# Introduction

*Design Issues* serves as a forum for the presentation of diverse perspectives on design. The table of contents offers the reader an initial indication of the material collected in each issue. While the simple list of authors and titles with page numbers found on the table of contents page is a straightforward exercise in information design (who, what and where) it remains a superficial account of an issue's contents. Familiar categories such as design history, education, theory, and criticism can be imposed quickly on the material as the reader begins the process of organizing the issue for his or herself. On a deeper level, however, the multiple themes that constitute the particular discourse of each issue emerge only as the reader makes his or her way through the articles. At this stage the efficacy of established categories is called into question. Claire Badaracco's article on George Salter's book jacket design executed during the period 1925–1944, for example, initially appears to be a contribution to design history. Like Rob Roy Kelly's account of the early years of graphic design education at Yale University, Badaracco's article prompts the reader to reflect upon significant episodes or experiences in the evolution of modern design. Yet her description of a book jacket as a bridge between the book and its audience, one that belongs simultaneously "to the interpretive level of the book and to the market forces that lead to the production of its meaning as an objective text" opens up potential connections with other articles in this issue. Peter Lloyd and Jerry Busby's report on how engineers employ language and Keren Smith's article on stage design for classical drama, like Badaracco's essay on Salter, seek to identify the multiple ways designers negotiate the intersection of intention and reception. The depth of this discussion is barely hinted at in the simple list of the table of contents. An editorial such as this serves to alert the reader to the deeper level of connections and content that imbue each issue with its own character. In this issue the reader will encounter thoughtful discussions of epistemological, methodological, and ethnographic approaches to design studies. Beyond the description of particular products and reflections on diverse forms of process, Richard Buchanan essay "Human Dignity and Human Rights: Thoughts on the Principles of Human-Centered Design" addresses the fundamental question of *purpose* in design. In an issue that also includes a book review of Steven Heller's chilling study *The Swastika: Symbol Beyond Redemption?* Buchanan's call to consider the ends as well as means of design merits serious attention.

Richard Buchanan
Dennis Doordan
Victor Margolin

# The Early Years of Graphic Design at Yale University

Rob Roy Kelly

An expanded and revised version of the keynote address presented at the Graphic Design Education Association Conference, Chicago, Illinois, June 23, 1989.

Yale University was the first in this country to establish a degree program in graphic design.[1] The term "graphic design" had been used earlier by professionals including William Dwiggins, Alvin Lustig, Herbert Bayer, Ladislav Sutnar, Lester Beale, and William Golden. During the 1930s, there was a high school program in graphic design at Brooklyn taught by Leon Friend who also co-authored a book titled *Graphic Design*.[2]

Alvin Lustig taught a summer course at Black Mountain college called graphic design prior to coming to Yale. Institutions such as Cooper Union, Cranbrook, and the Institute of Design offered courses in graphic design, but not a degree. The Yale program was unique at the time, and its graduates were instrumental to establishing the profession of graphic design in the United States during the 1960s. The origins and early years of graphic design at Yale University are therefore of historic importance.

The defining years were between 1950 and 1955, when the program was established, took shape, and set a course. Between 1955 and 1965, it matured, and the majority of graduates moved into professional practice while others were recruited to teach in design programs around the country.

On July 15, 1950, the *New York Times* reported an announcement by Dr. Charles Sawyer, Dean of the College of Fine Arts and Director of the Division of the Arts, regarding a new Department of Design at Yale University with Josef Albers as chairman. Instruction in the new program was to begin during the 1950–51 academic year.

The explanation given today by Dr. Sawyer for a "Department of Design" was to disassociate the new program from the existing one in fine art, and to better identify it with architecture. Of no small consequence was the fact that it also permitted Albers to develop curriculum and hire new faculty without interference from tenured faculty members.

The program was described as a four-year course with a revised professional curriculum in painting, sculpture, and the graphic arts. The design program would culminate in a Bachelor of Fine Arts degree. In a letter from Josef Albers to Alvin Lustig dated February 23, 1951, Albers explains, "...so far, all students are working together in only two rooms of which one is the printing shop.

1 Yale did not invent graphic design. Its origins are European and date back to the turn of the century. Before the 1960s in America, graphic design perhaps was more of a label than a profession, but by the 1960s, graphic design was clearly a profession. No other institution has had the same impact on the profession and education as Yale University. This claim is based on graphic design at Yale as a sequential program in itself, and not as a course or courses within a broader program. Graphic design was a regionally accredited degree program, and it was Yale graduates who were directly responsible for establishing graphic design as a profession separate from advertising during the 1950s and 1960s. The Yale graphic design curriculum was the model for most educational institutions changing from advertising to graphic design educational programs during the 1960s. Yale graduates established and staffed many of these educational programs.

2 Leon Friend and Joseph Hefter, *Graphic Design: A Library of Old and New Masters in the Graphic Arts* (New York: McGraw-Hill, 1936).

This may indicate again that we are very much at the beginning, though there are even a few who do "graduate" work."[3]

Following its inception as a four year program, graphic arts soon changed from an undergraduate to a graduate program. For a short period of time, graduates from art schools with certificates were accepted into the program and required to complete one year for a BFA and an additional two years to receive the MFA degree. Those with an undergraduate degree completed the program in two.

The graphic arts program at Yale was introduced to the profession during 1951 at the initial Aspen Design Conference. Dean Sawyer and Egbert Jacobson were cochairmen of the conference, which was sponsored by Walter Paepke of Container Corporation of America. It was a landmark occasion for design as major professionals, industrialists, and educators came together for the first time in the United States. The conference served as an outstanding opportunity to introduce the new program in design at Yale University. Dean Sawyer and Alvin Eisenman spent two weeks in Aspen planning the introduction. Josef Albers and the architect Lou Kahn from Yale also were participants. Ero Saarinen, Charles Eames, Herbert Bayer, Leo Lionni, and Dino Olivetti were in attendance. Harley Earle of General Motors and Walter B. Ford of Ford Motors along with Frank Stanton, President of CBS, Hank Brennan of *Life* Magazine, Stanley Marcus of Nieman Marcus and Walter Howe of R. R. Donnelly were among the many prominent business leaders attending the conference. It is unfortunate that the proceedings did not have wider distribution or publication, because it was a lost opportunity for establishing Yale's role in the United States as a leader within the design field.[4]

By the late 1940s, most teachers in the Division of the Arts at Yale University were older, tenured, and had not practiced in years. The Yale administration brought in Charles H. Sawyer as dean for the express purpose of effecting change. In the words of Dean Sawyer, "The faculty and administration knew pretty well what our objectives were; a rather moribund school needed a good shaking up, and we invited new students to participate in the process. We met stout resistance from several of the senior faculty and some from students. We "newcomers" were united in our belief as to the importance of breaking down the walls which had grown up between departments, and giving students an opportunity to learn from each other." [5]

Dean Sawyer was influenced in his views to a great extent through his interaction with Bauhaus principals who had emigrated to the United States. First at Andover during the late 1930s, and later at Worcester, Massachusetts, he was in contact with Walter Gropius and Josef Albers, among others. He was well acquainted with Bauhaus pedagogy and was greatly impressed by the integration of several disciplines within design. Sawyer established the

3 Personal papers of Elaine Lustig Cohen.

4 Dr. Sawyer was bitterly disappointed that the Yale University Press refused to print the Aspen Design Conference proceedings on the grounds that they "were not sufficiently scholarly."

5 Correspondence from Dr. Sawyer.

Department of Design with its own curriculum and faculty, which was separate from the existing program in fine arts. An educational policy was instituted based on making use of renowned practicing artists and designers as teachers and role models. At the graduate level, the art and design programs were directed toward professional practice, marking a significant shift from the beaux arts emphasis of the existing program and the liberal arts programs at most other universities.

Before Sawyer's appointment, there were other activities and events which contributed to shaping the new program. During l933, Carl P. Rollins, a book designer at the Yale University Press, Theodore Sizer, an art historian, and Dr. Keough, a Yale librarian, began offering a course in fine printing, typography, and book design called "The Art of the Book." Rollins was a devotee of the arts and crafts movement, and this undoubtedly was reflected in the content of the course. The rare book collections at Yale University afforded students a marvelous opportunity for examining original printings. The course was offered through the library, although it was under the auspices of Art History and it was attended mainly by students from Yale College. The course was made available to students on an irregular basis between 1933 and 1948.

After World War II, a number of veterans attended the School of Fine Arts at Yale University under the G.I. Bill. Among these was James Fogleman. He later created the corporate design program at CIBA in 1952, and was a cofounder of Unimark in the l960s. In 1972, he became corporate design director at Raychem. Fogleman remembers how he and several classmates agitated for a change of the Yale art program from its current focus. They advocated a curriculum which included applied arts. These veterans were older, and most of them had some practical experience with art before coming to Yale. They were excited about the newly emerging design fields.

Fogleman reminisced that students most interested in design concentrated in painting composition classes because classical composition was the closest thing to design at Yale in 1948. Professor Rudolph, an instructor in composition, arranged with a firm in New York City to sponsor a wallpaper design competition for his students. Fogleman won this competition, and when he told about the competition in later years, it is apparent that it gave him immense satisfaction at the time. To further broaden their design awareness, students enrolled in a variety of architectural studio and history courses.[6]

Student efforts for curriculum change were directed through Charles Sawyer, who was not only Dean of the School of Fine Arts & Architecture, but also Director of the Division of the Arts and Master of Timothy Dwight College. Fogleman remembers well the informal discussions between students and Sawyer in the Master's apartments regarding the role for applied arts within the Yale

6 Notes made from personal conversations with Jim Fogleman during the 1980s when he visited Arizona State University campus. We discussed his experiences as a student at Yale University during the period prior to the hiring of Albers and establishment of Graphic Arts.

program. Dean Sawyer was supportive of this broader interpretation of the arts. He also was aware of the course which had been taught by Rollins, Sizer, and Keough through the Yale library.

Dean Sawyer's recollection is that, initially, Chester Kerr, head of the Yale University Press, proposed that, if the Press hired another designer, it would be a joint-appointment with the Division of the Arts. Sawyer was to allocate funds for the appointment, and the person hired would initiate a program in graphic arts. This was shortly after the appointment of Josef Albers. The educational concept formulated by Sawyer and Kerr was that the program would be directed toward professional practice and identified as graphic arts. The program would reflect work done at the Yale University Press.

This accounts for the early curriculum's emphasis on typography, printing processes; and production, book, and periodical design.

Dean Sawyer had known Albers for a number of years, having first met him at Andover around 1938. During 1948, Albers was invited to Yale as a Visiting Critic. Shortly afterwards, Dean Sawyer and George Howe, Chairman of Architecture at the time, met with Albers in New York City. Both men were aware that Charles Kuhn at Harvard University was interested in hiring Albers, although the faculty there was not particularly enthusiastic about such an appointment. This lent a certain urgency to the interview, and Dean Sawyer immediately began negotiations with Albers, whose appointment was publicly announced sometime around November of 1949.

Sy Sillman, a student of Albers at Black Mountain College, came with him as his assistant. Sillman carried on the program in color and drawing after Albers retired from the university during 1958. Albers was a strong believer in interdisciplinary studies for all of the visual arts programs. During 1950, in a letter to Alvin Lustig, Albers describes the program as, "...most of the students are majoring in painting—I encourage the painters to learn lettering and typography—they are inclined to think first of etching, lithography, etc. Just recently, we were able to introduce class problems with emphasis on typographic problems."[7]

The entire department reflected the educational philosophies of Albers throughout his tenure at Yale University. It was the stature of Albers and his reputation that attracted so many outstanding critics to join the program at Yale.

Shortly after the appointment of Albers, Paul Nash at Dartmouth called Chester Kerr to recommend Alvin Eisenman as a replacement for Carl Rollins when he retired. Eisenman was hired as a joint appointment to work at Yale University Press, and he became the first Lecturer in Graphic Arts. Eisenman coordinated the various Visiting Lecturers and oversaw program affairs. His prim-

7 Personal papers of Elaine Lustig Cohen.

ary teaching responsibility was typography, which included the history of type.

Alvin Lustig was invited to join the design program by Josef Albers. Elaine Lustig Cohen has kept the telegram, dated February 6, 1951, from Albers offering Alvin a position as Visiting Critic in the graphic arts program. As previously mentioned, Lustig had taught a course called graphic design in conjunction with Albers at Black Mountain College during the summer of 1946. Lustig began his role as Visiting Critic from March through June of 1951.

In the initial class, there were approximately fifteen students, some at an under-graduate level and others as graduate students. John McCrillis and Norman Ives were among these early graduate students. Both were to become teachers at a later date, with Norman Ives becoming a full-time faculty member following his graduation in 1952 and teaching at Yale until his death in 1978. Herbert Matter was recruited during 1951 for the faculty. Gabor Peterdi was appointed in 1953 as the instructor in printmaking. By 1955, Joseph Low, Leo Lionni, Robert Osborn, Lester Beall, and Alexey Brodovitch had participated as Visiting Lecturers.

There were a number of illustrious visitors, such as Buckminister Fuller, who came as critics or lecturers in Architecture but also visited the design program. I recollect Lou Kahn, Senior Critic in Architecture, coming into the graphic design studios at night and "holding court" with design students who were working late. These were very stimulating discussions.

The following generation of visiting instructors included Walker Evans, Bradbury Thompson, Paul Rand, and Armin Hofmann among others. John Hill became a faculty member and taught photography. Eisenman and Ives continued in their faculty roles.

Although the program was listed as "graphic arts" in the catalog, most students referred to it as "graphic design." Sometime during the late 1950s, Robin Darwin, Director of the Royal College of Art in London, and Richard Guyatt, a design teacher there, visited the Yale design program. Darwin chided Eisenman for calling the program "graphic arts" because that suggested printmaking. Darwin and Guyatt both recommended "graphic design" and soon thereafter, graphic arts was officially changed to graphic design. At the beginning, graphic arts occupied two basement rooms within Street Hall. When I arrived during the fall of 1953, graphic design had moved into the basement of the new Kahn building, with the Yale Museum and the architects on the upper floors. The graphic design studios were off a sunken court, so one wall was all glass, allowing considerable natural light. There was one large studio with sawhorse and hollow door tables. Vandercook proof-presses, type cabinets, and work tables were at the rear of the studio. A row of steel lockers defined the right edge of the work tables. The office and pinup boards were at the front. The door at the front opened into the hallway, supply closet, and the York Street exit and stairs, or

you could go straight through into the printmaking area. The rear door opened into a photographic shooting area with light stands, print dryer, darkrooms, and copy-camera room. All art classes were in old Street Hall.

Every graphic design student was required to take six-week courses in photography, printmaking, and typesetting. The course in photography was to instruct students in photographic processes so that they might better understand the language and problems of professional photographers (However, Jay Maisel and Bruce Davidson were graduates from the early program). Other than using their own cameras, students were introduced to a copy-camera and photo-mechanics. They could enlarge, reduce, copy, and make photostats. Richard Avedon's posterization of photographic images using high-contrast film was popular at that time, and students were quick to emulate many of his techniques. They also were heavily involved in using found images, in particular, nineteenth century wood engravings or other images drawn from historical sources. This direction is readily understood because of their newfound expertise with a copy-camera. Also, there were students in the program with little or no training in drawing or design. Photography, collage, or using found imagery permitted them to execute class projects. There was one 4 x 5 view camera, and students did some studio photographic work with lighting.

The course in printmaking required students to initially work with intaglio and relief processes. A few years later, Herb Fink taught lithography. These mediums were viewed as prototype education for the three basic printing processes of letterpress, offset, and gravure. Printmaking also was a natural outlet for fine art students in painting and drawing. At Yale, printmaking was common ground for fine artists and designers, since the lab was adjacent to the graphic design studios and workshops.

The principal focus of the program was typography, printing, printing production and book or periodical design. Typography was taught as a minimal art—you did not change typefaces or sizes if priorities could be established through leading or placement. There always was painstaking consideration for the choice and appropriateness of type as it related to content and function. The "color" or "texture" of text was an important consideration. There was equal concern for margins. The standard for styling was to use as few type changes as possible, and to rely more on visual tension, leading, and placement. Typesetting was taught in a letterpress shop using Vandercook proofing machines and foundry type or monotype.

Every student was required to purchase the two volumes of *Printing Types: Their History, Form and Use* by Daniel Updike. Most of us studied these books with great diligence. Students became adept at type identification. Typographic and printing histories were very important within the program. Most students became

avid collectors of display types. These were recorded on 4 x 5 ortho film negatives and kept in files. In conjunction with type, there was extensive involvement with all aspects of printing production, which included lectures and field trips. Graphic design graduates were considerably more knowledgeable about printing production than their counterparts graduating from art schools.

In 1953, Eisenman while on a trip to Europe, purchased some magnificent large wood types from Derberny and Peignot—an old and illustrious French type house. Students inked these types individually with small brayers and hand stamped them onto newsprint or rice paper. Many of these playful student exercises were to find their way into the later work of graduates, when they became professional designers.

At the same time that graphic design students were taking type, photography, printmaking, and printing production, they were required to take Albers's color class. A number of design students elected to enrolling drawing classes taught by Albers or Bernard Chaet. As I remember, art or architectural history were required and students chose other electives from the Yale College curriculum. Herbert Matter taught photography and, on occasion, design. Eisenman was responsible for typography and printing production; Ives concentrated in design. Peterdi instructed in printmaking, and the Visiting Lecturers gave students either short or extended practical problems. In their last year at Yale, graduate students were expected to find a manuscript (or write one), and then to design, print, and bind an edition of fifty books. By the time of the second generation of instructors—the late 1950s—book projects were no longer required.

Critiques and reviews were conducted by several teachers working together, which broadened the scope of criticism and discussion enormously. Teachers worked as a unit, so there was no pigeon-holing of classes in separate rooms with separate instructors. Students were expected to perform competently in all the areas of design, typography, printmaking, and photography. To fail in any one area was to fail the program. (I do not remember any student ever being failed, but we were told, and we believed, that to fail one course was to fail them all). Treating the program of study as a whole strengthened the interrelationships between the various areas and, combined with team-teaching of sorts, made graphic design at Yale different from design instruction at the majority of other schools during that period.

Grading was done at the end of each semester by review. Eisenman, Ives, and one or more of the Visiting Critics would occupy the front office. Students would come into the room one at a time with their portfolio. A timer from the photography lab was set for fifteen minutes. The reviews were conducted by Alvin Eisenman. They consisted of all faculty members present examining and discussing the student work along with some general counseling.

When the timer sounded, the review was over and you were out of there.

The new design program at Yale was unique in several other respects. The curriculum of design, typography, photography, and printmaking was exclusive to it. The faculty and the Visiting Lecturers constituted the most prestigious concentration of designers teaching at one school in the country. That failure in one course was to fail the entire program was a new concept. Team teaching was relatively different, and grading through review was an innovation not found at most other schools. Undergraduate and graduate design students were mixed together in the studios, so every student knew every other student. Concentration in the major and other visual art courses was considerably more than allowed at that time by art schools, and several times over what was permitted at other universities. I recall taking only three academic courses-art history with Theodore Sizer and John McCoubrey, and two semesters of anthropology with Ralph Linton.

There was a great deal of interaction between undergraduate and graduate students within the graphic art studio. Combining undergraduate with graduate students and holding critiques in the studio opened up all critiques and discussions to all students. Admission policies permitted individuals to be accepted into the program who previously had not taken art or design. The main criteria was that they were bright, motivated, and knowledgeable in their field. Albers's correspondence with Lustig during the first year suggests that at the time, most, if not all the students were from fine arts. I recall that my class for the fall of 1953 included four students who came from unaccredited art schools (three advertising design majors and one printmaker), one from a technical school (photography), one was a pre-med student at Amherst who took the Yale summer program and changed school and major, one had a journalism background with no art or design experience-the others I do not remember. According to Dean Sawyer, upper administration at Yale was never enthusiastic about his admissions policies for graduate students in the Division of the Arts. Administration continually questioned the "academic" credibility of students accepted into professional programs.

During the early years, Dean Sawyer accepted students directly into art programs on several occasions. While serving as an Examiner for the Honors College at Wesleyan in Middletown, Connecticut during 1949, Sawyer was so impressed with Norman Ives that he immediately invited him into the Yale program. Sawyer accepted me from the Minneapolis School of Art while on a lecture tour through the Midwest during 1953.

Dean Sawyer was a close friend of Dana Vaughn, dean, and Ray Dowdin, chairman of art at Cooper Union. The three men believed an alliance to be in their common interest, particularly since Cooper Union enrolled many talented students from the New

York High School of Music and the Arts. At a later date, Ray Dowdin was to direct the Yale Summer Program.

It was the mid-to-late 1960s before graduates from graphic design programs regularly applied at Yale. It is my impression that, as time went on, policies for acceptance into graphic design changed. More minority and foreign students were accepted and, almost without exception, each applicant had an undergraduate degree in graphic design. The earlier strategy for admissions into graphic arts at Yale had been to create an environment that would nurture graphic designers without predicting which students eventually would develop into designers. I think the policy of accepting talented students from a variety of disciplines was lost over a period of years, and in my opinion, it took something very vital away from the overall program.

As the reputation of the graphic arts program grew, so did the number of applicants. By the mid-'60s and afterwards, this number swelled to several hundred each year. It is a credit to the program and Yale University that, no matter how many applicants, the number of students accepted did not change, and the evaluation and interview of applicants remained scrupulous.

The prestige and resources of Yale University itself were powerful forces in shaping and enriching the design program. Yale University attracted the best teachers, critics, and students. The reputation of Yale added considerable luster to the credentials of graduates when they sought employment. The prestige of Yale University induced industry to provide corporate support and become involved with its graphic design program. The success of the program also reflects the strength of leadership and vision in the Dean's office at the time that art at Yale University was being redefined and new programs adopted. It is my impression that support for Dean Sawyer by higher administration cooled within the space of just a few years. Dean Sawyer soon was replaced by Boyd Smith from drama as Interim or Acting Dean. He remained in office until 1958, when Gibson Danes was hired as Dean. However, momentum from the first few years of the new programs conceived by Dean Sawyer continued for a decade and more.

The influence of Josef Albers on graphic design students was of greater import than many graduates realized then or now. Unfortunately, not every graphic design student recognized the value of his teaching, but those who did realized benefits that lasted throughout their careers. Only recently, Alvin Eisenman related to me an anecdote about Albers which is so typical of him. When anyone asked him to comment on matters pertaining to graphic design, he would defer them to Lustig or Eisenman by saying, "I am not a graphic designer but my nonsense is helpful to them."

Color and drawing courses were attended by students from painting, printmaking, sculpture, architecture, and graphic design as well as from Yale College. This mixture of students was unusual

in itself. Student interaction was spontaneous and unstructured, but highly effective. This was due, to a large extent, to the high degree of respect generated by Albers.

