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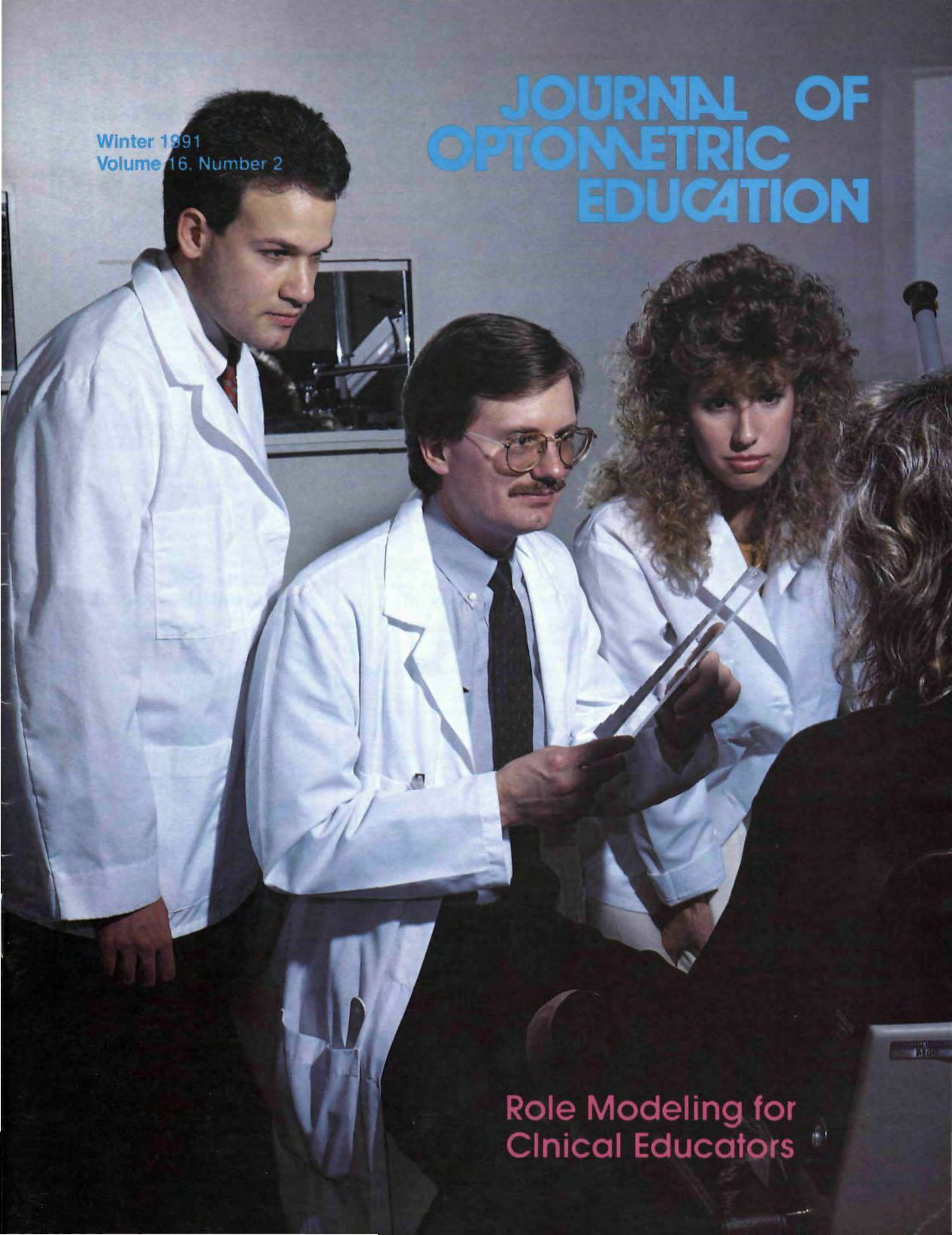

Role Modeling for Clinical Educators

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Cover photo credit:
Ron Davidoff, Pennsylvania College of Optometry. PCO interns John Godfrey and Sandy Grossett observe Dr. Joseph Ruskiewicz treating Terry Waltrich.

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GUEST EDITORIAL

The Role of Basic Science in Optometric Education

Lynn A. Cyert, Ph.D., O.D.

Recently the National Board of Examiners in Optometry announced its decision to increase the number of basic science test questions in the biological sciences. This action followed recommendations from several diverse groups, including an ASCO faculty conference, the Exam Council of the National Board, and a group of consultants from outside the profession. One of the current critical problems in optometric education is achieving the proper balance between basic science and clinical science. This essay will examine the role of basic science in optometric education. Increasing the number of basic science questions in the biological sciences is appropriate but focusing only on the biological basic sciences is too restrictive.

Basic science education should equip an optometrist to understand the reasons why a certain procedure works, why a piece of equipment functions as it does, why a disease process is likely to respond or fail to respond to a specific therapy. A basic science background makes it possible for a doctor of optometry to understand why the course of action chosen in a clinical situation is the best course of action. The procedures themselves are often not difficult. A technician can learn to do Goldmann tonometry, administer a color vision test, or insert and remove a contact lens. What a technician cannot do is evaluate the data which result from such procedures and decide what the next clinical step should be; making such decisions requires a background in the basic sciences.

A foundation in basic science education is essential for an optometrist to grow in professional expertise throughout a lifetime of patient care. Our profession has expanded its scope dramatically in the last fifteen years. It should continue to expand in the years ahead. The student's level of clinical performance at graduation cannot represent the doctor's mode of practice throughout an entire professional lifetime. The optometrist must be able to evaluate new instruments, new pharmaceuticals, new contact lenses, and new therapies. Evaluating advances in patient care requires a background in the basic sciences.

