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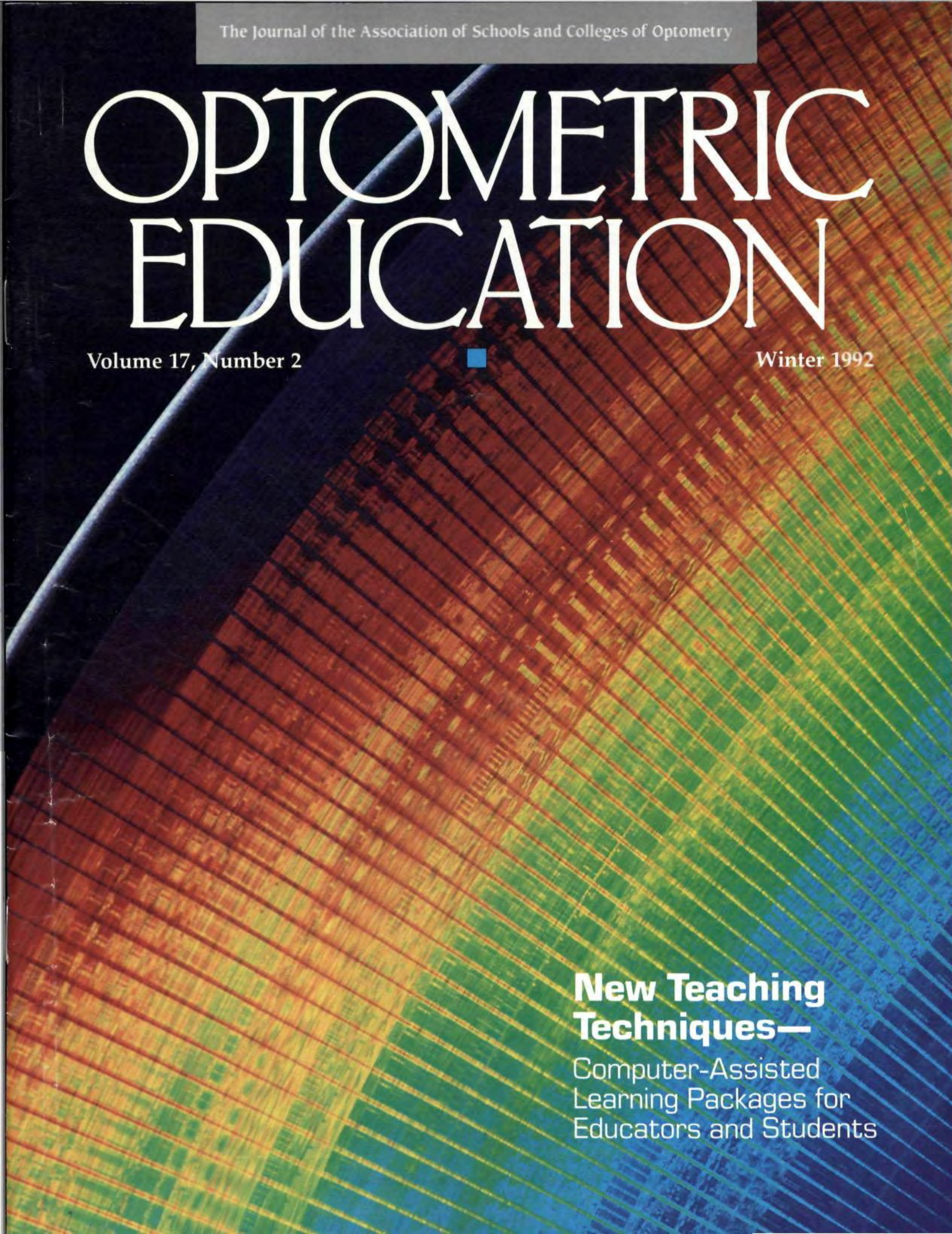

New Teaching Techniques—

Computer-Assisted Learning Packages for Educators and Students

Association of Schools and Colleges of Optometry

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The **JOURNAL OF OPTOMETRIC EDUCATION** is published by the Association of Schools and Colleges of Optometry (ASCO). **Managing Editor:** Patricia Coe O'Rourke. **Art Director:** Dan Hildt, Graphics in General. Business and editorial offices are located at 6110 Executive Boulevard, Suite 690, Rockville, MD 20852 (301) 231-5944. **Subscriptions:** JOE is published quarterly and distributed at no charge to dues-paying members of ASCO. Individual subscriptions are available at $15.00 per year, $20.00 per year to foreign subscribers. Postage paid for a non-profit, tax-exempt organization at Rockville, MD. Advertising rates are available upon request. *The Journal of Optometric Education* disclaims responsibility for opinions expressed by the authors. Article copies, 16mm microfilm, 35mm microfilm and 105mm microfiche are available through University Microfilms International, 300 North Zeeb Road, Ann Arbor, Michigan 48106.

ASCO

EDITORIAL

Educator Involvement

Optometric education faces many challenges for the future. There is explosive growth in new biomedical and other scientific knowledge; there is a continually expanding scope of optometric practice; and there is an ever increasing availability of new video, computer and laser technologies for education and patient care. These factors create enormous pressures upon the optometric education system in the United States and Canada to constantly revise curricula, resources and faculty capabilities.

The leadership of optometric education, as embodied by the Association of Schools and Colleges of Optometry (ASCO), has exercised a responsible approach to these pressures by co-sponsoring with the American Optometric Association an Education Summit next spring and by the ongoing activities of the ASCO Standing Committee on Academic Affairs (CAA) in curriculum analysis. These leadership efforts are most important to the determination of the long-range direction of our profession's educational program and should be given full support by all.

In addition to the educational administrators of ASCO, faculty are and will continue to be involved in these planning efforts, as they should be. However, in addition to planning, the role of faculty is a more fundamental on recommended programmatic changes ultimately will be implemented through faculty activity. Thus, in any institution, the faculty have a significant responsibility for the quality of the education, and they meet that responsibility by their continual attention to their course content and teaching skills.

The previously mentioned challenges facing the educational community are real opportunities for progress if the faculty and administration of each school and college adopt a forward looking attitude that embraces new curricular requirements and encourages the use of advancing technological and other innovative teaching methods to meet these requirements and to enhance educational effectiveness.

It is an essential priority of this journal, *Optometric Education*, to support such educational growth and development by publishing educational scholarly papers by the members of our education community. As educators, we must use *Optometric Education* effectively to enhance our personal and collective educational capabilities. *Optometric Education* has been and continues to be our **forum** for discussion of educational content, methods, innovation and research. We can each significantly strengthen this tradition through the submission of manuscripts.

All optometric educators, be they educational administrators or faculty, are constantly and naturally involved in the process of change and redevelopment of their respective teaching programs, whether they realize it or not. We need to be sensitive to the unique intellectual contributions to optometric education that we each make in our day-to-day responsibilities. We need to share our ideas, experiences and experiments in education so that our colleagues and students at other institutions can benefit and grow. *Optometric Education* can help us do this if we will become avid readers and participants.

The goal of greater involvement by educators is shared by the review board member from your institution who is listed on the inside front cover of the journal. Your review board member is the "ambassador" of *Optometric Education* at your institution and will be happy to assist you in any way possible with identifying and developing your ideas for journal submission. Likewise the managing editor, Ms. Patricia O'Rourke, and I are willing to offer any assistance we can to each of you regarding journal submissions.

Optometric Education is your journal! Help us work to maintain and improve its high standards and its value to our profession by your personal involvement.

Felix M. Barker, II, O.D., M.S.
Editor

The Secret To Perfect Imaging... Volk Pan Retinal 2.2 and 78D Lenses!

Separately, or as a set, the *Pan Retinal 2.2* and the *Volk 78D* deliver the most advanced optics available for indirect ophthalmoscopy.

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Pan Retinal 2.2 52mm	2.56	56°	34.1	✓	.39
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INDUSTRY NEWS

Companies appearing on these pages are members of ASCO's Sustaining Member Program. Sustaining Members are listed on the inside front cover of each issue. Membership is open to manufacturers and distributors of opthalmic equipment and supplies and pharmaceutical companies.

Varilux to Sponsor Super Bowl at AOSA Meeting

Varilux is sponsoring the First Annual Optometry Super Bowl, a competition among the 19 schools and colleges of optometry in the United States and Canada. Utilizing a quiz show format asking questions from all areas of the optometric curriculum, preliminary qualification rounds will narrow the field to eight contestants for the main event. First prize is a grant of $1,000.00, second prize of $500.00, third prize of $250.00. In addition, a traveling trophy will be placed in the winner's school for one year.

"We anticipate a lively, competitive exchange among the optometry schools, as well as a fun-filled evening for everyone," said Danne Ventura and Dr. Rod Tahran, coordinators of the event for Varilux Corporation.

The Super Bowl will be held on Friday, January 10, 1992, from 6-8 p.m. during the AOSA convention in Chicago.

Volk Introduces New Lens And Retinal Scale

The new TransEquator NF (No Fluid) Lens achieves high magnification and superfield fundus viewing without the use of solution. The new Volk NF Lens is designed to be used with the normal tear film as the fluid interface. No other solutions are needed. Application and removal of the lens is facilitated and repeat applications are accomplished easily. The cornea remains clear so that fundus photography can be done immediately after removal of the lens.

Volk also introduced a new Retinal Scale that allows exact disc, cup and rim measurement as well as precise determination of lesion size and growth. The precision AR-coated glass scale attaches to the TransEquator contact lens housing and is situated in the aerial image plane as produced by the lens. According to Donald Volk, president of Volk Optical, "With its unique combination of magnification and field of view, the high resolution Volk TransEquator lens with retinal scale is an excellent diagnostic tool." The Lens and Retinal Scale can be ordered at (800)345-Volk.

B & L Donates Fitting Sets To Optometry Schools

Bausch & Lomb donated fitting sets of some of its leading specialty lens lines to the nation's optometric schools.

"This is part of the company's ongoing commitment to the optometric schools and to the education of the nation's future optometrists," said Linda Coffey, senior product manager for specialty lenses. "We've found a great deal of interest in toric and bifocal lenses among students this year, and felt that providing fitting sets would be the best way for students to become familiar with these lenses."

Bausch & Lomb also donated audio tape library sets from its 18th annual National Research Symposium on Contact Lenses (NRS) to all domestic optometric schools. "We sponsor NRS as a forum for our industry — practitioners, researchers, clinicians and educators alike — to explore state-of-the-art technology," said William R. Reindel, O.D., M.S., manager of professional program development for Bausch & Lomb. "So it's only fitting that we offer the contact lens professionals of tomorrow an opportunity to also review this information," he added.

Ciba Introduces Illusions® Lenses

James M. Callahan, CIBA Vision Corporation president and chief executive officer, announced the launch of Illusions® eye-color-changing soft contact lenses for dark eyes. The lenses are available in deep blue, soft blue, grey, deep green, soft green and soft amber. The Illusions® soft contact lens iris pattern, modeled from a photograph of an actual eye, covers the patient's natural dark eye color. Then, the SOFTCOLORS® surface tint is applied to the front surface of the lens, offering a three-dimensional effect for natural appearance.

Second Quarter Market Share Booms For Vistakon's New Soft Lens Fits

The Vistakon division of Johnson & Johnson Vision Products, Inc., dramatically increased its market share of soft contact lens new fits by nearly five share points in the second quarter of 1991, according to data supplied by Health Products Research.

The company's gain was more than four times that of its nearest competitor. Vistakon attributed a significant part of the growth to its new SUREVUE™ contact lens. SUREVUE, the first daily wear contact lens designed specifically for two-week replacement, was introduced in April 1991.

"During its first quarter on the market," said Philip R. Keefer, Vistakon's executive vice president of marketing, "SUREVUE™ captured more than three percent of total daily wear soft lens new fits. After only three months on the market, SUREVUE now ranks as the number 10 daily wear lens for new fits."

Corning Awards Scholarships

After a two-year hiatus, Corning resumed its scholarship program with the schools and colleges of optometry. In its new format, the program awards two stipends of $3,000 each. The scholarships are open to third-year students who must submit a paper or essay on a topic suggested by Corning for the year of the award. Additional consideration is given to general academic excellence and extracurricular activities.

Two students were chosen for this year's awards: Steven A. Kuhl, University of Missouri-St. Louis; and John-Mark Turner, University of Alabama at Birmingham School of Optometry. The cash awards were supplemented by commemorative plaques which were presented by Corning's optometry school liaison, Mr. Reinhard P. Krause.

Polymer Program to Increase Retail Distribution

Polymer Technology Corporation has developed a program to increase the availability of BOSTON Advance™ products in neighborhood drugstores and pharmacies. The program is an effort to broaden the retail distribution of PTC's BOSTON Advance Solutions. A group of 15,500 independent pharmacists received a mailing which contained negotiable checks for BOSTON advance Solutions in amounts of $5.00 and $10.00 When retailers "cash" the checks, they automatically receive BOSTON Advance products. BOSTON Solutions currently have the strongest distribution of any RGP solution in various retail categories — 94% in drug and mass merchandise and 63% in food.

W-J Grant To Expand Berkeley Facilities

Schering-Plough Foundation, on behalf of Wesley-Jessen, donated $15,000 to the University of California at Berkeley School of Optometry. The funds are designated for the school's Minor Hall Expansion Campaign, a $9 million project to expand the school's clinic, laboratory and teaching facilities.

"We're very proud to make this donation. It further demonstrates Wesley-Jessen's commitment and dedication to serving the vision care profession," said Dwight H. Akerman, O.D., W-J's director of professional services.

Logo Paris Reports Fast Turnaround

Logo Paris recently conducted a test of the efficiency of their product delivery service by sending a business reply card survey to a random selection of 500 product shipments. With nearly 60% of the questionnaires returned, over 90% of the responses were overwhelmingly positive. The office of David E. Hankins, O.D., of Winter Springs, Florida wrote, ". . . by far the quickest turnaround of the 17 companies we deal with."

"I was especially pleased and proud to read the glowing responses from many of our customers on the East coast," commented Fredric Grethel, Logo Paris' vice president of sales & marketing, "This is positive feedback that our outstanding same-day turnaround coupled with a good air express company is just as good — or better than — being across town." For further information call 1-800-556-Logo.

B&L Launches Program for Optometry Students and New Practitioners

Bausch & Lomb is launching an ambitious program to directly support the efforts of fourth year optometric students about to enter optometric practice. The program includes an expanded New Practitioner Program available to the approximately 1,200 1992 graduating seniors throughout the country, as well as a new "Practice Management" educational program which Bausch & Lomb will sponsor at optometric schools in 1991 and 1992. The educational program will be available to third year students as well as graduating seniors.