Albers was a tremendous influence on students, but there were others. Among the Visiting Lecturers, Lustig preached, "The solution to any design problem lies within an analysis of the problem." Lustig also defined graphic design as communication, and believed that designers always should ask themselves, "What am I trying to communicate? Can I communicate more clearly?" A number of influential designers have always been willing to teach, but Lustig differed in that he was interested in educational planning and organization. He was more concerned with an overview of total programs than most professionals. He had never had an art school or university education himself, and this might have been a motivational factor in his concern for design education. According to Elaine Lustig Cohen, the greatest design influence on Alvin was a German émigré art instructor, a Professor Koplick[8] who taught at a junior college in Los Angeles. Before coming to Yale, Lustig had drawn up design programs for the Universities of Georgia and North Carolina. His educational interests are clearly revealed in a small book published after his death by a graduate student at Yale, *The Collected Writings of Alvin Lustig*.[9]

Lester Beall presented his projects through a written problem statement in which he included misleading information to challenge students to separate the relevant from the irrelevant—to analyze. Alexey Brodovitch emphasized experiments. He once gave a photo assignment to cover a hurricane which was headed for New Haven. The storm veered inland sixty miles south, and left students with only wind and rain. When students showed their photographs, his comments were that the photographs did not reflect a hurricane. When students protested the difficulty of photographing an event which did not take place, his reply was to send them into the darkroom and create a hurricane!

Eisenman and Thompson concentrated on printing history, type, and typographic styling. Eisenman taught students that type was "important" and, knowing this, most students treated type as being important. Perhaps of even greater significance, Eisenman introduced the concept of typographic and printing history, with historical research into the graphic design educational program. Until this time, design students had to be content with either art or architectural history. To this day, I am amazed at Eisenman's grasp of the breadth and detail of printing and typographic history. It is entirely possible that the present inclusion of design history into graphic design programs evolved from the type and printing history first taught by Eisenman at Yale.

Bradbury Thompson focused on publication design and the history of type. His first design job had been with the Westvaco Paper Company in 1938, where he designed the "Inspirations" jour-

8 Elaine Lustig Cohen cannot be certain if this spelling is correct.

9 *The Collected Writings of Alvin Lustig* Holland R. Melson, Jr. ed.,(New York: Thistle Press, 1958).

nal. Ives primarily was interested in formal values. His special magic was his ability to silk-screen two colors on a twenty-cent piece of paper in a manner that students carefully picked it up at the extreme edges with thumb and forefinger. Matter insisted that students carry their cameras at all times, and use them constantly in all places and situations. He would not permit us to go across the street for a cup of coffee without taking our cameras. This most gentle old man, with his hair going in all directions and the inevitable cigarette with the long ash could be deadly in critique. When confronted with pictures of babies, pets, or similarly saccharine subjects, he would say, "That's nice, that's always nice!"

Paul Rand insisted on quality, and especially that design solutions must be relevant to the content and objectives of the problem. Rand was most responsive to humor or playfulness in design and, as a teacher, he encouraged it. Rand, as did Lustig, had a keen interest in education. Armin Hofmann, an instructor from the Kunst Gewerbeshule at Basel, Switzerland, stressed formal values more strongly than anyone since Albers. Many of his American and European students from Basel were hired into American corporations, design studios and educational institutions, and several of them taught or lectured at Yale. Under his tutelage, students at Yale developed strong handskills and perceptual sensitivity. Hofmann, as did Albers, understood perceptual studies and was very successful in teaching students to recognize and use visual properties. Influences shaping graphic design students came more from contact with a variety of individuals than from any one "school" or "philosophical" approach. A common characteristics of the faculty was that many of them were European educated. Only Paul Rand had any strong connection with advertising. Most faculty members were well-schooled in art and design history, although several were educated in fields other than art or design. Eisenman, a Dartmouth graduate, studied typography with Paul Nash and had a book design and publishing background. Beall had been educated in art history. Lustig did not have a formal education in art or design. Lionni was educated as an economist in Italy and was a self-taught graphic designer. Matter studied painting at the Ecole des Beaux-arts in Geneva and the Academie Moderne in Paris under Leger and Ozenfant. Thompson was a graduate of Washburn College, a small liberal arts school in Kansas. He had been a cartographer during World War II. Paul Rand, largely self-taught, was influenced by European painters and designers. He attended night classes at Pratt Institute, took some courses at Parsons School of Design and studied with George Grosz at the Art Students League.

Albers and Hofmann understood visual theory and were effective teachers in this area. Lustig, Lionni, Beall, and Matter taught from professional experience, and they dealt with the practical. However, all of them were superb role models and contributed a great deal to the overall educational experience of students.

What took place in graphic design at Yale during the formative years not always was by plan or intention, and its uniqueness was seldom realized by faculty members. It was the students who recognized the value and distinction of the new program. This was especially true for those students who had attended another school before coming to Yale.

Students did not see themselves as preparing for careers in advertising or commercial art. They viewed graphic design as being focused on problem solving and communication, and something quite separate from advertising. Graphic design students saw design as being professional rather than service-oriented, and similar to architecture in status. Seldom has a single school or program had such an immediate and overwhelming impact on any profession as did graphic design at Yale University during the 1950s and 1960s. It had a similar impact on design education. By 1968, graphic design programs were beginning to surpass advertising programs at American art schools and universities.

The spectrum of student backgrounds and credentials in graphic design narrowed with time. Graphic design moved from the Kahn Building across the street to the new art building designed by Paul Rudolph. The Division of the Arts became the School of Art; and the graphic arts program became graphic design. Photography eventually became a separate program. No matter how much change took place during succeeding years, the integrity of the graphic design program remained consistent under the leadership of Alvin Eisenman, who retired in the Spring of 1991.

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The author's own recollections have been greatly enriched through telephone conversations, correspondence and sharing of personal papers with the following individuals, and he is greatly indebted for their kind assistance: Dr. Charles Sawyer, Professor Emerti Alvin Eisenman, Elaine Lustig Cohen's sharing of correspondence between Josef Albers and her husband and the late James Fogelman.

# The Dominant Stances on Ecodesign: A Critique

Kate T. Fletcher and Phillip A. Goggin

**Introduction**

Environmental issues are not new to the design professions. William Morris was among the first to consider the environmental as well as the social implications of his work. Buckminster Fuller in the 1930s and Victor Papanek until recently, have carried the environmental baton and explored the numerous ecodesign concepts found today. Although not designers, Fritz Schumacher in his seminal work *Small Is Beautiful*[1] and Ivan Illitch in *Tools for Conviviality*,[2] have helped shape many of the social, structural, and economic arguments that can facilitate design for healthy, equitable, and autonomous living. Yet, while designers have long drawn inspiration from critiques on the industrial economy; environmental policy making; alternative technology movements; systems thinking and city planning, among other subjects; it is only recently that there has been evidence of a reciprocal action: a growing interest in these quarters in design. For example, explicit reference now can be found to the significance of design in achieving environmental, economic, and social policy goals at national, regional, and international levels.[3] In many ways, this acknowledgment of the role of design in creating more sustainable forms of living and working is a reflection of the broadening concerns and issues that are increasingly accepted as influencing the work of designers. Such extension of the design space is evidenced through the shift from design for environment contained within the "factory gates," to issues such as energy efficiency and recycling, to design for the whole product lifecycle and, more recently, to functional innovation and the integration of new design concepts within systems of service delivery.

It is within the above context, of an expanding and increasingly complex role for the design professions, that this paper is written. While it already is recognized that the scale of environmental impact depends on population size, what this population does, and the technology it uses,[4] the consideration in ecodesign of consumption, human choices, and actions has been overshadowed by an emphasis on pollution and resource use during production as the main object of environmental concern. Greater consideration in the ecodesign of anthropogenics and the social, cultural, and economic processes that shape environmental change seems overdue. This paper, therefore, examines dominant design approaches to environ-

1 E. F. Schumacher, *Small Is Beautiful* (London: Abacus Books, 1973).

2 Ivan Illich, *Tools for Conviviality* (London: Calder and Boyars, 1973).

3 See, for example: UK Foresight Programme in *Sustainable Technologies for a Cleaner World* (London: Office of Science and Technology, 1998), which sets out some key areas to integrate design thinking, sustainable development, and government action.

4 This is commonly referred to as the IPAT identity, (I=PxAxT where I is impact, P population, A equates to a measure of affluence, and T a characteristic of technology) and is discussed in Paul Ehrlich and Ann Ehrlich, *The Population Explosion* (London: Hutchinson, 1990), 58.

mentalism with particular reference to consumer (human) behavior. Our context is clothes washing, or more specifically, the design, production, and consumption of washing machines; the provision of clean clothes; new developments in textiles, washing, and clothing services; and the socially and culturally determined need to keep clean. The social and cultural phenomena which are the subject of this paper are necessarily situation-specific—particular to the UK at the end of the twentieth century. Gaining such specific knowledge about a narrowly defined area is a small step in developing and understanding the dynamics of a broader framework or methodology, and once this task is complete, the issues identified can be expanded towards other sectors, countries, and models of development.

The environmental implications of consumer behavior are not just underrepresented in design but also in other disciplines, where there is no shared definition of consumption suitable for studying environmental effects nor a community dedicated to studying its dynamics. There are many factors that influence the environmental significance of consumption, influences which are "both direct and indirect; that are interdependent, acting in combinations rather than additively; that it will take many disciplines working together to understand; and that act on different time scales."[5] This multidisciplinary, multi-temporal requirement represents a significant challenge for those involved in examining the human behavior/environment interface. It is a challenge which transcends the formalized boundaries of the natural and social sciences to include a necessary role for those who make decisions about the technologies we use, which includes the design professions.

**Ecodesign**

For the purpose of this paper, the term ecodesign is used as shorthand to represent the wide range of design-environment approaches that are variously labeled "green design," "ecological design," and "sustainable (product) design," among others. Distinctions between these terms have been set down elsewhere,[6] and embody differences between these approaches on issues of scale, ease of implementation, potential environmental benefits, and the focus of design activity.

This paper is organized around three broad clusters of ecodesign strategies, each with a different focus: *product focus*—making existing products more resource efficient; *results focus*—producing the same outcome in different ways; and *needs focus*—questioning the need fulfilled by the object, service, or system, and how it is satisfied. Rather than investigate terminology, it is the aim of this paper to show that the success of a range of approaches to ecodesign is at least partly contingent on people and that this largely has been overlooked to date.

5 Paul C. Stern, Thomas Dietz, Vernon W. Ruttan, Robert H. Socolow, and James L. Sweeney, "Consumption as a Problem for Environmental Science" in *Environmentally Significant Consumption* Paul C. Stern, Thomas Dietz, Vernon W. Ruttan, Robert H. Socolow, and James L. Sweeney, eds. (Washington, DC: National Academy Press, 1997), 3.

6 See, for example: Pauline Madge, "Ecological Design: A New Critique," *Design Issues* 13: 2 (1997): 44-54.

**Product Focus**

Ecodesign strategies with a product focus attempt to influence environmental impact by making existing products more efficient. Most ecodesign activity to date has been concerned with this focus, and considerable research is being undertaken on the development of methodologies (such as lifecycle assessment[7]) to further refine current systems. In the particular context explored here—clothes washing—improvements in the design of washing machines have been shown to have significant potential. For example, a Danish study found that energy consumption could be reduced by more than seventy percent if the most efficient washing machines replaced existing stock.[8]

For a typical washing machine, ninety-five percent of its total environmental impact arises out of the use phase of the lifecycle.[9] Consequently, it is this stage where most design attention is directed and, in particular, at issues associated with energy, water, and detergent use.[10] It certainly is possible to create washing machines which use these consumables more efficiently. Indeed, one of the UK's "white goods" manufacturers has designed a washing machine that is able to mechanically wash clothes in cold water with comparable results to warm-water washing. Resulting from an innovation in detergent technology, it removes the need to wash in heated water, thus saving energy without sacrificing cleanliness. In addition, the simple detergent ball or tablet is not only more effective than the dispensing tray in delivering the detergents to the clothes, but also reduces resource consumption because less detergent is required or wasted during the wash cycle. Such simple ideas remove the need for complex water heating and detergent-dosing mechanisms, as well as the sophisticated controls required to provide the range of wash programs found in many machines.

Consumers' acceptance of these design outputs is, however, inhibited due to the sometimes conflicting barriers of product status, performance, and cost. These new features—or rather the lack of them—are seen by some companies as unacceptable platforms from which to launch and market new products. One UK firm conducted its own market research, which convinced it that inexpensive, simple, easy to use, reliable, and long-lived washing machines would not sell because they were considered by potential customers as inferior and lacking status. While this is a comfortable conclusion for a white goods manufacturer to draw as it endorses current business practice, it also is indicative of the enhanced image, choice, and control (regardless of usefulness) which customers have come to expect of new products. Further, it is a signal, borne out by evidence from other sectors, that products commonly are consumed as expressions of wealth, lifestyle, and identity.[11]

A further factor limiting the acceptance of these technologies is that white goods is a saturated market, with most washing machine purchases bought as replacements. This means that it is

7 Lifecycle assessment (LCA) is a method by which all environmental burdens associated with a product, process, or activity are recorded and assessed so that opportunities for improvement can be identified.

8 Ernst von Weizsaecker, Amory B. Lovins, and L. Hunter Lovins, *Factor Four: Doubling Wealth, Halving Resources* (London: Earthscan, 1997), 30-31.

9 PA Consulting Group, *Environmental Labeling of Washing Machines: A Pilot Study for the DTI/DOE* (Royston, Hertfordshire: PA Consulting Group, 1991).

10 See, for example: Robin Roy, "Designing a Greener Product: The Hoover 'New Wave' Washing Machine Range," *Co-design: The Interdisciplinary Journal of Design and Contextual Studies* 5&6 (1996): 34-39.

11 Neva R. Goodwin, "Overview Essay" in *The Consumer Society,* Neva R. Goodwin, Frank Ackerman, and David Kiron, eds. (Washington, DC: Island Press, 1997), 3.

unrealistic to expect immediate and widespread substitution of existing washing machines with the most efficient alternatives. Cost also inhibits extensive take-up, because environmentally superior machines tend to be more expensive than their less-efficient equivalents. This effectively excludes a substantial section of the market from using the most efficient machines, with the implication that those with less money have little choice but to pollute more than the rich. Compounding this further, it appears that, not only do the poor use less efficient machines than those who are more well-off, but they use these machines *more* frequently to do *more* laundry. It has been suggested that this is because they spend more time at home than their more affluent counterparts, and while at home textile maintenance is one of the "jobs" do be done, to take time over and/or pride in.[12]

In addition to improvements in the design of washing machines, ecodesign strategies with a product focus extend to designing clothes that are "easier" to clean (that is, cause less impact as they are washed). Just as with environmental burdens associated with washing machines, those resulting from the clothing lifecycle are mainly a consequence of use.[13] Yet it is the case that the environmental approach of the textile and clothing sector has not focused on use but instead on remedial "cleanup" treatments and resource management in textile processing. Thus, the design of "environmentally friendly" garments and "environmentally friendly" systems of laundering these same garments have developed in isolation.[14]

The impact associated with clothes laundering, as influenced by clothing design, can be reduced in a number of ways including washing less frequently, on lower temperatures, and in fuller loads. Garments can be designed, for example, that are more resistant to soiling and odor. Stain-blocking coatings form a barrier around the fibers, giving stain and soil repellency, and deodorizing fibers or layers act to control bacterial growth on the fiber surface. Such developments reduce resource consumption if their application translates into less frequent washing. However, without a change in current laundering habits, in which it has been shown that consumers rarely wash clothes to remove dirt (In Britain, in 1993, there were, on average, only seven stains per load of washing, approximately four kg of textiles.) few benefits are likely to be gained. Since it is only when the removal of dirt is the principal motive for laundering, and then only when laundering is delayed until the dirt shows, that coatings begin to affect washing frequency, and hence, resource consumption.

Where the potential environmental benefits from developments such as coatings are determined by changes in behavior, inquiry into current behavior can also provide scope for environmental improvement. For example, studies reveal that different fiber types are laundered on different temperatures. Cotton items are

12 Diana E. Uitdenbogerd, Nienke M. Brouwer, and Ans P. Groot-Marcus, *Domestic Energy-Saving Potentials for Food and Textiles: An Empirical Study* (Wageningen, The Netherlands: Agricultural University, 1998), 42.

13 Franklin Associates, *Resource and Environmental Profile Analysis of a Manufactured Apparel Product: Woman's Knit Polyester Blouse* (Washington, DC: American Fiber Manufacturers Association, 1993).

14 Kate T. Fletcher, *Environmental Improvement by Design: An Investigation of the UK Textile Industry* (Ph.D. thesis, London: Chelsea College of Art & Design, The London Institute, 1999), 27, 268.

commonly washed at the boil (70°C), while synthetics are washed at 40°C. This means that, by substituting synthetic fibers for cotton, there is considerable potential to reduce the environmental impact associated with consumer care. Indeed, estimates suggest that making this switch may result in saving up to seventy percent of the energy consumed in laundering. Thus, it seems that selecting fibers that wash well on cool temperatures and dry quickly could bring major benefits. This is, of course, dependent on consumers correctly differentiating between different material types and washing them accordingly. Evidence indicates, however, that this is not the case. While there are approximately the same number of natural and synthetic textiles in circulation, cotton or cotton blends make up the bulk (eighty-nine percent) of washing loads.[15] This indicates that cotton fabrics are laundered more frequently than synthetics (as well as on higher temperatures) and, subsequently, have a higher environmental impact (and therefore should be avoided). An alternative explanation, however, is that consumers are unsure of the fiber content of textiles and unconsciously launder non-cotton articles as cotton. If this is the case, careful specification of particular fibers in the design stage would be ineffectual, because the majority of textiles are laundered as cotton regardless of their actual fiber content.

When studies of how people *sort* their laundry are taken into account, it is clear that, in the majority of cases, sorting is done on the basis of color and not fiber type. These variously sorted loads then are then laundered at hotter temperatures if they are white or light colored than if they are made up predominately of darker shades. This suggests that color, as well as fiber type, influences the way in which a textile is laundered, and provides some potential for an alternative and lower impact way to satisfy the need for clean clothes. The volume of laundry is another variable that can be influenced by textile and clothing design. However, observations of actual laundering practices again reveal that a reduction in the volume of laundering (perhaps through modular design, for example detachable collars and cuffs) would only bring environmental benefits through less frequent washing in particular households. While it is the case that large households, which generate large volumes of laundry and normally wash in full loads, probably would be affected positively by modular design and have wash frequency reduced, small households would not. One-or two-person households (of which there are an increasing number) tend to wash when dirty items are needed, rather than wait for a full load to accumulate. By reducing the volume of laundry further via modular design, small households would likely continue the same frequency of washing, but with ever smaller load sizes, resulting in progressively less-efficient resource use.

Ecodesign, therefore, has a major requirement to understand consumer actions in their many modes of operation. Thus, we

15 Ans P. Groot-Marcus and Mirjam van Moll, "Textile characteristics, Laundering and the Environment," *Journal of Consumer Studies and Home Economics* 20 (1996): 261-273.

return to the recurring theme of this paper, personal (human) behavior; and it is chiefly the constraints of this, rather than determinants of a technological or conceptual nature, which are the main barriers to the introduction of a range of ecodesign strategies.

**Results Focus**

Ecodesign strategies also extend to investigating the way existing products and combinations of resources are distributed, organized, and used. Under this banner, some significant attention has been paid to the development of products—and systems of products—which are compatible with, and advance, product sharing. Shared products meet the same needs with fewer units by intensified product use. Many examples of product sharing exist, such as laundry facilities in densely populated urban areas which make use of community—or local authority—run—machines. Such schemes, it is popularly argued, are successful and are held up as examples of "good," efficient design.[16] The centralized, community laundry reduces the number of machines in use, so lessening materials and processing costs; it reuses warmth and water by washing continuously rather than in inefficient batches; its single location allows the easy introduction of more sophisticated, efficient machines; and its local site means that polluting transportation is reduced to a minimum. Community or locally based laundering schemes can promote other, more sustainable practices, too. They may, for example, support conviviality and encourage communication within and across communities, as well as stimulate other services such as a local notice board or child-care facilities.

However, while the technology and product infrastructure to support resource efficient community laundries already is in place, the necessary accompanying social infrastructure, of appropriate consumer behavior and cultural acceptance, is less well developed. The result is that community laundries (and, by implication, product-sharing schemes in general) do not necessarily bring major environmental benefits. Such a conclusion may be seen as antithetical to accepted stances on ecodesign, yet it provides us with evidence—which will be further supplemented throughout this paper—of the need to regroup our thoughts, actions, and priorities on ecodesign. There is a need to reorganize in such a way that the major factor constraining assumptions about the success of ecodesign strategies, human behavior, is brought to center stage. According to David Orr[17] it is only then, and through recognition of the "limited and fallible" nature of people, that we can begin to propose a process of redesigning and rebuilding a more sustainable world from the bottom up and, in so doing, engage a more "active and competent citizenry."

Thus, it can be argued that it is the "people" element of a community laundry that limits environmental improvement. Consumers are free to continue bad laundry practice: incorrect

16 von Weizsaecker, et al., *Factor Four: Doubling Wealth, Halving Resources*, 93.

17 David Orr, *Ecological Literacy* (Albany: State University of New York Press, 1992), 29.

dosing of detergents; unnecessarily high washing temperatures; and semi-full loads. Without changes in consumer behavior, there are no major environmental benefits to be gained from using fewer washing machines more intensively. While a product-sharing scheme employs *production* resources more efficiently (one machine meets many people's needs), it does not address resource efficiency in *use* (clothes are still washed as frequently). When the environmental cost of the use phase is significant (as with this case), intensified use does not address areas of major impact. Therefore, the actual number of washing machines in service makes little difference to the overall environmental impact of laundering. Rather, it is how the machines are used—consumer behavior—that is most significant. A product-sharing scheme, such as a community laundry, will bring few benefits if no change is made to consumer behavior in the way products are used. Further, these benefits are dependent on cultural acceptance of the new scheme which, in this instance, would have to overcome such issues as the perceived inconvenience of clothes washing outside the home and the social stigma of laundries, linked in many minds with poverty.

Many of the barriers to achieving significant environmental benefits from product-sharing schemes also are likely to affect the success of services. Preparing for the switch from the consumption of products to the utilization of services is regarded as one of the cornerstones of the ecological approach to design. Its basic premise is that products are, "mere instruments or means to produce the needed functions to consumers,"[18] and thus the material components of the product are *utilized* rather than *consumed* by the user through a service or lease arrangement. The environmental benefits of selling utility or results rather than products arise out of the different role played by materials in the two schemes' drive for profit. In selling products, profit is maximized by selling more materials. In selling services, profit is maximized by serving more people with fewer materials. Since the financial success of a service relies on resource efficiency; energy and materials inputs, and associated environmental impacts, have the potential to be reduced to a minimum.

There already are well-established laundry services which clean a range of textile products, most commonly hotel and hospital linen. These services offer tangible environmental benefits: efficient, centralized operations reuse thermal energy, water, electricity, and detergent; automatic dosing and loading of machines overcomes inefficient consumer behavior; and no direct access to washing machines dissuades consumers from "casual" laundering. Yet, as with the design of product-sharing schemes, it is unclear whether the design of services will bring unconditional environmental improvements. As argued above, the intensified use of a product which causes the greatest environmental impact as it is used does not address key environmental problems. Also, the requisites for a

18 Rens Meijkamp, "Changing Consumer Needs by Eco-efficient Services," *Towards Sustainable Product Design Conference Proceedings* (Farnham, UK: The Centre for Sustainable Design, 1997), unpaginated.

laundry service: higher washing temperatures (to maintain hygiene standards); clothes drying; and transportation mean that a laundry service consumes more energy than private laundering.[19]

In addition to overcoming such resource inefficiencies, successful services have to address social, cultural, and psychological issues, such as those surrounding material ownership and the display of status by means of prestige goods. While many services are based on material or product combinations of some sort (in this case, washing machines), the materials are not owned by, and in some instances not visible to, the consumer. Yet, as is especially evident in Western culture, material ownership is a key symbol of wealth and social differentiation. Materials are a culturally accepted satisfier of psychological needs. Against such a context, the lack of material representation of services on consumption gives them dubious prestige. And it is prestige and high levels of cultural attractiveness of alternative solutions, such as services, that are widely accepted as imperative for a smooth transition to a more sustainable system of production and consumption.[20]

Consumers of services fulfill their need not by material ownership, but by buying results. There is some concern, however, that the disassociation between object and source of satisfaction in service design may further undermine environmental improvement. Evidence to support this negative influence can be seen in services which use products as a mechanism to deliver results, but which place little value on the them (for example, mobile phones). The products, and the associated embodied materials and energy, thus are seen as expendable, and are frequently discarded or updated with changing technology and fashion trends.