A background in basic science makes it possible for an optometrist to think scientifically and to understand the limitations of the application of the scientific method. Given the exponential growth of scientific knowledge, it is important for optometrists to be able to read new scientific findings critically. Training in the scientific method prepares an optometrist to understand the strengths and weaknesses in scientific articles. It enables an optometrist to evaluate an experimental design, to understand biases in research, and to evaluate statistics so that claims made for new data can be analyzed. Thinking scientifically is different from thinking clinically. An optometrist needs training in both of these abilities.

For many of today's optometry students, basic science education is far less compelling than clinical training. The optometry student often sees the clinical training as exciting and important and the basic science education as boring and irrelevant. It can be extremely difficult to motivate students to understand vision and related processes which are not perceived as directly and immediately applicable to patient care. Basic science education, however, does not need to be immediately and directly applicable to be important. Nothing related to vision is ultimately irrelevant. Training a professional rather than a technician depends upon good quality basic science education.

As optometric educators, we will be in error if we emphasize the basic biological sciences to the neglect of the non-biological basic sciences. There is a tacit assumption that the non-biological basic sciences are being taught and tested adequately and do not need to be updated, while our teaching of the basic biological sciences is inadequate. It certainly is true that the basic biological science training needs to be expanded. This is necessitated by the growth of scientific knowledge in this area as well as the expansion in the scope of optometric practice. However, optometry's traditional strengths in geometric and physiological optics need re-examination as well.

The traditional vision sciences need to be re-examined in terms of course content, as do the basic biological sciences. Are we really teaching state-of-the-art vision science courses? The current focus on the biological basic sciences should be expanded to include the non-biological sciences. A conference examining these areas of optometric education and outside consultants to evaluate testing in these areas are needed. We also need to examine the course content in these basic sciences and assure ourselves that we are doing a thorough explication of them.

(continued on page 48)

SUSTAINING MEMBER NEWS

Varilux Introduces Readables

The world leader in the correction of presbyopia introduced Readables, a new concept and technology in ophthalmic spectacle lenses designed to overcome visual limitations of traditional single vision reading lenses by providing an expanded range of vision into the intermediate zone.

The central portion of the Readables aspheric lens surface carries the prescribed power for the working distance. The prescribed power gradually decreases -0.75D above optical center to accommodate and expand the intermediate range and stabilizes 12mm above. The prescribed power also increases by +0.75 below optical center providing extra power for fine detail work. This soft, gradual increase stabilizes at 16mm below optical center.

Varilux sees this new concept and technology as the answer to traditional single vision lens restrictions. Developed and manufactured by Essilor, Varilux conducted extensive research, with both professionals and consumers, as well as clinical testing before introducing the product in the USA. "Clinical tests showed 25 out of 27 patients preferred Readables to their prior single vision readers and/or half eyes," said Karen Wilmer, vice president, Marketing. "The most common reasons cited for preference were convenience, visual comfort, ease of ambulation, and clarity."

Mike Daley, president of Varilux Corporation, emphasized that "Readables are not a progressive lens—they are intended strictly for the single vision reader patient and are not intended for full time wear or use requiring full distance correction. For presbyopic patients requiring a multifocal lens and/or distance correction for general purpose use, the Varilux Infinity multi-design provides the best progressive lens for every add power."

Sunsoft Announces Appointments

Sunsoft Corp. recently announced the appointment of Rod Porter, O.D., to the newly created position of director of professional services. Dr. Porter comes from Ciba Vision where he held a similar position.

"Dr. Porter is an important addition to our company's overall commitment to the eye care profession," said Dick Fulmer, director of sales for Sunsoft.

In his new position, Dr. Porter will oversee all aspects of the professional services area, including the development of a comprehensive educational support program.

Sunsoft also announced the appointment of Susan Bruketta, as marketing director with worldwide marketing responsibility for all corporate products.

Bruketta served as marketing manager for Paragon Optical where she was responsible for all RGP marketing as well as the development and implementation of Paragon's newly created telemarketing group. Prior to joining Paragon, Ms. Bruketta was director of marketing for PAL Health Technologies, a leading orthopedic marketing company located in the midwest.

Sunsoft is a custom manufacturing company specializing in soft torics.

Sola Announces Promotions

Sola Optical announced that Mark Bedford, formerly director of new product development, has been promoted to vice-president, total quality management. Most recently, Mark has been leading Sola's program to introduce TQM concepts and programs into Sola's ongoing operations. Jim Cox, former senior vice-president, is now executive vice-president, manufacturing operations. In a similar move, Tom Balch has been promoted from senior vice-president to executive vice-president, research and development. Mark Mattison-Shupnick was promoted from director to vice-president of new products.

"The individuals have made outstanding contributions to Sola's success and have shown leadership in developing teamwork throughout the organization," said Dick Kapash, president.

Vistakon Optometrist Named NOA's "Optometrist of the Year"

Terrence N. Ingraham, O.D., manager of professional relations at Vistakon, Inc., a Johnson & Johnson company, was named the 1990 "Optometrist of the Year" by the National Optometric Association (NOA).

The NOA, which was formed in 1969, annually honors optometrists who have demonstrated a sense of professional and community awareness of vision care among Blacks and minorities. The primary objectives of the organization are to improve the delivery of professional eyecare among this sector, as well as provide support to Black and minority practitioners and graduate students enrolled in optometry programs.

Dr. Ingraham joined Vistakon in 1982 as a clinical research optometrist. Since then, he has held positions as senior clinical scientist, and manager of clinical studies.

"Dr. Ingraham has played a major role in the clinical and test marketing of the ACUVUE® Disposable Contact Lens," said Vistakon President Bernard W. Walsh. "We are very pleased with his recognition and professional accomplishments."

Ross/Ohio State Meeting Attracts Over 800

The Ross/Ohio State National Contact Lens Meeting drew nearly 800 ophthalmologists, optometrists, opticians, and ophthalmic assistants to Columbus, Ohio, on September 7, 8, and 9 to participte in a multidisciplinary event.