"To create a fresh approach that was focused on meeting the needs of optometry students, we surveyed students in December 1990, many of whom are now fourth year students, to get their input about what kinds of programs and support they would most like from manufacturers," said William Reindel, O.D., manager of professional program development for Bausch & Lomb.

The survey of over 1,100 students, conducted by an independent polling firm and sponsored by Bausch & Lomb, asked students, among other things, to choose the topics they would most like to hear about at manufacturer-sponsored educational programs. The students chose "practice management tips" as their top choice, followed by " 'how to' information on opening a practice."

"Through the New Practitioners Program and the in-school educational program, Bausch & Lomb continues a strong tradition of supporting optometric students and the profession. In our survey, students ranked Bausch & Lomb the top manufacturer for providing "excellent support" of students, contact lens programs at schools, and the profession in general," Dr. Reindel said.

Sola Releases Video

Sola Optical released "Aspherics and High Index Made Simple," a 10-minute educational video that explains the basics of aspheric designs and high index materials, and how together they can result in a thinner, lighter, flatter lens.

"The thin and light market is one of the fastest growing segments in the industry," said Janice de Ryss, marketing communications manager. "But the wide variety of products can be confusing. Our goal is to give dispensers the information they need to select a lens that's best for their patient." The video is available for $12.95 at (800)358-8258, #8.

Continuing Education Needs of Ohio Optometrists

A Comparison with Other Health Care Providers

Alan Escovitz, Ph.D.
Arol Augsburger, O.D., M.S.

Abstract

An interdisciplinary survey of 1775 Ohio health care providers in five different disciplines including optometry is described. Key issues for planning continuing education programs were surveyed and are reported. These results provide a framework for program development and design of individual and interdisciplinary continuing professional educational experiences in the health sciences. The study showed that program content, date, time and location are the most important factors influencing program attendance. General optometric educators will be interested in the comparisons of opinions of optometrists and other health care providers toward continuing education.

Key Words
Continuing Education, Interdisciplinary, Needs Assessment, Planning

Introduction

The profession of optometry has been a leader in the movement to formalize continuing education through mandatory participation related to license renewal. The assumption has been that through this vehicle, practitioners can keep abreast of scientific, technological, clinical patient care, and social changes affecting their practices, and can actively participate in these changes. The argument for this worthwhile purpose has been so persuasive that virtually all states have enacted mandatory continuing education requirements. In Ohio, the State Board of Optometry has required continuing education for nearly twenty years. Optometry was the first licensed health care professional group in the state to actively lobby for mandatory continuing education legislation.

After twenty years a further evaluation of the perception of optometrists with regard to continuing education would be timely. Do optometrists (or other health providers) choose to take continuing education because it is mandated? Do other factors enter into the decision to take continuing education? Is optometry more or less similar to other health professions in regard to opinions about continuing education? Are providers of continuing education addressing the perceived needs of optometrists? What changes could be made to offer even better continuing education to optometrists? The assessment of continuing education needs for individual health professions has been previously reported[1,2] but interdisciplinary assessment of continuing education has rarely been addressed.[3,4,5]

To answer these questions a project was designed by the Advisory Committee for the Center for Continuing Health Sciences Education at the Ohio State University. Included in this committee were representatives from the College of Optometry, College of Pharmacy, College of Medicine, College of Nursing, Department of Nursing Staff Development OSU Hospitals, and the School of Allied Medicine. Specifically the project was designed to:

1) identify the demographic characteristics of five health care groups (optometrists, physicians, pharmacists, nurses, and allied medicine personnel).
2) define the past participation in continuing education.
3) assess the preferred formats for obtaining continuing education.
4) survey opinions related to current professional issues.

Methods

The survey questionnaire designed by the Advisory Committee for the Center for Continuing Health Sciences Education was mailed to a random sample of 4692 Ohio health providers in the summer of 1989. The four page survey instrument is appended to this study. Table 1 summarizes the distribution of the 4692 surveys which were mailed and the percent returned for each professional group. Optometrists displayed

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Dr. Escovitz is executive director of the Council of Ohio Colleges of Pharmacy, the educational consortium of four Ohio pharmacy colleges, and director of the Center for Continuing Health Science Education at The Ohio State University.

Dr. Augsburger is a professor of clinical optometry and chairman of the continuing education committee at The Ohio State University College of Optometry.

TABLE 1
Description of Survey Respondents

Health Care Profession	Surveys Mailed	Surveys Returned	Percentage Returned
Allied Med	1,086	446	41%
Medicine	1,002	291	29%
Nursing	1,002	344	34%
Optometry	600	308	51%
Pharmacy	1,002	374	37%
TOTAL	4,692	1,775	38%

TABLE 2
Current Practice Status of Professions by Percent

Profession	Full-Time	Part-Time	Retired	Not in Practice	Other
Allied Med	74	17	1	1	1
Medicine	78	11	9	3	<1
Nursing	60	31	3	5	1
Optometry	83	11	2	2	<1
Pharmacy	75	17	4	4	1

the highest rate of return (51% of 600 mailed surveys) whereas physicians had the lowest response rate (29% of 1002 mailed surveys). Overall 40% of all surveys were returned. Not all returned surveys were included in this report because of incompleteness in filling out the survey or the failure to indicate the professional discipline. The resulting 1775 surveys yielded a usable rate of 38%.

The survey consisted of four components:

Past Participation — Respondents described the type of continuing education which they utilized in the previous 12 months. A profile of participation by each profession was developed from this information.

Program Format — Respondents assessed factors related to their decision to attend previous continuing education programs. Factors included such items as convenience, travel, scheduling, preferable days, months, fees, and other criteria which affected past participation. Also included in this section were questions related to preferred continuing education delivery systems, program format, program amenities and program location. Respondents were asked to rank these factors according to their perceived importance in the decision to attend a continuing education program.

Professional Issues — Survey respondents were asked to rate continuing education content according to their perceived educational needs.

Demographics — The survey concluded with a component in which respondents supplied demographic data.

A cover letter accompanied the survey encouraging individuals receiving the survey to provide a prompt and accurate response. Randomized population samples for optometry, medicine, nursing, pharmacy and allied medicine including sub-populations of allied medicine (medical dietetics, medical technology, medical records, radiologic technology, physical therapy, and occupational therapy) received the initial mailing in July 1989 with a second mailing to the same sample in August.

Results/Demographics

The data demonstrated that the respondents to this survey in the professions of medicine and optometry are predominately male practitioners, 91% in both professions, while nursing (99%) and allied medicine (90%) are predominately female practitioners. Approximately two-thirds of pharmacists in the study were males (64%), and 36% were females.

Collectively optometrists and pharmacists both indicated a mean of 1970 for their initial year of licensure or registration. The most recent certification/licensure/registration group of the health care professionals was represented by the allied medical professionals whose mean year was 1977. The oldest members in this study were represented by physicians (mean graduation year 1964), and nurses (mean graduation year 1965).

All populations studied, nevertheless, demonstrated sufficient time since their initial certification that continuing education should be relevant in their efforts to remain current in their fields. Currently three of the five surveyed Ohio professions (medicine, pharmacy, optometry) require mandatory continuing education for license renewal; some of the sub-populations within allied medicine (medical dietetics and medical records) also require mandatory continuing education for relicensure. Nursing required continuing education after January 1, 1991.

The survey allowed respondents to identify the characteristics of their employment, i.e., whether full-time, part-time, retired, not currently in practice, or other description. At least three-fourths of allied medical, optometry, medical, and pharmacy professions were employed full-time in their practices (see Table 2). Nursing revealed a significantly lower rate of full-time practice (59.8%) as compared to the other groups.

Respondents were asked to indicate the setting of their primary professional practice. The large majority (85%) of optometrists were in solo or group practice. Approximately 30% of the pharmacists practiced in chain pharmacies and 30% in independent community pharmacies. Community hospitals and teaching hospitals each accounted for nearly another 20% of the pharmacists' settings. Allied medicine and nursing respondents had similar profiles consisting predominantly of employees in community hospitals and teaching hospitals, but substantial numbers also practiced in educational institutions, extended care facilities, and ambulatory care centers. Physicians most often reported community hospitals and solo practice as their settings followed by teaching hospitals and group practice. Many indicated both a hospital based and a private practice based setting. Approximately 10% of the physicians practiced in an educational institution or in an ambulatory care center or a health maintenance organization.

A continuous scale representing a rural-to-urban continuum was included in the study to allow individuals to indicate their perception of their practice location. Survey evaluators assigned a scale from 1 (rural) to 99 (urban) to analyze the responses. The mean scale value among the five health care professions was 66 which suggests a typical practitioner in a suburban practice setting. Optometrists seemed to perceive their practices in more rural settings than other disciplines (see Figure 1). Physicians perceived their practice locations as the most urban.

Results/Past Participation

Nearly 90% of all respondents indicated that continuing education relevant to their needs was currently available including 95% of responding optometrists. However, one fourth of all nursing respondents indicated a current unavailability of classes relevant to their needs.

The most frequently utilized form of continuing education was a conference or seminar format with 86% of respondents indicating their recent participation in a speaker moderated program. Next in prevalence for recent participation was continuing education via printed home study materials. Other modes of continuing education (TV broadcast, radio, video tapes, audio tape or clinical rounds) were utilized during the past year by fewer than one in seven respondents. Radio formats were the least utilized with 3% indicating recent participation.

Several notable exceptions to the above generalities included attendance at clinical grad rounds in which a much higher percentage of physicians, more than half, have participated this past year. While seminar presentations were the most utilized, only two-thirds of pharmacists indicated attending a seminar; printed home study was utilized by pharmacists more often than any other single discipline.

Physicians utilized the greatest variety of continuing education formats, and in fact had the highest percentage of participation in every category except conference/seminars (in which a higher percent of optometrists indicated participation, 97%). Pharmacists utilized the fewest modes of continuing education format, but were more strongly involved in home study print continuing education than any other discipline surveyed.

The most common reason given for recently attending continuing education was to remain current, especially if that perception of "currentness" had a content which was appealing. "Currentness" and "content" were consistently the top two reasons for attending for all disciplines except optometry, medicine, and pharmacy where a higher ranked reason for taking continuing education was because it is required for relicensure.

Lowest ranked reasons for deciding whether or not to attend continuing education related to the cost. Whether the continuing education was inexpensive or paid for by an employer was not a highly ranked factor for any discipline and particularly not for medicine or optometry. Each discipline rated as the least likely reason for attendance that of "required by employer."

Factors such as a convenient time, location, or a specific faculty were modestly important for all disciplines, but definitely not the most likely reason for choosing a continuing education course.

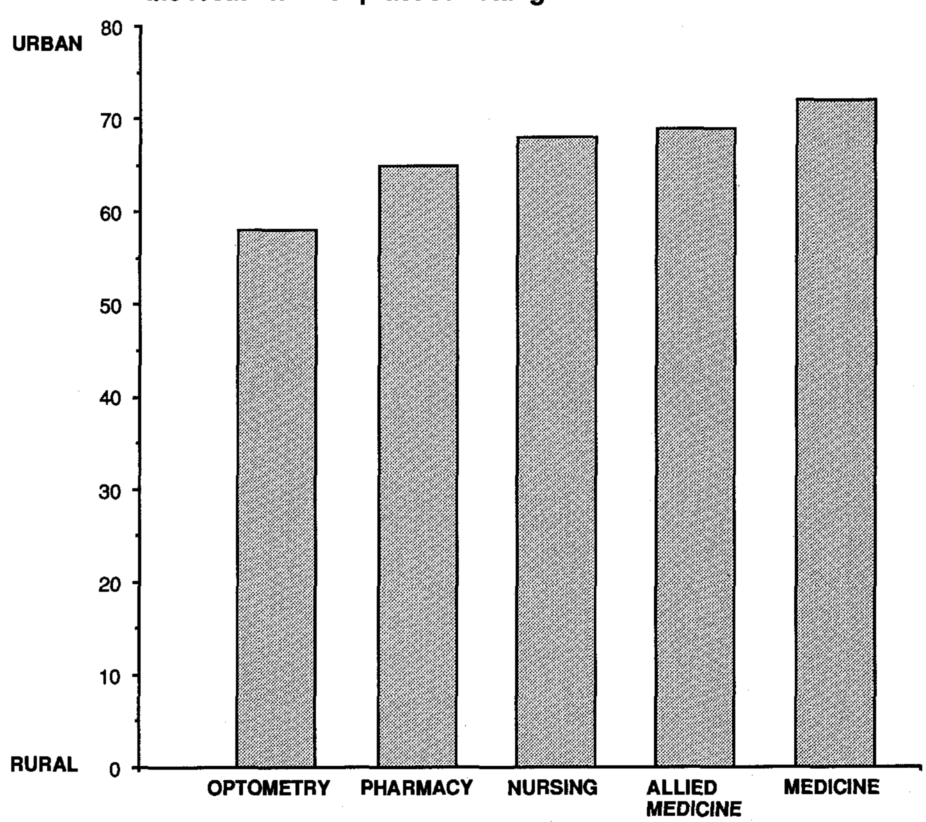
Optometrists surveyed ranked the content of the continuing education as the primary factor for attending a continuing education program. Still important, but significantly less than "program content," were the date and time of the program being offered. Rankings which are consistently closer to "least important" than to "most important" included the number of credit hours being offered, the distance required to travel to the continuing education program, and the specific faculty members teaching the course. Rated least important by the optometrists was the cost of registration and travel.

Optometrists' responses were not significantly different than all other health professionals surveyed, except for the less important factors of program registration fee (optometrists rated this as a less important factor), and for faculty and credit hours (optometrists rated this as a more important factor). Figure 3 describes how the optometrists compared to other health professionals in this survey with regard to factors which influenced their decision to attend continuing education.

Results/Program Format

Over 96% of all responders expressed a willingness or interest in

FIGURE 1
How each profession perceives the location of its practice setting



taking continuing education including 98% of optometrists. Even if taking the continuing education meant traveling, over 80% of all disciplines except pharmacy (68% willing), indicated a willingness to travel. Ninety-six percent of optometrists indicated a willingness to travel to continuing education.

Physicians and optometrists were willing to travel the farthest for continuing education averaging about 300 miles or greater. Nurses and pharmacists responded with a willingness to travel less than 100 miles. Allied medicine respondees suggested a distance between these two extremes as an average distance for continuing education travel.

Respondents were asked to indicate preference for seven locations to attend continuing education on a scale of 1 (most preferred) to 7 (least preferred). The most preferred location for attending continuing education across disciplines was a suburban hotel with a mean rank of 3.1.