Clean clothes (rather than just cleaning equipment) also could be delivered as a service. A clean clothes service is not without precedent. Formal dress, for example, can be rented and then returned to the owner, who maximizes profit by minimizing the costs of upkeep. Potential environmental benefits arise from there being fewer items and from the economies of scale associated with laundering large volumes in an efficient way. However, many of the arguments raised above, such as there being few benefits from the intensified use of a product (in this case, a garment) which causes most impact as it is used, still stand. Clothes would have to be cleaned (or "serviced") on a very regular basis at significant cost and at the supplier's expense. Of paramount concern to the supplier, therefore, is the need to minimize the costs of consumer use, by reducing the frequency of laundering, making laundering more efficient, or avoiding it altogether.

Given that behavior in laundering restricts the resource efficiency of garments, it therefore would appear that one possible solution would be to design clothes never to be washed. In that way, consumer behavior in, and attitudes towards, clothes washing would be irrelevant. Hygienically and culturally, durable, no-wash

19 Robert van den Hoed, "Sustainable Washing of Clothes," *Towards Sustainable Product Design Conference Proceedings* (Farnham, UK: The Centre for Sustainable Design, 1997), unpaginated.

20 Ezio Manzini, "Design, Environment, and Social Quality: From 'Existenzminimum' to 'Quality Maximum,'" *Design Issues* 10:1 (1994): 37-3.

clothes are currently unacceptable. Less contentious in cultural terms, disposable clothes may offer a means to reduce environmental impact arising out of washing. The concept of disposability, however, undermines sustainable development's traditional message of longevity; the implications of which could be far-reaching and impact upon how all garments—long and short life—are used, maintained, and discarded. While disposable clothes prevent significant environmental impacts arising as a result of laundering, other impacts associated with the environmental cost of production: materials extraction, processing, distribution, reclamation, and disposal have to be assessed.

There is no available evidence which compares environmental loadings arising out of the production of say, fifty disposable items to the cost of producing one durable item and laundering it fifty times. Environmentally responsible, no-wash garments presuppose an efficient product and processing sequence, low-impact materials, nonpolluting transportation, and an effective and economical cycle of materials reclamation and reuse. The efficacy with which current systems of textile and clothing production and reclamation could meet such requirements still is to be investigated. It would seem likely, however, that major improvements in materials, production, distribution, and reclamation efficiency would be necessary. While barriers to the introduction of no-wash garments are mainly organizational, technical and, to a certain extent, conceptual (indeed this article represents its nascent stage), the environmental compatibility of this system still is dependent on individuals. Without consumer acceptance, a highly organized and efficient system of producers, distributors, and reclaimers would collapse.

Just as the ecological implications of short life, no-wash garments are uncertain, so are their implications for a wide range of interest groups such as designers, producers, and consumers. Further, the necessary and frequent replacement of clothing in a short-life system will impact on fashion cycles, particularly in the short term, probably stimulating an increasing rate of change in fashion trends. Changing trends are problematic in environmental terms for products with materials and a structure designed to last, as they induce premature replacement and wasted resources. However, products with a life-span shorter than the fashion cycle are used up before they can become obsolete and, in part, appear to transcend fashion and the problem of fashion-induced obsolescence. This raises some interesting questions relating to the form a fashion trend would take in such circumstances and how rapid a rate of change the fashion industry could sustain. Disposability also has tremendous implications for the perceived value of textile materials and textile aesthetics. Aesthetics, in particular, are likely to play a key role in making any alternative, environmentally preferential system more attractive to consumers.

This acknowledgment of the importance of consumers and their behavior in the success of ecodesign strategies emphasizes that a results focus, like the product focus described earlier, requires broader, more inclusive design priorities than those currently in operation. The heterogeneous nature of consumer behavior means that ultimate resource efficiency will require different fabrics with different characteristics and different lengths of life to be linked to different end users.

**Needs Focus**

Unlike strategies, which focus on products and results, a needs focus in ecodesign is, by definition, concerned with people. At this level, a particular human need can be approached in a nonconventional way, and because each way of meeting needs has different material and environmental implications, new and less resource-intensive solutions have the potential to be developed. Thus in the context of this paper, the shifting design emphasis can be plotted and shown to move from clothes washing (a product focus) through conceptions of clean clothes (a results focus), and finally to considerations of cleanliness (a needs focus). This is not just a semantic shift, but describes a substantial conceptual leap for problem solvers (designers and others associated with satisfying needs), and makes explicit a requirement to resolve traditional divisions between industrial sectors since needs are not sector specific. Examples of a needs focus in ecodesign are extremely limited, and yet it is here that the people-centered frame of reference for ecodesign activity has to be established.

In the context explored in this paper, the needs focus engages with societal and cultural perceptions about cleanliness, the ways in which we keep clean having major implications for consumer washing behavior and associated environmental impact. Cleanliness, while originally motivated by disease prevention and satisfying the fundamental human need for protection, now is driven by social competition and is linked to cultural values such as "success," "acceptance," and "happiness."[21] Thus, keeping clean has become a structurally determined need and one legitimized by the marketing and product world built up around a culture of "whiter than white." And just as with consumer reluctance to accept inexpensive and durable washing machines because of their perceived inferiority and lack of identity, cleanliness' dominant social status and complex cultural significance makes modification of present-day hygiene standards difficult. Cultural norms change constantly, but the ways in which they do so are not easily predicted or influenced.

The complex, interrelated, and constantly changing relationship between design and culture perhaps has restricted the evolution of design-led examples of alternative, and more environmentally responsible, ways to approach needs. It is likely, however, that these gaps in theory and practice are not found in

21 Suellen Hoy, *Chasing Dirt: The American Pursuit of Cleanliness* (New York: Oxford University Press, 1995), 171.

design alone, but also in other fields of study. Some of these gaps are starting to be addressed by ad hoc, informal moves to "downshift" or embrace alternative lifestyles. Design is enriched by giving form and currency to this focus on needs, and thus maximizing opportunities for environmental improvement.

**Conclusions**

This paper provides a critique of ecodesign, examining in detail a variety of approaches associated with clothes washing. While specific, the discussion has obvious relevance for all designed surroundings and includes various levels of approach which can include a focus on products, results, and needs; and include issues around technology, systems, economics, and perceptions of consumer behavior.

It is argued that achieving optimal environmental gains through design is contingent upon people and on understanding the way in which people respond to their material surroundings. Yet the dominant approaches to ecodesign to date tend to focus on pollution and resource use in production, rather than human choices and actions. In contrast to this, a people focus in ecodesign considers ways of satisfying fundamental human needs and, we would suggest, here lies the greatest potential benefits: different satisfiers have different implications not only for those involved, but also for external factors such as the environment.

A focus on needs and the ways that needs are satisfied does not exclude the design and production of products, services, or systems. Conversely, a focus on the design of products, services, and systems cannot continue without consideration of people's needs. Implicit within this is a requirement to deal with issues underlying consumer actions, to understand behavior in many contexts, and to connect with people's aspirations and expectations.

# Mathematics and Design Education

Oğuzhan Özcan and Lale Akarun

**Introduction**

Many people believe that mathematical thought is an essential element of creativity. The origin of this idea in art dates back to Plato. Asserting that aesthetics is based on logical and mathematical rules, Plato had noticed that geometrical forms were "forms of beauty" in his late years. Unlike his contemporaries, he had stressed that the use of geometrical forms such as lines, circles, planes, and cubes in a composition would aid to form an aesthetics.[1] The rational forms of Plato and the rules of geometry are the basis of antique Greek art, sculpture, and architecture and have influenced art and design throughout history in varying degrees. This emphasis on geometry has continued in modern design, reflected prominently by Kandinsky's geometric classifications.[2]

Mathematics and especially geometry have found increasing application in the computer-based design environment of our day. The computer has become the central tool in the modern design environment, replacing the brush, the paints, the pens, and pencils of the artist. However, if the artist does not master the internal working of this new tool thoroughly, he can neither develop nor express his creativity. If the designer merely learns how to use a computer-based tool, he risks producing designs that appear to be created by a computer. From this perspective, many design schools have included computer courses which teach not only the use of application programs, but also programming to modify and create computer-based tools.

In the current academic educational structure, different techniques are used to show the interrelationship of design and programming to students. One of the best examples in this area is an application program that attempts to teach the programming logic to design students in a simple way. One of the earliest examples of such programs is the Topdown Programming Shell developed by Mitchell, Liggett, and Tan in 1988.[3] The Topdown system is an educational CAD tool for architectural applications, with which students program in Pascal to create architectural objects. Other such educational programs have appeared since then. A recent fine example is the book and program called "Design by Number" by John Maeda.[4] In that book, students learn programming by coding in a simple programming language to create various graphical primitives.

1 Reginald Hackforth, (English translation), *Plato's Examination of Pleasure, The Philebus* (Cambridge: The Cambridge University Press, 1945), 100.

2 Wassily Kandinsky, *Point, Line to Plane* (New York: Dover Publication Inc., 1979).

3 William Mitchell, "The Topdown System and Its Use in Teaching, an Exploration of Structured, Knowledge-based Design" in ACADIA'88 Workshop Proceedings: *Computing in Design Education,* ed. by P.J. Bancroft (Michigan: University of Michigan, 1988), 251-262.

4 John Maeda, *Design by Numbers* (Cambridge, MA: MIT Press, 1999).

However, visual programming is based largely on geometry, and one cannot master the use of computer-based tools without a through understanding of the mathematical principles involved. Therefore, in a model for design education, computed-based application and creativity classes should be supported by "mathematics for design" courses. The definition of such a course and its application in the multimedia design program is the subject of this article.

**Mathematics Instruction in Design Education**

Mathematics courses often are offered in the freshman year, as part of a common scientific core. However, in that case, the students do not consider the subject as a part of their creative development, and regard it as a boring compulsory course: a monotonous repetition of high school subjects. Our aim is the correct placement of mathematics in the context of design education, and the organization of the topics in the course from this viewpoint. In designing the course, we have taken into consideration the following points:

1. Our aim is to highlight the relationship of each topic with design and graphics. The students will place the topic in perspective as to where and in which stage of their design education it fits into.
2. This placement in perspective should be so successful that it will instill an enthusiasm for mathematics. The students should be able to draw parallels between the beauty in design and the mathematical forms that underlie and develop an appreciation for the beauty in mathematics.
3. Most important, the knowledge acquired in this course should enhance and open new horizons in creativity.

We have designed the course with these concerns, and have included topics which are relevant from the viewpoint of design and computer graphics. The subjects in the course are grouped not in the traditional way, but as a designer would need and use them. Each topic in the course is introduced after a discussion of why we need this topic. The discussion is supported by an analysis of specific examples from art and design history, where appropriate. For example, after a discussion of hyperbola, their use in the airport by Saarinen[5] is illustrated. Homework may be assigned to find similar examples from art and design history, and to contrast these examples. The topic is then discussed in detail with the underlying theory; with the specific application being worked out in the form of examples and homework assignments. As a last step, the student visualizes the graphical application of the mathematical concept through the use of an educational program developed for this course in the computer laboratory.

5 Kenneth Frampton, *Modern Architecture: A Critical History* (London: Thames and Hudson, 1992).

**Breakdown of Topics**

We have selected the topics covered in this course from the standpoint of their utility in design and graphics. Table I summarizes these topics. As we have outlined above, in the implementation of the course, we introduce each topic by a discussion of where one might need it. We follow this discussion by an example from art and design history. We analyze this example in depth; and give the students an assignment to research this topic in depth. We then undertake the discussion of the mathematical subject in depth. We select classroom examples and homework assignments from graphical applications. Programming assignments in related topics are assigned in a concurrent course in programming. In this course, our aim is to make use of a visualization tool that has been developed for the course. The laboratory session enables the students to visualize the mathematical forms, and to experiment with the mathematical form in creating new designs using this visualization tool. Here, we discuss in detail how each topic is developed and discussed and what the visualization laboratory module for each topic aims to illustrate.

***Vectors in two-dimensional space:*** The introduction to the course starts with a discussion session: What is the simplest form of all? We show that all forms may be represented as a collection of points, the simplest form of all. Designs involving points, such as the work by Müller-Brockmann (figure 1), are shown. The mathematical counterpart, a vector in two-dimensional (2D) space is introduced. The discussion of vectors continues with norms of vectors, inner products, and angles and leads to different ways of representing lines. We illustrate these concepts with classroom examples of drawing lines with the desired slopes and specific angles. The visualization laboratory module for this topic enables students to experiment with placing points and drawing lines on the screen. Unlike a conventional application program in which the mouse is used, the students are asked to enter x and y coordinates of points, and the slopes and intercepts of lines. Different options enable the students to experiment with random numbers and special functions to specify these coordinates; encouraging them to create different designs using mathematical formulas.

*Polygons:* We discuss the polygon as a graphical primitive, with emphasis on modeling real-world objects. We study polygonal models of real world objects as classroom examples. The discussion of lines already has prepared the basis for polygons. Here, the discussions continue with special polygons: Squares, rectangles, parallelograms, triangles. Special triangles are discussed, and the angles between lines are revisited. The definitions of area, perimeter, and convexity are given. The visualization laboratory module enables students to experiment with drawing polygons with specific

Table I
Course Plan of Mathematics for Design

| **Traditional Mathematical Theme** | **Relationship to Graphics** | **Examples from Art and Design** | **Computer Lab Applications** |
|---|---|---|---|
| Vectors in 2D space; their norms; vector addition and subtraction dot products; explicit, implicit and parametric representations for a line | Points in 2D<br>Lines and Line segments | Paintings by Seurat | Visualization of points, lines and line segments; selection and placement of these primitives in a composition |
| Polygons; convexity; special polygons | triangles<br>squares<br>other polygons | Pied Mondrian<br>Red, Yellow, Green | Visualization of polygons and compositions involving different polygons |
| Quadratic curves; their implicit and parametric forms; tangents to curves | circles<br>ellipses<br>hyperbola<br>parabola | Saarinen's TWA Building[5] | Visualization of these primitives, effect of various parameters |
| Parametric polynomial curves; Bezier curves; tangents to Bezier curves | Freeform curves | Malevich sketches, industrial design at Renault | Visualization of Bezier curves, effect of changing control points, joining different curve segments |
| Boolean operations | Boolean AND, OR and set difference | Spreckelsen and Andreu's Arche de La Defense[5] | Using Boolean operations on Polygons to create compositions involving different colors |
| Matrices; matrix products, inverses ; homogeneous coordinates | transformations<br>rotation<br>translation<br>scaling<br>symmetry | Mondrian and Malevich; | Application of these transformations to the primitives developed: concatenation of different transformations |
| Perspective transformation | Points and lines in 3D<br>Perspective transformation | Perspective examples from Renaissance Art | Visualization of 3D points and lines, development of perspective |
| Vectors in 3D space; Planes; normals, vector cross products | Planes in 3D; polygons in 3D | Wright's Falling Water[5] | Visualization of polygons in 3D. Specifying planes in different ways |
| Polyhedra<br>Booelan operations revisited | Cubes, pyramids, etc | Louvre's Pyramid[5] | 3D visualization of polyhedra |
| Quadratic surfaces | Sphere<br>Ellipsoid<br>Torus | Etienne Boullee's Newton Monument[6] | Visualization of spheres, ellipsoids, toruses, specification and effect of parameters |
| Matrices revisited | transformations in 3D | Architectural examples from Eisenman[5] | Rotation, and scale about an axis; concatenation of transforms in 3D |
| Fractals | Texture | | Mapping texture to primitives |
| Angles between 3D vectors revisited | Illumination shadows<br>illumination models | Francis Coppola's Drakula, Rumble Fish | Effect of placing light sources in 3D space, effects of angles between surfaces and light |
| Interpolation | Animation | Luxo Jr. by Pixar[7] | Specifying interpolating curves for animation |

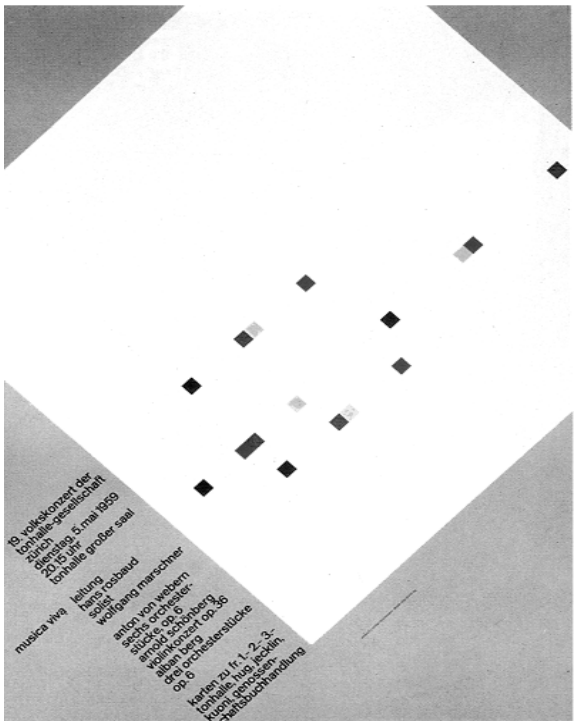


Figure 1
A design involving points and lines, titled *Musica Viva* by Müller-Brockmann.

From W. N. Meggs and E.P. Meggs, *A History of Graphic Design*, 330 (1998.) Reprinted by permission of John Wiley & Sons, Inc.

angles. The students can draw polygons by specifying coordinates of vertices or by specifying angles between edges and length of edges. As an option, the student can specify these parameters in terms of random numbers and special functions, and create designs involving color-filled polygons.

*Quadratic curves:* Discussion on modeling of circular objects leads into quadratic curves. Implicit and parametric representations of circles, ellipses, parabolas, and hyperbolas are discussed. Discussion continues with differentiation of quadratic curves and tangent lines. A possible classroom example is finding the intersection of a line and a circle. The visualization laboratory module enables students to specify parameters such as centers, radii, etc., to draw quadratic curves.

*Parametric Polynomial curves:* The discussion starts with the history of computer-aided design and of Bezier's work at Renault. The representation of freeform curves in terms of cubic Bezier polynomials is discussed. Control points and joining of different curve segments is shown with examples. Visualization laboratory experiments let the students model 2D objects with the selected number of Bezier curve segments.

*Boolean Operations:* More complex objects may be defined by combinations of simple primitives. Boolean operations are introduced for this purpose. Two-dimensional image objects are represented as sets, and union and intersection are defined on these sets. Regularized Booelan operations are defined. The visualization laboratory module enables students to create objects using unions and intersections of closed objects such as polygons and circles.

*Matrices: Copying*, moving, enlarging and rotating objects: These simple transformations are an important part of any drawing program. They can be represented in terms of matrices. Starting from this point, we introduce matrices. Rotation and scale operations are represented as matrix operations. Homogeneous coordinates are introduced and translation operation is represented in matrix form. Concatenation of transformations and matrix multiplication is discussed. Examples are studied to show that matrix multiplication is not commutative. Visualization laboratory examples direct the student to specify parameters of transformation matrices, and to specify the order of transformations to achieve the desired object placement.

*Perspective transformation:* The simplest two primitives studied, points and line segments, are extended to three dimensions (3D). We illustrate the effect of perspective with examples, which show that "further objects look smaller." Perspective transformation is formulated in matrix form. Visualization laboratory experiments enable students to change the position of viewpoint and position of objects, and to see the resulting change in perspective projections of objects.

*Vectors in three-dimensional space:* We extend all the primitives studied to three dimensions. Planes in 3D space are introduced and different ways of specifying a plane are discussed. Cross products of 3D vectors are introduced and plane normals are defined. Nonplanar polygons are illustrated. The visualization laboratory module enables students to visualize planes specified by different methods: by supplying parameters to the plane equation, by specifying three points on a plane, and by specifying a point and a normal vector.

*Polyhedra:* The discussion of polyhedra starts with one of the most famous polyhedral forms: the pyramid. Starting from the pyramid and the cube, we introduce different polyhedra, and state conditions for convexity and simplicity. We show the topological atlas of polyhedra, and define the corresponding data structure. In the visualization lab, students learn to use this data structure to define simple polyhedra. Booelan operations enable the students to define more complex forms.

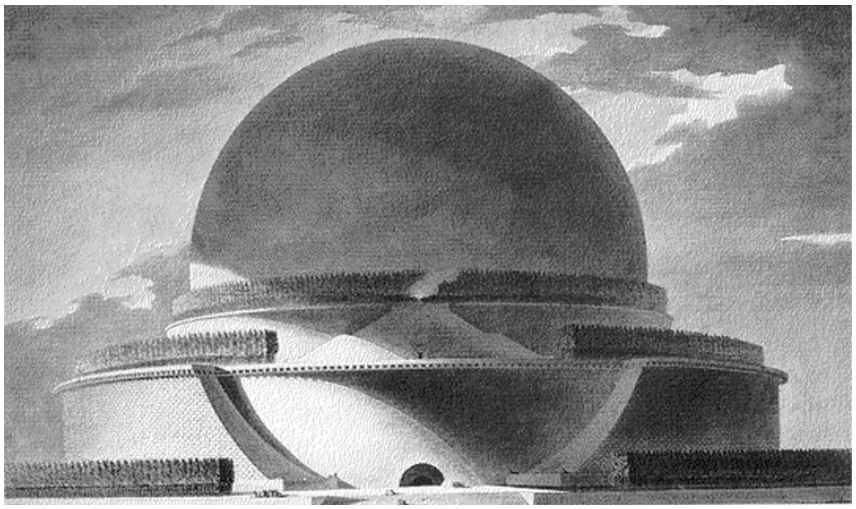

Figure 2
Etienne Boullee's design of a cenotaph for Newton.[6]

*Quadratic surfaces:* Extensions of quadratic curves to 3D yields quadratic sur-faces such as spheres, ellipsoids, and toruses. We discuss the use of these surfaces in architecture (figure 2). The implicit and parametric forms of these surfaces are introduced. In the visualization laboratory, students experiment with parameters to create different forms, and use intersections with each other and with planes to visualize cross sections.

*Matrices revisited:* Transformations defined on 2D are extended to 3D. We define the rotations about coordinate axes and about an arbitrary direction. We illustrate scale along an arbitrary line. In the visualization laboratory, students see the effects of rotations and scale about an arbitrary direction, as well as the effects of transformation order.

*Fractals:* Discussion starts with examples from nature: the texture of leaves, tree branches and microorganisms. Recursive and procedural definitions that mimic this self-similar growth patterns are introduced. Different fractals are discussed. In the visualization laboratory, students create different fractals by supplying rules.