"The program agenda coupled with the prestigious faculty made the event an excellent continuing educational experience," said Murray Sibley, Ph.D., director of research and development, Consumer Products and Lens Care for Ross Laboratories.

The latest trends surrounding contact lenses and lens care were discussed during 20-minute presentations followed by open Q & A sessions. Topics included contact lens solutions in the 1990s, use of contact lenses after refractive surgery, and new gas permeable lens materials. Dr. Sibley said that according to the attendees, "the information provided at the Ross/Ohio State National Contact Lens Meeting was more timely and useful than other meetings they had attended."

New Cleaner Now Available from Polymer Technology

Polymer Technology Corporation (PTC) announced the availability of BOSTON ADVANCE Cleaner, a new solution designed to meet the cleaning challenges of both fluoro silicone acrylate and silicone acrylate rigid gas permeable (RGP) lenses. This breakthrough cleaner features an aggressive lipid-specific, non-ionic surfactant system and new ultra-micronized friction enhancing agents to improve overall lens performance and patient satisfaction.

"By incorporating a system to effectively and safely remove lipids and common oil-based contaminants (such as hand lotions, mascara, soap film, etc.), we've significantly improved on our proven BOSTON Cleaner formula," notes Cynthia Lee-Ryden, director of solutions marketing, Polymer Technology Corporation.

The BOSTON ADVANCE Cleaner is the newest component of the BOSTON ADVANCE Care System, which also includes BOSTON ADVANCE Conditioning Solution and BOSTON ADVANCE Reconditioning Drops.

Symposium on Contact Lenses Sponsored by Bausch & Lomb

The seaside village of Sorrento, Italy was the site of the 1990 European Symposium on Contact Lenses held October 12-15, 1990. This well-respected symposium has been sponsored by Bausch and Lomb since 1975.

The European Symposium is one of the largest contact lens meetings in the world with close to 1,000 delegates attending from all continents. The official language of the meeting is English; however, the meeting proceedings are translated into Swedish, French, Spanish, German, Italian and Dutch.

"Practitioners attending the meeting heard presentations on the most current research being conducted around the world, as well as relevant clinical findings," said Ronald L. Zarrella, senior vice president and president of Bausch and Lomb's International Division. A faculty of well-known experts in contact lens research from 10 countries presented 26 papers over the three-day period.

"The European Symposium offers the most current contact lens research presented by a faculty of world renowned experts, and valuable clinical perspectives, all in a spectacular setting," said Juan Carlos Aragon, O.D., director of international professional services for Bausch & Lomb.

Allergan Humphrey Sells Management System to Datamedic Corp.

Allergan Humphrey, the ophthalmic diagnostic instrument subsidiary of Allergan, Inc., one of the world's leading eye and skin care companies, and Datamedic Corp., an industry leader in the field of office-based physician practice management systems, jointly announced the sale of the Allergan Humphrey Practice Management Systems product line to Datamedic. The product line consists of a computerized ophthalmic office management system. Terms of the agreement were not announced.

Datamedic, a nationally recognized leader in the industry, has been providing practice management systems and service to office-based physician practices for almost 20 years. As an advanced IBM Business Partner, Datamedic services over 2,000 practices throughout the United States.

Allergan Humphrey, located in San Leandro, California, is a subsidiary of Allergan, Inc., which is comprised of six business units: Allergan Pharmaceuticals—prescription and nonprescription eye care products; Allergan Optical—contact lenses and lens care products; Allergan Medical Optics—surgical ophthalmic products and services; Allergan Humphrey—microprocessor-based ophthalmic diagnostic instruments; Herbert Laboratories—prescription and nonprescription skin care medications; and Allergan International, which markets Allergan products in more than 90 countries around the world. Allergan employs over 6,500 people worldwide, and is headquartered in Irvine, California.

Wesley-Jessen Names Director of Professional Services; Provides AOA/CLS Memberships

Dwight H. Akerman, O.D., has been named to the newly-created position of director of professional services for Wesley-Jessen Corp. "Dr. Akerman's appointment represents an expansion of our commitment to the professions," said Thomas F. Steiner, W-J's senior director, International and Professional Marketing. "As we develop new products and programs, we increasingly rely on our dialogue with practitioners, which will be one of Dr. Akerman's chief responsibilities," he added. Dr. Akerman joins W-J from a career in both private and corporate practice. Upon graduation in 1980 from Illinois College of Optometry, Dr. Akerman joined the contact lens-only practice of Robert A. Koetting, O.D., in St. Louis, where he practiced until 1983. From 1984 to 1986, Dr. Akerman served as manager, and then director of technical and professional services for American Hydron, Woodbury, NY. Since 1986, Dr. Akerman has owned and operated four practices on Long Island, NY.

In an effort to promote membership in the Contact Lens Section (CLS) of the American Optometric Association (AOA), Wesley-Jessen is offering to pay half the annual membership dues for new O.D. members of the CLS. "The CLS is already the largest and one of the most prestigious membership organizations in contact lenses. As its membership grows, so too does its influence. As we have always supported the CLS's educational and professional activities, W-J believes an even stronger CLS makes for an even stronger contact lens industry," said Dwight H. Akerman, O.D., W-J's director of professional services.

In order to take advantage of W-J's offer, O.D.s need only submit a completed membership application to the AOA CLS by December 31, 1990.

To request a membership application, contact the AOA CLS, 1505 Prince Street, Suite #300, Alexandria, VA 22314, or call 1-703-739-9200.

Paragon Optical Announces New President

John C. Jakoski has been named president of Paragon Optical according to Marc Steuer, vice president of Pilkington Visioncare, Paragon's parent company. He replaces Don Ratkowski, founder of the company, who retired recently. Mr. Jakoski has 20 years experience in the vision care industry. He leaves the position of executive vice president of Pilkington Visioncare International.

Mr. Jakoski spent 12 years in the Rx lab and rigid gas permeable lens industry. "I am looking forward to returning to my roots," said Jakoski. "It's very exciting to return to the RGP industry at this time. Paragon is poised to launch several new technologies within the next year and I look forward to being part of these activities."