Medicine (2.9) and optometry (2.6) most preferred a resort location, while nursing indicated an additional preference for a location at their place of employment (3.2). A state park location was the least preferred by all disciplines.

Although preference for location can be inferred from this data, the mean response for all locations ranged from 3.1-4.7, which indicates a fairly neutral opinion on the preference for a continuing education program location (see Figure 2).

Respondents indicated a strong preference for discipline specific sessions (73%), when attending a conference. Preference for interdisciplinary sessions received a more moderate response (41%).

Respondents also indicated a preference for future continuing education programs to include a keynote speaker, although medicine (47%) and optometry (54%) indicated a more moderate preference than other disciplines. Nursing indicated the strongest preference for a keynote speaker (76%).

Continuing education in small groups (36%) or in conjunction with exhibits (38%) were indicated as preference for less than half the respondents. The availability of round table discussion (24%) and networking sessions (29%) were moderately low in preference. Poster sessions were not preferred by any of the disciplines (9%). Optometrists specifically did not prefer "networking" sessions (15%), but rated exhibits higher than other groups (45%).

Amenities most preferred by respondents were the provision of lunch (66%), and the opportunty to converse with faculty (53%). The disciplines were consistent in their response on preference with conversation with faculty (44% to 58%). The preference for lunch was high with nursing (79%), allied medical professions (73%) and pharmacy (68%) respectively, while moderately preferred by medicine (51%) and optometry (50%).

The other amenities preferred during continuing education programs ranked in the following order:

cultural activities (35%)
recreational facilities (34%)
tours (24%)
social activities (22%)
receptions (21%)
sporting events (19%)
banquets (17%)

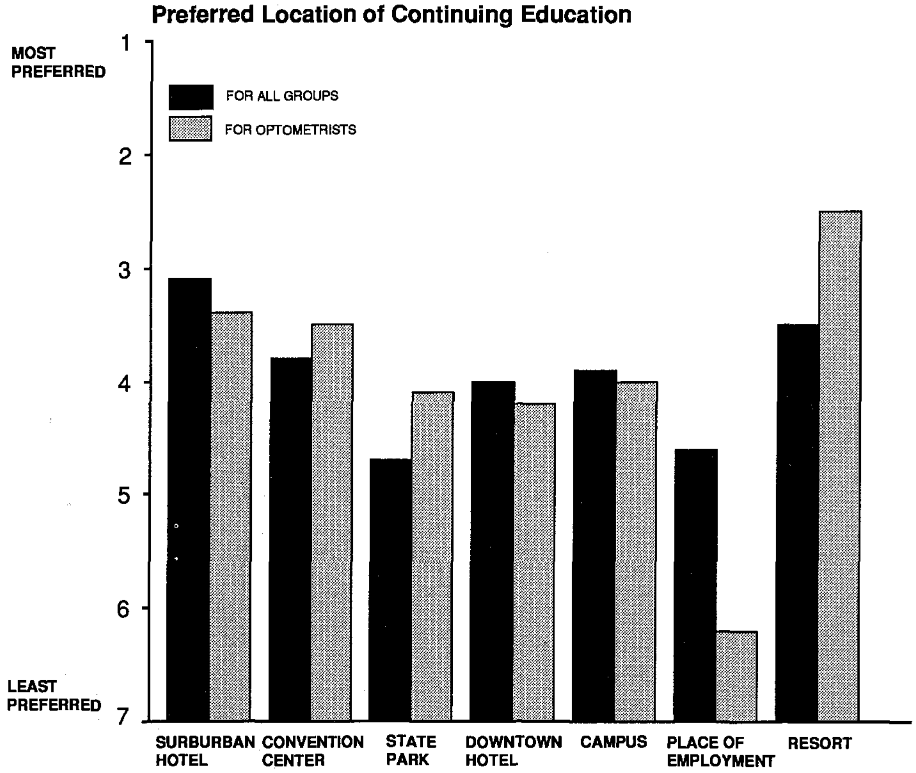
Optometrists and physicians were more likely to favor recreational facilities (46%). A banquet was the least preferred program amenity by optometrists (7%).

Respondents varied significantly on the dollar amount they were willing to pay to attend a six (6) hour continuing education program. The average cost that disciplines were willing to pay was $50 or less (pharmacy), $50-70 (nursing), $80-90 (allied medical professions and optometry), and $100-120 (medicine).

Sixty percent of the respondents indicated their employer provided some financial support for their attendance at continuing education activities. Thirty-nine percent of respondents received full support and 22% of the respondents received partial support. Fourteen percent received no support and 25% of the respondents indicated it was not applicable. Optometry (70%) and medicine (38%) rated the item as not applicable, perhaps reflecting the self-employment practice settings of these two professional groups.

Among disciplines, allied medical professions (80%) and nursing (77%) were the disciplines most likely to receive financial support. Fifty percent of the respondents from medicine and pharmacy reported receiving some kind of financial support to attend continuing education programs while optometry (24%) was the least likely professional discipline to receive financial support for atten-

FIGURE 2
Preferred Location of Continuing Education



dance at continuing education programming.

Of those receiving full financial support, the majority of all respondents received either paid time off (66%) or registration costs (54%). Allied medical professions and nursing received paid time off from work more frequently than the other disciplines. Less than half of the respondents receiving financial support are provided with the *full* costs incurred by attendance at continuing education activities.

The most preferred months for attending conferences for all groups were October (63%), April (59%), and March (58%). In addition, medicine indicated a preference for November (58%), nursing a strong preference for March (70%) and optometry a preference for January (60%). Pharmacy and allied medical professions preferences were consistent with those of the total sample, but optometry and medicine varied from the overall patterns. December was the least preferred month overall, but August was least preferred by optometrists (22%).

Overall, respondents indicated a preference to attend one-day programs and preferred these programs to be held on a Wednesday or Saturday. Medicine and optometry indicated preference for two-day programs.

When comparing disciplines, allied medical professions most preferred a one-day program to be held on Friday (53%) or Saturday (47%). Nursing preferred programs on Wednesday (56%), Thursday (53%) or Tuesday (52%). Preferred program days for medicine were on Wednesday (35%) and Saturday (37%). Pharmacy rated the preferred day fairly evenly across the week, with a moderate preference for Wednesday (37%) and Sunday (35%). Optometry was the only discipline to indicate a strong preference for one-day programs held on Sunday (62%), while allied medical professions (17%) and nursing (12%) indicated Sunday as least preferred.

As a group, respondents neither strongly favored nor strongly opposed two-day conferences. Days of the week preferred by disciplines for two day programs were Tuesday/Wednesday (nursing), Thursday/Friday (allied medical professions), Friday/Saturday (medicine), and Saturday/Sunday optometry (65%). Pharmacy indicated Sunday/Monday as their least preferred choice, and optometry's least preferred choice was Monday/Tuesday (6%).

Respondents ranked eight (8) factors that most influenced their attendance at continuing education programs on a scale of 1 (most important) to 8 (least important).

Respondents indicated the content of the program (2.0), date/time (3.5), and location (3.9) as the factors that most influenced their attendance. Content was ranked as most important by all disciplines. Travel/cost was marked as the least important by all disciplines (6).

Pharmacy in addition ranked faculty (6.3) and medicine ranked credit hours (6.2) as least important. Distance to travel to attend a continuing education course (4.5) and fee (4.5) were ranked of moderate importance by all respondent groups (see Figure 3).

Results/Interest in Professional Issues

Respondents were asked to indicate their level of interest for each of 19 professional issues. The issues were selected because of possible interest across the multiple health care disciplines being surveyed. Interest was rated on the following four-point scale: 1=high, 2=average, 3=low, 4=no interest.

Across all 19 items for all five disciplines, the mean response was 2.0 thus indicating average interest. Nursing and optometry indicated the most interest in these issues overall and medicine the least interest. The only issue to be rated well above average in interest by all disciplines was the general issue of "continuing education."

The remaining 18 issues can be viewed as three clusters of six. Based on means and ranks within disciplines, one cluster is slightly above average in interest, one cluster is about average, and the other cluster is below average. The issues comprising each cluster and their average across disciplines are presented in Table 3. The only large disagreement across disciplines existed for "case management" with medicine and optometry indicating much more interest than the other disciplines.

Overall, optometrists expressed highest interest in future continuing education programs which would be related to specific case management protocols. Also receiving above average interest for optometrists were programs addressing general con-

FIGURE 3
Factors That Most Influence Attendance

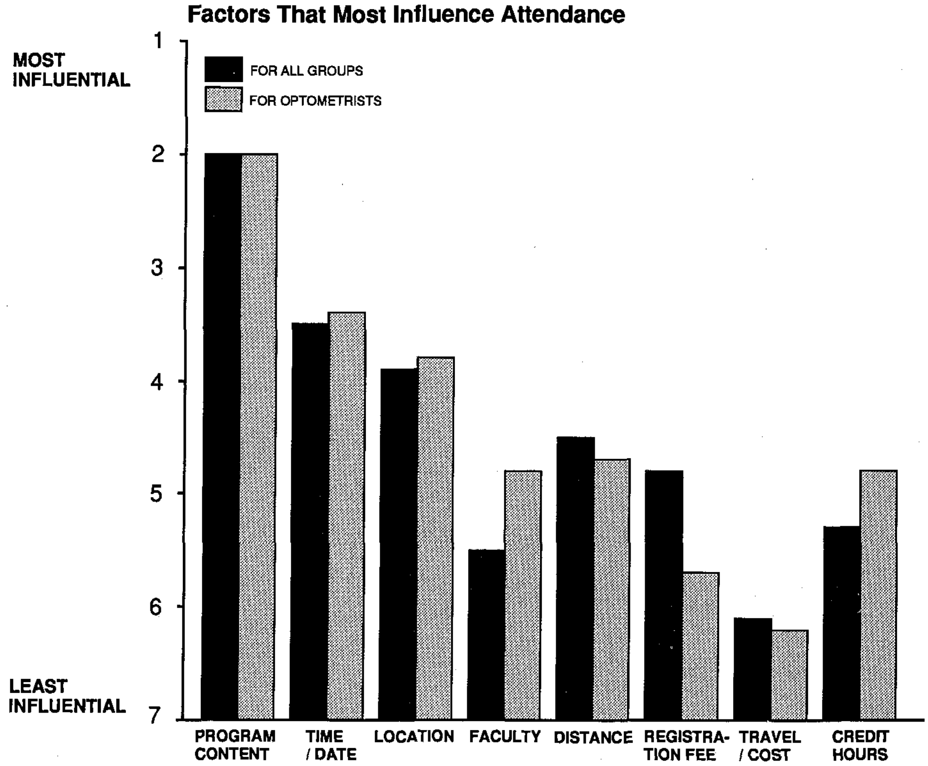


TABLE 3
Indicated Level of Interest in Topics of Possible Common Interest to All Five Disciplines Surveyed

	All groups	Optometry
Slightly Above Average		
Trends in Health Care	1.8	1.9
Legal Issues	1.9	1.9
Quality Issues	1.9	1.9
Patient Assurance	1.9	1.9
Patient/Prof Relations	1.9	1.7
Ethics	1.9	1.9
Average		
Legislation Trends	2.0	1.9
Interprof. Relations	2.0	1.8
Case Management	2.0	1.5
Patient Compliance	2.0	1.8
Risk Management	2.1	2.0
Future of Resources	2.1	2.1
Below Average		
Finance in Health Care	2.2	2.0
Licensing Require	2.2	2.1
Entrepreneurship	2.2	2.0
DRG's	2.3	2.1
Board Certification	2.3	2.2
Home Care	2.4	2.7

(1.0 High 2.0 Average 3.0 Low 4.0 No Interest)

tinuing education topics specific for optometrists, patient and professional relations, and interprofessional relations. Other topics specifically suggested on the survey only received average interest ratings by optometrists with the exception of the topic of home care. This topic was rated as one of low interest.

Other content areas suggested by optometrists in an open-ended question format included the following topics in alphabetical order: (If more than one optometrist suggested this topic the number suggesting it is in parenthesis)

amblyopia
business management for small offices (2)
contact lenses (3)
corneal physiology
emergency care protocol
extended ophthalmoscopy procedures
eye disease review/updates
geriatric vision care/eye care
glaucoma evaluation and management
gonioscopy
infection control in offices

legal issues
malpractice
negligence
orthoptics
ocular side effects of commonly used systemic medications
pharmacology of topical ocular pharmaceutical agents (4)
practice management (6)
product liability
refraction
strabismus
vision standards
vision training
visual therapy
visual fields (2)

Summary and Conclusions

This survey developed a demographic profile of five health professions in Ohio (allied medicine, medicine, nursing, optometry, and pharmacy) and identified their perceived learning characteristics and the perceived educational needs of these health care groups. The study found that within the five sample populations, three-fourths of the survey participants were practicing full-time with the exception of nursing. Optometry had the highest percentage of full-time practitioners.

The survey demonstrated the number of years past formal education for each health provider group. Physicians and nurses represented the oldest, or groups furthest from formal education; allied medicine represented the most recently licensed or certified group in the study. The average optometrist was first licensed twenty years ago.

Most of the respondents showed a strong preference for live programs (i.e., conferences and seminars), although pharmacists indicated a strong interest in home-study correspondence courses. The majority of those surveyed preferred one-day programs with Wednesday and Saturday as the days of choice. The optimum months for continuing education programs varied with the discipline. Suburban sites represented the preferred location for taking continuing education courses. A program's content, date and time, and location were the most important factors influencing program attendance. The data also indicated that travel and cost concerns ranked least among factors for all the disciplines. Optometrists indicated a willingness to travel; the preferred travel distances for optometrists and physicians were greater than for other groups. Course fees which respondents were willing to pay for a six-hour course were between $80 and $90 for optometrists. While two-thirds of the sample indicated that their employer provided some financial support for their attendance, this was not a frequently expressed situation for optometrists.

Meaningful trends or interests in professional issues were revealed in the survey findings through a high preference by optometrists and physicians for education related to patient case studies. Overall respondents showed only a slightly above average interest in critical issues relating to quality assurance, patient education, legal and ethical issues.

The results of this study indicate patterns of common education needs along with specialized needs for subpopulations within the health professions. Optometrists tended to show more similarity to physicians in attitudinal preferences and experiences with continuing education, although their distribution throughout the state more closely parallels pharmacists. Optometrists and other health care providers do make decisions to attend continuing education courses for a variety of reasons. A necessity to comply with mandated continuing education regulations is one issue that influenced their decision to attend continuing education.

Note: Copies of the survey instrument are available by writing Dr. Augsburger at The Ohio State University College of Optometry, 338 West Tenth Avenue, Columbus, Ohio 43210-1240.