*Angles between vectors revisited:* We discuss the behavior of light and illumination. We introduce simple illumination models as applications of vector operations. Students apply these illumination models in the visualization laboratory and see the effect of angles between surface normals, lighting, and viewing directions.

*Interpolation:* Animation by key-framing is the concept used to illustrate interpolation. We discuss a well-known early example of computer animation by key framing, *Luxo Jr.,* directed by Lassater,[7] as an example (figure 3). Linear, quadratic, and B-spline interpolation is discussed. Selection of keyframes and the interpola-

6 Sketch of a Design for a Cenotaph for Sir Isaac Newton, Bibliotheque Nationale, Paris, 1784 ) A.M. Vogt, *Art in the Nineteenth Century*, 9-10.

7 John Lasseter, "Principles of Traditional Animation Applied to Three-dimensional Computer Animation," *Computer Graphics* 21:4 (1987): 35-44.

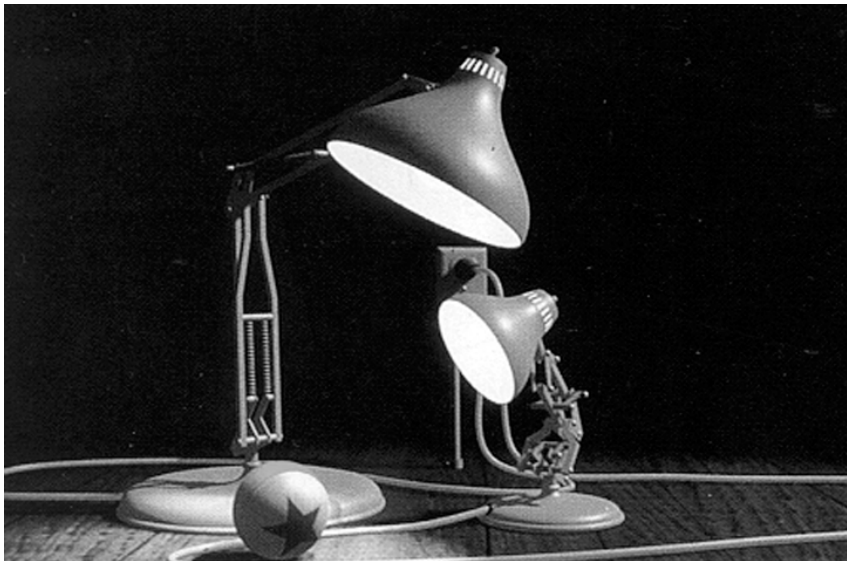

Figure 3
An example of keyframe animation: *Luxo Jr* Directed by John Lasseter. (© Pixar Animation Studios, 1986).

tion function is discussed with examples. In the visualization laboratory, students get the chance to animate simple objects by specifying key frames and interpolation functions.

**Conclusion**

The purpose of the course structure described above is to teach the student the mathematical structure behind "form." We explain the relationship between this mathematical structure and the design components through important examples in the history of art and design, and reinforce this relationship by explaining the underlying mathematical structure behind these examples. The visualization of the mathematical concepts are achieved through a visualization laboratory. A dedicated visualization tool is being developed for this course.

Furthermore, as the related topics are covered, students are reminded of Kandinsky's geometric classifications covered earlier in history of art, basic design, and drawing courses. In that way, students will perceive the mathematical concepts covered in this course not as independent, isolated topics, but as an integral part of all the design education they get; with reference to all of the other courses and topics.

Some difficulties in teaching the course involve the resources: While an instructor with a computer graphics background can teach the course, a second instructor with an art and design history background is needed to give insight into the examples discussed. The course is being offered the second time this year. In order to evaluate the effectiveness of our methods and the degree to which we reach our goals, we plan to do follow-up studies when these students graduate.

We expect that this new way of teaching mathematics to design students, making them analyze the role of mathematics in design applications, will make the course more fun and that the mathematical concepts learned in the course will enhance their creativity.

*Reflection*

# Human Dignity and Human Rights: Thoughts on the Principles of Human-Centered Design

Richard Buchanan

As I walked on the shore of Cape Town to the opening ceremonies of a conference on design in South Africa, I saw through the rain and mist a small sliver of land in the bay.[1] Naively, I asked my host if it was part of the peninsula that extends south of the city or an island. With what, in retrospect, must have been great patience, she quietly explained that it was not "an" island, it was "the" island. I was embarrassed, but I knew immediately what she meant. I spent the rest of the evening thinking about the political prisoners who were held on Robben Island, human rights, and the irony of a conference within sight of Table Bay that seeks to explore the reshaping of South Africa by design.

I was helped in these thoughts by the address of the Minister of Education, Dr. Kadir Asmal, who opened the conference by exploring the meaning of design, the need and opportunities for design in South Africa, and, most importantly, the grounding of design in the cultural values and political principles expressed in the new South African Constitution. I have never heard a high government official anywhere in the world speak so insightfully about the new design that is emerging around us as we near the beginning of a new century. Perhaps everyone in the audience was surprised by how quickly and accurately he captured the core of our discipline and turned it back to us for action. Many of his ideas were at the forward edge of our field, and some were further ahead than we are prepared to admit. For example, I believe we all recognized his significant transformation of the old design theme of "form and function" into the new design theme of "form and content." This is one of the distinguishing marks of new design thinking: not a rejection of function, but a recognition that unless designers grasp the significant content of the products they create, their work will come to little consequence or may even lead to harm in our complex world.

I was particularly surprised, however, by Dr. Asmal's account of the creation—and here he deliberately and significantly used the word "design"—of the South African Constitution. He explained that after deliberation the drafters decided not to model the document on the familiar example of the United States Constitution, with an appended Bill of Rights, but rather to give central importance from the beginning to the concept of human

1 This essay is based on a paper delivered at a national conference organized by the Design Education Forum of Southern Africa, "Reshaping South Africa by Design," held in Cape Town from June 22 to June 24, 2000.

dignity and human rights. Though he did not elaborate the broader philosophical and historical basis for this decision, it is not difficult to find. Richard McKeon, co-chair of the international committee of distinguished philosophers that conducted a preparatory study for the Universal Declaration of Human Rights, explains that the historical development and expression of our collective understanding of human rights has moved through three periods.[2] *Civil and political rights* were the focus of attention in the eighteenth century; *economic and social rights* were the focus in the nineteenth century; and *cultural rights*—formally discovered in the preparatory work for the Universal Declaration—became the focus in the twentieth century. The U.S. Constitution begins with a statement of *political rights,* and the appended Bill of Rights is a statement of *civil rights* protected from government interference. The document was properly suited to the historical development of human rights in the late eighteenth century, and in subsequent evolution the United States has gradually elaborated its understanding of economic and social rights as well as cultural rights. The South African Constitution begins with a statement of *cultural rights,* suited to the current historical period in the development of human rights. It seeks to integrate civil and political rights, as well as economic and social rights, in a new framework of cultural values and cultural rights, placing central emphasis on human dignity. The result for South Africa is a strong document, suited to a new beginning in new circumstances. The opening article of the Constitution, quoted by Dr. Asmal, reminded me of the Preamble of the Universal Declaration of Human Rights, which announces "recognition of the inherent dignity and of the equal and inalienable rights of all members of the human family."

Dr. Asmal's account was both historically important and a conscientious reminder of the cultural context of the conference. However, the next step of his argument brought the room to complete silence. He made the connection between practice and ultimate purpose that is so often missing in our discussions of design, whether in South Africa, the United States, or elsewhere in the world. Design, he argued, finds its purpose and true beginnings in the values and constitutional life of a country and its peoples. Stated as a principle that embraces all countries in the emerging world culture of our planet, design is fundamentally grounded in human dignity and human rights.

I sensed in the audience an intuitive understanding of the correctness of this view, though the idea itself probably came as a surprise because we often think about the principles of design in a different way. We tend to discuss the principles of form and composition, the principles of aesthetics, the principles of usability, the principles of market economics and business operations, or the mechanical and technological principles that underpin products. In short, we are better able to discuss the principles of the various methods that are employed in design thinking than the *first* princi-

2 Richard McKeon, "Philosophy and History in the Development of Human Rights," in *Freedom and History and Other Essays: An Introduction to the Thought of Richard McKeon*, ed. by Zahava K. McKeon (Chicago: University of Chicago Press, 1990).

ples of design, the principles on which our work is ultimately grounded and justified. The evidence of this is the great difficulty we have in discussing the ethical and political implications of design and the consequent difficulty we have in conducting good discussions with students who raise serious questions about the ultimate purpose and value of our various professions.

The implications of the idea that design is grounded in human dignity and human rights are enormous, and they deserve careful exploration. I believe they will help us to better understand aspects of design that are otherwise obscured in the flood of poor or mediocre products that we find everywhere in the world. We should consider what we mean by human dignity and how all of the products that we make either succeed or fail to support and advance human dignity. And we should think carefully about the nature of human rights—the spectrum of civil and political, economic and social, and cultural rights—and how these rights are directly affected by our work. The issues surrounding human dignity and human rights provide a new perspective for exploring the many moral and ethical problems that lie at the core of the design professions.

What is important at the moment, however, is that we may recognize in Dr. Asmal's argument the major tenet of new design thinking: the central place of human beings in our work. In the language of our field, we call this "human-centered design." Unfortunately, we often forget the full force and meaning of the phrase—and the first principle which it expresses. This happens, for example, when we reduce our considerations of human-centered design to matters of sheer usability and when we speak merely of "user-centered design." It is true that usability plays an important role in human-centered design, but the principles that guide our work are not exhausted when we have finished our ergonomic, psychological, sociological and anthropological studies of what fits the human body and mind. Human-centered design is fundamentally an affirmation of human dignity. It is an ongoing search for what can be done to support and strengthen the dignity of human beings as they act out their lives in varied social, economic, political, and cultural circumstances.

This is why Robben Island remained in my thoughts on the first evening of the conference. It reminded me that the quality of design is distinguished not merely by technical skill of execution or by aesthetic vision but by the moral and intellectual purpose toward which technical and artistic skill is directed. Robben Island, site of the prison in which Nelson Mandela and other political prisoners were isolated so long from direct participation in the national life of South Africa, is another symbol of twentieth-century design gone mad when it is not grounded on an adequate first principle. It is a symbol of the wrongful use of design to shape a country in a system that denied the essential dignity of all human beings. Robben Island

belongs with other disturbing symbols of design in the twentieth century, such as the one that my colleague, Dennis Doordan, chillingly cites. He reminds us that the Holocaust was one of the most thoroughly designed experiences of the twentieth century, with careful attention to every obscene detail.

Dr. Asmal's argument carried an urgent message for the work of the conference and for everyone in the design community. Not only is design grounded in human dignity and human rights, it is also an essential instrument for implementing and embodying the principles of the Constitution in the everyday lives of all men, women, and children. Design is not merely an adornment of cultural life but one of the practical disciplines of responsible action for bringing the high values of a country or a culture into concrete reality, allowing us to transform abstract ideas into specific manageable form. This is evident if we consider the scope of design as it affects our lives. As an instrument of cultural life, design is the way we create all of the artifacts and communications that serve human beings, striving to meet their needs and desires and facilitating the exchange of information and ideas that is essential for civil and political life. Furthermore, design is the way we plan and create actions, services, and all of the other humanly shaped processes of public and private life. These are the interactions and transactions that constitute the social and economic fabric of a country. Finally, design is the way we plan and create the complex wholes that provide a framework for human culture—the human systems and sub-systems that work either in congress or in conflict with nature to support human fulfillment. These range from information and communication systems, electrical power grids, and transportation systems to managerial organizations, public and private institutions, and even national constitutions. This is what leads us to say that the quality of communications, artifacts, interactions, and the environments within which all of these occur is the vivid expression of national and cultural values.

We are under no illusion that design is everything in human life, nor do we foolishly believe that individuals who specialize in one or another area of design are necessarily capable of carrying out successful work in other areas. What we do believe is that design offers a way of thinking about the world that is significant for addressing many of the problems that human beings face in contemporary culture. We believe that conscious attention to the way designers work in specialized areas of application such as communication or industrial design is relevant for work in other areas. And we believe that general access to the ways of design thinking can provide people with new tools for engaging their cultural and natural environment.

As we work toward improving design thinking in each of our special areas of application, we also contribute to a more general understanding of design that others may use in the future in

ways that we cannot now anticipate. The urgent message of Dr. Asmal is that we must get on with our work as designers in all of these areas if we are to help in sustaining the revolution that has been initiated in South Africa and the wider revolution in human culture that is taking place around us throughout the world.

# George Salter's Book Jacket Designs, 1925–1940

Claire Hoertz Badaracco

The paradigm of the reader as a "poacher" or intruder on the relationship between the author and text is integral to an interpretation of design in the history of modern book production. As described by the theoretical framework of reception theory, the meaning of the text depends on how an audience receives an objective formula of letters arranged on the page, and the jacket designer could be regarded either as an intruder or as a bridge between the author's intention and the audience's reception. Belonging at once to the interpretive level of the book and to the market forces that led to the production of its meaning as an objective text, the book jacket designer bridged the book and its audience by wrapping the object in an advertisement, targeting the mass market reader. Book jacket designers, then, interpreted the author for the reader: rather than "poach" meaning, the jacket designer drew attention to the practice of reading by visualizing the book's interior. With the rearrangement of type on the page, and with the introduction of "breathing space" between the letters, the "horizon of reception" changed, as cultural historian Roger Chartier noted.[1]

The value of the book encompasses its literary and aesthetic nuance, but it also includes its more tangible surface appeal. Rather than a practice imposing on the readers' silent interaction with a literary narrative whose meaning is determined by "poachers" who steal interpretative elements for their own purposes, the jacket served to confine the space within which meaning was constructed. The importance of the jacket, as one trade journalist commented, had little to do with protecting the book. Rather, it "accompanies the book on its long journey from publisher to reader. In the hands of the book agent, it presents the books to the bookseller, in the shop window to the buyer and, thus, is its own publicity agent." [2]

George Salter was among the most prolific of the commercial designers who applied their talents to the promotion of books, and to the professionalization of the book jacket as a design specialization. Born in Bremen, Germany in 1897, Salter studied at the Municipal School of Arts and Crafts in Charlottenburg between 1919 and 1922, when he started work as a stage and costume designer, completing sets for one-hundred and twenty operas and more than two hundred plays in five years. In 1931, he taught commercial art in the Municipal Graphic Arts Academy in Berlin and, within two years, supervised ten instructors. Salter's stylistic

1 Roger Chartier, *Cultural History: Between Practices and Representations* (Ithaca: Cornell University Press, 1988), 1-23.

2 Charles Rosner, *The Art of the Book Jacket* (Cambridge: Harvard University Press, 1954) xviii; *Jackets Required: An Illustrated History of American Book Jacket Design 1920-1950* (San Francisco: Chronicle Books, 1995).


Figure 1
*Der Tunnel* by Bernhard Kellerman, published by S. Fisher Verlag, c. 1929.

roots were in the "new typography" that evolved from the Bauhaus era. The propaganda value of the book during the Weimar era was equally important to his evolution as a designer. The political power of the book, and its implications for the social order, belonged to the intellectual current of the artistic revolutionaries of the Bauhaus, and the Russian constructivists, suprematists, Italian fascists, and British vorticists. In Berlin between 1927 and 1930, the political value of the public text, particularly its potential power to change the social order by influencing the reader's mind, overshadowed the aesthetic interest held by any design element or nuance of the letter. As one German printing trade magazine reported, "Publishers of political books with extreme tendencies were the first to recognize the possibilities latent in the protective jacket and the first to produce good and striking effects. It was relatively long before more hesitant publishers of *belles lettre* followed their example." [3]

Salter's early jackets completed in Germany for the firm of Fischer demonstrate that he, like Jan Tschichold, had been deeply impressed by the 1923 Weimar Bauhaus exhibition, and earlier experiments by El Lissitzky and Laszlo Moholy-Nagy with the form of the book, including typo-photo (type superimposed on a photo), and the kinetic power that could be conveyed through design, as in *Der Tunnel* by Bernhard Kellermann (see figure 1). Other elements typical of the new typography or plain style that occur in Salter's early work include the rearrangement of the axis of the page, as in the cover for *The 42nd Parallel* by John Dos Passos (see figure 2); the hyper-textual concentration on a single letter or groups of letters, as if disembodied from a narrative or interpretive context, and suspended in space as if fixed by the book's architecture. Salter's affection for the principles of the new typography, though, were tempered by his roots in Germanic script. So we begin to see in his early covers for Fischer the delightful combination of typographic elements in his hand-lettered capitals mixed with calligraphic

3 *Graphik* 38 (Zurich, 1951): 147.

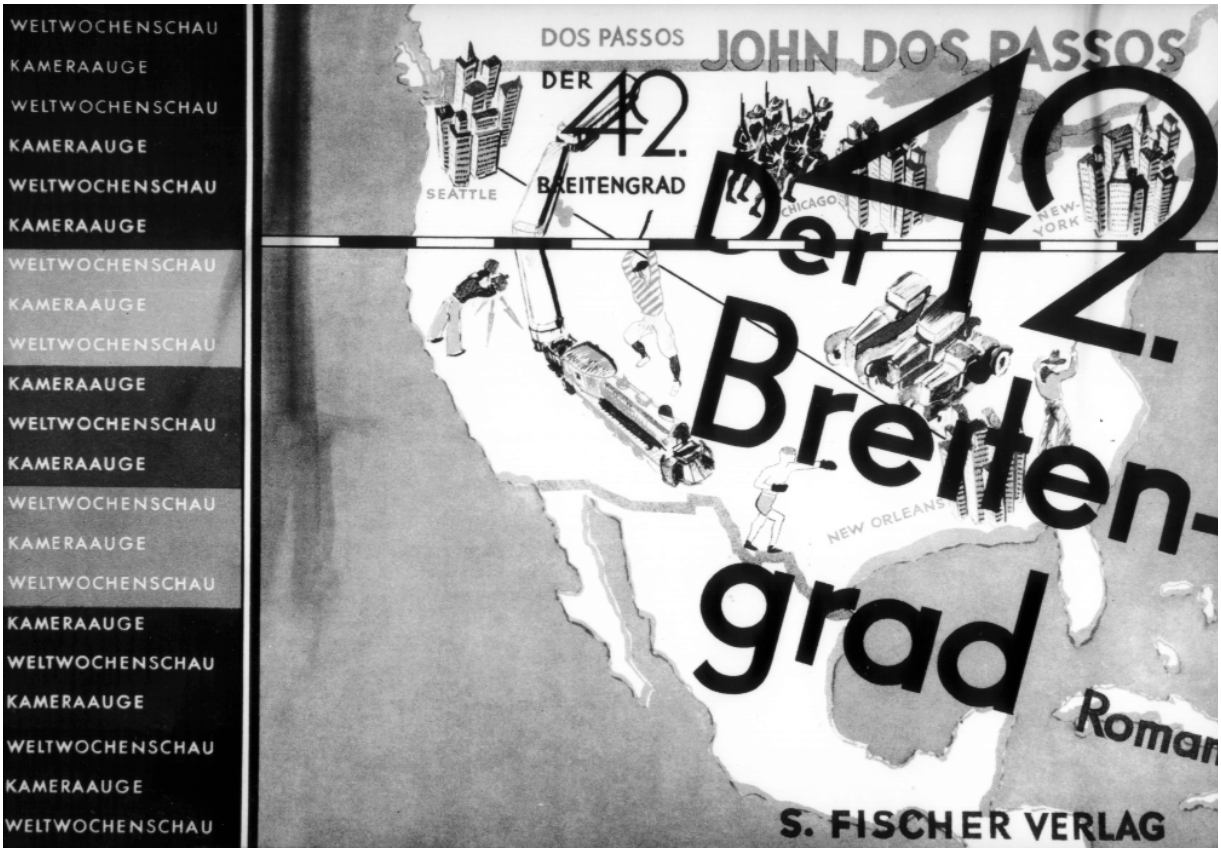


Figure 2
*42nd Parallel* by John Dos Passos, published by S. Fisher Verlag, c. 1929.


Figure 3
Original cover design for *Berlin Alexanderplatz* by Alfred Doblin, published by S. Fisher Verlag, 1929.

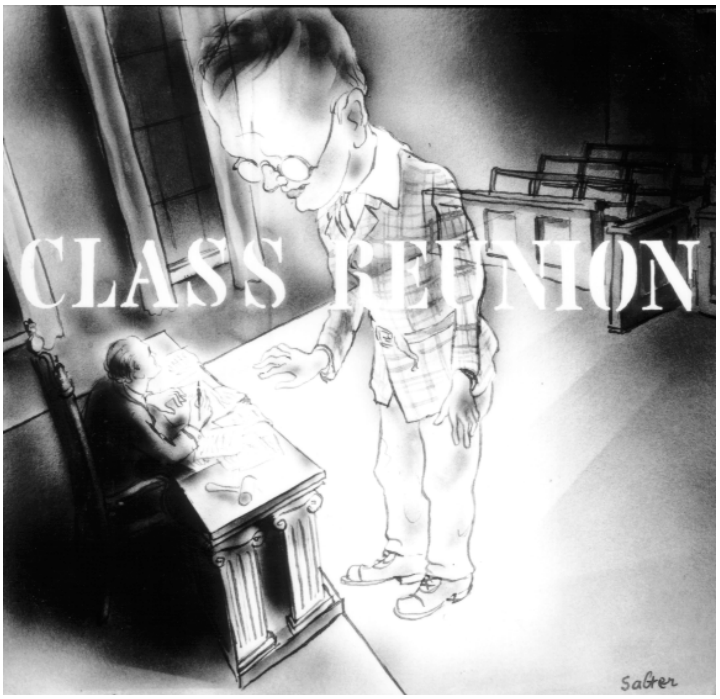


Figure 4
Original cover design for *Class Reunion* by Franz Werfel, published by Mercury Books, 1940.

elements in his type. In Salter's cover for Alfred Doblin's *Berlin Alexanderplatz* (figure 3), for example, the designer demonstrates his fascination with lettering as foreground that superimposes itself as text. In his later work for Alfred Knopf's Mercury label, Salter playfully arranges cartoon and type, counterbalancing the unfinished quality of the drawings with the rough edges and imperfect square of letters (see figure 4).