Paragon Optical, based in Mesa, Arizona, is an innovative manufacturer of RGP lens materials. In addition to developing several polymers for contact lenses, Paragon also molds materials for RGP lens use. The company markets its products through a network of high quality, independent laboratories.

CIBA Announces New Division: CIBA Vision Ophthalmics™

CIBA Vision Corporation, a subsidiary of CIBA-GEIGY Corporation, announced the formation of CIBA Vision Ophthalmics,™ a business expansion into the ophthalmic pharmaceutical market.

Jim Callahan, president and CEO of CIBA Vision Corporation, has appointed Stephen M. Martin president of the new division. "Steve's expertise in business development and former pharmaceutical experience make him ideally qualified to guide CIBA Vision into this new stage of development," Callahan sais. In 1980, Steve Martin was CIBA Vision Corporation's first employee, appointed as vice president of operations from CIBA-GEIGY's Pharmaceutical Division. He most recently served as CIBA Vision Corporation executive vice president of technical affairs and business development in Atlanta and as a member of the CIBA Vision worldwide group management committee headquartered near Zurich, Switzerland.

"When we first started CIBA Vision in the United States we were the 27th entry into the contact lens market. Only ten years later, we are a market leader. Innovative products, forceful marketing, and a customer orientation have allowed us to become a successful and profitable business providing quality soft contact lenses and lens care products," Martin said.

Varilux Awards Student Grants

For the first time, there was a tie for the annual Optometry Student Grant Program's national award. The co-recipients were Bonnie Aiken ("A Clinical Study of Patient Acceptance and Satisfaction of Varilux Plus and Varilux Infinity Lenses") and Carl H. Spear ("The Effect of Excessive Add Power on the Acceptance of Progressive Addition Lenses") both of the University of Alabama at Birmingham School of Optometry. As national recipients, they received an all expense paid trip to Paris and split the cash award of $500.

Other recipients of the $500.00 grant include: Marjean Taylor, Ohio State University; Jon Crum, Southern California College of Optometry; Diane Gabriel, Southern College of Optometry; Larry R. Henry, University of Missouri at St. Louis School of Optometry; A.J. Contento, State University of New York College of Optometry; Tracie Sponseller, Northeastern State University College of Optometry; and Gregg Eric Russell, University of Houston College of Optometry.

Bausch & Lomb to Sponsor the First World Conference on Optometric Education

Bausch & Lomb has pledged $25,000 to sponsor the First World Conference on Optometric Education to be held December 4-5, 1990. The Conference, the first of its kind, is being coordinated by the International Optometric and Optical League (IOOL) and will be held at the University of Houston, Houston, Texas.

The interest in expanding the scope of optometric practice and developing optometry in countries where it does not exist as a health discipline is quite high. The goal of the Conference is to bring together those who are working in isolation to resolve obstacles, magnify interest and reinforce dedication to their efforts.

Because of Bausch & Lomb's generosity, educators representing the world's optometric schools will meet to discuss areas of possible cooperation. The purposes of the Conference are to share experiences, strengthen resolve and create a common bond among the educators. Areas of discussion on the agenda will include the search for common curriculum elements and common aspects of practice as well as presentation of practical guides for achieving educational goals.

"Over the past century, optometry has evolved into a recognized profession. During this period of time, Bausch & Lomb has actively supported optometry around the world. This historical commitment continues through the sponsorship of the First World Conference on Optometric Education," says Juan Carlos Aragon, O.D., Director of Professional Services for Bausch & Lomb's International Division.

Study Reveals Practitioners and Patients Prefer the Hydron® Echelon® Bifocal Soft Contact Lens

Results from a multicenter clinical study conducted by Allergan Optical report that clinical investigators prefer the Hydron® ECHELON® (polymacon) Bifocal Soft Contact Lens nearly three to one over their previously preferred methods of bifocal contact lens vision correction, including monovision.

When asked how the ECHELON® Lens compared with the contact lenses they had preferred for correction of presbyopia before the study, 16 investigators preferred the ECHELON® Lens when the study was completed, while only six maintained their pre-study preference. An additional nine investigators had no preference, but this represented a change for eight of them who had previously preferred contact lenses other than the ECHELON® Lens.

Of the 22 investigators who were confirmed advocates of monovision, currently the most frequently prescribed method of correcting presbyopia, 12 preferred the ECHELON® Lens by the end of the study compared with only four who still preferred monovision, while six had no preference between the two lens types.

Thirty-one eye care practitioners conducted detailed three-month evaluations of the ECHELON® Lens on a total of 225 wearers between January and August of 1989. Practitioners and patients alike were highly enthusiastic about the ECHELON® Lens both during and after the study. Patients experienced good vision, comfort and few lens-related problems. Eighty-one percent said they would recommend the lens to family and friends, according to Richard Courtney, O.D., vice president of Allergan Optical's Clinical Research & Development.

Statistical Tools for Predicting Academic Performance in Optometry School

David A. Corliss, O.D., Ph.D.

Abstract

Professional school admissions committees are charged with the task of selecting applicants who will succeed both academically and clinically. While studies which test the predictive validity of variables such as undergraduate grades and test scores provide useful information, they do not provide practical tools which an admissions committee can use efficiently in its deliberations. The present study was designed to develop a multiple regression equation for predicting an optometry grade point average and a discriminative function designed to distinguish between students who are likely to have academic difficulty and those who are not. The traditional measures of grade point average and test scores were used in these functions along with a measure of the competitiveness of undergraduate institutions and a measure of variability in academic performance. This latter measure, called the Weighted C-Factor, is a new measure of performance that was found to have a better correlation with the optometry grade point average than any of the more traditional measures. A contingency table for predicting academic success using both the regression equation and the discriminative function is described.