Acknowledgments

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Integrating Graphics and Speech

A Neural Sciences Computer-Assisted Learning Package

Leonard Levine, Ph.D.

ABSTRACT

A new program for the Macintosh computer has been written and compiled in QuickBasic™ for the Neural Sciences Computer-Assisted Learning Package (Journal of Optom Educ 1990; 12:84-92). This program, Review Drawings apl, expands the scope of the Learning Package by the inclusion of graphics and synthesized speech. Its 21 modules fall into six categories: anatomical drawings, diagrams illustrating physiological concepts, records from experiments, flow charts of neuroanatomical pathways, 'progressive' charts and mathematical equations. These modules, by incorporating visual and auditory learning modalities, should significantly improve learning, especially when used together. The program and source code is freely available to interested optometric educators and optometry students.

John, now a second year optometry student at Pacific University, had National Boards on his mind. The academic year was quickly coming to an end, and he planned to take the Basic Science Section in August. All through the present school year he and his classmates had been haunted by the results from the previous summer: nationally, more than 50% of those taking the Basic Science Section had failed. Clearly, some hard study was needed, and he would have to develop and execute a study plan.

As a start, John consulted the National Board Candidates' Guide. As he browsed through the Content Outlines, he was impressed with how many topics dealing with the nervous system he encountered. Indeed, these topics were not only in the Neuroanatomy/Neurophysiology section, but also in the Histology and General Physiology sections. Reflecting on these neural science topics, he was struck by how many of them correlated with modules in the Neural Sciences Computer-Assisted Learning Package, which he had used successfully in his first-year course in Structure and Function of the Nervous System.

To refresh his memory, John took the Candidates' Guide to the student microcomputer lab and brought up the Neural Sciences Computer-Assisted Learning Package. He was delighted to find that he had remembered correctly — just about every reference to the nervous system in the Guide corresponded to some component in the Learning Package.

But John found more than he had anticipated. A new module had been added to the Package. Called Review Drawings, the new module added two additional dimensions: graphics and speech. John spent a few minutes examining the new module and quickly discovered that it included labeled figures of the brain, diagrams of neurophysiological concepts, electro-physiological tracings, block diagrams of neural pathways, a summary chart of pharmacology, and even a mathematical equation.

Although it addressed more complex themes than other parts of the Package, it was as easy and as fast to use. In addition, he discovered that all but two of the 21 modules could be run using a sound option. When the option was on, each response was not only displayed on the computer screen, but was spoken aloud by a voice synthesizer.

John left the microcomputer lab greatly cheered and relieved. He felt that by making use of the Neural Science Computer-Assisted Learning Package, he had an easy-to-use, fast, and efficient way to review, for those parts of the National Boards dealing with the nervous system.

Introduction

A previous edition of this Journal described a Neural Sciences Computer-Assisted Learning Package for the Macintosh computer, which had been developed to assist first-year optometry students in a course concerned with the structure and function of the nervous system.[1] Briefly, this package consisted of a series of free-standing applications, written and compiled using QuickBasic™, which could be used as study aids. Among the modules included were (a) a simple flashcard program, (b) progressive charts which expanded to expose successive layers, (c) neural reviews, which were functionally multi-sided flashcards, and (d) data-

Dr. Levine is professor of physiology and pharmacology at Pacific University College of Optometry.

bases which allowed retrieval of stereotyped information concerning human nerves, muscles, or health science terminology.

Copies of this package have been distributed to optometric educators and students throughout the United States, and feedback indicates that it has been favorably received. The present article describes a major expansion of the original package: development of a new, free-standing program, Review Drawings apl, which incorporates graphics and speech.

Creating the Modules

All modules were written in QuickBasic™ for the Macintosh (Microsoft), then concatenated and compiled into the free-standing application, Review Drawings apl. Graphics used in Review Drawings apl were saved in PICT format and stored in the resource file, CortexPictRes. Both of these files must be present in the same folder for the program to run.

Some of the graphics were copied from textbook figures by use of a hand scanner (Mars 105™). Scanned images were saved in TIFF format, then opened with DeskPaint™, edited, and saved in Macpaint™ format. They were then converted to PICT resources and saved in CortexPictRes. Other graphics were created using MacDraw™ or MacPaint™, then saved in MacPaint™ format, converted to PICT resources and saved in CortexPictRes.

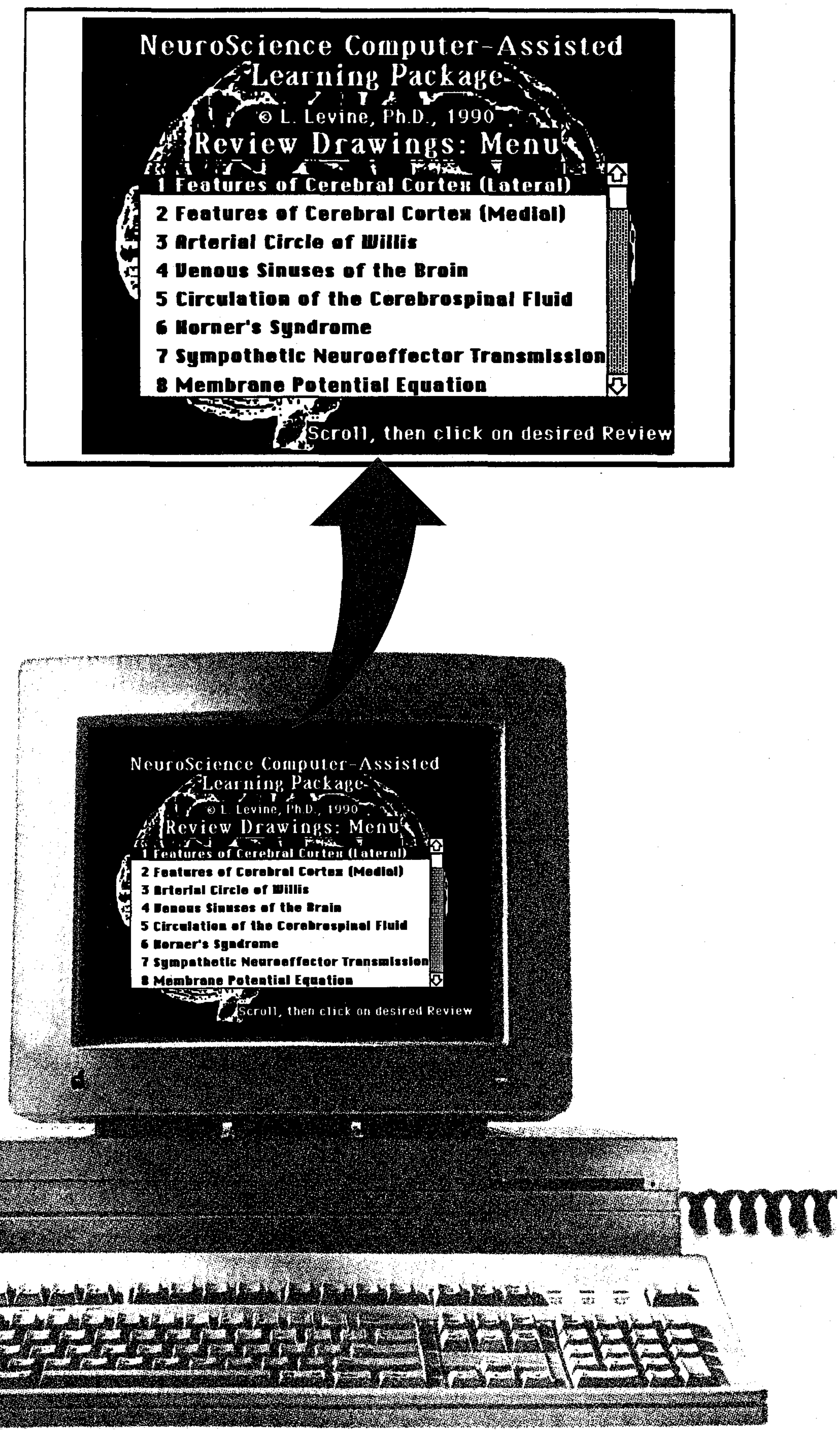

Figure 1. The Main Menu for the program showing 8 of the 21 modules on a scrolling list.

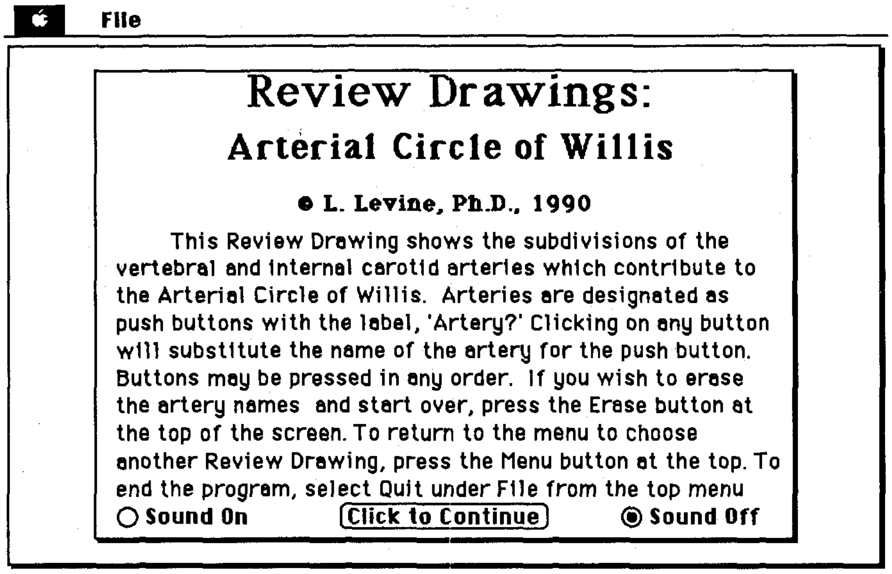

Figure 2. The title screen from the module, Arterial Circle of Willis.

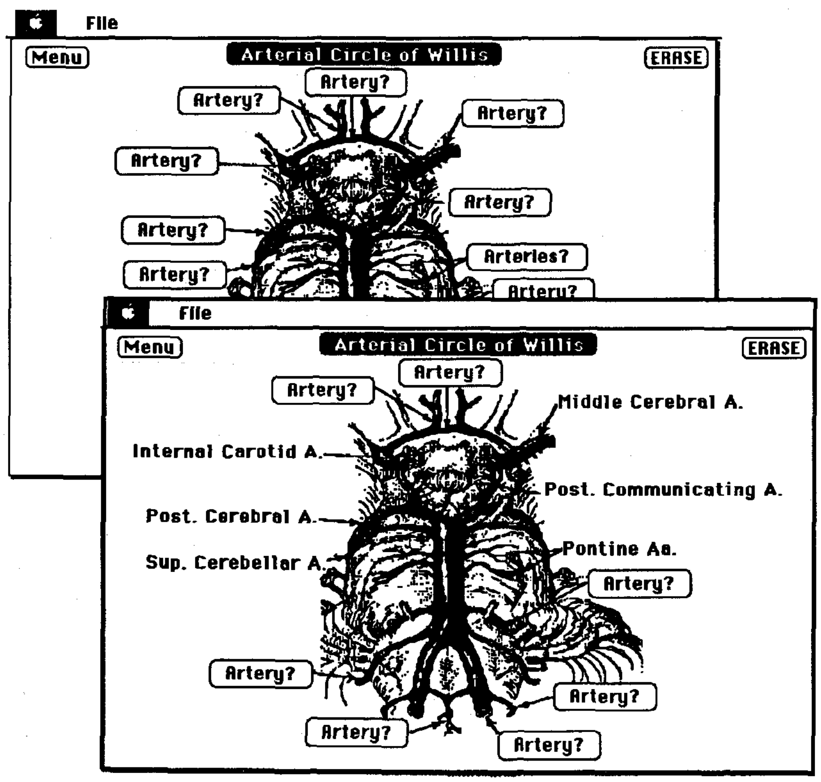

Figure 3. Two superimposed screens from the module, Arterial Circle of Willis, illustrating Anatomical Drawings.

Synthesized speech was made possible by use of the system file, Macintalk™, which must be present in the system folder for execution. Calls to the Macintosh toolbox routines were made from QuickBasic™ using SpeechLib™ (Clear Lake Research). Words to be spoken were manually converted into their corresponding phonemes, and then passed to the SpeechLib™ routines.

Program Features

Two of the strengths of the Macintosh computer are its outstanding graphics capability, and its ability to incorporate, via Macintalk, synthesized speech. These features are especially propitious, since current learning theory recognizes several learning modalities, including visual (pictures, graphs) and auditory (spoken).[2,3] The original Neural Science Learning Package, which was almost entirely dependent on learning through reading, has now been expanded to include a 21-module program of graphic displays and incorporated speech. Any of the 21 modules may be invoked by clicking on its title from the scrolling main menu (Figure 1).

(1) ANATOMICAL DRAWINGS

The program contains 6 modules in this category: Features of the Cerebral Cortex (lateral), Features of the Cerebral Cortex (medial), Arterial Circle of Willis, Venous Sinuses of the Brain, Circulation of the Cerebrospinal Fluid, and Cytology of the Neuron. The opening screen from Arterial Circle of Willis is shown in Figure 2. All opening screens are similar to this one, and allow the user the option of adding speech to the displays. The default setting for all modules is Sound Off, so the program runs silently unless the user changes to Sound On.

Figure 3 shows two superimposed screens from the module, Arterial Circle of Willis. The upper (rear) screen is the default, which appears when the module is started. The lower (front) screen shows the appearance after six of the push buttons were clicked. The terms, "Middle Cerebral A.," "Internal Carotid A," "Post. Communicating A.," "Post. Cerebral A.," "Superior Cerebellar A., and "Pontine AA." have replaced the corresponding push buttons labeled "Artery?".

On this, and on all other modules, the user may click on the ERASE button at the top of the screen at any time, and the default screen will reappear. There is also a push button labeled "Menu" which allows the user to return to the main menu (Figure 1) to make a different choice. The Menu push button is found in all modules.

(2) DIAGRAMS ILLUSTRATING PHYSIOLOGICAL CONCEPTS

The program contains four modules in this category: The Voltage Gated Potassium Channel, The Voltage Gated Sodium Channel, Horner's Syndrome, and Sympathetic Neurohumoral Transmission. Figure 4 shows two superimposed screens from the module, The Voltage Gated Sodium Channel.