Salter moved to New York in November of 1934, a year after applying for a license to practice commercial art in Berlin, denied later by the Third Reich on the grounds that he could not be trusted to "cooperate as a commercial artist... in the furthering of German culture with responsibility toward the People and the Reich."[4] When George Salter arrived in the US, propaganda design was easy work to pick up: the language was plain, the purpose simple, and the genre something that pervaded public culture. Among his first assignments in America in 1935-1936 were six government propaganda books published for the Foreign Policy Association, a "nonprofit organization founded to carry on research and educational activities to aid in the understanding and constructive development of American foreign policy." Salter's widely reprinted later work, produced for Knopf's Borzoi label attracted public attention and awards. His greatest achievements were in the 1940s with covers for Knopf, Random House, Fischer, Sheed and Ward, and Little Brown.[5]

According to Sidney Jacobs, Salter knew "ten words" of English when he arrived, and it took him a week to read a manu-

4 Sidney Jacobs, "George Salter: A Profile" *Publishers' Weekly* (June 3, 1939): 2053-56.

5 Ibid.

script. Perhaps his early difficulties with language led him to adopt illustrating the jacket rather than the text of the book, which he could not yet read. According to Jacobs, Salter's younger brother, Stefan, who had been in New York for three years, would read the book aloud, and on the basis of that reading, George would design the jacket. "From an indecipherable German script," according to Jacobs, he developed "a rugged calligraphic hand."[6] Salter had been in America for about a year when Dr. Helmut Lehmann-Haupt invited him to teach at Columbia University. Salter also taught at New York University. He taught book jacket design at the Cooper Union Art School for thirty years. Teaching allowed him to develop the set of principles he incorporated in the "Code of Ethics" for the Book Jacket Designers' Guild, which he was instrumental in forming in 1947.[7]

In 1938, the American Institute for Graphic Arts, along with the London Society of Scribes and Illuminators, mounted an important, trendsetting exhibition in the British Building of Rockefeller Center, displaying the work of three-hundred English and American artists. Trade journalists hailed the exhibit as "New York's first comprehensive showing of calligraphy, illumination, and inscription lettering on wood, stone, gold, silver, and plastic."[8] Francis Meynell, the distinguished printer in England, thought the first exhibition of American book jacket design work so "delightful" that he wrote to request his own copy of the catalog, which represented the work of thirty-two artists. The art director of N.W. Ayer expressed an inter-

6 Ibid.

7 Salter papers, Wing.

8 In 1947, Salter was one of several designers who organized the Book Jacket Designers' Guild in New York. The purpose of the organization was to "raise the standards" of design. Salter, along with his cofounders, established bylaws, a code of ethics for book jacket designers patterned on that articulated by the advertising profession, created a consultation service for young designers to help them learn the business, a publicity committee, and a cultural committee whose activities included, but were not limited to, arranging for exhibitions. At one mid-December meeting in New York, for example, the cultural committee chaired a "two-hour discussion of cultural values from early beginning of time to the present." Because Salter was a teacher, and the Guild's purpose was to instruct as well as preserve principle, the cultural committee set a schedule of six meetings at two-month intervals during its first year to cover the following areas: the history of the book jacket; the content, style, and individuality of expression through the jackets (two sessions); sources and research for their stylization; "The blurb versus the manuscript," weighing the commercial advertising value of the jacket copy against the textual value of the book itself, and last, the function of form: letter, calligraphy, and text.

The Guild announced its existence and celebrated its first organizational year by sending letters to 152 publishers, inviting them to submit entries for the juried, retrospective show, exhibiting jackets from books published between 1940 and 1947. The new professional organization received more than 1,000 jacket submissions for the 250–300 spots in its first juried exhibition. The Cultural Committee afterward reported that all services but $70 had been donated by members of the Guild or contributing publishers.

Reflecting the increase in the number of jackets produced by the industry, the exhibit consisted of the following: eight jackets for 1940; eleven for 1941; fifteen for 1942; twelve for 1943; twelve for 1944; seventeen for 1945; fifty-five for 1946; one-hundred and twenty-four for 1947; a total of two-hundred and fifty-four jackets, almost half produced in 1947. Similarly, the catalog for the exhibition included one selection for 1940; two for 1941; one for 1942; three for 1943; none for 1944; five for 1945; fifteen for 1946; and twenty-one for 1947. Similar patterns could be demonstrated in Guild membership. The catalog displayed one-hundred and seventy-three jackets completed by twenty-nine members of the Guild; and eighty-one by those who did not belong to the organization. Of the two-hundred and fifty-four jackets in the show, forty percent were two-color, and sixteen percent were four-color; the rest were black and white.

The Guild's retrospective was an important exhibition for the new professional network. Its formation and development built upon earlier advances by the American Institute of Graphic Arts' Book Clinic, which selected fifty books each year during the 1930s to stimulate interest in improving the quality of trade book production. Publication of the catalog and news of the jacket exhibition had a ripple effect, according to the Guild's cultural committee report.

est in reprinting twelve jackets from the catalog in an article he intended to write for *Advertising & Selling*, the largest trade magazine in the U.S. read by those in the book publicity industry. Similar requests for specimens to be used in critical reviews and trade journal articles about book jacket design came from *Publishers' Weekly* and *American Artist*, and *Bookbinding & Book Production*. The Society of Typographic Artists in Chicago wanted the exhibition to travel to the Midwest, as did the Arts and Crafts Center of Pittsburgh, and a thirty-week national tour was arranged by the American Federation of Arts in Washington, DC. The exhibition included the work of Alfred A. Knopf, publisher of the Borzoi label: The House of Knopf and Random House (one corporate entity by then) had produced nearly a third of the titles exhibited. The other firms included the university presses of Princeton, Oxford, and Columbia; Sheed and Ward; Macmillan; Farrar Straus; Viking; Doubleday; Pantheon; New Directions; and Little, Brown. The books exhibited the work of typographer and designer William Addison Dwiggins, as well as Paul Rand, Miriam Woods, Jean Carlu, Alvin Lustig, Leo Manso, Jeanyee Wong, and Gene Federico; and the book jackets of George Salter (1897-1967).[9]

Salter, a "second-generation Borzoi enthusiast," worked as art director for Mercury Publications between 1939-1960, in addition to designing the title page for the *American Mercury* magazine, which Knopf published between 1924 and 1934. Salter also designed the jackets for many of Knopf's Borzoi books, along with jackets for more than three-hundred other mass market trade books published by several competitor firms. Knopf's commissions established Salter's presence in the American literary design world, according to book historians, providing the status and connection with a network of prominent artists and commercial illustrators including McKnight Kauffer, William A. Dwiggins, and Oscar Ogg, all part of Knopf's design team. Salter later described the Borzoi brand as a design "mode rather than a fixed graphic form,"—"editorial system" rather than a style. "The good book-jacket is the product of an editorial mind," Salter wrote, "able to extract the essence of the whole contents of the book and project it on the cover in a visual manner. "[10] So enthusiastic was Salter about calligraphy, according to Paul Standard in the *Penrose Annual*, that he "saw no reason why entire books should not again be written out in some agreeable script and so reproduced in quantity like ordinary trade editions." According to the British trade journal, Salter had gone far to prove the point: he wrote out a several page version of Franz Kafka's *The Trial* in calligraphy, and he "felt it only a matter of time before the idea is accepted by many a publisher as routine practice," wrote Standard.[11]

The Borzoi label represented a "planned" work, "produced with the greatest care," according to the designer, and represented stylistic and editorial techniques that left the design "unaffected,"

9 TLS Francis Meynell to BJDG, n.d. but probably 1948. Salter/Wing; Typed report of the BJDG, cultural committee, 1948. Salter/ Wing.

10 Typed manuscript, "There Is a Borzoi Style" (Salter papers). Draft for chapter in published in *AAK Portrait of a Publisher* (George Salter papers). Wing Foundation Collection on the History of Printing, Newberry Library, Chicago. Hereafter referred to as Salter/Wing. See also Joseph Blumenthal, *Printed Book in America* (Boston: David R. Godine, 1977); John W. Tebbel "Design, Printing, and Manufacturing" in *A History of Book Publishing in the United States* .

11 Paul Standard, "Calligraphy in Recent U.S. Book Production," *Penrose Annual* XLII (1940): 1-5.

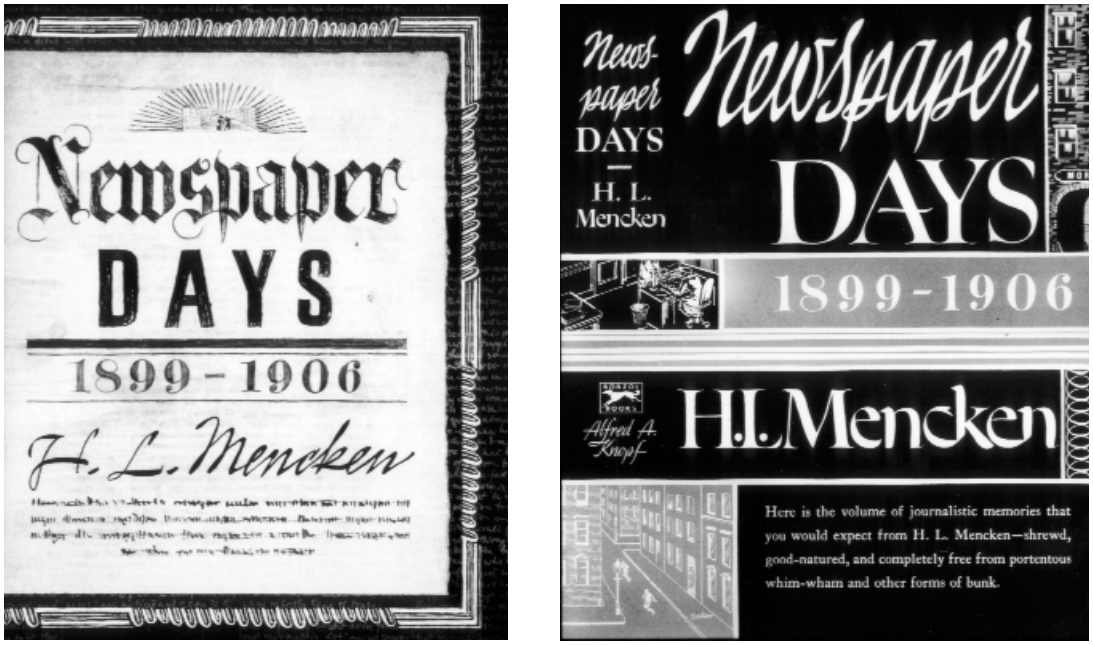


Figure 5
Original cover design and revised cover for *Newspaper Days* by H.L. Mencken published by Borzoi Books, Alfred A. Knopf, 1941.

and the graphic designer free to interpret the meaning of the text, just as any common reader would. Knopf did not "impose his personal taste on the books," according to Salter. The Bozoi style was the "instrument upon which the composition is played, not the composition itself," he wrote. All Borzoi books bore a colophon on the last page giving proper credit to the designer. Salter wrote that Alfred A. Knopf was "the only book publisher in the U.S. who consistently gives credit to his designers in promotion and advertising." [12]

A comparison of the designer's rough and the publisher's final cover design in one case, however, demonstrates how Salter's style changed between Germany and his work in the U.S. The designer's rough for Alfred A. Knopf's edition of *Newspaper Days 1899–1906* by H.L. Mencken provides a rare example of how Salter's work was altered by the Borzoi style. In Salter's original, the title is weighted to the lower left, bridging the spine, with the word "newspaper" in gothic script centered above the word "days" in plain type; the author's name is in calligraphy, and the whole title frame is superimposed over a background of newsprint (figure 5). The Borzoi influence on Salter's drawing substitutes glimpses inside the newsroom and at the exterior of the building for the newsprint, itself, and the title frame is weighted at the top rather than at the bottom of the page. The word "newspaper" is in modern calligraphy, "days" in full capitals, perhaps Times New Roman, in advertising bold, as are the dates and the author's name. The advertising "pitch" reaches out aggressively across the lower right of the cover to the casual reader, promising a memoir that is "shrewd, good-natured, and completely free from portentous whim-wham and

12 Alfred A. Knopf, *Portrait of a Publisher* (New York: Typophiles, 1942, v.2), 280-284; Cathy Henderson, compiler, *The Company They Kept: Alfred A. and Blanche W. Knopf, Publishers: An Exhibition Catalog* (Harry Ransom Humanities Center, The University of Texas at Austin, 1995), 217.

other forms of bunk." The "dust jacket blurb," something the casual reader might expect on the inside of the jacket flap has been moved from the interior to the exterior cover itself: the newspaper as background has been replaced by the advertisement as foreground. This cover, both the original drawing and the revision by Knopf, well illustrates the tension between art and commerce epitomized by the Borzoi label.

Salter and Knopf shared two important "rules" about modern book design: first, the designer was free to interpret the text as a reader, not as a functionary of the publishing house or firm, and that represented a departure from general professional practices. Second, the sexual clichés of Hollywood were not the same as genuine public appeal. In fact, the use of "public appeal" and the cinematic text marks the stylistic difference between Salter's book jacket designs in Germany, in which he used the printing ideas generated by the disciples of the new typography, and those designed for Knopf and other popular American publishers. [13]

Salter noted that when he designed his first book jacket in Berlin in 1927, the idea of a jacket being an active element of the promotional side of publishing books "was still in its infancy." He wrote: "In those days, it was a statement rather than an advertisement, quiet, bookish, and not competitive."[14] Among the greatest advocates of the practice of advertising books through well-designed jackets, Knopf protested, years later, that he could not prove the link between sales and jackets, though publishers claimed that every book with a Salter jacket sold more than 20,000 copies .[15]

The two men, one the publishing giant and son of an advertising man, and the other a commercial designer denied the right to practice by the Nazis, were unabashedly enthusiastic about one another. Salter thought Knopf's work equal to that of the German publisher Fischer and, upon receiving the comparison as a compliment, Knopf replied to Salter, "Putting me in a class with Sammy Fischer suits me down to the ground. I bought my first Fisher book before I went to Europe in 1911." In anticipation of the fiftieth anniversary of the Knopf firm, Salter wrote to the publisher. The publisher remarked at the end of their long professional association that "There are some books which, without his [Salter's] help, would have taken a good deal longer to make the public grade. And there were others... which seemed to have been written so that George could design them." [16] During his lifetime, Salter reciprocated Knopf's high regard, inviting Knopf to address the *Trade Book Exhibit* of the American Institute of Graphic Artists. In Knopf's address, "Good Design Doesn't Cost a Nickel More," he said, "There is not the slightest doubt that every one of the long columns of Knopf books had been chosen for its worth and manufactured with respect for the simple fact that a book, every book, is an image of humanity. The blame for bad or indifferent design does not go to the manufacturing department, but to the publisher who does not

13 Borzoi Style, *AAK*.

14 Ibid.

15 Ibid.

16 TLS Alfred A. Knopf to George Salter, June 19, 1958 and TLS Alfred Knopf Jr. "Pat" to Agnes Salter, Nov. 2, 1967, Salter/ Wing.

concern himself with the physical makeup of his books. Conversely, the credit for qualitative consistency goes to the publisher whose convictions back up his consistent participation in the production of his books. When he feels that design is an integral part of the book... he will make design possible." [17]

The artistic freedom Salter enjoyed in his work with Knopf not only provided him the opportunity to establish a popular reputation for his book jacket design work, but also contributed to the professionalization of an industry. Four years after establishing the Book Jacket Designers' Guild, Salter commented, "Twenty years ago, book jacket assignments were easier to fulfill.... To attract attention was of greater importance than to represent the book. The artist received and accepted complete directives which left little to his ability of interpretation. Today, the book jacket designer is often given the manuscript of his book and also an opportunity to form his own reactions. His function is that of a reader who can express his impressions graphically." [18]

One might conclude, in the context of the reception theory used by cultural historian Chartier, that the book jacket or dust cover of a book forms the constructed page, and that the space between the literary text and the well-designed book, as a material object with marketplace value, occupies the discrepancy between what the author intended at the time of composition, and readers' consumption of its materiality, and that would change over time, depending on the cultural context within which the text was received.

17 ALS George Salter to Alfred A. Knopf, Salter/Wing.

18 Jacobs, 2055.

# Designerly Ways of Knowing: Design Discipline Versus Design Science

Nigel Cross

This is a revised version of a paper prepared for the Design+Research Symposium held at the Politecnico di Milano, Italy, May 2000.

**Design and Science**

I would like to begin this paper with a brief review of some of the historical concerns that have emerged with respect to the relationship between design and science. These concerns emerged strongly at two important periods in the modern history of design: in the 1920s, with a search for scientific design products, and in the 1960s, with a concern for scientific design process. The 40-year cycle in these concerns appears to be coming around again, and we might expect to see the reemergence of design-science concerns in the 2000s.

A desire to "scientise" design can be traced back to ideas in the twentieth century modern movement of design. For example, in the early 1920s, the *De Stijl* protagonist, Theo van Doesburg, expressed his perception of a new spirit in art and design: "Our epoch is hostile to every subjective speculation in art, science, technology, etc. The new spirit, which already governs almost all modern life, is opposed to animal spontaneity, to nature's domination, to artistic flummery. In order to construct a new object we need a method, that is to say, an objective system." [1] A little later, the architect Le Corbusier wrote about the house as an objectively designed "machine for living:" "The use of the house consists of a regular sequence of definite functions. The regular sequence of these functions is a traffic phenomenon. To render that traffic exact, economical, and rapid is the key effort of modern architectural science." [2] In both comments, and throughout much of the modern movement, we see a desire to produce works of art and design based on objectivity and rationality, that is, on the values of science.

These aspirations to scientise design surfaced strongly again in the "design methods movement" of the 1960s. The Conference on Design Methods, held in London in September, 1962 [3] generally is regarded as the event which marked the launch of design methodology as a subject or field of inquiry. The desire of the new movement was even more strong than before to base design process (as well as the products of design) on objectivity and rationality. The origins of this emergence of new design methods in the 1960s lay in the application of novel, scientific, and computational methods to the novel and pressing problems of the Second World War—from

1 T. van Doesberg, "Towards a Collective Construction," *De Stijl* (1923) (Quoted by G. Naylor, *The Bauhaus*, London: Studio Vista, 1968).

2 Le Corbusier, *CIAM 2nd Congress*, Frankfurt (1929).

3 J. C. Jones and D. G. Thornley, eds., *Conference on Design Methods* (Oxford: Pergamon, 1963).

which came civilian developments such as operations research and management decision-making techniques.

The 1960s was heralded as the "design science decade" by the radical technologist Buckminster Fuller, who called for a "design science revolution" based on science, technology, and rationalism to overcome the human and environmental problems that he believed could not be solved by politics and economics.[4] From this perspective, the decade culminated with Herbert Simon's outline of "the sciences of the artificial," [5] and his specific plea for the development of "a science of design" in the universities: "a body of intellectually tough, analytic, partly formalizable, partly empirical, teachable doctrine about the design process."

However, in the 1970s, there emerged a backlash against design methodology and a rejection of its underlying values, notably by some of the early pioneers of the movement. Christopher Alexander, who had originated a rational method for architecture and planning,[6] now said: "I've disassociated myself from the field... There is so little in what is called "design methods" that has anything useful to say about how to design buildings that I never even read the literature anymore... I would say forget it, forget the whole thing." [7] Another leading pioneer, J. Christopher Jones, said: "In the 1970s, I reacted against design methods. I dislike the machine language, the behaviorism, the continual attempt to fix the whole of life into a logical framework. [8]

To put the quotations of Alexander and Jones into context, it may be necessary to recall the social/cultural climate of the late-1960s—the campus revolutions and radical political movements, the new liberal humanism, and the rejection of conservative values. But also it had to be acknowledged that there had been a lack of success in the application of "scientific" methods to everyday design practice. Fundamental issues also were raised by Rittel and Webber,[9] who characterized design and planning problems as "wicked" problems, fundamentally unamenable to the techniques of science and engineering, which dealt with "tame" problems.

Nevertheless, design methodology continued to develop strongly, especially in engineering and some branches of industrial design. (Although there may still have been very limited evidence of practical applications and results.) The fruits of this work emerged in a series of books on engineering design methods and methodology in the 1980s. English-language ones included Tjalve,[10] Hubka,[11] Pahl and Beitz,[12] French,[13] Cross,[14] and Pugh.[15]

Another significant development throughout the 1980s and into the 1990s was the emergence of new journals of design research, theory, and methodology. Again, English-language publications included *Design Studies* in 1979, *Design Issues* in 1984, *Research in Engineering Design* in 1989, the *Journal of Engineering Design* and the *Journal of Design Management* in 1990, *Languages of Design* in 1993, and the *Design Journal* in 1997.

4 B. Fuller, *Utopia or Oblivion* (New York: Bantam Books, 1999).

5. H. A. Simon, *The Sciences of the Artificial* (Cambridge, MA: MIT Press, 1969).

6. C. Alexander, *Notes on the Synthesis of Form* (Harvard University Press, 1964).

7 C. Alexander, "The State of the Art in Design Methods," *DMG Newsletter* 5:3 (1971).

8 J. C. Jones, "How My Thoughts About Design Methods Have Changed During the Years," *Design Methods and Theories* 11:1 (1977).

9 H. Rittel and M. Webber, "Dilemmas in a General Theory of Planning," *Policy Sciences* 4 (1973): 155-69.

10 E. Tjalve, *A Short Course in Industrial Design* (London: Newnes-Butterworth, 1979).

11 V. Hubka, *Principles of Engineering Design* (Guildford: Butterworth, 1982).

12 G. Pahl and W. Beitz, *Engineering Design* (London: Springer/Design Council, 1984).

13 M. J. French, *Conceptual Design for Engineers* (London: Design Council, 1985).

14 N. Cross, *Engineering Design Methods* (Chichester: Wiley, 1989).

15 S. Pugh, *Total Design: Integrated Methods for Successful Product Engineering* (Workingham: Addison-Wesley, 1991).

Despite the apparent scientific basis (and bias) of much of their work, design methodologists also sought from the earliest days to make distinctions between design and science, as reflected in the following quotations.

> Scientists try to identify the components of existing structures, designers try to shape the components of new structures.
> —Alexander [6]

> The scientific method is a pattern of problem-solving behavior employed in finding out the nature of what exists, whereas the design method is a pattern of behavior employed in inventing things...which do not yet exist. Science is analytic; design is constructive.
> —Gregory [16]

> The natural sciences are concerned with how things are...design on the other hand is concerned with how things ought to be.
> —Simon [5]

There may indeed be a critical distinction to be made: method may be vital to the practice of science (where it validates the results), but not to the practice of design (where results do not have to be repeatable, and, in most cases, must *not* be repeated, or copied). The Design Research Society's 1980 conference on "Design: Science: Method" [17] provided an opportunity to air many of these considerations. The general feeling from that conference was, perhaps, that it was time to move on from making simplistic comparisons and distinctions between science and design; that perhaps there was not so much for design to learn from science after all, and that perhaps science rather had something to learn from design. Cross et al.[18] claimed that the epistemology of science was, in any case, in disarray and, therefore, had little to offer an epistemology of design. Glynn[19] later suggested that "It is the epistemology of design that has inherited the task of developing the logic of creativity, hypothesis innovation, or invention that has proved so elusive to the philosophers of science."

Despite several attempts at clarification (see de Vries, Cross, and Grant [20]), there remains some confusion about the design-science relationship. Let us at least try to clarify three different interpretations of this concern with the relationship between science and design: (a) scientific design, (b) design science, and (c) a science of design.

**Scientific Design**

As I noted above, the origins of design methods lay in "scientific" methods, similar to decision theory and the methods of operational

16 S. Gregory, "A Design Science," in S. A. Gregory, ed., *The Design Method* (London: Butterworth, 1966).

17 R. Jacques and J. Powell, eds., *Design:Science:Method* (Guildford: Westbury House, 1981).

18 N. Cross, J. Naughton, and D. Walker, "Design Method and Scientific Method," in R. Jacques and J. Powell, eds., *Design:Science:Method,* (Guildford: Westbury House, 1981).

19 S. Glynn, "Science and Perception as Design," *Design Studies* 6:3 (1985).

20 M. de Vries, N. Cross, and D. Grant, eds., *Design Methodology and Relationships With Science* (Dordrecht: Kluwer, 1993).

research. The originators of the "design methods movement" also realized that there had been a change from the craftwork of pre-industrial design to the mechanization of industrial design—and perhaps some even foresaw the emergence of a post-industrial design. The reasons advanced for developing new methods often were based on the assumption that modern, industrial design had become too complex for intuitive methods.