Key Words: admissions, predicting success, multiple regression, discriminant analysis, grade point averages, Optometry Admission Test

Dr. Corliss is assistant dean for student affairs at the University of Alabama at Birmingham.

Introduction

Professional school admissions committees are charged with the task of selecting the best qualified candidates from a pool of applicants. This means, in effect, that they must predict which applicants have the most likely chance of success in the academic and the clinical parts of their professional program and, ultimately, as clinicians serving the public. It has been demonstrated that both the non-cognitive and cognitive characteristics of applicants play a role in determining success or failure,[1-8] but this paper will focus only on the cognitive characteristics. Virtually all of the studies done in this area report individual correlations between measures of undergraduate performance and academic and clinical performance in professional programs. While these correlations have broad implications in that they indicate which variables are the most predictive, they do not provide admissions committees with the practical tools necessary for making critical decisions. For example, it has been found in numerous studies that grade point averages (GPA's) and test scores correlate significantly with the GPA at the end of the first year of a professional program. The question naturally (and often) arises as to how much weight should be given to these two measures when comparing two candidates, one of whom might have higher test scores but a lower GPA than the other. In order to answer that question, the variables at hand must be combined in some manner that weights them properly and predicts an outcome. Multiple regression equations in various forms provide a means of doing this.

The study described below was undertaken to develop predictors of academic performance which can be readily used by admissions committees to select the academically best qualified candidates from among those applying for admission to the UAB School of Optometry. These predictors were to be based entirely on candidates' undergraduate grades, the institutions they attended, and their performance on the Optometry College Admission Test (OCAT).[a] Two independent measures of outcome have been derived: one is a prediction of what the GPA at the end of the first year of the optometry program will be and the other is a measure of the probability of failing one or more courses. It is important to bear in mind that these tools are not appropriate for predicting clinical performance.

Methods

Sample. Data were collected for all matriculated students from 1978 to 1987 to produce a sample size of 385. The actual numbers of students used in some calculations varied slightly from this because not all of the students finished the first year of the program.

Grade Point Average (GPA) Calculations. There were three undergraduate cumulative grade point averages (GPA's) computed. The science GPA (SGPA) includes all sciences, both undergraduate and graduate, not just the prerequisites. The non-science GPA (NSGPA) includes all other courses, both undergraduate and graduate, while the overall GPA (OGPA) includes all courses. These were computed in the standard manner. The first year optometry GPA (FIRST) was also computed in the standard manner.

The Weighted C-Factor (WCF) Derivation. A GPA is equal to the average number of quality points earned per credit hour taken. It says nothing about the distribution of grades nor the variability in performance. For example, a student could achieve a GPA of 3.0 by either getting all B's or all A's and C's Obviously the latter student (of which there is one in the sample) took a different approach to the course load than the former. The derivation of the WCF was an attempt to determine whether variability in academic performance has any predictive validity.

Many different combinations of variables related to the distribution of grades were calculated and tested. All of them were based on the number of semester hours of science and the grades earned for those semester hours. Some of the combinations tried included such things as the ratio of the hours of A (HOURS_A) to the hours of C (HOURS_C) and the difference between HOURS_A and HOURS_C. The WCF reported here was determined to be the best predictor from among several derived variables. The WCF is defined as follows:

$$WCF = \frac{1}{WIR} * \frac{C+D+F}{A+C+D+F} = \frac{CF}{WIR} \qquad (1)$$

where the letter designations, A, C, D, and F, correspond to HOURS_A, HOURS_C, etc., and WIR is a factor related to the competitiveness of the undergraduate institution or institutions the student attended (see below). A person having no C's, D's or F's in the sciences will have a WCF equal to zero. A person with no A's, any number of C's, D's and F's and a WIR equal to 1 will have a WCF equal to 1.0. It is clear that the WCF is a number indicating the preponderance of semester hours of science below the B level. The preponderance is reduced as the competitiveness of the undergraduate institution at which those grades were earned increases.

Weighted Institutional Ranking (WIR) Derivation. Everyone intuitively feels that the quality of the undergraduate institution that an applicant attends plays a role in the future performance of that student in professional school. In the ideal one would like to be able to evaluate the science programs to which students were exposed and be able to "correct" students' SGPA's according to the performance of previous students from those programs. However, such corrections require large numbers of students from particular undergraduate programs taken over an extended period of time and therefore have limited utility for either small professional programs or undergraduate institutions from which small numbers of matriculants have been accepted. As a small program drawing from a large geographical area the UABSO does not have the numbers to proceed in this manner. The alternative approach was to use overall undergraduate institutional rankings.

In an attempt to determine whether or not an overall undergraduate institutional ranking (IR) produced useful information, a preliminary study was done using the categorical rankings of four year colleges and universities found in Barron's *Profiles of American Colleges.* Their "admissions selector" is based on various measures of admissions competitiveness. Such variables as average SAT and ACT scores, the average class rankings of matriculants, and the ratio of applicants to acceptances are used in the assessment of competitiveness. There are nine possible categories ranging from noncompetitive (IR = 1) to most competitive (IR = 9). In the former category are those schools which generally only require evidence of graduation from an accredited high school for admission. Junior colleges and community colleges were included in this category. In the latter category are the Ivy League schools among others. Most state universities fall in the 3-5 range.

In a preliminary study, the number chosen for testing was simply the IR for the school from which the student received a degree. If they did not have or expect a degree, then the rank of the last institution attended was used. This number proved to have predictive power and therefore a more detailed analysis was done. The WIR reported below is the weighted average of all the IR's for all the schools a student attended. The weighting factor is the number of semester hours of science taken at each institution. The equation is

$$WIR = \frac{\sum hrs*ir}{\sum hrs} \qquad (2)$$

For example, suppose a three-year student took 60 semester hours of science at a community college (IR = 1) and 30 hours at an institution for which IR = 4. The WIR is

$$WIR = \frac{60*1+30*4}{60+30} = 2 \qquad (3)$$

If the two unweighted IR values had just been averaged the result would have been 2.5. Using the IR of the more recently attended institution would have overestimated the ranking of the undergraduate record.