The top (rear) screen represents the resting state of the sodium channel and is the default presentation. The lower (front) screen represents the open state, and appears when the "open" push button is clicked. Whenever a state push button is clicked, (1) the inactivation and activation gates are redrawn, (2) the text adjacent to the gates is replaced with terms that specify their current status, and (3) the text at the bottom of the channel is replaced with a phrase that specifies the corresponding phase of the action potential.

(3) RECORDS FROM EXPERIMENTS

Review Drawings apl contains two modules in this category: Effect of Ions and Drugs on Voltage Clamp Records, and Threshold and Subthreshold Stimuli. Figure 5 shows two superimposed screens from Effect of Ions and Drugs on Voltage Clamp Records.

The upper (rear) screen is displayed when the module is first started. It shows a typical voltage clamp record, illustrating normal tracings of membrane voltage and current. The three distinct current phases carry push buttons which, when clicked, identify the sources of those currents.

The right side of the lower (front) screen shows the voltage clamp record after the Local Anesthetic button in the lower horizontal row had been clicked.

This module helps students understand how ion substitution experiments can illuminate the early inward

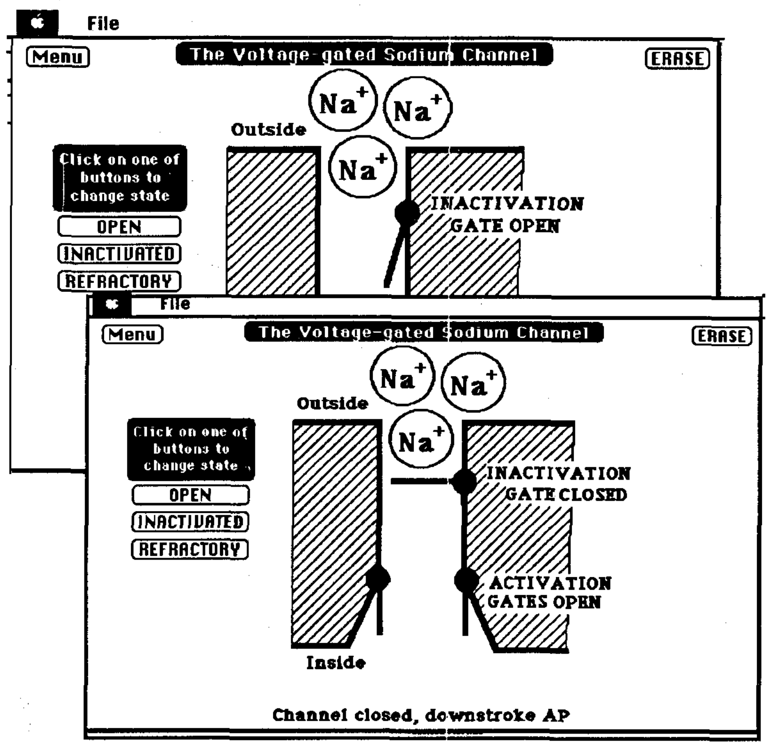

Figure 4. Two superimposed screens from the module, The Voltage-Gated Sodium Channel, representative of Drawings Illustrating Physiological Concepts.

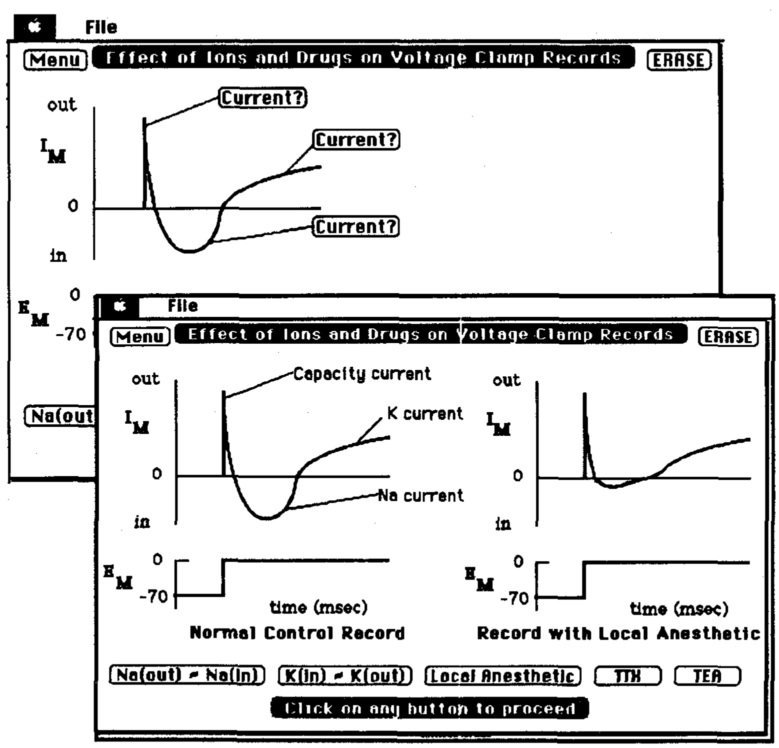

Figure 5. Two superimposed screens from the module, Effect of Ions and Drugs on Voltage Clamp Records, illustrating Records from Experiments.

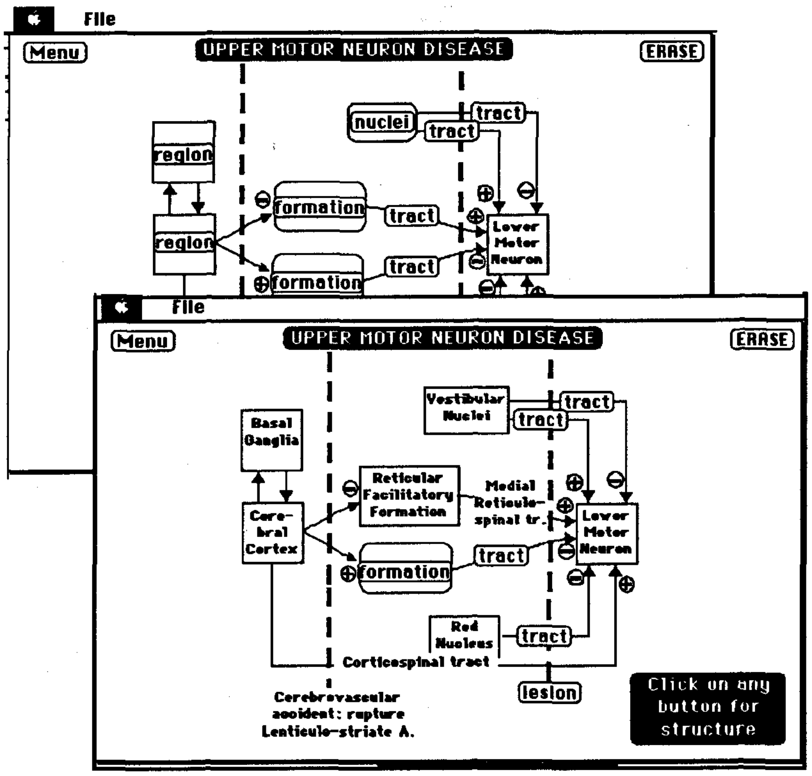

Figure 6. Two superimposed screens from the module, Upper Motor Neuron Disease, illustrating Flow Charts of Neuroanatomical Pathways.

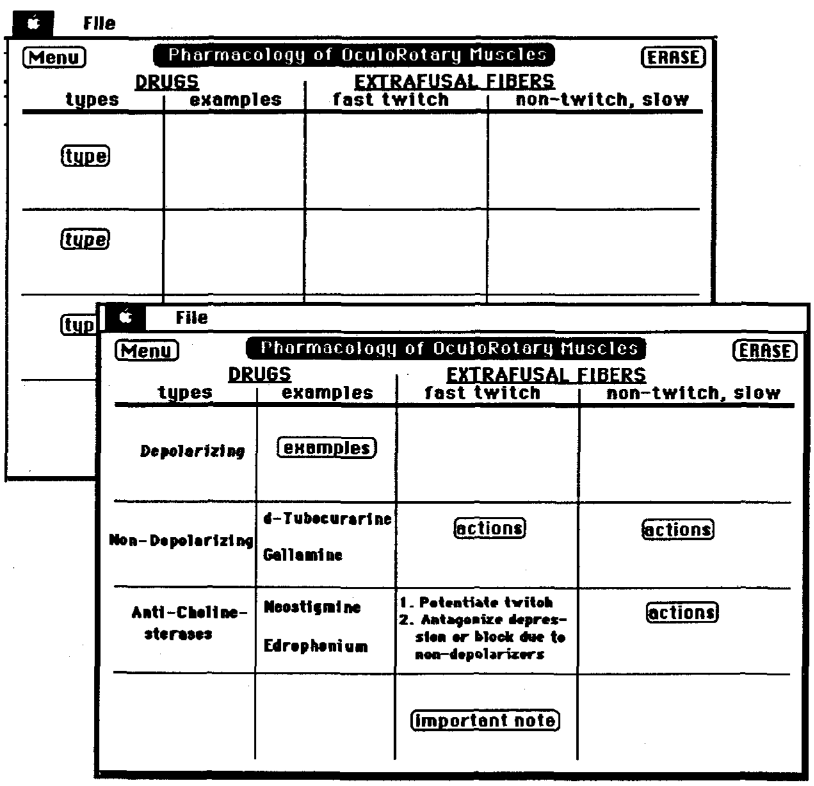

Figure 7. Two superimposed screens from the module, Pharmacology of Oculorotary Muscles, illustrating 'Progressive' Charts.

and delayed outward currents, and also how voltage clamp experiments were used to reveal the mechanisms of action of local anesthetics and the poison, tetrodotoxin.

(4) FLOW CHARTS OF NEURO-ANATOMICAL PATHWAYS

The program contains 5 modules in this category: Muscle Spindle Reflex, Parkinson's Disease, Upper Motor Neuron Disease, Pathway for Saccadic Eye Movements, and Pathway for Pursuit Eye Movements. Figure 6 shows two superimposed screens from Upper Motor Neuron Disease.

The upper (rear) screen is the default screen. It shows, as a series of push buttons, the major pyramidal and extrapyramidal motor pathways that impinge on the lower motor neurons, along with the gray matter structures from which they originate. When the user clicks on one of the push buttons, it is replaced by the name of the pathway or structure.

The lower (front) screen shows the display after eight of the push buttons have been clicked.

This module is intended to reveal how cerebrovascular accidents and hemisection of the spinal cord result in the symptoms of upper motor neuron disease.

(5) 'PROGRESSIVE' CHARTS

The program contains one module in this category: Pharmacology of the Oculorotary Muscles. As illustrated in Figure 6, the program opens with a table which is largely blank (top, rear), and three active push buttons. Clicking on any of these buttons then fills in more of the table, and uncovers additional push buttons which may, in turn, be clicked to continue the process of completing the table.

The lower (front) screen shows the partially completed table after clicking all three buttons in the Drugs, Types column, two buttons in the Drugs, Examples column, and one Actions button in the Fast Twitch column. Buttons may be clicked in any order, so that the user may fill in the table either by row or by column.

(6) MATHEMATICAL EQUATION

There is only one module in this category: General Equation for Resting Membrane Potential. In this example, the equation under study was created as a graphic using MacDraw™ so that terms in the numerator and denominator, and subscripts and superscripts could be precisely positioned. This equation appears at the top of the upper, rear screen of Figure 7, which is the default display.

On this screen all terms in the equation, and their units, are listed in the left-hand column. The normal values of these terms are listed in the center column, Default Values. A right-hand column, Current Values, consists of a series of user-changeable edit fields. The user may change only a single value or, if desired, all of the values. Whenever the user clicks the Calculate button, the equation is evaluated using whatever values then appear in the Current Values column.

The lower (front) screen illustrates one way that this module assists students to appreciate the factors involved in determining the resting membrane potential. Here the value of r, the pump ratio, has been changed from 1.5 to 1.0, i.e., from an electrogenic to an electrically neutral pump. When the Calculate button is clicked, it reveals what is not intuitively obvious, i.e., that the resting membrane potential changes by only a small amount, from -88.5 to -86.1 mv.

Speech

All but 2 of the modules offer the user the option of having synthesized speech accompany the visual responses. This option is offered on the Title screen with which the module starts (see Figure 2), with the default condition being Sound Off. If the speech feature is enabled, then each time one of the push buttons is clicked, the resulting response is made both visually on screen and spoken aloud with synthesized speech. In this way, the student hears, as well as sees, the response.

Additional Comments

Review Drawings apl significantly enhances the Neural Sciences Computer-Assisted Learning Package by a unique addition of graphics and speech. Adding graphics considerably expands the scope of what may be presented in these learning modules, and adding synthesized speech increases the number of sensory modalities impacted. According to current learning theory,[4] this should significantly improve retention.

This learning package should be of assistance to students as a review of the subject matter of neural science, in preparing for course examinations and/or State or National Board examinations. It may also be interesting and useful to optometric educators as a teaching adjunct in courses in neural science or, suitably modified, in other courses.

As with the original programs in the Neural Sciences Computer-Assisted Learning Package, the QuickBasic™ source code for Review Drawings may be easily modified to accommodate additional modules, update existing modules, incorporate user suggestions, or be converted for use with other subject areas.

Review Drawings apl has been copyrighted to protect it from unauthorized modifications or distribution for profit. But it is the author's intention that it be freely available to optometric educators and optometry students. Interested readers may obtain a copy of (a) Review Drawings apl, (b) CortexPictRes, and (c) Macintalk™ by sending a blank, 3.5 inch floppy disk to the author. Those interested in modifying any of the modules to suit other courses or topics should request authorization in writing and a copy of the QuickBasic™ source code. Please note that in order to modify any of the speech passages, the modifier would need CLR SpeechLib™ (available for $35.00 from Clear Lake Research, Houston, TX 77005).