The first half of the twentieth century had seen the rapid growth of scientific underpinnings in many types of design—e.g., materials science, engineering science, building science, and behavioral science. One view of the design-science relationship is that, through this reliance of modern design upon scientific knowledge, and through the application of scientific knowledge in practical tasks, design "makes science visible." [21]

So we might agree that *scientific design* refers to modern, industrialized design—as distinct from pre-industrial, craft-oriented design-based on scientific knowledge but utilizing a mix of both intuitive and nonintuitive design methods. "Scientific design" is probably not a controversial concept, but merely a reflection of the reality of modern design practice.

**Design Science**

"Design Science" was a term perhaps first used by Buckminster Fuller, but it was adapted by Gregory [16] into the context of the 1965 conference on "The Design Method." The concern to develop a design science thus led to attempts to formulate *the* design method—a coherent, rationalized method, as "the scientific method" was supposed to be. Others, too, have had the development of a "design science" as their aim; for example, Hubka and Eder,[22] originators of the *Workshop Design Konstruction* (WDK) and a major, continuing series of international conferences on engineering design (ICED), also formed "The International Society for Design Science." Hansen[23] had stated the aim of design science as being to "recognize laws of design and its activities, and to develop rules." This would seem to be design science constituted simply as "systematic design"—the procedures of designing organized in a systematic way. Hubka and Eder regard this as a narrower interpretation of design science than their own: "Design science comprises a collection (a system) of logically connected knowledge in the area of design, and contains concepts of technical information and of design methodology.... Design science addresses the problem of determining and categorizing all regular phenomena of the systems to be designed, and of the design process. Design science also is concerned with deriving from the applied knowledge of the natural sciences appropriate information in a form suitable for the designer's use." This definition extends beyond "scientific design," in including systematic knowledge of design process and methodology, as well as the scientific/technological underpinnings of the design of artifacts.

21 R. A. Willem, "Design and Science," *Design Studies* 11:1 (1990).

22 V. Hubka and W. E. Eder "A Scientific Approach to Engineering Design," *Design Studies* 8:3 (1987).

23 F. Hansen, *Konstruktionswissenschaft* (Munich: Carl Hanser, 1974).

So we might conclude that *design science* refers to an explicitly organized, rational, and wholly systematic approach to design; not just the utilization of scientific knowledge of artifacts, but design in some sense as a scientific activity itself. This certainly is a controversial concept, challenged by many designers and design theorists. As Grant [24] wrote:

> Most opinion among design methodologists and among designers holds that the act of designing itself is not and will not ever be a scientific activity; that is, that designing is itself a nonscientific or ascientific activity.

**Science of Design**

However, Grant also made it clear that "the study of designing may be a scientific activity; that is, design as an activity may be the subject of scientific investigation." There remains some confusion between concepts of design science and of a science of design, since a "science of design" seems to imply (or, for some people, has the goal of) the development of a "design science." But the concept of a science of design has been clearly stated by Gasparski and Strzalecki: [25]

> The science of design (should be) understood, just like the science of science, as a federation of subdisciplines having design as the subject of their cognitive interests.

In this latter view, therefore, the science of design is the *study* of design—something similar to what I have elsewhere defined as "design methodology"; the study of the principles, practices, and procedures of design. For me, design methodology "includes the study of how designers work and think, the establishment of appropriate structures for the design process, the development and application of new design methods, techniques and procedures, and reflection on the nature and extent of design knowledge and its application to design problems." [26] The *study* of design leaves open the interpretation of the *nature* of design.

So let me suggest here that the *science of design* refers to that body of work which attempts to improve our understanding of design through "scientific" (i.e., systematic, reliable) methods of investigation. And let us be clear that a "science of design" is not the same as a "design science."

**Design as a Discipline**

Donald Schön [27] explicitly challenged the positivist doctrine underlying much of the "design science" movement, and offered instead a constructivist paradigm. He criticized Simon's view of a "science of design" for being based on approaches to solving well-formed problems, whereas professional practice throughout design and technology and elsewhere has to face and deal with "messy, problematic situations." Schön proposed, instead, to search for "an epis-

24 D. Grant, "Design Methodology and Design Methods," *Design Methods and Theories* 13:1 (1979).

25 W. Gasparski and A. Strzalecki, "Contributions to Design Science: Praxeological Perspective," *Design Methods and Theories* 24: 2 (1990).

26 N. Cross, *Developments in Design Methodology* (Chichester: Wiley, 1984).

27 D. Schön, *The Reflective Practitioner* (London: Temple-Smith, 1983).

temology of practice implicit in the artistic, intuitive processes which some practitioners do bring to situations of uncertainty, instability, uniqueness, and value conflict," and which he characterized as "reflective practice." Schön appeared to be more prepared than his positivist predecessors to put trust in the abilities displayed by competent practitioners, and to try to explicate those competencies rather than to supplant them. This approach particularly has been developed in a series of conferences and publications throughout the 1990s in "design thinking research": Cross et al.,[28, 29] Akin,[30] and Goldschmidt and Porter.[31]

Despite the positivist, technical-rationality basis of *The Sciences of the Artificial,* Simon did propose that "the science of design" could form a fundamental, common ground of intellectual endeavor and communication across the arts, sciences, and technology. What he suggested was that the study of design could be an interdisciplinary study accessible to all those involved in the creative activity of making the artificial world. For example, Simon wrote that "Few engineers and composers... can carry on a mutually rewarding conversation about the content of each other's professional work. What I am suggesting is that they can carry on such a conversation about design, can begin to perceive the common creative activity in which they are both engaged, and can begin to share their experiences of the creative, professional design process." I believe that this is what we have been seeing in the development of interdisciplinary design studies in our journals and conferences.

Design as a discipline, therefore, can mean design studied on its own terms, and within its own rigorous culture. It can mean a science of design based on the reflective practice of design: design as a discipline, but not design as a science. This discipline seeks to develop domain-independent approaches to theory and research in design.[32] The underlying axiom of this discipline is that there are forms of knowledge special to the awareness and ability of a designer, independent of the different professional domains of design practice.

What designers especially know about is the "artificial world"—the human-made world of artifacts. What they especially know how to do is the proposing of additions to and changes to the artificial world. Their knowledge, skills, and values lie in the techniques of the artificial. (Not "the sciences of the artificial.") So design knowledge is of and about the artificial world and how to contribute to the creation and maintenance of that world. Some of it is knowledge inherent in the activity of designing, gained through engaging in and reflecting on that activity. Some of it is knowledge inherent in the artifacts of the artificial world (e.g., in their forms and configurations—knowledge that is used in copying from, reusing or varying aspects of existing artifacts), gained through using and reflecting upon the use of those artifacts. Some of it is knowledge inherent in the processes of manufacturing the artifacts,

28 N. Cross, K. Dorst, and N. Roozenburg, eds., *Research in Design Thinking* (Delft: Delft University Press, 1992).

29 N. Cross, H. Christiaans, and K. Dorst, eds., *Analysing Design Activity* (Chichester: Wiley, 1996).

30 O. Akin, ed., "Descriptive Models of Design Activity," *Design Studies*18:4 (1997).

31 G. Goldschmidt and W. Porter, eds., *4th Design Thinking Research Symposium* (Cambridge, MA: MIT Press, 1999).

32 N. Cross, "Design Research: A Disciplined Conversation," *Design Issues* 15:2 (1999).

gained through making and reflecting upon the making of those artifacts. And some of each of these forms of knowledge also can be gained through instruction in them.

Just as the other intellectual cultures in the sciences and the arts concentrate on the underlying forms of knowledge peculiar to the scientist or the artist, so we must concentrate on the "designerly" ways of knowing, thinking, and acting.[33, 34] Following Schön and others, many researchers in the design world have realized that design practice does indeed have its own strong and appropriate intellectual culture, and that we must avoid swamping our design research with different cultures imported either from the sciences or the arts. This does not mean that we should completely ignore these other cultures. On the contrary, they have much stronger histories of inquiry, scholarship, and research than we have in design. We need to draw upon those histories and traditions where appropriate, while building our own intellectual culture, acceptable and defensible in the world on its own terms. We have to be able to demonstrate that standards of rigor in our intellectual culture at least match those of the others.

33 N. Cross, "Designerly Ways of Knowing," *Design Studies* 3:4 (1982).

34 N. Cross, "Natural Intelligence in Design," *Design Studies* 20:1 (1999).

# "Designing Readers: Redressing the Texts of Classic Drama"

Keren M. Smith

**I. Introduction**

In an essay published in 1992, Roger Wilson suggests that one of the things that characterizes Western theater is its tendency to prioritize the audial at the expense of the visual. Wilson, a director also involved in performance, design, and production aspects of his pieces, is commonly associated with the "theatre of images" group, which seeks to liberate visual and aural imagery from its subservience to the written word. It is the subservient and illustrative relationship of image to text which Wilson believes is responsible for the relatively limited theatrical language in Western theater. By contrast to some Eastern traditions, such as Japanese Noh or Kabuki, theater in the West assumes a play first and foremost to be words: "It's still bound by literature so we think a play is a text, or something that's spoken." [1]

In this article, I want to take up Wilson's challenge by concentrating on the kind of theater in which such a dichotomy is most likely to occur: "classic" theater, whether "classic" refers to the ancient Greek world of Euripides or the renaissance of Greek art and culture that inspired the seventeenth-century Racine. The point is that classic theater often is referred to as such not simply because of its historical time-frame but because of certain assumptions about the enduring excellence of "the text"—faith in its universality and transparency of meaning to any and every audience. In such a context, design could seem to be of secondary, even negligible importance, so long as the actors can act and their lines can be heard. My contention, however, is that it is precisely in such a strongly verbal context that the classical nature of theatre itself, in its alliance of the visible and the intelligible, may be "seen" and appreciated.

As director Peter Brook indicates a play is never, and has never been, simply about "words":

> A word does not start as a word—it is an end product which begins as an impulse, stimulated by an attitude and behavior which dictates the need for expression. This process occurs inside the dramatist; it is repeated inside the actor. Both may only be conscious of the words, but both for the author and then for the actor the word is a small visible portion of a gigantic unseen formation.[2]

1 Robert Wilson in "Bühnen Raum, Stage Space," *Daidalos* 44, (June 15, 1992): 92-101.

2 Peter Brook, *The Empty Space* (Harmondsworth: Penguin, 1990 [1968]), 15.

If we accept this view of a play as being generated by an inner vision or "impulse," a "gigantic unseen formation," then the manner by which this impulse is brought to light and made intelligible obviously is significant. All art, Paul Klee tells us, is about rendering visible the invisible. How much more obvious and needful is this rendering in theater, where the visible has a special tangibility and "presentness" through the sensual medium of the actor's body and voice. On purely historical, linguistic grounds, theater is *theomai:* a matter of beholding, in the old sense of this word which implies not just a seeing but also a sitting up and taking notice; paying careful attention. And *theatron,* in the ancient Greek, was considered an aspect of speculative thought as well as referring to the act of looking, while *thereo,* the one who theorizes, also was called a spectator: *theoros.* Visibility and intelligibility are inseparable in the language and culture from which much of our Western theatrical tradition derives.

The process of making the invisible visible is not restricted to dramatists and actors. The definition of the actor's body and the space in which he moves requires clear and intelligent decisions in the matter of design. However "universal" in action or character, no classic drama can be played exactly as it was first intended. It is impossible to recreate the first theatrical moment, conditions and intentions of the dramatist. Staging therefore must be literally by design: a work of imaginative animation not a reproduction. Choices facing interpreters of the classics may be informed by the additional concern that the time-gap of the "classic" not become an understanding gap. Choosing to represent a play in period costume makes it into an historical play, and this may not be appropriate for the text, especially if it was not originally written with a clear sense of time or place. As Richard Loncraine points out, "Shakespeare never performed his plays in period costume." [3] Similarly, if recent decades have seen a revived interest in modernization-assisted perhaps by the vogue for updated Shakepearean films and quest for "relevance"-contemporary images may prove to be distracting. Ultimately, as most directors and critics would agree, what matters is not old clothes or new but that the classics be "made intelligible in their essence." [4] Even though ideas about what that "essence" really consists of may vary, the question of design is related more to the unseen giant of the dramatic imagination than to the particularities of period, so that the task facing the director is not: "choosing the period of the costumes" but, as Jean-Loup Rivière phrases it, "finding the costumes most able to reveal the question of the work." [5]

In some cases, the director also may fulfill the function of designer. Most often, however, the architecture of space and movement requires the skills and expert knowledge of a designer, whose role in opening up the "question of the work" and making the text "readable" is as important as the director's. The tendency to stress

3 Richard Loncraine in *Cinéaste, Shakespeare in the Cinema Supplement,* 24:1 (1998): 53.

4 Tim Supple in an unpublished interview with K. Smith, June 5, 1998.

5 Jean-Loup Rivière, 'Le coût du vent,' program notes for the Comédie-Française production of *Iphigénie*, 1992: 14.[Author's translation.]

the director at the expense of the designer suggests an ignorance of the theatrical process, and is the result of a false conceptual opposition between word and spectacle. David Whitton notes the rise to prominence of the director as one of the defining features of recent French stage and cinema history.[6] One of the reasons such an imbalance has persisted is, perhaps, the result of a certain suspicion of the ocular, evident in such works as Odette Aslan's study of director Roger Blin. In this work of criticism, Aslan praises Blin for his loyalty to "textual theater," where the audience is made conscious of the "primacy of listening," and of the actors as "carriers of words" over and above their function as "expressive bodies." Referring to Blin's "uneasiness" with the "distance" between the original project and "its concretization in space," she concludes:

> Concretization is a barbarous word for the visionary poet/painter who dreamed of an almost abstract support for his play, and who suddenly sees a materialized ground […] The artist-designer in his studio had prepared an esthetic and functional object; the director had turned over ideas and worked with the minds and bodies of the actors. Suddenly his stage is invaded.…[7]

Apart from the apparent devaluing of the physical nature of theater in Aslan's dream of abstraction, her remarks seem to imply that the designer is a being of inferior understanding in the matter of texts and actors. Aslan is not alone in this assumption. French *créatrice de costumes* for stage and screen, Yvonne Sassinot de Nesle, was only reluctantly given equal prominence in the credits for *Swann in Love* alongside director, Peter Brook, despite the fact that her work entailed equally detailed research into the text and close interaction with the cast. In the chronology of David Williams's book *Peter Brook, A Theatrical Casebook,* (1988) writers of the screenplay for the film (Brook, Carrière, and Estienne) and the principal actors (Muti, Irons, and Delon) are mentioned, but the name of the designer is not.[8] Although she is happy to describe the director as the "maître d'œuvre," Mme Sassinot de Nesle received a César award for her costumes for *Swann in Love.* She was the first designer in French cinema history to do so: an important victory in an art form whose critics occasionally have reflected the same imbalance Wilson deplores in theater.

Contrary, then, to explicit or implicit judgments about the importance of the designer, I would contend that, through an informed knowledge of the text, the designer is indispensable to sensitive visualization, and concretization is not "barbarous," but fundamental to classical theater. The designer is, in short, a visual director responsible for formulating the image-based language of the stage, which must acquire its own coherence if it is to serve the coherence of the text.[9] In the following study, the first production referred to is the work of a designer who also is a director, a clear

6 In his *Stage Directors in Modern France* (Manchester: Manchester University Press, 1987) David Whitton describes the last forty years in France as the history of the emergence of directors "for whom the text is more a pretext for the expression of their own aesthetic, metaphysical or ideological vision." viii.

7 Odette Aslan, *Roger Blin and Twentieth-Century Playwrights* trans. Ruby Cohn, (Cambridge: Cambridge University Press, 1988), 9, 5, and 7.

8 David Williams, *Peter Brook. A Theatrical Casebook* (Methuen, 1988).

9 New Zealand set designer and Senior Lecturer at VUW School of Architecture, Dorita Hannah, is one who sees the designer as a "visual director." Lecture at Victoria University, March 1999.

testimony to the fact that designing is an interpretative and creative activity, and not simply a matter of props and costumes.

**Kokkos: *Iphigénie***

Yannis Kokkos, himself Greek, always has accepted the Greek alliance of form and meaning, describing the designer as one who conjugates "the inner mystery with visibility, with an objective vision." [10] For Racine's *Iphigénie* at the Comédie-Française (1991), Kokkos assumed, for the first time, the dual role of designer and director, a role which enabled him to fully realize his belief in the theatrical partnership between materiality and the visions of the inner eye: "Being a scenographer," he explains, "also is one way of being a director. My scenographical propositions have never been solely plastic. They have always involved a personal interpretation of the work." [11]

The stage for this production is almost entirely bare, lit with intense walls and fingers of light that reveal at once the drama of heat and marble that was the twentieth-century idea-image of Greece, and the stark simplicity that is Racinian tragedy. It also forms a near whiteness of space against which the forms of the actors can move with symbolic power. Costumes are of a "classical" elegance, mobile draperies clothing the women and covering the military dress of the men. Their simple lines evoke the ancient toga, while allowing for a structuration of the body that is at once, mobile and symbolic. The cloth wound around the body is free enough to follow its movement, concretizing for a moment its direction and impetus, and sketching in space its anger or despair.

A sense of movement is one of the most noticeable features of Kokkos's preparatory drawings also, which he never finishes in the manner of an illustration, but leaves incomplete; an idea in suspension, awaiting the completion of the actor's body, while suggesting the dynamism of theater which is incompatible with complete or closed forms. (figure 1) He thinks on paper as he later will think in the three-dimensional space of the stage: "It allows me to keep the ideas fluid, to maintain a sense of movement and integrate this constantly into the way the performance is conceived." [12] At the same time, the actors whose forms become part of a moving frieze, occupy a particular symbolic space in Racine's drama. Color reflects their essential character and predicament: Iphigenia in white, Clytemnestre in red, and Eriphile, the one fated to the double death of suicide, in black.

Like the choreography of movement, the language of color is all the more clearly articulated because of the relative simplicity of the stage: almost but not quite bare. Stage right is a slab of rock which remains throughout, a mute reminder of what is to come, and a rough-hewn altar of sacrifice and of marriage that repeats the irony of Achille's line to Iphigénie: "You are destined by your father for the altar." (III, iv) Beside this rock, Kokkos also has Clytemnestre

10 Yannis Kokkos in *Le Scénographe et le Héron* Georges Banu, Actes Sud, Arles, 1989, 41. [Author's translation.]

11 Yannis Kokkos in "Yannis Kokkos l'Athénien," *La Croix* (October 21, 1991).[Author's translation.]

12 Kokkos, *Le Scénographe et le Héron,* 16. [Author's translation.]

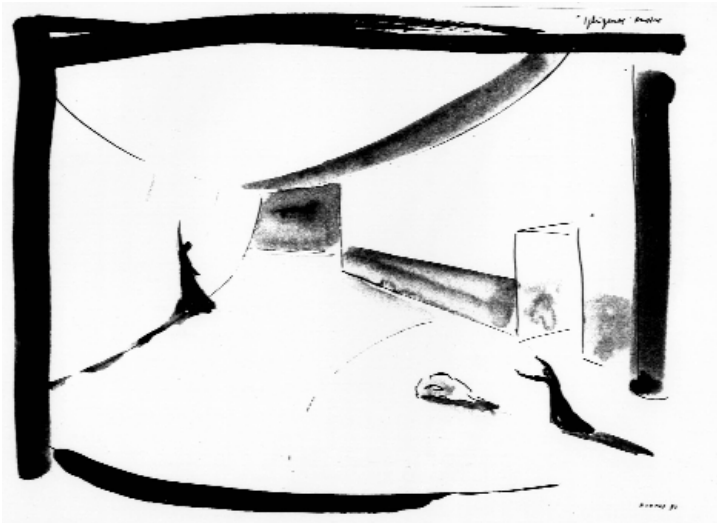

Figure 1
Preliminary designs for *Iphigenia*, Strasbourg, 1991, Comédie-Française, 1992. Direction, set, and costumes: Yannis Kokkos. Reproduced with the permission of the designer, Yannis Kokkos.

crouch in pain, a waiting menace of rage. Objects such as this acquire a symbolic, almost iconic, status in Kokkos's work, and in their essential simplicity, combined with their powerful symbolism in relation to the work, they form recognizable elements of Kokkos's stage language.

It is the great length of cloth suspended above the stage, however, which is the perfect realization of Kokkos's aim to find and reveal to the audience what he calls the "secret geometry of the work." This watermarked expanse of canvas, slackly hanging over the heads of the actors, provides, in a single image, both the tent from Racine's only stage direction ("The scene takes place in Aulis, in Agamemnon's tent") and the lifeless, salt-stained sails of the ships, waiting for the wind. The sense of foreboding that broods over the characters, entrapping them in a fateful destiny, is there before our eyes. Even Kokkos's manner of speaking of this "secret geometry" is a reminder of something self-evident to a scenographer, namely, that a work has an underlying shape and design. The latter is not merely a matter of philosophical or ethical ideas as Rivière's reference to the "question of the work" might imply. It is a matter of a vision conjuring up powerful images which demand physical actualization.

The abstract, atemporal nature of cloth, stone, and canvas mean that Kokkos's stage geometry may be responded to and completed by the spectator in the same way that his sketches are completed by the bodies of the actors. *Iphigénie* is the story of a father sacrificing his child to satisfy a call for blood linked implicitly in the text to biblical images of expiatory sacrifice and Jansenist doctrines of predestination. It also tells of a demand for carnage that is political. At the time of rehearsals at the Comédie-Française, the Gulf war had broken out. In Iran, as in the United States, sons were sacrificed by their political "fathers" to serve the call of dubious

nationalistic oracles. Parallels were made by spectators of the play without these having been made explicit by the designer:

> […] this near-fanatical hunger for sacrifice, may… be seen as a very contemporary metaphor, one towards which Kokkos guides us, albeit discretely, at a time when everywhere, not only in Iran, children are sent to die in wars instigated by adults.[13]

Kokkos's atemporal set thus is open to comparisons, but these are made through association and an effort of creative reflection on the part of the spectator. What Kokkos calls the esthetic barrier separating us from Racine—again, from the designer's point of view the question of relevance is an aesthetic question, based on the assumption that a vision of the world also will shape and organize the world in a tangible style—is not lifted through overt translation from one period to another, but through the creation of an open, symbolic space that allows for a free association between periods.

If a choreography of color and gesture forms the basis of many of Kokkos's productions of classic plays, a 1995 production of Racine's *La Thébaïde* established a more overt dialogue than the 1991 production between ancient and "modern" worlds.[14] Kokkos described the décor merely as: "the antechamber of a Mediterranean palace which opens onto an exterior of rooves, ruins, and modern apartment buildings." What the interchange of spaces actually comprised was a Greco-Roman architectural backdrop on which is superimposed a Poussin-style fresco: a "classic" image of violence recalling the *Rape of the Sabines*. Down right, a pillar dominates; left, a great white wall, in which a jagged opening has been torn, as by a bomb-blast, the careful debris of the whole downstage area evoking both the timeless devastations of the passions and the scarred spaces of twentieth-century warfare. If critics drew parallels at the time between Racine's Thebes and Sarajevo, or even the political fracas between Jacques Chirac and Edouard Balladur shaking the Élysée palace, the effort of imaginative identification is left up to the audience.