The Outcome Variables. The result of this study is two predictive equations. The first is a multiple regression equation which predicts the grade point average at the end of the first professional year (FIRST). This is heavily weighted in the basic health sciences and optics. It is particularly important to look at FIRST as the outcome variable since most students who get into serious academic difficulty do so in the first year. The second equation is a discriminative function which predicts whether an applicant will fall into a passing group or a failing group. To derive this function the outcome variable was set to either 0 or 1, with 1 indicating that the student had failed something anywhere in the curriculum.

Results and Discussion

Table I shows the Pearson and Spearman correlation coefficients between FIRST and several variables derived from the undergraduate record. Both correlation coefficients were calculated because of the nature of the data used and because there are different assumptions underlying each.[9-10] Pearson correlations are best suited to data which conform to an interval scale, while Spearman correlations should only be used on ordinal or ranked data. An interval scale implies that the differences between any two pairs of points on the scale are equal. For example, to assume that grade point averages are an interval scale implies the belief that the difference between a 2.0 and a 2.5 is the same as the difference between a 3.0 and a 3.5. In terms of the underlying abilities this may not be entirely true. An ordinal or ranking scale has no such implication; it simply means that points on the scale may be ordered in some fashion. For example, a GPA of 2.0 is poorer than one of 3.0, but one cannot say by how much in terms of underlying ability. A comparison of the two correlation coefficients gives some idea of the effect of these assumptions.

All the correlations in Table I are significant at a probability of at least 0.01. Note that the Spearman correlation coefficients are higher than the Pearson coefficients for those variables related to grade point averages, but their relative order is maintained. This may mean that there is some effect of the assumption that grade point averages are interval measurements.

The results for WIR and the OCAT scores are different. WIR is an ordinal scale as are the OCAT scores. The latter are percentile scores which do not conform to an interval scale[11] since the difference between the 70th and 80th percentiles is not the same as the difference between the 10th and the 20th percentiles in terms of the underlying raw scores and the abilities that they imply. Since OCAT scores are already rankings and not interval values, the effect that is really being demonstrated with the OCAT correlations in Table I is that induced by changing FIRST from its value to a rank. This effect is small as seen by the differences in the two correlation coefficients.

Weighted C-Factor and the Science Hours. It is clear from Table I that this variable is tapping into an aspect of undergraduate performance that is more closely correlated with the first year optometry GPA than the undergraduate GPA's by themselves. The basic interpretation is that, the greater the preponderance of C's, D's and F's as opposed to A's, the poorer that student is likely to do in the professional program. This is supported in part by the fact that HOURS_C by itself correlates nearly as well with FIRST as the SGPA.

It is interesting to note that, if a similar variable is computed using HOURS_A instead of HOURS_C + HOURS_D + HOURS_F in the numerator and multiplying by the WIR instead of dividing, then the correlation of this variable with FIRST is 0.444. This is slightly better than the SGPA by itself, but not as good as WCF. HOURS_A does not correlate with FIRST as well as HOURS_C. If HOURS_B is included in the denominator of Equation 1 the correlation between that derived value and FIRST is -0.398. This is significant but not as good as the one produced by Equation 1. Note that the correlation between HOURS_B and FIRST is fairly low by itself. This is because most students have a predominance of B's; the overall SGPA for this cohort was 3.2.

Another important point about the WCF is that dividing the CF by the WIR clearly increases the correlation over CF alone. This means that C's earned at a more competitive institution represent a greater academic achievement than C's earned at a less competitive institution. One can also conclude that A's at all the institutions are less affected by the competitiveness of the undergraduate institution than are C's. As the numerator of Equation 1 (CF) approaches 0.00, the WIR has less effect in differentiating among students. It is clear that when the CF is zero there is no effect at all.

The Grade Point Averages. It is perhaps not surprising that, of the three computed undergraduate GPA's, the SGPA correlates the most strongly with FIRST though the OGPA is not far behind. Kegel-Flom[6] found slightly lower Pearson correlations with FIRST at the University of Houston School of Optometry, but the relative order was the same even though she did not compute a GPA that included all the sciences; only the prerequisites were used.

One might expect that modifying the SGPA in some manner by the WIR would improve the correlations since GPA's from institutions of varying competitiveness might have different meanings. The simplest transformations are to either multiply the SGPA by the WIR or add the two together. As shown in Table I, neither of these operations improves the basic correlation. Other, more complicated, i.e., non-linear, transformations may work better, but there are not enough data at the upper end of the IR scale to make these attempts all that sound. This will become clearer in the discussion of the WIR below.

Weighted Institutional Ranking. The two correlation coefficients between WIR and FIRST are low but significant. Kegel-Flom[6] found the correlation to be 0.19 which is significant at the 0.01 level. The WIR used in that study was apparently not weighted in any way to account for different undergraduate institutions that a given student may have attended.

TABLE I
Pearson and Spearman Correlation Coefficients of the Listed Variables with the First Year Optometry Grade Point Average

VARIABLE	PEARSON	SPEARMAN
Science GPA (SGPA)	0.438	0.464
Non-Science GPA (NSGPA)	0.244	0.254
Overall GPA (OGPA)	0.415	0.430
Unweighted C-Factor (CF)	−0.429	−0.467
Weighted C-Factor (WCF)	−0.476	−0.526
Weighted Institutional Ranking (WIR)	0.248	0.249
WIR * SGPA	0.377	
WIR + SGPA	0.377	
HOURS—A	0.336	
HOURS—B	−0.157	
HOURS—C	−0.401	
HOURS—D	−0.287	
HOURS—F	−0.194	
OCAT Biology	0.288	0.300
OCAT Chemistry	0.373	0.371
OCAT Physics	0.361	0.366
OCAT Verbal	0.233	0.208
OCAT Quantitative	0.350	0.343
OCAT Study Reading	0.326	0.313
OCAT Average	0.458	0.445