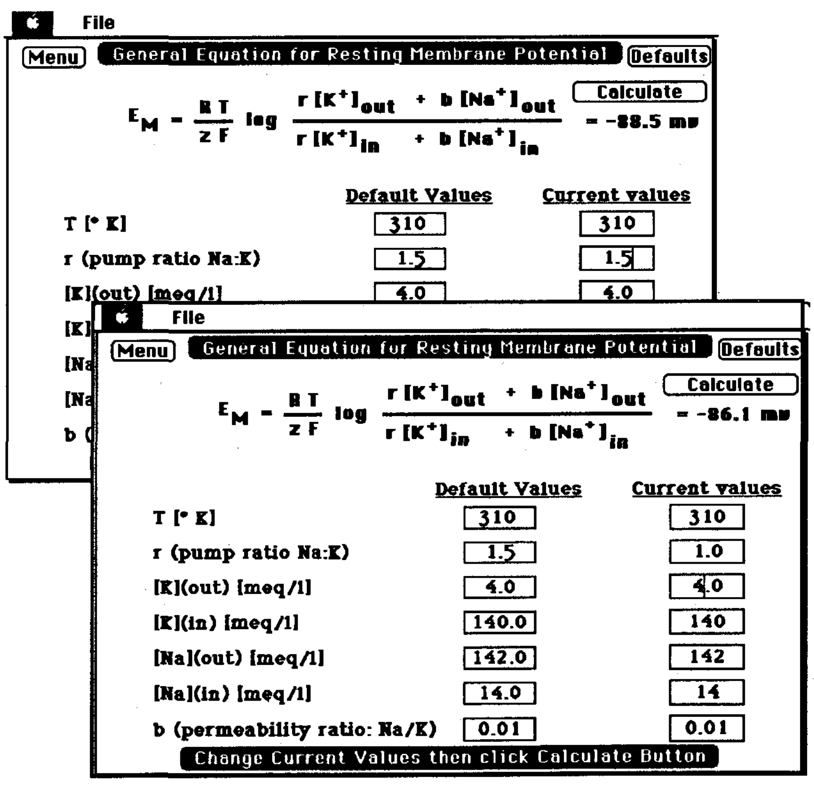

Figure 8. Two superimposed screens from the module, General Equation for the Resting Membrane Potential.

Author's Address:
Pacific University
College of Optometry
2043 College Way
Forest Grove, OR 97116

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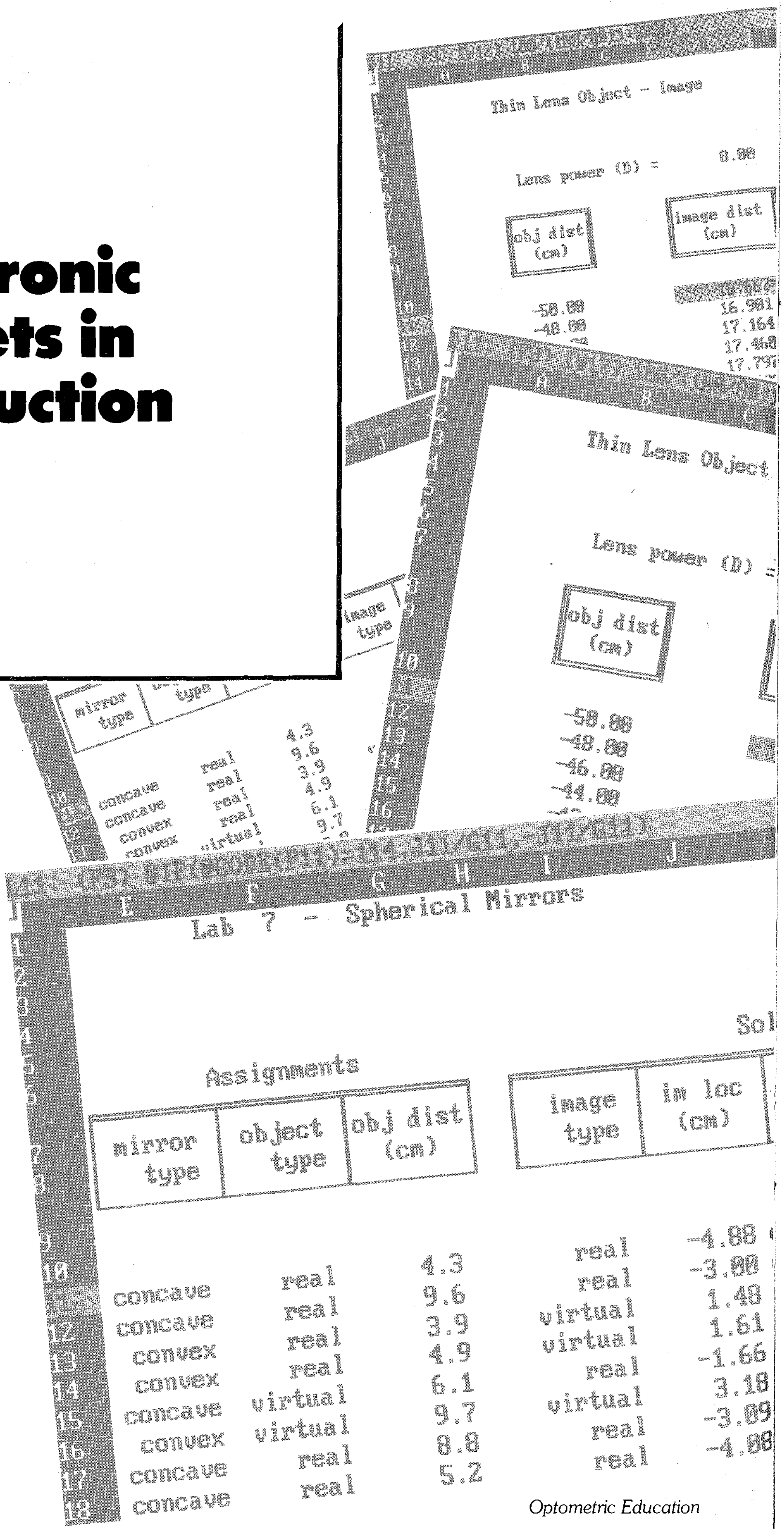
Use of Electronic Spreadsheets in Optics Instruction

C.H. Cobb, Ph.D.



Abstract

A significant challenge for instructors of courses that require analysis and problem solving is to teach and evaluate these skills for each individual student in a large enrollment class environment. This paper describes a mechanism where spreadsheet software programs for personal computers are used to generate unique assignments for each student and to provide corresponding solutions that can be checked within a reasonable time. The mechanism minimizes the tendency of some students to inspect solutions by others without actually solving the problems themselves.

Data from the assignment lists can also be used to prepare graphs of how one quantity depends on another to supplement lecture presentations.

Key Words

Spreadsheets, computers, instruction

Dr. Cobb is a professor at Southern College of Optometry. He is a member of the editorial board of Computers in Physics.

Introduction

Desktop and portable computers have been available long enough now so that some faculty members have devised uses for them as aides in teaching optometric concepts. Computers are not inherently better teaching aides than any other device or methodology. The choice of which medium to use as an aide to achieve the instructional goals of a particular course affects the cost or extent of delivering instruction, but only the content of the medium will influence educational development.[1] That is, how one uses the medium is more important than which medium is used.

To justify the expense of using a computer as an instructional aide, the computer must:

- accomplish something that can only be done with a computer
- accomplish a task more efficiently using computer technology as opposed to other instructional aides
- support development of skills and quantitative habits that are part of the course objectives.

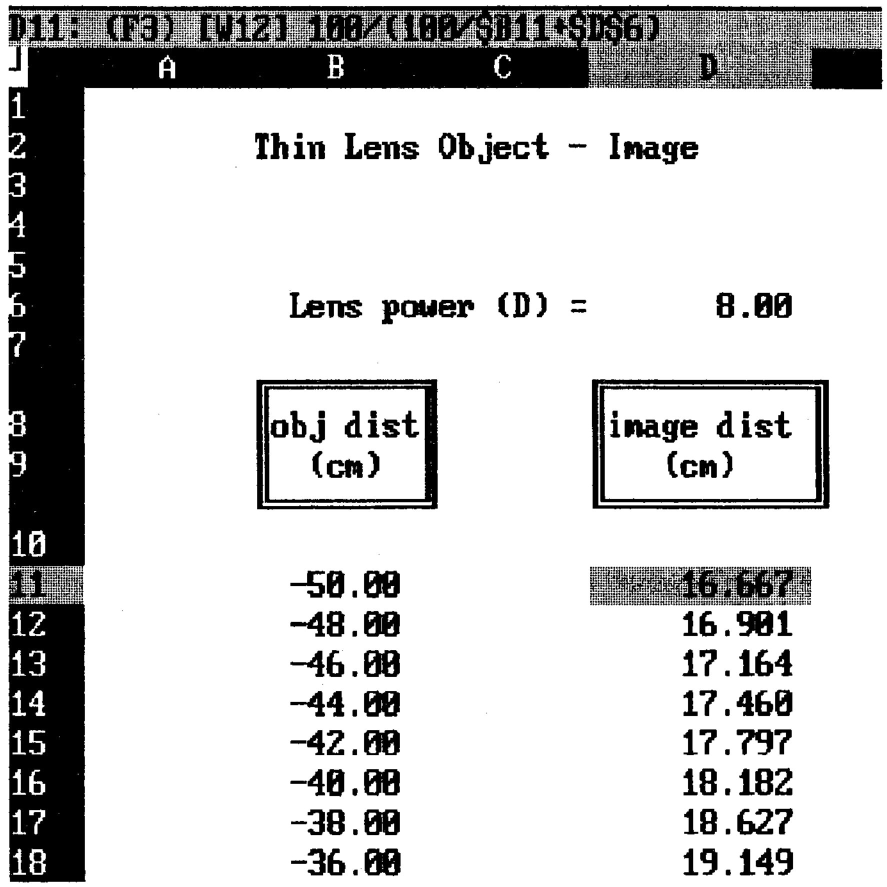


Figure 1. Spreadsheet design illustrating formula definition. The example is to compute the image position in air for a +8 D thin lens at given object positions. The formula definition is shown at the top line.

Examples of applications that can be accomplished more efficiently with a computer include course logistics and learning objectives. In course logistics, the instructor uses the computer to grade individual student examinations and assignments and to post such grades in a file that can be used to ascertain a final assessment of student learning. Many instructors use electronic spreadsheet software for this purpose, as it frees them to deal with those out-of-the-ordinary needs of students that can be cared for only by human intelligence. The learning objectives of some courses are of such a nature that the use of a computer is required to achieve these goals. This paper describes one such application as an aide in teaching optics to optometry students.

An example of an application that supports the development of skills that are part of the course objective is computer aided instruction (CAI) where the student interacts with the computer in answering questions designed to measure and direct the mastery of specific learning objectives by the student. An optometric example has been described for the neural sciences.[2]

Reason for System

Optics never has been, and probably never will be, a favorite basic science course taken by optometry students. The subject requires analysis and application of basic concepts rather than rote memorization. Consequently, instructors of optics courses have devised many ways to impart the necessary skills and experience in problem solving to their students that will insure success on examinations and on later applications in clinical settings. These ways have included assigned problems from textbooks, prepared problem sets for the class and examples in lectures and laboratories. Since class size determines the extent of individual attention given by the instructor to the problem's solutions, the success of each procedure varies according to the class size.

For small class enrollments, the instructor is able to see each student demonstrate every step in the problem solution, and the instructor usually assumes that the same skills can be applied to different problems presented on examinations. As class enrollments increase, instructors tend to add teaching assistants, when funds are available, to help them analyze the problem solving skills of the students. Irrespective of class size, however, problems in textbooks are finite in number, and solutions to them are generally available for students to "look at" as a time reducing replacement for individual solutions by each student. Further, prepared problem sets for the class tend to be completed by a few students and are then made available for the remaining students, especially if the problem sets are not different each year.

A main goal of an optics course is to teach problem solving skills, and this is best accomplished when each student individually solves the problems. This paper describes one way to use computers to implement this goal.

E11: (F1) @RAND*9+2

	A	B	C	D	E
1		Lab 7	-	Spherical Mirrors	
2					
3					
4					
5				Assignments	
6					
7	Std No		mirror	object	obj dist
8			type	type	(cm)
9					
10					
11	6180		concave	real	4.3
12	6181		concave	real	9.6
13	6182		convex	real	3.9
14	6183		convex	real	4.9
15	6184		concave	virtual	6.1
16	6185		convex	virtual	9.7
17	6186		concave	real	8.8
18	6187		concave	real	5.2

Figure 2. Spreadsheet design to generate unique assignments for each student. The pointer at cell E11 illustrates the quasi-random generation of numbers within a specific range by the program.

System Design

The particular way computers have been implemented to encourage individual problem solving is by use of the class of computer software programs known as spreadsheets. Originally conceived to help business and financial personnel make financial decisions and to design budgets, spreadsheets have emerged as an extremely versatile and useful tool for mathematical analysis and scientific work. Examples of such mathematical and scientific applications have previously been described.[3] The particular application developed here has not been described before.

A spreadsheet allows the user to define a matrix of cells, where each cell contains a single entity such as a number, string of characters, mathematical expression or a reference to another cell or cells. The programs can be arranged so that formulae can be evaluated once or repeatedly. Logical branching can be used to achieve looping and indexing. Procedures can rapidly be generated, validated and saved for later use. Most spreadsheets have a wide selection of mathematical functions internally available and also provide some type of graphical display of the results. Many of the optometric applications of optics need only these internal functions.

The technique described here does not depend on the use of any particular commercial spreadsheet program. The examples presented below are from the application of Lotus 1-2-3™ since it is the industry standard. Other spreadsheet programs such as Quattro Pro™, Excel™, PlanPerfect™, Lucid 3-D™ or SuperCalc™ for the MS-DOS operating system and Excel™ or WingZ™ for the MacIntosh™ class computers will work equally well. In fact, most of the spreadsheet programs contain utility codes to convert to and from the formats of other programs.

The application of spreadsheet programs to optics instruction is based on the definition of an independent variable in one column and a dependent variable in another column. The independent variable column contains numbers such as the position of a real object from a thin lens, and the dependent variable column contains a formula by which some quantity, such as the position of the image from the lens, is evaluated. An example of this formula definition is shown in Figure 1. In Figure 1, the cell pointer is at cell D11, and the formula definition is shown in the top line. The reference to cell B11 is to the independent variable of object position in centimeters, and the reference to cell D6 is to a constant which is the same for all rows, namely the thin lens power. Standard spreadsheet techniques of "data fill" to generate the range of numbers in column B for independent variable, and of "copy" to equivalently reproduce the D11 cell equation in all rows of column D were used. As a consequence, the spreadsheet contains in columns B and D a set of ordered pairs of numbers that can be either graphed for visual enhancement of lecture presentations or printed in an assignment or a problem list for students.

The utility of spreadsheet programs is demonstrated by noting that changing the constant in cell D6 (that is, the thin lens power) causes the program to re-evaluate all the values in column D for the new constant. A whole new set of ordered pairs of numbers is then available within a few seconds.

Examples

Several examples of the design of a spreadsheet to generate unique assignments for each student in a class are presented below.

