for perception is active, self-initiated movement in the environment" (Bourne and Ekstrand, 1976, p. 92).

It is my observation that technology (such as the artist's design tool, the computer) creates a similar carousel whereby design students are continually passive riders, limited to the same scenic view, re-mediating passive works of art. The practice among design programs of using the computer encourages a carousel for passive riders and discourages self-initiated movements such as haptic/visual activities.

In the context of the visual arts, the computer was designed to eliminate tedious, hand-rendering skills with a degree of immediacy. This produces an illusion among art students that traditional techniques (haptic/visual exercises) are annoying, unnecessary, tedious and non-beneficial with regard to time and effort. Thus, these students define their artistic talent by the level of proficiency with software. In other words, the computer provides a false sense of security, confidence and redefines creative talent among design students. In fact, it has been my experience that design students become extremely defensive and argumentative when projects are assigned with computer restrictions. This discussion addresses one principal question: The computer is designed to eliminate several tedious hand skills; however, are these tactile/kinesthetic skills necessary for human cognitive development and for greater neural organization?

### Intellectual and perceptual motor skills

David Rosenbaum, a researcher in the field of brain mechanisms, addressed both intellectual and perceptual skills in his paper "Acquisition of Intellectual and Perceptual-Motor Skills" (Rosenbaum, 2001). According to Rosenbaum, perceptual motor skills develop before intellectual skills are manifested. Traditional views suggested that intellectual and perceptual-motor skills are represented in different parts of the brain, and depend on distinct brain circuits (Rosenbaum, 2001). This view has been challenged by recent findings in brain science research. Advanced brain imaging techniques have shown that the cerebellum (a portion of the brain that controls balance, muscle tone and motor coordination in general) is also active during performance tasks such as word generation, tactile discrimination and maintenance of information in working memory. Thus, the cerebellum plays a role in intellectual as well as perceptual motor performance. Research also suggests that the motor cortex (part of the cerebral cortex from which messages leading to bodily movement originate) is involved in a higher level of planning (Rosenbaum, 2001).

Rosenbaum's conclusion is that both intellectual and perceptual motor skills may be distinct in their forms of expression although their means of acquisition are strikingly similar. As observed by Piaget, perceptual motor and intellectual skills have closely related developmental origins (Rosenbaum, 2001). Rosenbaum discusses that “Diamond's [1990] neurological perspective illustrates the . . inseparable links between intellectual and perceptual-motor substrates of a wide range of concepts” (Rosenbaum, 2001). Rosenbaum states:

A class of findings that supports the view that intellectual skills are [active performances] that coordination and timing seem to be required for intellectual as well as perceptual-motor skills. Mental skills in a number of domains depend on the use of the external environment to maintain information for immediate performance, requiring real-time coordination of mental activity with externally available information . . . Thus, coordination, which has long been viewed as crucial for skills of perception and movement, turns out to be needed as well for skills of the intellect (2001).

It is the support of these findings that visual/haptic exercises executed by the designer's hand, fosters perceptual-motor skills which are crucial for the development of intellectual skills and conceptual thinking.

## Cognitive Development and Learning

Researchers suggest that both intellectual and perceptual motor skills go through similar stages with in regard to long-term learning. James Craig in "Somesthesis," (Craig, 1999) cites researchers Jones (1994) and Matthews (1988) as stating that kinesthetic receptors in muscles contribute to the development of perceptual abilities (Craig, 1999). Roberta Klatzky, professor and head of the department of psychology at Carnegie Mellon University, supports the view that the sense of touch gives rise to implicit and explicit forms of memory (Klatzky and Lederman, 2002).

These views suggest that perceptual motor skills, such as haptic/visual exercises, are stored in memory, a gateway to long-term learning. A supporter of haptic exercises, Goldberg reports that learning is based on what the student experiences himself/herself, citing research claiming "people tend to remember 10 percent of what they hear, 50 percent of what they see, and fully 90 percent of what they do” (2000, p. 8).

Dr. Tak Cheung and Dr. Garth F. Petrie, authors of "The Brain Learns Better in Well-Designed School Environments," state:

As we learn, our brain cells--neurons--pass information along at speeds of up to 200 miles an hour. A single neuron can receive thousands of signals from other neuronal sources even though they do not make physical contact with one another. Rather, our neurons send and receive chemical messages (Jensen 1998). Constantly firing with electrical and chemical energy, our neurons gain strength through use. . . By learning and practicing in the visual and performing arts, the human brain actually rewires itself to make more and stronger connections (Kolb and Whishaw, 1990, in Cheung and Garth F. Petrie,1998).

Neurodegeneration is the slow death of neurons of brain cells. Susan Greenfield, researcher in the area of neurodegeneration, suggests that the lack of environmental stimuli reduces the level of neuron activity and thus initiates neurodegeneration, a link to Alzheimer's disease. Greenfield's research references a study by McGuire and colleagues whereby subjects were selected having the same specific profession (London taxi drivers--a profession that requires extensive spatial memory). The subjects' brains were scanned, examining the hippocampus (an area related to memory). Amazingly, the hippocampus of each subject was larger compared with the brain scans of people of a similar age. Greenfield states that the more a trade is practiced, the more knowledge is obtained, thus reducing the level of neurodegeneration (2001).

## CONCLUSION

The considerations outlined in this paper seem to support my hypothesis concerning the importance of haptic/visual exercises by design students prior to the use of the computer. The collection of research not only addresses the topic of technology and the arts, more so, the results raise prime questions: In a techno-driven culture, is perceptual intelligence and human development degenerating? Technology extends the life of our bodies, but does it foster and extend the growth of our minds?

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