All correlations are significant at $p <= 0.01$. N = 380

In spite of the fact that the correlation between WIR and FIRST is low, the effect of the undergraduate institution on student performance becomes very clear in graphical representation. Figure 1A shows the means and standard deviations of the OGPA plotted against WIR. There is a statistically significant decrease in the average OGPA for students coming from the more competitive undergraduate schools. Figure 1B shows the opposite effect on the OCAT average. There is a statistically significant relationship between OCAT average and WIR for values of the latter between 1 and 7. Figure 1C shows that the first year optometry grade point average (FIRST) increases with WIR. The conclusion which can be drawn from these graphs is that, on the average, students from more competitive undergraduate institutions performed better on the OCAT and in the first year of optometry school in spite of the fact that there is a general downward trend in the OGPA's of admitted students for the same institutions.

The OCAT Scores. The correlations between the OCAT scores and FIRST are generally fairly low though they are all significant. The fact that they are lower than those for the GPA's is not too surprising. The OCAT is a four hour snapshot of an applicant's abilities in the areas tested and is probably subject to more extraneous influences than the long term measures might be. It is interesting that the chemistry section has the highest correlation given that biochemistry is the only course the students take in the first year that is directly related to this section.[a] The physics and quantitative sections have the next highest correlations. These are probably related to the three quarter sequence of optics given in the first year.

Predicting the Optometry Grade Point Average. As indicated above, correlation coefficients yield information about the strength of a relationship between two variables. They are, however, only qualitatively predictive; that is, it is possible to say that undergraduate SGPA's are better predictors of FIRST than are the NSGPA's and that higher SGPA's are associated with higher values of FIRST since the correlation is positive. The correlation does not predict what the probable optometry GPA might be for a given undergraduate SGPA. Regression analysis must be used for this purpose if concrete numbers for making admissions decisions are desired. Furthermore, multiple regression must be used in order to take into account the fact that a combination of variables may work better than a single variable.

Stepwise multiple regression was used to select the combination of variables that best predicted FIRST. Four variables remained: WCF, the OCAT average, OGPA, and WIR. For reasons that will become clear below, the WCF was dropped and the following equation was adopted:

$$PFIRST = -0.034 + 0.641*OGPA + 0.011*OAVG + 0.077*WIR \qquad (4)$$

where PFIRST is the predicted first year grade point average. The multiple correlation is 0.602, the squared multiple correlation is 0.362 and the standard error of the estimate is 0.487. This correlation is clearly better than any of the individual correlations shown in Table I for these same variables. The WIR takes on more significance in combination with these other variables than it did by itself. Furthermore, it is not the SGPA but, rather, the OGPA which is the better predictor in combination with the other variables.

All of the coefficients in Equation 4 are positive and it can therefore be termed compensatory. This makes sense in interpreting the equation. For example, suppose two students had identical OGPA's and OAVG's but one of them had attended a more competitive undergraduate institution. That student would have a higher PFIRST than the other. Similarly, if two students had identical OGPA's and WIR's but one did better than the other on the OCAT, then the student with the higher OCAT average would have a higher PFIRST.

The power of this kind of analysis is that you do not need to assign arbitrary weights to the different variables available from the undergraduate record. Furthermore, the numerical result of the equation incorporates that combination of variables which is best at predicting the outcome variable. These factors obviate the necessity of the admissions committee trying to decide in each individual case which variable should be the most important. Theoretically, one should be able to rely on this equation to do the best job of selecting a class based on the variables listed in Table I above.

TABLE II
T-Statistic Between Pass and Fail Groups for the Variables Listed

VARIABLE	t	(p)
Science GPA (SGPA)	8.161	
Non-Science GPA (NSGPA)	4.083	
Overall GPA (OGPA)	7.556	
Weighted C-Factor (WCF)	10.527	
Weighted Institutional Ranking (WIR)	4.307	
HOURS—A	4.606	
HOURS—B	1.570	(0.117)
HOURS—C	8.489	
HOURS—D	5.792	
HOURS—F	4.588	
OCAT Biology	1.416	(0.158)
OCAT Chemistry	3.723	
OCAT Physics	3.230	
OCAT Verbal	2.078	
OCAT Quantitative	5.368	
OCAT Study Reading	3.216	
OCAT Average	4.521	

N=292 in passing group and N=93 in failing group. All values are significant at better than p=0.001 except as indicated.

Predicting Academic Difficulty. The endpoint of the multiple regression analysis described above is an equation that predicts a grade point average after one year in the professional program. Given this number, the admissions committee deliberations should focus on maximizing predicted performance across a class. PFIRST should not be taken as an absolute, however, since there is a possible range of values within which the student may actually fall. Furthermore, there are students with reasonable grades and OCAT scores from good undergraduate institutions who will have a good PFIRST and yet find themselves in academic difficulty. The purpose of discriminative analysis is to determine those variables which predict which students are likely to have academic difficulty.

The ideal discriminator is a statistical measurement which unambiguously separates applicants into passing and failing groups. This is a different goal from the previous analysis in that the desired outcome is a cutoff score that separates applicants into two groups rather than one which predicts a continuous variable. An initial approach to the problem of determining which variables best discriminate between a passing and a failing group is to employ the t-statistic. Table II shows the t values for most of the same variables shown in Table I. The WCF clearly stands out as the best discriminator. This is followed by the number of HOURS—C. The SGPA is also a good discriminator. Among the OCAT sections the best is the Quantitative Ability test.