1. *Laboratory assignments*

Figure 2 illustrates the design of a spreadsheet to generate unique laboratory assignments. The particular example is the use of ray tracing to find the image formed by a specific given spherical mirror. Column A represents some anomymous way of identifying each individual student. Here it is a unique student number assigned to each student. Columns C, D and E represent the assignments. Since columns C and D had only two possible choices each, they were entered manually. A formula to enter them randomly is possible and not particularly difficult to design. The values of the independent variable in column E could be any number within a specified range. To reduce predictability to these values, one of the spreadsheet's internal functions was utilized. This is shown in Figure 2 by the contents of cell E11 shown in the top line. The function RAND quasi-randomly generates a fractional number between 0 and 1; therefore, the contents of each cell in column E contains a number between 2 and 11. This particular range was required since the students are required to verify their individual calculations by tracing actual rays from a spherical mirror in the laboratory.

A solution set is contained in additional columns of the same spreadsheet. Figure 3 shows the solution columns I through L in addition to the assignment columns E through G. The assignment columns differ in letters from those in Figure 2 since a column containing the name of each student and one containing a sequential number, present in the solution list but not in the assignment list, were deleted before the assignment list was printed. Figures 2 and 3 are part of the same spreadsheet, and only the instructor and any teaching assistants see the solution columns. Only a subset of the total spreadsheet needs to be printed for each assignment list. The assignment list is posted each week for student access.

The formula in column L as represented by the top line in Figure 3 illustrates the use of logical statements. While the specific example in Figure 3 assigns a positive or negative sign to the image magnification according to whether the image has the same or opposite orientation as the object, the particular formula would depend on the equation relating the dependent variable to the independent variable.

2. *Problem assignments*

The spreadsheet design for class problem assignments is conceptually the same as for the laboratory assignments in the first example. In the laboratory, the instructor is constrained in the use of certain values of variables since they represent physical devices which will be used by students to measure quantities to compare with the results of their individual calculations. In the spherical mirror examples illustrated in Figures 2 and 3, the mirror power is constant.

L11: (F3) @IF(@CODE(F11)=114,J11/G11,-J11/G11)

Lab 7 - Spherical Mirrors

	E	F	G	H	I	J	K	L
6	Assignments				Solutions			
7–8	mirror type	object type	obj dist (cm)		image type	im loc (cm)	orient	magnif (x)
11	concave	real	4.3		real	-4.88	opposite	-1.135
12	concave	real	9.6		real	-3.00	opposite	-0.313
13	convex	real	3.9		virtual	1.48	same	0.380
14	convex	real	4.9		virtual	1.61	same	0.328
15	concave	virtual	6.1		real	-1.66	same	0.273
16	convex	virtual	9.7		virtual	3.18	opposite	-0.328
17	concave	real	8.8		real	-3.09	opposite	-0.351
18	concave	real	5.2		real	-4.08	opposite	-0.784

Figure 3. A different portion of the same spreadsheet of Figure 2 showing the solution columns corresponding to the assignment columns. The pointer at cell L11 illustrates logical statement use by the program.

D8: ^power

Lab 7 - Spherical Mirrors

	A	B	C	D	E	F
6			Assignments			
7–8	Std No		mirror type	mirror power	object type	obj dist (cm)
11	6180		concave	25.00	real	4.3
12	6181		concave	21.00	real	9.6
13	6182		convex	20.25	real	3.9
14	6183		convex	14.75	real	4.9
15	6184		concave	13.00	virtual	6.1
16	6185		convex	18.75	virtual	9.7
17	6186		concave	16.25	real	8.8

Figure 4. The addition of another variable to the same spreadsheet of Figure 2 to allow problem assignment with greater variety.

For the classroom, the instructor is free to allow all independent variables to vary to any values he/she desires. This introduces another level of independent change in the assignments to assure individual attention to the assigned problem by each student.

To convert the spherical mirror spreadsheet in Figure 2 into one for problem assignment, the instructor could add an additional assignment column for the mirror power. An example of this is shown in Figure 4, where the mirror power has been added as an additional variable in column D.

3. *Lecture illustrations*

The spreadsheets used for class problem assignments or laboratory assignments can also produce illustrations to enhance lecture presentations. This is achieved by use of the graph facilities that are part of every commercial spreadsheet program. The graphing functions usually allow the user to plot the ordered pairs of data in the spreadsheet columns in formats of bar, pie or xy plots.

Most appropriate for the type of spreadsheets likely to be designed for optics instruction are xy plots. The data in the independent variable column would be defined as the x axis of the plot, while the data in the dependent variable column would be defined as the y axis of the plot. For the assignment spreadsheets, the independent variable generated different, unique numbers for each student and could represent some physical quantity such as the object position from a thin lens. A graph of the data in Figure 1 is shown in Figure 5, where the y axis would represent the image dependence by the thin lens on the object position. Depending on what computer hardware is available to the instructor, the graph could be plotted in color directly on an overhead transparency by a x-y plotter, printed on a printer with an overhead transparency produced on a photocopy machine or displayed directly from the computer screen onto a large screen by use of a video projector.

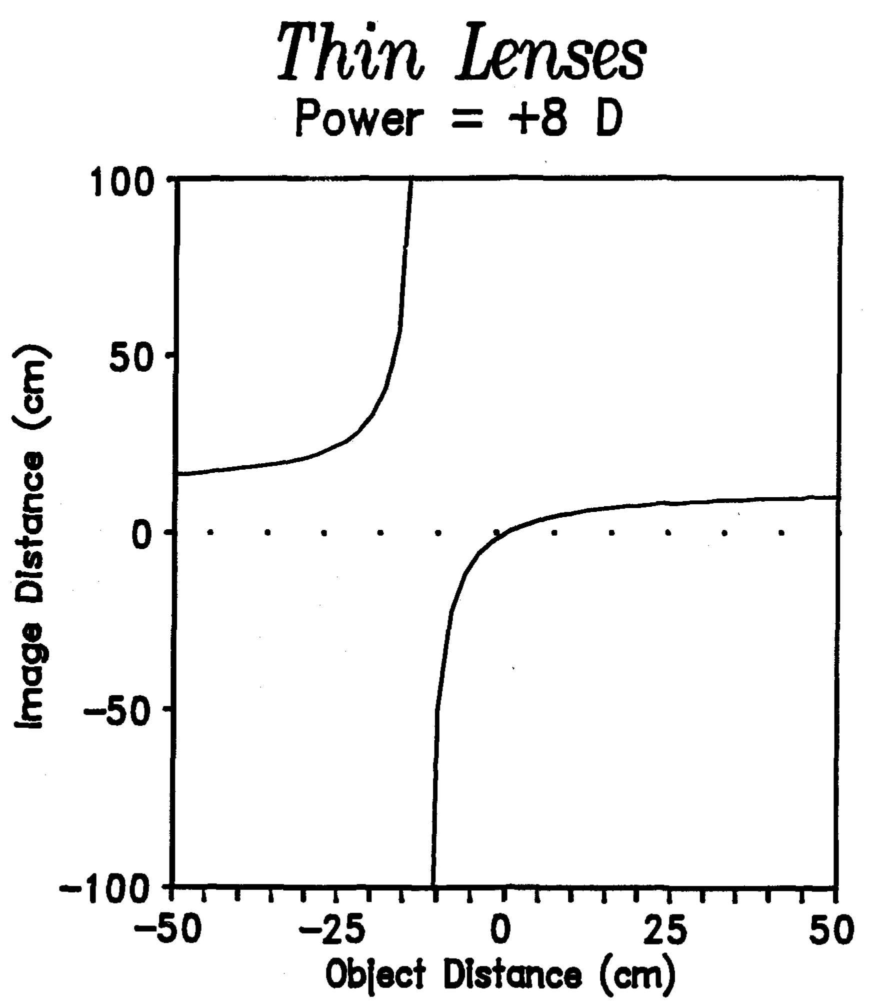


Figure 5. Graph created by spreadsheet program for use as a lecture illustration.

Conclusions

In an environment like the curriculum of an optometry degree program, time is always scarce. Activities that require more time than others, such as analysis and problem solving, are the objects of attempts by students to shorten the time expended on them. Efforts in this regard include the preparation of problem solution sets by one or a few students followed by distribution to the remaining students to "study," and copying of laboratory data and reports completed by one student for many other students.

Requiring each student to solve the problems and to collect and analyze laboratory data must be followed up by some means to verify that this has indeed been completed. A large class enrollment requires that some means be designed to make this feasible for the instructor. One effective way to do this is through the use of spreadsheet software for personal computers.

The ability to generate columns of unique numbers as individual assignments to students in each row and to generate formulae to evaluate the functional dependence of some quantity on the assignment numbers makes spreadsheet programs a very versatile and efficient way for an instructor to require and verify that each individual student practices analysis and problem solving skills.

The use of this process for three years in an environment of about one hundred students each year has produced a noticeable improvement in the problem solving skills of first year optometry students in a year-long optics course.

Note: Copies of the spreadsheet designs are available by writing Dr. Cobb at Southern College of Optometry, 1245 Madison Avenue, Memphis, TN 38104.

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Making Complex Concepts Understandable

The Use of Rhetorical Devices in Optometric Education

Richard M. Frankel, M.D., M.S.Ed.

Abstract

There are a variety of circumstances in which optometrists are called upon to explain complex ideas to those who may have little initial understanding of them. Making these ideas understandable may be accomplished with the use of rhetorical devices. Rhetorical devices are a time-tested means of making complex concepts vivid and understandable. As an example, the difficulties in communicating to students a set of everyday but complex clinical concepts regarding inflammatory disorders are discussed and an illustration of an approach to this problem involving the use of rhetorical devices is given.

Key words:
rhetorical device; metaphor, simile, analogy, parable, allegory; inflammatory process, host defenses, auto-immunity, anti-inflammatory agents

Introduction

"Doctor" is derived from the Latin, *docere*, to teach. Those bearing that title have the privilege and responsibility of teaching what they have learned as a part of helping others. For doctors of optometry, this may occur in a variety of settings: in the office or clinic, in effective patient education; in the classroom, in introducing important concepts to students; in the academic literature, in communicating to non-specialists; and in the mass media, in clarifying issues for the non-optometrist.

In all of these settings, optometrists may be called upon to explain complex ideas in a manner which is easily understood and remembered. This presents a real challenge, especially in those situations in which there is a significant disparity between the knowledge and experience of the instructor and the listener. This communication, in elevating the rhetorical device to a more conscious level, can increase our effectiveness as doctors who must teach.

Rhetorical Devices—Techniques for the Effective Communication of Complex Ideas

The rhetorical device is a special way of comparing a complex idea to a simpler one in order to enhance understanding. A novel, abstract concept is compared to a familiar, concrete concept. This technique has been used effectively by many over time, including biblical and contemporary religious figures, philosophers and teachers of science.

The rhetorical device involves the use of language which suggests certain associations to the reader or listener, rather than relying on literal meanings. The most basic form of this type of language is the *metaphor*. In this rhetorical technique, two different objects or concepts, one abstract and the other concrete, are equated. "A mighty fortress is our God," makes the abstract concept of God more understandable by implying that the qualities of a fortress—great strength and the ability to protect—exist in God.[1]

A related technique, the *simile*, uses the words "like" or "as" and makes a more explicit comparison.[2] For example, "The proteins in cell membranes drift like icebergs in a lipid sea" effectively communicates to the student that the cell membrane is more fluid than classic descriptions or static diagrams suggest.

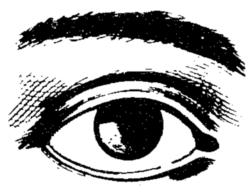
In an *analogy*, the comparisons are extended ones, and may be sustained over paragraphs, or pages.[1] They are especially useful in clarifying complex processes and making them more vivid.[3] For example, cell processes have been compared to the workings of a factory.[4]

A *parable* is a story in which there is an implied analogy or comparison to other situations or life in general.[5] Usually, the narrative conveys a message, moral, or lesson. The parable of The Good Samaritan shows the way to ethical behavior by force of analogy.[6,7]

An *allegory* is a form of analogy in which characters and occurrences have not only a literal meaning, but also convey an abstract concept or set

Dr. Frankel is on the faculty of the New England College of Optometry where he teaches pathology, histology and epidemiology. He is a graduate of the Tufts University School of Medicine.

of ideas.[5] Plato's Allegory of the Cave illuminates a very abstract metaphysical view of reality by comparing the shadows on a cave wall to the people in the cave casting them, urging us to strive to perceive true reality, rather than the mere shadows of reality.[8]



Allegory may make use of a figure of speech known as *personification.* In this literary device, inanimate objects and abstract concepts are represented as human characters.[9]

All of these rhetorical devices may be employed to shed light on and clarify difficult abstract concepts.

It has been indicated that there are a variety of circumstances in which optometrists are called upon to communicate complex ideas in an understandable fashion. One such circumstance in which many optometric educators find themselves is the communication of complex concepts to students. One such set of complex concepts relates to inflammatory disorders.

Inflammatory Disorders—Complex Clinical Problems Which Must be Made Understandable to Students

The proper approach to the management of inflammatory disorders is a concern which confronts optometrists daily. It is therefore incumbent upon clinicians and basic scientists to explain to students what they know of the phenomenon of inflammation in an understandable fashion. This presents a challenge, for the clinical presentation as well as the underlying process can be quite complex.

The experienced optometrist has come to realize that whereas the outward signs of a variety of inflammatory disorders may present similarly, the underlying processes may greatly differ. Each of those processes represents a unique interplay between host defenses and external agents. The practitioner must tailor his therapeutic strategy to those forces at play.[10]

The forces involve a variety of environmental insults and a limited repertoire of inflammatory responses. These are played out on a small, delicate, crowded unit of interdependent ocular tissues, a setting which does not allow much latitude for clinical misapprehensions.

The body's inflammatory responses to injury involve efforts to eliminate environmental agents which cause injury. This may result in the neutralization of the pathogen without injury to the host eye, or may result in a spectrum of injury extending to loss of the eye itself. The student must come to appreciate that the inflammatory process is not only capable of ridding the body of injurious agents, but, in the process, can injure the eye itself.[11,12]

A related notion that may seem unusual to the student is that the considerable force of the inflammatory process is unleashed not only in the direction of virulent, intrinsically destructive organisms, but, in some individuals, also at seemingly innocuous environmental elements: feathers, tree pollens, or dust.

Perhaps the most alien concept that students must grapple with is the concept of autoimmunity.[13] Here, the inflammatory forces of destruction turn against the host itself. Now, the body's tissues, including ocular tissue, are the target for neutralization, for elimination. And since those targets represent essentially a bottomless reservoir, the autoimmune processes, once instigated, may smolder for a lifetime. The notion of a body at war with itself, resulting in chronic disease, is something the student must come to understand and deal with in order to accurately diagnose and effectively treat a variety of autoimmune disorders.[14]

What is accepted as a matter of course by the practitioner, then, can be unusual to students: that the host defense, far from being a monolithic defender and preserver of the body, is also capable of, and often does, cause injury to it.