For here again, what captures the eye are not facile correspondences or literal images of the action, but timelessly simple, symbolic form and shadow, while Kokkos plays with the drama of light to reveal the spiritual vision of the work, and fix in the mind of the audience the play's principal emphasis on conflict. (figures 2 and 3) At the same time, if the huge gutted wall makes the underlying "question" of the work consciously intelligible, the stage space as a whole retains its own beauty and coherence. In allowing for the freeplay of historical association, Kokkos also creates a stage world that has a reality and mythical power which function parallel to the text—a co-creation rather than an illustration of the text's meaning. The language of stage imagery creates a form of scenic writing more immediate than the words themselves, in so far as, like all imagery,

13 Chantal Aubry, "Racine à l'Heure du Golfe," *La Croix,* (October 25, 1991).[Author's translation.]

14 *La Thébaïde,* Comédie-Française 1995, Mise en scène, décor, and costumes, Yannis Kokkos; with Assistante décor, Muriel Trembleau; Assistante costumes, Lili Kendaka.

Figures 2 and 3
Photographs by Didier Lefèvre for the Comédie-Française production of *La Thébaïde*, 1995. Direction, set, and costumes: Yannis Kokkos.

it impacts on the unconscious mind and has the capacity to "enter (the spectator) before they (have) a chance to defend themselves against it." [15] Kokkos's scenography not only replaces the lost social context of Racine's original, but also provides an entrance point, a door of the imagination for the contemporary spectator into a seventeenth-century world. The magic of the theater thus is able to perform its ritual of both displacement from the everyday world and enticement into the world of the drama, assisted by the scenographer's art.

**Théâtre du Soleil: *Les Atrides***

Ariane Mnouchkine's production of Euripides's *Iphigénie* provides a second major example of how design may actualize dramas of the past for a modern audience.[16] In this instance, we are dealing with the ancient Greek world of Euripides, rather than the more refined intellectualism of Racine.[17] And Mnouchkine is a director first and

15 Anne Michaels in an interview in *The Evening Post* (March 13, 1998).

16 1990 production of Euripides's *Iphigénie à Aulis* (part of the *Atrides* sequence which included *Agamemnon*, *The Libation Bearers* and *The Eumenides* by Aeschylus, translated by Ariane Mnouchkine).

17 Note Racine's reaction to the "shamefully sullied" altar of Diana in most ancient Greek versions of the *Iphigenia* story: "How could I possibly have sullied the stage with a horrible murder of so virtuous and lovable a person as Iphigenia necessarily had to be in this play?". Racine's "Preface to Iphigenia," *Iphigenia/Phaedra/Athaliah*, trans. and intro., by John Cairncross, (Harmondsworth: Penguin, 1970 [1963]), 50.

foremost rather than a designer. Nevertheless, Mnouchkine's conception of space in this production is worked out organically and in close conjunction with the inspiration of Nathalie Thomas and Marie-Helene Bouvet (costumes), and of Guy-Claude-François (set). The actors also play a part in the assembling of their final dressing up, adding details and embellishments of their own, and thus making this a particularly cooperative company in pursuit of a democratic art.[18] If the designers are not as vocal as the director in articulating the ethos of the company, the kind of distinct, even competitive, separation of designer and director as is implied in Aslan's commentary, is irrelevant in this strongly community-based company.

Where Kokkos develops a spatial vocabulary which involves light, sound, and movement, Mnouchkine provides a clear example of so-called total theater, where visual, audial, and textual are closely interwoven. Music for *Les Atrides* production, of which *Iphigénie* is a part, is composed and performed by Jean-Jacques Lemetre. It is impossible to separate this specially commissioned music from the musicality of Euripides's text. The rhythm of feet beat out the choreography of passion in stylized movements which betray a company strongly influenced not only by the East, but also by the Commedia dell'arte tradition, where physical gesture is a language as important as the written word. With the chief visual impact of the production deriving precisely from the moving mass of color and form that is generated by this emphasis on sound and movement, the set clearly is not a matter of props, lighting, and scenery. It extends to include the acoustic and dynamic spaces defined by the music and dance. This brings the Soleil production of Euripides within the boundaries of performance art, a style of theater that has been accused of sacrificing text to spectacle in the creation of a new work from the author's play. It also brings it closer to Robert Wilson's ideal, which is that visual and audial should be at least equal partners in a performance where theater, as *theatron*, is not sacrificed to text.

Not surprisingly, Mnouchkine, like Wilson, looks east for theatrical inspiration, citing Artaud's view that, at heart ,"Theater is oriental." [19] While disclaiming equivalent knowledge or training in comparison with a tradition where, "The actors start at the age of six" and acquire a training established over thousands of years which includes exercises for every part of the body "from the eyeball to the toes," [20] Mnouchkine affirms the importance of the oriental emphasis on the actor as mover as well as reciter. Elements of Kabuki, Nô, and Kathakali are evident in most of her productions. Essentially, oriental art is symbolic not mimetic, and this axiom is considered basic to oriental theater, where movement and delivery are learned disciplines and the performance space reveals its artificial nature to the spectator.

18 For a description of the way the costume is a product of an evolutionary process, as well as of design, see 47-48 of *Dresser un monument à l'éphémère, Rencontres avec Ariane Mnouchkine*, Josette Féral, Editions Théâtrales, 1995, Paris.

19 Mnouchkine, in *Dresser un monument à l'éphémère*, 49. [Author's translation.]

20 Mnouchkine, 49.

Figure 4
The Coryphaeus, played by Catherine Schaub in *Iphigenia in Aulis* as part of *Les Atrides*, performed by the Théâtre du Soleil in 1990. Set: Guy-Claude François, and costumes: Nathalie Thomas and Marie-Hélène Bouvet. Photograph reproduced with the permission of the photographer, Michèle Laurent.

Figure 5
Statues by Erhard Stiefel for *Les Atrides* at the Théâtre du Soleil, 1990. Set: Guy-Claude François, and costumes: Nathalie Thomas and Marie-Hélène Bouvet. Photograph reproduced with the permission of the photographer, Michèle Laurent.

The chorus in Mnouchkine's *Iphigénie* are the most suggestive of eastern influence in their massed, mesmeric dancing. Their role in the drama also is overtly artificial; while their commentary on the action provides an inbuilt alienation effect in terms of the audience's ability to perceive the action as "realistic." It was Nietzsche who first apprehended the chorus's anti-naturalistic, "theatrical" potential, when he described their use in ancient Greek drama as "the decisive step by which war is declared openly and honorably against all naturalism in art." [21] The beauty of the costumes and dance formations in Mnouchkine's production further contributes to the effect of what Nietzsche would call the redeeming power of illusion,[22] where the satisfying coherence of color and line acquires a cathartic function in relation to the visceral agonies played out on the stage. It is not entirely coincidental that the chorus leader, the coryphaeus, wears a costume of particularly intricate beauty (figure 4).

Nevertheless, Mnouchkine does not, like Nietzsche, invite us to be arrested by the beauty of the surface, the "skin, the fold of appearance." Nor in this spectacle, where visual beauty plays almost a transcendent role, does she seek to diminish the textual. In so far as she speaks of beauty directly, it is still of the beauty of the

21 Friedrich Nietzsche in *The Birth of Tragedy and The Case of Wagner*, trans. Walter Kaufmann (New York: Random House, 1967), 58.

22 Nietzsche, 45.

work, and so, of the text, just as she speaks of respect for the audience before whom the work is performed: "Nothing must supersede the beauty of the work and respect for the public.…" [23] Even in this context of "total" theater, then, the word is given a certain preeminence, while being perceived from a different perspective which requires an alternative mode of perception from the audience.

The concern for text and spectator is carried over into the definition of space in the designs of Guy-Claude François (set) and Erhard Stiefel (sculptures). Actors are required to approach the stage at the beginning of rehearsals with a respect bordering on religious awe, touching the objects and surfaces with respectful care. For this production, the open arena of the stage is roughly boxed by an interrupted line of walls, like the underground complex of an amphitheater. In the adjacent space, an archaeological set is created out of clay statues, comprising a series of ancient warriors with their horses which rise out of the "dig" of four "excavations." (figure 5) But the figures are not Greek. They could be Chinese or Abyssinian. What is important is their evocation of an ancient world which jolts the spectator out of their present reality into the mythological space of the drama. This is achieved through a symbolic rather than a precise, representational language.

As was apparent from Kokkos's work, then, so in the Théâtre du Soleil, it is clear that good design creates its own language, and its own imaginative frame of reference. In an age that has been only too ready, after Lacan, to posit that the unconscious is structured like a language, it should not be seen as surprising or inappropriate that, in an art form that deals with the most powerful impulses of human beings, the visual will create its own insistent forms of intelligibility that will interrelate with the written word. The wealth of documentary evidence assembled in the Cartoucherie foyer testifies to serious "intellectual" research informing the production, and to the ultimate aim to "reincarnate Greek theater, so that what happened two thousand years ago happens again in the theatre now." But accurate recreation is acknowledged as both impossible and incompatible with the company's aesthetic. As Mnouchkine asserts with respect to the costumes: "I asked specifically for them to avoid the Greek "look," because we don't know what Greece was like then, and I didn't want to end up with a lot of bed-sheets." [24] The artificial, created nature of theatrical space is foregrounded, and this is what has enabled the company to continue to develop its own stylistic language. This language is reflected in the actors' mode of delivery—not simply Eastern but multi-accented from their multinationalities—and in the set and costumes which also combine elements from diverse cultures and histories in a distinctive, coherent manner. Repeated selections of color and line help to create a stage mythology that is unique to this company, while also providing the key to the function of design in the whole experience of theater generally.

23 *Dresser un monument à l'éphémère*, 60. [Author's translation.]

24 *Dresser un monument à l'éphémère*, 48. [Author's translation.]

Each of the director-designers considered here have worked within the Western tradition of a strongly text-based theater. Their designs have entailed a certain response to the "meaning" of a classic text, to their perception of its essential question. Mnouchkine speaks of "respect" for the text, and Kokkos of its "secret geometry." In this regard, they do not, perhaps, go quite as far as Wilson, who in his image-based theater, sometimes will pursue the image to the point of its disjunction with the word. Nonetheless, as Mnouchkine points out, Western and Eastern traditions, in their respective emphases on the audial and the visual, need not be as opposed in their aims and effects as Wilson suggests: "We have this tradition of the written word, which need not, however, be opposed to the other kind of tradition." [25] If the Théâtre du Soleil represents the ideal of a company actively seeking to incorporate influences from both traditions, Kokkos approaches design from the point of view that the word has no life until it is "made flesh," and that this flesh must assume its own coherence. For, although design may be developed in relation to the text, unless it possesses an alternative form of readability, it will prove either a garbled distraction or an irrelevance. If these are, in some respects, inescapably "Western" terms of description they also are Wilson's own, when speaking of the process of style endemic to all art: "You start with a gesture and another gesture, and you end in a language." [26]

Design, then, must "speak" with and alongside the text, which, in theater, must be seen to be believed.

25 *Dresser un monument à l'éphémère*, 50. [Author's translation.]

26 Robert Wilson in "Bühnen Raum, Stage Space," *Daidalos* 44 (June 15, 1992): 92-101, 97.

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# Softening Up the Facts: Engineers in Design Meetings

Peter Lloyd and Jerry Busby

## 1 Engineering Design in Theory and Practice

Engineering design is, perhaps, the most consistently complex of design processes—both in terms of the technical problem solving involved and the huge numbers of people having to communicate with each other in the average project. In a recent book describing the design and development of the Ford Taurus, for example, the author estimates 300 people were involved in producing a product with 30,000 parts.[1] It is self-evident, then, that engineering problems require both technical and social expertise. However, perceptions of engineering designers generally tend to simplify their character and role within a social and societal context. Although they often have a fine understanding of technical issues (allied with an uncanny ability to use computers effectively) this reasoning goes, they lack the social skills necessary for "good" communication, and tend to be reactionary or simply dull.

There is, however, a growing body of work recapturing something of the "humanity of engineering design," often by concentrating on the epistemology of practice,[2] but also by studying and documenting the highly specialized ways in which social interaction mediates technical problem-solving processes.[3] By refocusing on these aspects of engineering design *as it is experienced,* an identifiable constructivist approach has begun to emerge (drawing from, for example, the work of Donald Schön and Nelson Goodman[4]). This approach has arisen in opposition to rather Taylorist notions of "engineering design science," [5] which holds that good engineering design is a result of following a normative set of scientifically determined procedures. Schön terms these notions pejoratively as "technical rationality." [6] They usually are voiced by stressing a way of working over the qualities of the people carrying out the work. The following quote provides an impression of a process "waiting to happen":

> By identifying and quantifying factors that affect critical element positions early in the configuration design stage, a design team is in a better position to specify a configuration that accommodates all the critical relationships necessary for function in a machine.[7]

1 M. Walton, *Car: A Drama of the American Workplace* (New York: W.W. Norton & Company, 1997).

2 S. Florman, *The Existential Pleasures of Engineering Design* (2nd Edition) (New York: St. Martin's Press, 1996), E.S. Ferguson, *Engineering and the Minds Eye* (Cambridge, MA: MIT Press, 1993); J.E. Holt, "The Designer's Judgment," *Design Studies* 18 (1997): 113-123; D.A. Schön, "Designing: Rules, Types, and Worlds," Design Studies 9 (1988): 181-190; W.G. Vincenti, *What Engineers Know and How They Know It: Analytical Studies From Aeronautical History* (Baltimore: John Hopkins University Press, 1990).

3 L.L. Bucciarelli, "An Ethnographic Perspective on Engineering Design," *Design Studies* 9 (1988): 159-168; L.L. Bucciarelli, *Designing Engineers* (Cambridge, MA: MIT Press, 1994); K. Grint and S. Woolgar,*The Machine at Work: Technology, Work, and Organization* (Cambridge, UK: Polity Press, 1997); T. Kidder, *The Soul of a New Machine* (Harmonsworth, UK: Penguin, 1981); S.L. Minneman, *The Social Construction of a Technical Reality: Empirical Studies of Group Engineering Design Practice* (Ph.D. thesis, Stanford University, 1991); and [9]M. Walton, *Car: A Drama of the American Workplace.*

4 D.A. Schön, *The Reflective Practitioner* (London: Temple Smith, 1983); and N. Goodman, "Words, Works, Worlds" in *Ways of World Making,* N. Goodman, (Indianapolis: Hackett Publishing Co., 1978), 17-29.

5 V. Hubka and W. Ernst Eder, "A Scientific Approach to Engineering Design," *Design Studies* 8 (1987): 123-137; and G. Pahland and W. Beitz, *Engineering Design* (London: The Design Council, 1984),6.

The unnamed "design team" has only to execute this process correctly. There is a clear indication that the correctness of this method applies independently of the people who find themselves in this design process, and who are then bound either to be passive or to be wrong.[8]

This kind of "scientific" view contrasts very strongly with anyone familiar with the average engineering design meeting. The participants usually are anything but passive, often using a variety of means to get their point of view across. It is in these design meetings that one begins to observe very particular things: the past experiences, intuitions, and preferences of participants; the present subject in relation to the organizational history; the varying relationships between those present; the misunderstandings that occur; and even the surprisingly questionable and ephemeral nature of technical information. Most of all, one notices how these contingencies are expressed, interpreted, and re-expressed through language. One notices how words and phrases can refer to actual things, but also how they construct design opportunities and possible futures. In a previous paper,[9] the mechanism of "storytelling" was described in which individual narratives—often collapsed into a word or phrase—act as touchstones in social exchanges. The point here is that, in a very real sense, designers—engineering or otherwise—spend a great deal of time talking about something that, although slowly coming into existence, doesn't exist.

In a series of conversational vignettes, this paper will attempt to show just how far the process of engineering design is a process dependent on sketching out possible futures in words. It will conclude by suggesting that, if this "verbal sketching" ability indeed is a large part of being an experienced engineering designer, then, perhaps, courses promoting this skill, for example in rhetoric, should be explicitly taught at undergraduate level.

## 2 The Study of Language in the Design Process

Studies of the design process through an analysis of language are becoming increasingly popular.[10] They often center around the idea that every design situation is unique, and that, in design conversations a kind of "world" is constructed with its own references, assumptions, symbol systems, and contributing experiences. With a close reading of these conversations, it has been possible to examine the construction of such a "world" and to identify mechanisms by which language functions in relation to a developing artifact. Elsewhere, cognitive studies have mentioned the idea of a particular "designerly" way of thinking,[11] and studies that focus on language seem to be asking a similar question: "Is there a designerly way of talking?"

David Fleming,[12] examining student/supervisor discussions in a graphic design project, finds a difference between what he terms "object-laden talk" and "language-laden talk." The former

6 D.A. Schön, *The Reflective Practitioner*, 21-69.

7 K. Harrison and C.C. Wilson, "Evaluating Configuration Complexity in Machines," *Journal of Engineering Design* 8 (1997): 165-174.

8 Larry Bucciarelli in *Design Engineers* describes a similar episode (152-159). At the beginning of a design meeting, a "performance specification" is set and those present try to choose between alternative design solutions as the method prescribes. However, no one can agree on just what constitutes a "performance specification." Bucciarelli comments that, although those present at the meeting felt it was a disaster, the conversation that occurred actually was useful. It helped to develop "shared meanings" and begin to construct the discursive "objects of design."

9 P. Lloyd, "Storytelling and the Development of Discourse in the Engineering Design Process," *Design Studies* (2000): 367-73.

10 L.L. Bucciarelli, *Design Engineers*, and D. Fleming, "Design Talk: Constructing the Object in Studio Conversations," *Design Issues* 14 (1998): 41-62; P. Lloyd, "Storytelling and the Development of Discourse in the Engineering Design Process"; and P. Medway, "Building With Words: Discourse in an Architect's Office" in *Carleton Papers in Applied Language Studies* (Vol. IX) (Ottawa: Carleton University, 1992), 1-32.

11 N. Cross, "Discovering Design Ability" in *Discovering Design: Explorations in Design Studies* R. Buchanan and V. Margolin, eds. (Chicago: University of Chicago Press, 1995). Cross builds on the work of Howard Gardner which critiques the notion of a single human intelligence, instead suggesting a number of intelligences. Cross suggests the existence of a particular design intelligence.

12 Fleming, "Design Talk: Constructing the Object in Studio Conversations," 46.

locates a design object in a discussion, "performing it" as Fleming refers to it, while the latter assumes the existence of certain design objects and concentrates on exploring their possibilities. This serves to: "position [them] in time, social relations, a system of values, etc.," [13] and to make them real in some sense, rather that just conjecture. Peter Medway,[14] studying conversations in an architect's office over a two-day period, remarks on similar findings, noting in particular the "textual" nature of an architect's work; the interpretation of many interrelated types of media (drawings, faxes, legal documents, conversations, etc.).

For architects or industrial designers, one particular type of "text" dominates design discussions: the sketch. Sketches provide a common reference point to explore and explain a nascent design. The engineering design process, it might be argued, is a rather different affair. Although one still has the "textuality" of a design process, there would appear to be less visual thinking, less "reading" of sketches. Engineers are more adept at "reading" circuit diagrams, or layout schemes, or picking through software. Engineering design projects, often multidisciplinary in nature, lack the sketch "text" as a common means of expression. This multidisciplinary nature of engineering design is suggested by Bucciarelli to describe what he terms "object worlds"—"worlds of technical specializations; with their own dialects, systems of symbols, metaphors and models, instruments, and craft sensitivities." [15] With many disciplines negotiating during the course of an engineering design conversation, it makes more sense to talk about the existence of a number of discourses being conducted. Bucciarelli describes how the existence of different "object worlds" result in what he terms "constraining," "naming," and "deciding" discourses. It is in these episodes that we can begin to get a sense of language being used for very specific functions, as an essential part of the engineering design process.

### 3 The Design of a Tire Assembly Machine

It is the aim of this paper to try to relate some of the findings about the use of language in the design process to the present data set, using a discourse analytic method. The present data is constituted by five conversational segments, taken from transcriptions of a series of three engineering design meetings held over a six-week period in April–May 1998. The series of meetings concerned the design of a truck tire assembly machine for clients MB.[16] This is a machine that takes tires and wheel rims, and combines them into a completed wheel. This is the kind of operation that is carried out at "Kwik Fit," for example, but as a continuous process and at much greater speed. The enormous size of truck tires also presents considerable problems.

The design project was planned to last from February to September in 1998 and contained a penalty clause. This meant that,

13 Fleming, "Design Talk: Constructing the Object in Studio Conversations," 46.

14 Medway, "Building With Words: Discourse in an Architect's Office," 22-3.

15 Bucciarelli, *Design Engineers* , 62-64, and Bucciarelli "An Ethnographic Perspective on Engineering Design," 162-163.

16 The names of organizations have been changed to ensure confidentiality.

if the company was late delivering the product, it would have to pay compensation for lost production to its client. Progress meetings were held every two weeks. The design content of the project was largely mechanical, but with electrical and software elements as well. Six designers were involved in the project, with approximately twenty-five people in total—including sales, manufacture, service, and management. An average of about eight people were present during the meetings that were recorded.

The company at which the meetings were held is called Chi-Tech.[16] It has approximately one-hundred employees, and is situated on the outskirts of Birmingham in the United Kingdom. Chi-Tech produces test and assembly equipment mainly for the transportation industry. When a vehicle is being assembled on a production line, this sort of equipment helps to test whether it has been assembled correctly and is functioning properly. The total period of study at Chi-Tech was two months, during which time interviews, observation, the attendance at meetings, and the collection of documentation formed a complete data set.

Since tape-recording was not allowed by the organization during meetings, the transcripts were a combination of quickly-taken notes together with the observer's recall, following the meeting, of what was said. Obviously, this means that small parts of the conversation may have been missed, but it is felt that the conversation segments retain much of their original sense and tone. Five segments were selected from the larger transcription of the meetings on the basis of two criteria. The first was coherence; each segment is about something fairly concrete and identifiable as a definite episode in the general flow of conversation. The second was variety; in total twelve segments were analyzed in detail, with the final five being chosen because they allowed a number of different subjects to be covered.

Underlying this approach to the data are two general analytical principles that should be made explicit. The first is that each segment should be a self-contained text with as little as possible reference to the wider context. This automatically ensures that it is the form of the language that is looked at, rather than the specifics of the design problem being solved. The second is that enough "text" should be given to allow alternative interpretations to be made by the reader. It often is the case in analyses of this sort that explanations are given without sufficient text as evidence for the explanation. (And a consequence of taking a discourse analytic approach is that there always are other explanations.) It is felt that enough evidence should be presented to allow (at least in principle) for the possibility of falsification.

## 4 Five Segments of Engineering Design Conversation

In the following sections, each conversational segment will be presented and then immediately followed by an interpretation of the exchange. Technical terms will be briefly explained in footnotes. The final discussion looks at the general form of the texts, and describes some of the discursive skills demonstrated by the engineering designers.

### 4.1 Text 1

**Mark** This weekend we had MB to visit to see about information. […] We were successful about putting more pressure in the tire and we didn't damage the rim. We pointed out that, in production, the machine has to be spotlessly clean.