Students must eventually assimilate the unsettling realities that the destructive power of the inflammatory process is often not well focused, that the process is inappropriately intense, and that it may continue longer than it is needed.[15]

The comprehension of these apparent incongruities is not only important in diagnostics, but is requisite to an understanding of the rationale for the use of anti-inflammatory agents—agents which are therapeutic because they help keep the inflammatory process in line, limiting tissue injury. Beyond this, the student must appreciate that anti-inflammatory agents, notably, corticosteroids, must be used judiciously, since they tend to suppress body defenses.

This is no more evident than in the management of various ocular infectious inflammations, such as herpetic keratitis. The intact immune response helps prevent dissemination of active herpetic epithelial ocular infection.[16] Corticosteroids disrupt, at many levels, the integrity of the immune response.[17] The use of corticosteroids in corneal epithelial disease is therefore discouraged.[18] On the other hand, corticosteroids are beneficial in the treatment of one form of herpetic stromal involvement, disciform edema, in which the host immune response has a pathogenetic role.[19]

The appropriate use of corticosteroids in the management of inflammatory disorders can enter even murkier waters, as in certain clinical presentations of epidemic keratoconjunctivitis.[20] Navigating through these waters certainly requires a sense of the interplay of inflammatory processes underlying the symptomatology.

The significance of immune and inflammatory concepts demands their early exposure to the student. Communicating such critical abstract concepts to students may be enhanced by the use of rhetorical devices.

Making Complex Concepts Understandable with a Rhetorical Device—An Illustration:

In the following allegory, the complex process of inflammation involving a dual nature is personified as two warlords. In this manner, a set of unfamiliar abstract concepts which will later become essential to clinical practice is presented in vivid and familiar terms. The device is designed to be both conducive to understanding and retention of concepts relating to the clinical presentation of ocular inflammation:

An Allegory:

Every once in a while or, in some times and places, very often, there existed (and still does) a very important land. The land was presided over by two powerful warlords. It was a land bordered both by peaceable folk and by those who sought to invade and despoil the land. The inhabitants of our land were generally grateful for their warlords' protection, for they were both well schooled in the art of defense. But in other ways, they were unlike.

The first warlord had an even-tempered disposition. Further, he was wise, with great discerning powers and unparalleled judgment. When emissaries or wayfarers approached our realm, he was quick to separate friend from foe, harmless from harmful, peaceable from destructive. To each, he responded appropriately. He always tolerated the comings and goings of the well-intentioned. However, to those bent on thievery or parasitism, he dealt defensive blows appropriate to the magnitude of the threat. Mildly intrusive outsiders were repelled gently, without much commotion in the realm. Dangerous and potentially deadly intruders were thrown back with a mighty counter attack, which occasionally resulted in some destruction to the land. The carnage was produced partly by the poisonous emanations of the invaders as they penetrated the outer defenses and pushed inward, creating a path of destruction. But the land was also laid waste by the ferocity of the warlord's response, inflamed as he was, and resolute to defend our land. He was thus possessed of a double-edged sword which could dispatch his foes, but which could also cause injury to his own territory.

Perhaps the most alien concept that students must grapple with is the concept of autoimmunity.

The second warlord was equally skilled in the art of defense, but he lacked the judgment of state possessed by his alter ego. Unhappily, his powers of perception were poor, so much so that sometimes he could not distinguish between wayfarers who were incapable of doing, or intending to do no harm and those who were up to mischief. In some sense, he was "hypersensitive." Often, then, he responded to minor irritants with a ferocity which should have been directed against a real enemy of the land. At other times, he reacted inappropriately to one of his own subjects. This warlord's power was thus unleashed, sometimes with infense fury, laying waste to the land, really for nought.

The first warlord is the embodiment of that aspect of the inflammatory process which responds appropriately to agents of injury, including microbial pathogens. For example, bacteria which gain entrance to our countryside are soon waylaid by phagocytes, antibodies and complement. These act to destroy the invader, with relatively minor effects on the host.

The second warlord is the embodiment of that aspect of the inflammatory process which responds inappropriately, both in a hypersensitive way and in a misdirected fashion against the body itself. For instance, it can over-react to innocuous antigens such as flower pollen or feathers by IgE-mediated degranulation of mast cells, thereby opening up the floodgates of the vascular inflammatory reservoir. In misdirected actions, it can perceive its own person as foreign antigen and mount an attack upon itself, as for instance, upon its own sclera and joints as in rheumatoid arthritis.

These warlords are both blessing and curse. Having no other choice, we must live with these warlords in ourselves, sustaining them as our defenders and placating them in their fury. The land, our land, is of us.

A Place for Rhetorical Devices in Explaining Inflammation or any Complex Idea

The nuances and complexities of the inflammatory process, obvious to the seasoned practitioner, are not obvious or readily comprehensible to the student. Years of practice will afford an understanding of it, but its great importance dictates that instructors inculcate the basic concepts as early as possible in the optometric curriculum. Teaching the inflammatory process must be accomplished in the most effective way possible.

An illustration has been given where a rhetorical device has been used to make a complex set of concepts more easily understood. Rhetorical devices can be used in a variety of situations in which optometrists are called upon to explain complex ideas to others.

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IN REVIEW

The Vision Care Assistant — An Introductory Handbook, Pamela Miller, Vision Extension, Santa Ana, CA, 1990, 112 pp., soft cover, $15.00.

The Vision Care Assistant — An Introductory Handbook serves as a guide to the new paraoptometric working in an optometric practice. The book is divided into short chapters which briefly cover front office procedures, terminology, ocular anatomy, ocular emergencies, ocular pharmacology and pathology, the vision examination, dispensing, lenses, tints and coatings, contact lenses, vision therapy, low vision, and occupational vision. Several examples of forms, checklists, and telephone scripts which can be modified for each individual practice are included and provide an organized approach to scheduling and patient instruction.

The Vision Care Assistant is easy to read and understand and gives a general overview of optometric assisting for someone new in the field. It provides an entry point for those paraoptometrics interested in learning more of the theory behind the skills that they perform, and can serve as a guide on many topics associated with optometric assisting.

I liked the book for its basic approach to the different topic areas. It provides a starting point for the education of on-the-job trained assistants and can be used to introduce them to the many areas of optometry. The reference list is good because it encourages advanced learning; however, the dates on some of the texts should be updated to reflect current editions. This book appears to be too basic for use in formal education programs, as it does not go into enough depth on the various topic areas.

The Vision Care Assistant would be a nice addition to the optometric practice that trains its own staff and could be used by the new assistant to obtain a basic understanding of optometric practice. It could also be used by the paraoptometric who has been in the field for awhile and wants a quick overview of some of the topic areas.

Guest Reviewer:
Ms. Barbara Hetrick
Program Director
Owens Technical College
Toledo, Ohio

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Vascular Disorders of the Ocular Fundus, A Colour Manual of Diagnosis, Rodney Grey, Butterworths, London, 1st edition, 1991, 118 pp., including index, hardbound, $85.00.

According to the author, this book "is intended to bridge the gap between the basic general textbooks and the comprehensive, multiple volume works." The text is written in an easy-to-read style and is organized in a logical manner with sub-groupings of retinal vascular diseases. Included is a discussion of normal vasculature, fluorescein angiography, photocoagulation, as well as the varieties of retinal and choroidal vascular disease. It is a text that has been written for the clinician rather than the academic. There is a reference list at the end of each section.

The recommended management and treatment techniques are well written but fall short in the area of diabetic retinopathy. Several of the most recent studies regarding diabetic retinopathy management are not cited. The text does not adequately address the most important topic of diabetic retinopathy. There is no mention of the importance of glycosylated hemoglobin levels and the relationship to the predictability of proliferative diabetic retinopathy.

Color photographs and accompanying fluorescein angiographies are adequate but would be more useful if printed in a larger format. The text is well indexed.

I suppose one could say that the text bridges the gap between the general and the specific, but it could be a better bridge. Unfortunately, the author's intentions regarding atlases are often not realized because of the publisher's reluctance to give ground regarding color photos. There are several color photos in this text but their size detracts from their effectiveness. I would recommend this text only after the individual doctor has personally taken the time to review it to see if it fits his/her needs.

Guest Reviewer:
Dr. Larry J. Alexander
University of Alabama at Birmingham
School of Optometry

■ ■ ■

Immediate Eye Care — An Illustrated Manual, Nicola K. Ragge and David L. Easty, Mosby Year Book, St. Louis, 1991, 288 pp., illustrated with many color photos and color drawings, hardbound, $89.00.

Immediate Eye Care is a nice handbook for clinicians and trainees. Part I covers common eye diseases from the front to the back of the eye in separate chapters while Part II addresses more specialized areas of interest including: neuro-eye, trauma, pediatrics, occupational eye diseases, tropical eye diseases, drug induced problems, post-operative conditions, contact lenses and corneal donation.

The book is written in a short synopsis style, with brief paragraph descriptions that are illustrated by beautiful color photos, color diagrams and tables. The authors assume nothing in their treatment of the topics presented so that the book is good for the beginning student. Nevertheless, the diseases presented are subsequently dealt with in a bit more depth and this fact, combined with the excellent illustrations, make this handbook useful for the accomplished clinician as well.

It is amazing how much information is packed into this small edition, although the sections on post-op complications and contact lenses are skimpy. The thrust of this book is, therefore, toward disease entities and is mainly about the types of situations most often arising in the optometrist's office on a day-to-day basis.

One can refer to *Immediate Eye Care* as a chair side manual, can use it as a companion study guide in a course or can sit and read it through for self-improvement. I recommend it highly.

Radiology of the Eye and Orbit, Thomas Newton and Laissa Bilaniuk, ed., Raven Press, New York, 1990, 200 pp., illustrated, hardbound, $115.

The textbook is divided into nine chapters. The chapters cover MRI, ultrasonography, and CT. The book highlights MRI, ultrasonography and CT scanning. The introduction explains that MRI, in most cases, is now becoming the standard in radiology. The first half of the book explains MRI, techniques, anatomy and pathology. There are two chapters on ultrasonography and two chapters on CT scanning of the orbits.

The text is well written, and the illustrations are excellent. The organization of the disorders is well designed and the descriptions are concise. The captions and the arrows on the photographs are extremely helpful for pointing out the landmarks and pathologies.

The text on MRI scans, the pathologies and the associated captions were excellent.

This is a very informative broad-based book on the radiologic evaluation of pathology of the eye. This is a very helpful text for the modern clinician. However, many clinicians may be helped with a chapter on radiologic terminology and orientation.

This book would serve as a good reference book for the clinician practicing in a multidisciplinary setting, a full service private practitioner, hospital based HMO setting, academic setting or ophthalmology practice.

Dr. George White
Pennsylvania College of Optometry

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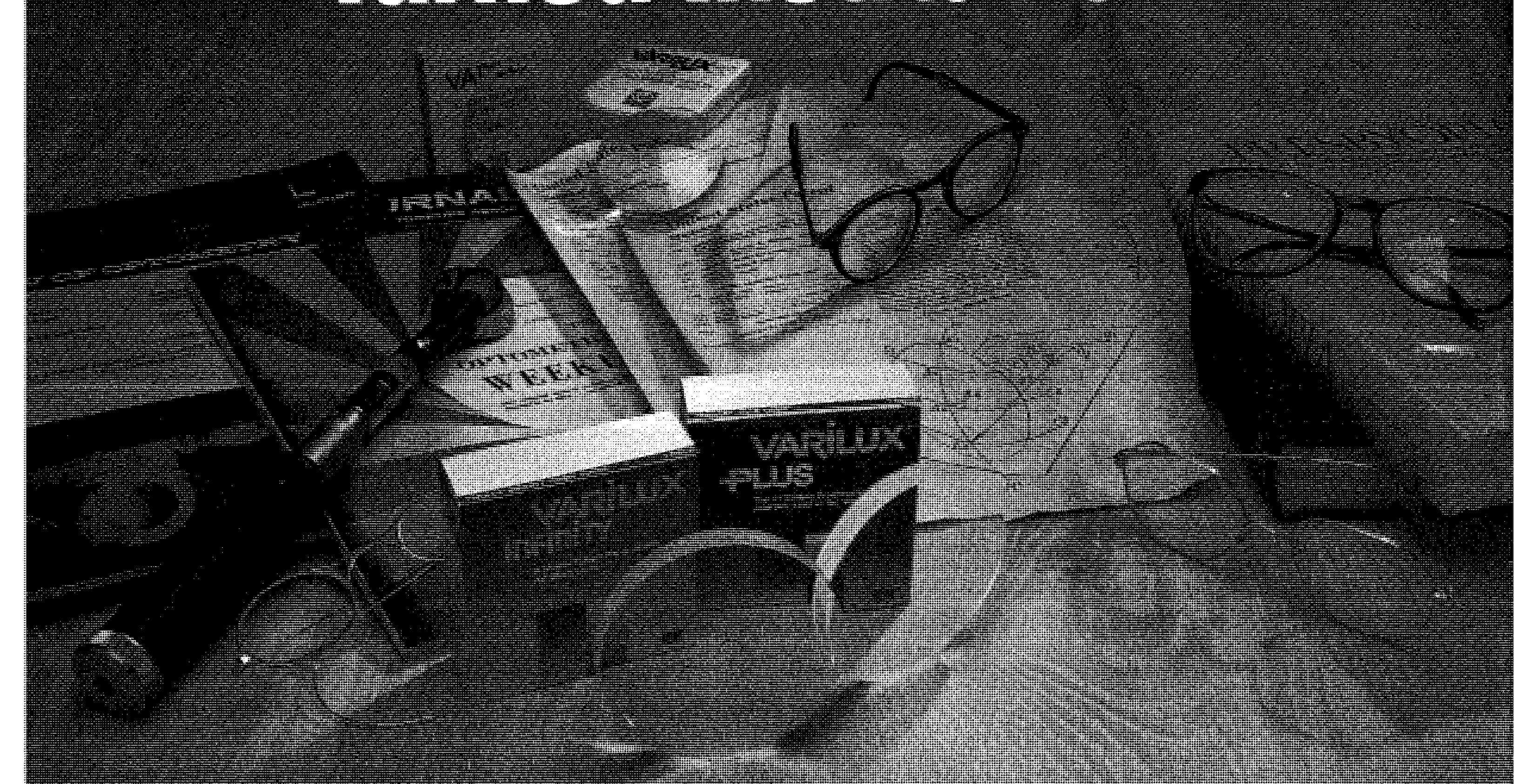

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