**Steven** How did you make the point? I mean, we really need to put it in writing.

**Nad** And also things like that should go into the manual.

**Ian** We shouldn't give them the idea that we've solved all the problems. Before we start writing letters, we should be sure to point out that it was a test on their machine.…

In text 1, Mark introduces the subject of a number of "inflation" tests that have been carried out on an existing MB machine, looking at tire pressure in relation to wheel-rim damage. He notes that the tests were "successful"—a positive result. MB has been informed of these results, but with an important caveat: when the new machine is used in production, it has to be "spotlessly clean." Now, most production environments are not "spotlessly clean," so there is a rhetorical sense to the "success" reported to MB. The "success" will give MB confidence about the effectiveness of the continuing design process, but this doesn't guarantee that the machine will work well. For Chi-Tech's purposes Steven, Nad, and Ian are quick to play down the effects of this rhetoric of "success."

Steven asks how the comment of keeping the machine spotlessly clean in production was made, perhaps suspecting only a verbal instruction. He feels that the comment is important enough to be put in writing. Such a move would protect the company from a claim by MB in the event of a breakdown. There is a sense here that Steven doesn't quite trust the "success" that Mark reports; or at least, can see it as rhetoric. Nad adds to Steven's view by mentioning that "things like that should go in the manual." Again, there is a feeling here that problems lie ahead in the use of the machine in a production environment. By including in the manual specific instructions to keep the machine "spotless," Chi-Tech representatives again are covering themselves. By noting that "things like that should go into the manual," Nad's emphasis is, however, on the use of the machine in practice, as opposed to contractual agreements between the organizations. Ian cautions against giving MB the "wrong idea." This is a direct comment about the rhetoric of

"success" and he clearly feels that too many unsolved problems exist for such impressions to work in their favor. Giving MB the wrong idea also implies that there is a "right" idea to give, assuming a more complex relationship between the actual process and the customers' perception of that process. Ian also notes that the tests were carried out on "their" (i.e., MB's) machine, preparing the way for the inference that if things do go wrong then it is partly "their" fault.

The specific results of the inflation tests that have been carried out initially are not questioned. Instead, the responses concentrate on either what needs to, should, or shouldn't happen as a consequence of the "successful" tests. Although the three responses are different from one another, they all suggest an understanding of the consequences that reporting such a "success" can bring. It would appear to be experience of similar situations that forms the basis for these imperatives; that is, experience of how one portrays what is happening in the design process to the customer.

There are, then, two things to note in this exchange. First, is the way that rhetoric is used as a continuation of well-defined tests that have been carried out during the course of the design process. Although the tests have yielded positive results—which the customer knows about—the discussion is about how to play down these results in the context of the possible future performance of the machine. The technical and objective results of the tests have been shaded into the wider discourse between design and client. Second is the conception driving this rhetoric, focusing on the differing representations of the design process between customer and manufacturer. The inference is that the manufacturer's representation of the design process is "the truth," while the customer's representation is an impression solely dependent on the information received from the manufacturer. This much is implied in the phrase "we shouldn't give them the idea that we've solved all the problems."

**4.2 Text 2**

**Paul** This project is going out one month after the TP project went out 16. I thought we were further ahead at this stage, Mark disagrees, but TP was a repeat job. On this one, we haven't got the advantage of built-in knowledge…

**Tony** We said at the beginning of this project that we need extra time because of the size of the wheels…

**Mark** Well, if we work backwards…we've got seven weeks to make all the bits.
[Phil shakes his head]

**Tony** We knew all this from the beginning, we sat down with Steven…

**John** It's very tight.

**Tony** It's more than very tight! On TP, people were virtually dead on their feet, and this is much heavier…

**Ian** But the positives are that we haven't got so many individual bits, just the sheer size, and that has got to mean more machining time. We've got to be mindful of the fact that we haven't done it before…

**Tony** It's going to take longer to put this together than TP just because of the sheer size…

The project is running late. The contract has a penalty clause associated with it, and this means that, if the machine is delivered late then Chi-Tech will have to pay compensation. Text 2 tries to establish how long the remainder of the project will take. Paul starts by saying that the TP project was "further ahead" in comparison.[17] The reason for this is that TP was a "repeat job"; itself a copy of a previous job. The difference with the present project is the lack of "built-in knowledge," the tacit knowledge acquired in the doing of something that speeds up the process of doing the same thing a second time. Paul is making the claim that the two projects cannot be compared in this respect. Tony doesn't contest Paul's reasons. Instead, he points out another reason for the difference: "the size of the wheels" to be fitted with tires. He then goes on to point out yet another difference: the present job is "much heavier" than the previous one, and that had been heavy enough ("people were virtually dead on their feet"). Ian stresses another difference between the two jobs, but it is a positive one. There are fewer components. However the "sheer size" of the components means "more machining time." Ian ends by echoing Paul, stressing that "we haven't done it before.…" Tony reiterates Ian's comment about the "sheer size" of the new machine compared with the previous TP job.

Despite all of the reasons for considering the two jobs as different, the past job remains as a reference point in the discussion. The exchange reveals seven conceptions of how the speed of carrying out the present project will differ from the speed of carrying out the past project. Two refer to the lack of tacit knowledge ("we haven't got the advantage of built-in knowledge…" "we haven't done it before"); three mention the size of the new job ("size of the wheels," "sheer size," and "sheer size"); one mentions the weight ("much heavier"); and one mentions the smaller number of individual components ("haven't got so many individual bits"). The evidence suggesting a difference between the two jobs is overwhelming, and there is strong agreement about this between everyone.

Yet the past project, or at least the idea of it, is fulfilling a function here. The common experience—and the level of agreement suggests that it is common experience—is providing a rich means of discussing the present job. However, although there is agreement about the "facts" of the matter, there is not agreement about the suggested outcome. Tony, the manufacturing manager, is using "the facts" to argue for more time than originally was planned for. By

17 The present machine is the same type of machine as the "TP project." They are both tire-assembly machines, however, the TP project was for car tires, which are much smaller than truck tires.

using the pronoun plural "we," he is suggesting that the "extra time" he thinks is necessary for manufacture was agreed on at the start of the project. Others in text 2, although acknowledging the truth of the facts, interpret them slightly differently. John simply says "it's very tight," suggesting that, although it will be difficult, the manufacturing department has enough time to complete the task. Tony has to persuade the others by attempting to exaggerate their common experience ("the facts"). He mentions that people were "virtually dead on their feet," and refers to the "sheer size" of the present project, both statements giving the impression of the present project's impossibility. In the exchange, what is of note is the agreement about certain "facts" and the corresponding differences in interpretation.

**4.3 Text 3**

**Nad** We need to move forward…

**Mike** It's only the circumstances of the drive that is holding me up…

**Mark** So how long before you start detailing and how long will it take?

**Mike** Eight weeks…

**Mark** Two weeks less then, on a heave?

**Nad** There will be a three week slippage is my guess, based on experience…

**Mark** We need a month at the end of the job to get the thing working…

**Nad** We've got to bring that forward, we can't let it slip by three weeks, poor old Mr. Tarling is going to be testing the machine on the ship over to Germany!

**Mark** Well, we know what happened at TP, we were out there for weeks and weeks…

**Mike** Hopefully, it won't become a bottleneck, but it's happened on every job I've done…

In text 3, Nad starts with the general feeling that project work "needs" to go further towards the final goal. Mike, being questioned as to how long it will take him to complete a set of concept drawings, answers that it is only external circumstances that are holding him up. Mark then asks Mike how long it will take him to start work on the detailed drawings. Mike is emphatic: "eight weeks." Mark, perhaps wanting a smaller figure and thinking that Mike's estimate has allowed for a large degree of error, suggests that, if he concentrated his efforts, the concept work might be completed sooner. Nad switches the focus to the work plan, commenting that there will be a "three-week slippage"—that the project will take three weeks longer than expected—given his experience with simi-

lar situations. Mark points out that a month will be needed "at the end of the job"—which means after the machine has been constructed—before it will be fully functioning.

A few seconds later Nad picks up on his thread again, possibly after having considered the consequences of what his experience tells him. He says that the project cannot afford to slip by three weeks, because that will leave very little time for testing. To support this view he provides a vivid image of the machine being tested on the ship on the way to Germany. Mark reinforces Nad's comment from his own experience ("at TP, we were out there for weeks and weeks") using "we," as Tony did in text 2, to draw in the others present and appeal to some sort of common knowledge or experience. Mike brings the discussion back to the amount of time it will actually take to finish the concept drawings. He hopes that the delay will not prove to be a problem, but thinks that it might be if his experience is anything to go by.

Although the conversation is ostensibly about the time it is taking to finish the concept drawings, it turns into a conversation about the time it will take to finish the project as a whole, a subtle difference. Contrasts are made between planned time, desired time, actual time, and past time. There is the desire to "move forward" past problems that are "holding up" the project; to get through a "bottleneck," Then there is the estimation of how long it will take for the concept drawings to be finished. "Eight weeks" is the estimation, reduced to six on the assumption that what can be done in eight weeks at a certain pace can be done in six at a quicker pace. There might be a "three-week slippage," which has implications for the "month" needed to get the machine working at the end of the project. In previous projects, this task had taken weeks.

The impression given here is one of a malleable time. There is an original project plan, certainly, and a delivery date has been agreed by the customer; but within these "real" constraints, time is being managed and bargained for. Delays are explained as "bottlenecks," and time can be made up by "heaving." There is a feeling of elasticity, with negotiations between different perceptions of timescales in relation to certain tasks. Finally, there are intuitive feelings for how the time will go, accumulated, we might infer, from similar experiences on other projects (and different experiences on similar projects).

At the end of the exchange, it remains uncertain what has actually been decided. The plan appears to have remained the same. What then could be the purpose of such a discussion? There seems a deep relationship between time and experience in the exchange, encapsulated in personal heuristics ("eight weeks can be reduced to six on a heave," "a month is always needed for testing," or "concept drawings are always a problem"). The only way that time can be talked about is either in relation to the past, or in relation to an intuitive feeling about the present situation with respect to the project

plan. Time here is not an absolute quantity, but a thing packaged with a particular task, past, or present. What happens in the exchange is that a number of possible scenarios are described. It would seem that the different scenarios illustrate to all present the sense of urgency that is needed. This is achieved not through any sense of control, but through a common understanding arrived at through different perceptions of possible outcomes. Some of these outcomes are baldly stated ("eight weeks"), while others are more creatively put ("poor old Mr. Tarling is going to be testing the machine on the ship"), but all give a sense of what possibilities lie ahead and it is also arguable that this also works to share responsibility between those present.

**4.4 Text 4**

**John** Basically we've got a chain conveyor on the walking loom.[18] It's going to be in the attention to detail…

**Nad** Is that sufficient for a 15-second cycle time? [19]

**Brian** I have my doubts about fitting it all in.

**John** We've got it down to 4.2 seconds on a small machine.[20]

**Mark** And the total machine time is 28 seconds.

**John** To get the time down, we've been looking at the rim grips, we used to use sixties technology to get the fitting head [21] to come down to find the rim, so it's got to come down slowly to sense the rim. With a servo motor, you can come down quickly.

**Nad** It's important to remember that, in everything we do, we don't forget the cycle time…

**John** Terry agrees that the fitting time is very tight, I personally can't see why you can't fit at increasing speeds…

**Brian** In theory I agree with you but, at increasing speeds, you might spin on the rim and leave the tire behind…

Text 4 is about the solution that has been used to converge on a key performance criterion: the cycle time. Initially, John describes the basic technology of the new machine ("a chain conveyor on the walking loom") suggesting that it simply needs refining to meet the key performance criteria: "it's in the attention to detail…". Nad questions whether this solution will meet the performance criteria, while Brian expresses stronger reservations ("I have my doubts about fitting it all in"). John replies by saying that the level of performance required has been reached on a previous, smaller machine which, together with the assumption that the big machine will behave in the same way as the small machine, suggests that the level of performance required can be reached. John then goes into more detail about specific refinements that have been made to the original level of technology, backing up his earlier "attention to detail" comment. He suggests that a servo motor will solve the problem. A little later, he reveals a slight difference in opinion about

18 The chain conveyor and walking loom are a mechanical technology that allow a sequence of operations to be carried out through the tire-assembly machine. Wheels are metaphorically walked through the machine.

19 There are three times that figure in the dialogue. "Cycle time" is the rate at which the machine produces assembled wheels and tires. "Total machine time" is the time it takes a separate wheel and tire to become an assembled wheel and tire. "Fitting time" is a proportion of the total machine time, and is the time taken to complete the sub-task of fitting the tire to the rim.

20 The "small machine" refers to the previous TP project, which assembled car tires.

21 The "fitting head" is the part of the machine that fits the tires to the wheel rims. This is a piece of equipment that descends to complete the operation once a wheel rim is in place beneath it. It completes the operation by turning the rim so that the tire gradually works its way onto the rim.

the proposed solution between himself and Terry (who is not present). John reiterates that he can see no problem fitting the tire at increasing speeds, while Terry obviously has told John how "tight" he thinks the tire fitting will be. Brian takes Terry's line and explains why the machine might not work at increasing speeds: "you might spin on the wheel."

Will the proposed solution work? No one says that it won't work, yet reservations are expressed about whether it will meet the "tight" performance criteria. The proposed solution is a refined and scaled-up version of solutions that have been used on previous projects. John sees no problem with this scaling up. Terry and Brian, however, are not so confident. During the exchange, John constructs a verbal "model" of this solution. All are agreed on this model—no one is directly disputing the solution principles—yet the consequences of this model, and the issue of whether or not it will meet the performance criteria, are the subject of a difference of opinion. The construction of this "verbal model" is possible only because of the familiarity everyone present has with both previous designs and the relevant technological principles, a common knowledge existing among those present. Out of these basic "materials," John is able to construct, in a few short utterances, a model of his proposed solution. He creates a common "object" for analysis.

Such a situation might seem highly specific. The design is at a very particular stage of development, and it is unlikely that it would be questioned in any fundamental sense. It could be argued that other participants may be keeping quiet about criticisms they may have. Yet the "method" of drawing on common experience to "sketch" a solution appears to be a familiar one. A way of quickly exploring a number of implications and consequences should a certain solution be adopted. There is a kind of tacit acceptance here, a suspension of disbelief among those conversing. There also is a sense in which the participants are "using" this "object," and commenting on its functioning. The key point is that the created conversational "object" is only a vehicle to explore decisions that have to be made. It is a hypothesis that will help to determine key indicators of success or failure.

**4.5 Text 5**

**John** Well, on the limit switches[22] MB was surprised that we suggested proximity switches. I said that they're standard at Chi-Tech. MB said proximity switches are expensive compared with reed switches, but I don't really mind…

**Brian** We've found reeds to be unreliable in the past…

**David** We changed a few on Tudor[23] because there were failures…

**Brian** They come loose and fall off, but there are applications where they can be used…

22 Limit switches are a way of detecting whether a moving component has reached its intended destination. There are various ways to do this, but two well known methods are: proximity switches which detect by magnetic induction, and reed switches, which detect by physical contact.

23 Tudor is another previous project.

**Ian** My guiding principle has always been, where the machine is concerned, not to use proximity switches…

**Mark** Ninety percent at MB are reed switches, but they're not Festo ones.

**Ian** Festo[24] are cheap and cheerful.

John introduces the topic of limit switches in Text 5. He mentions that MB was surprised about the choice of limit switch ("proximity switches") because they thought that they were more expensive than reed switches. Although the "standard at Chi-Tech" is the proximity switch, he ends rather neutrally by saying that he doesn't really mind what they use. There then follows a series of comments about the performance and application of reed switches, as compared to proximity switches. Brain says he has found them "unreliable," David says that on a previous project, they failed. Brian remarks on the way that they usually fail: "they come loose and fall off," but also adds that there are some things which they can be used for. Ian mentions that his "guiding principle" is "not to use proximity switches where the machine is concerned." This puts an emphasis on not using one thing (proximity switches), rather than positively using another (reed switches). We then get the fact that ninety percent of the switches at MB are reed switches though, perhaps significantly, not Festo reed switches. Ian underlines the significance of this remark by stressing that Festo reed switches are "cheap and cheerful."

There is a basic taxonomy of types and instances in the conversation. First of all, there are the types of limit switch: proximity switches and reed switches. Then there is an instance of a type of reed switch: "Festo reed switches." The conversation circles around evaluations, opinions, and experiences of different types of detection mechanisms and products. Everyone (including MB) seems agreed that a decision has to be made between reed switches and proximity switches. To aid this decision-making process, the outstanding attributes of each switch are offered. Reeds are "unreliable," they have failed in the past, they "come loose and fall off," they "can be used" in some applications, and "ninety percent of switches at MB are reed switches." Proximity switches are: "expensive," they are "standard at Chi-Tech," there are intuitions—"guiding principles"—against using them, or in a similar vein, "surprise" at using them. Then there are the particular attributes of Festo reed switches. They are not used at MB, and they are "cheap and cheerful."

Text 5 is somewhat ironic in that it is concerned with deconstructing the capacities of existing technology in the process of constructing the capacities of new technology (i.e., the tire assembly machine). Such a discussion implies that the capacities of the new technology rely to some degree on associations with the perceived capacities of its components. "Cheap and cheerful" components

24 Festo is a manufacturer of reed switches.

might then result in the final product being perceived as "cheap and cheerful." The irony is that, in discussing a component's capacities, the people present are denying the possibility of that component having actual or objective capacities while simultaneously attempting to construct the actual or objective capacities of their own product. The decision to use a certain component, then, is a complicated act of judgment. There are objective elements involved, certainly: sizes, materials, and also functions; but there also is a large degree of personal (and hence in a group situation aggregated personal) preference. These preferences are formed through both particular experiences ("they come loose and fall off") as well as more nebulous "guiding principle." There is a case for considering these preferences as aesthetic judgments.

It is of note that the inquiry into the suitability of limit switches was triggered by the "surprise" of MB. This surprise has caused an explicit examination of the reasons for the preference of a particular component; preferences that would, we might assume, have remained unquestioned otherwise.

## 5 Discussion and Concluding Remarks

It is self-evident that the five conversational segments took place over a bedrock of common assumptions and experiences. This clearly enables the participants to forego lengthy explanations, and to talk quickly about the current situation. Common assumptions concentrate more on the technical properties of the design—often, in the text, it was clear that a particular way of solving the problem was not questioned—while common experiences focus more on the past as a means of exploring the present situation. This illustrates how much the current design process depends on the past experiences of those present, which also shows just how unique a situation it actually is. In all five texts, we have noted how past experiences have acted as touchstones during the course of the meeting. In effect, this situates the present design within a web of connections with past designs. In text 2, for example, Tony remembers that: "on TP, people were virtually dead on their feet" while, in text 3, Mike recalls: "it's happened on every job I've done." To those present, such touchstones are, in many ways, an objective reference for the situation in hand. That is to say, they are "objects," perhaps "discursive objects" might be a better phrase for interpretation and analysis. Fleming [12] notes two kinds of discourse in the design process. He observes: "object-laden" talk—situating objects within a discursive context; and "language-laden" talk—explaining the consequences of certain objects being the case. It is notable that, in this professional design situation, the talk seemed heavily biased toward the language-laden end of the spectrum.

Common assumptions and experiences ensure a large level of agreement but, in every text, there always was some level of

disagreement. That is almost a prerequisite for a "discussion" taking place. This disagreement often was not, as one might have imagined in an engineering design context, over technical matters, but about the *consequences* of certain "facts" being the case. In text 1, the discussion was about how to represent the ongoing design process to the client; and in text 4, about how a certain solution would perform. In these discussions, the design engineers displayed a certain intuitive artfulness; their technical skill as designers playing second fiddle to their ability to make a convincing interpretation of the situation.

Such an ability is not one that usually is associated with engineering designers, and perhaps not even an ability they themselves are explicitly aware of. It is, nevertheless, an important ability as these texts show. The skill in constructing an effective argument from a few well-chosen words and references is one more akin to a politician than to an engineer. This is an important point. In the texts, the designers used several mechanisms to get their version of the consequences of a situation accepted by the meeting. One mechanism is the use of exaggeration and imagery. In text 2, Tony mentions that, in the past project, similar to the current project, people were "virtually dead on their feet." In text 3, Nad remarks on the limited time available by suggesting that the "poor old" test engineer "will be testing the machine on the boat on the way over to Germany." Both are effectively illustrating serious points. Another mechanism was the suggestive use of the pronoun plural "we." In text 2, Tony states "we knew all this from the beginning…" and, in text 1, Mark remarks "we were successful…. Both are trying to imply a *common* agreement about what has happened, in effect sustaining their "argument" for as long as possible. There also is an implied objectivity about past experience, something that is extremely difficult to refute directly. In text 5, Ian cites his "guiding principle" as a reason for not using a certain component while Brian has found that certain components "come loose and fall off…." In text 3, Mike mentions that something has "happened on every job I've done." Such remarks have an important rhetorical function in putting an argument across to the others.

If all of these mechanisms add up to a kind of "rhetorical ability" of engineers in the current study, then there is one more distinct ability to note. That is the critical ability; the ability to recognize, analyze, interpret, and aesthetically judge an object. Such an ability was demonstrated in Text 5, in which the technological capacities of sensing equipment were constructed, together with the associations of meaning they held for the meeting. It is here that one gets the feeling that many decisions are made just as much on aesthetic grounds as on purely objective or technical grounds. Aesthetic is used here to refer to an individual expression of preference rather than anything solely visual in nature. This is a surprise

given the supposed "objective" nature of engineering design (as illustrated by the quote at the beginning of the article [7]).

In design disciplines apart from engineering, graphical representations play a much larger "modeling" role in design discussions. In architecture, graphic design, or industrial design, a design is sketched, drawn, and modeled in a series of "physical" ways of expression. For these disciplines, it is easy to see how these physical objects can be "performed" in Fleming's terminology: [12] by pointing, gesture, and explanation. Once they have been accepted as valid objects for discourse, the consequences that derive from a performance then can be drawn out. It would seem as though engineering designers are achieving exactly this result, but by using words instead of graphical representations. That is to say that engineers use words to model and explore consequences. The words provide a sort of collective sketching function that is not possible in a graphical representation, simply because of the nature of the task. These words, these very particular words, can remain ambiguous while still suggesting possibilities—just as a quick sketch from an industrial designer might suggest a number of possible forms and hence, implications. And, just as industrial designers have a common sketching vocabulary, the engineer's words only properly function on a basis of common knowledge and experience. In other words, they provide a first level of prototyping.

Could it be that this kind of conversational function is found not only in engineering design and design in general, but also in other areas of professional practice? One of the essential aspects of design that we mentioned at the beginning was that design conversations are conversations about things that don't yet exist. It may well be that there are a number of possible parallels with other conversations concerning, for example, the future, or a future state of affairs. Schön [25] argues that design-like behavior forms a problem-solving prototype for much professional action, while Cross[11] has suggested that designing (and, we might infer, design talking) meets criteria to consider it as a separate kind of intelligence. This paper, however, has attempted to show how advanced this kind of talking is for engineering designers. This, we have proposed, might be because of the largely non-graphical nature of the task environment. It would appear that the typical analytical ability of the engineer—an ability that seems to be predicated on the idea of an individual "object world"[15]—also brings with it a skill in using and manipulating language—a strongly social ability.

There are educational implications here. If such a skill is something that experienced design engineers can perform without training, then explicitly nurturing that skill in students with a low level of experience might be worthwhile. The texts presented in this paper would point to both education in rhetoric and aesthetics as important areas of curriculum development in engineering design. It is highly likely that this knowledge could help engineers to

25 D.A. Schön, *The Reflective Practitioner,* 77.

become aware of the varying types of reasons, information, and experiences that design decisions are based on, and help to dispel the myth that all engineering information is somehow scientifically based.

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