The t-statistic is related to discriminative analysis as correlation is related to regression analysis: the best discriminators can be determined using a t-test, but the t-values do not provide a method for determining to which group a candidate belongs given his or her grades and test scores. Furthermore, it only uses one variable. For this purpose a discriminative function must be calculated. The techniques used for this calculation are very similar to those used in multiple regression[12] except that the dependent variable takes on only two values, pass-fail, rather than a continuum of values like a grade point average. It is also true that, like multiple regression, certain combinations of variables may work better than might be predicted from looking at the individual t-

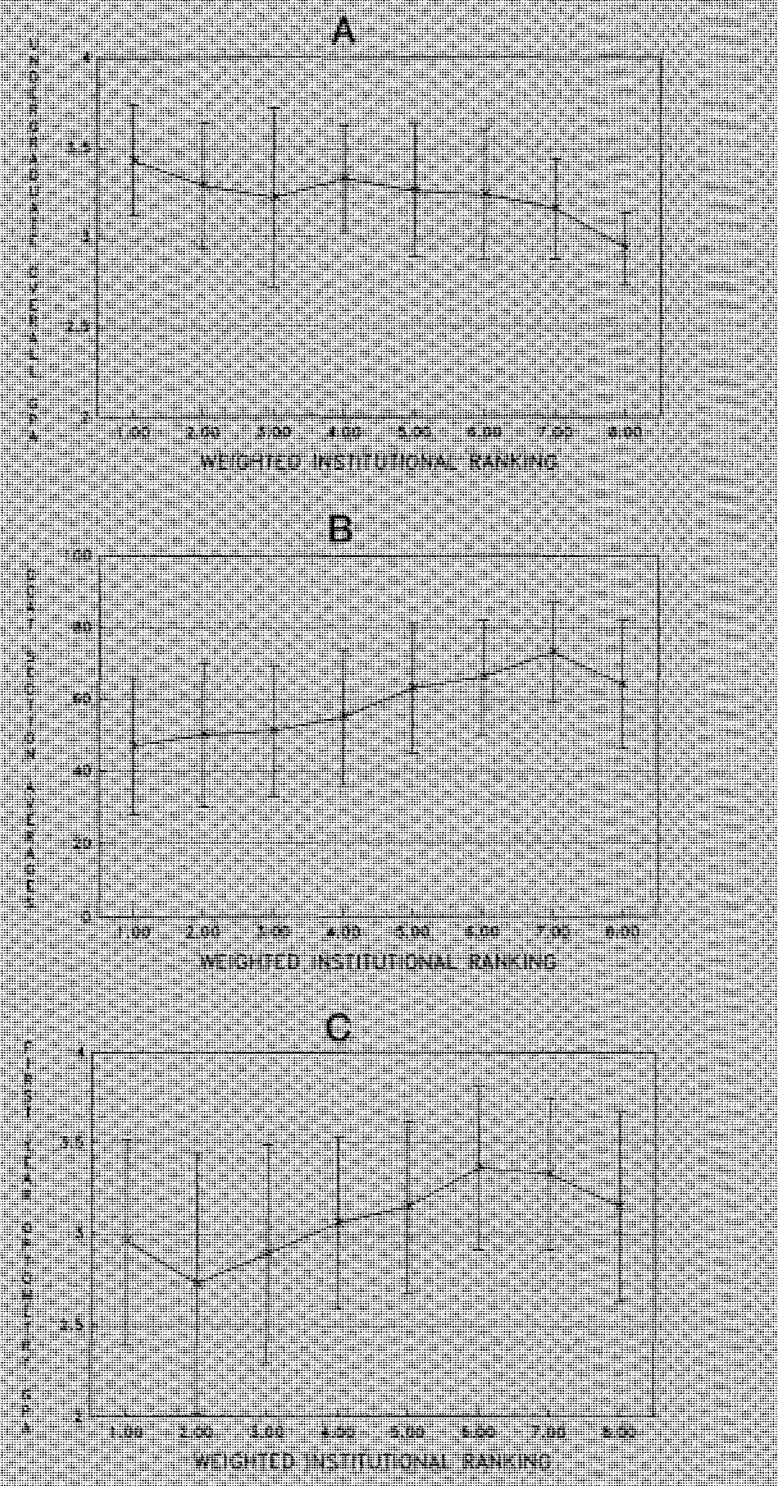

FIGURE 1
A. Means and standard deviations of the undergraduate overall grade point average (OGPA) versus the weighted undergraduate institutional ranking (WIR) rounded to the nearest whole number. B. Means and standard deviations of the OCAT section averages versus WIR rounded to the nearest whole number. C. Means and standard deviations of the first year optometry grade point average (FIRST) versus WIR rounded to the nearest whole number.

statistics.

Stepwise multiple regression was again used to select the combination of variables which best "predicted" passing or failing. Only two variables were selected: WCF and QA. The derived discriminative function has the following form:

$$DF = 1.167 - 12.674*WCF + 0.014*QA \quad (5)$$

The negative coefficient for WCF means that the greater the preponderance of C's, D's and F's, the more negative will be DF. Likewise the positive coefficient for QA means that higher scores on the Quantitative section of the OCAT will make DF more positive.

As stated above, an ideal discriminator should classify candidates into either a passing group or a failing group with 100% accuracy. This means that the ideal discriminative function has a cutoff score above which everyone passes and below which everyone fails. Figure 2 shows the departure of the data from the ideal. The distributions of passing and failing students along with the percent failing curve are plotted against the value of the discriminative function. The ideal percent failing curve is plotted on the same graph; it is equal to 0% above DF = 0 and 100% below DF = 0.

The determination of classification errors is a test of how well the discriminative function works. Of all the students who passed all their courses, 77.6% had positive DF values and 22.4% had negative values. Of all the students who failed one or more courses, 31.2% had positive DF values and 68.8% had negative values. Alternatively, of all those who had positive DF values, 89% passed; of those who had negative DF values, only 47.8% failed. Thus, the probability of error in classifying candidates is less if DF > 0 than if DF < 0. Another way of expressing this is to say that there are more unexpected passes in the negative group than there are unexpected failures in the positive group.

Making Admissions Decisions Using PFIRST and DF. The advantage of these equations is derived from the facts that, 1) they represent the combinations of

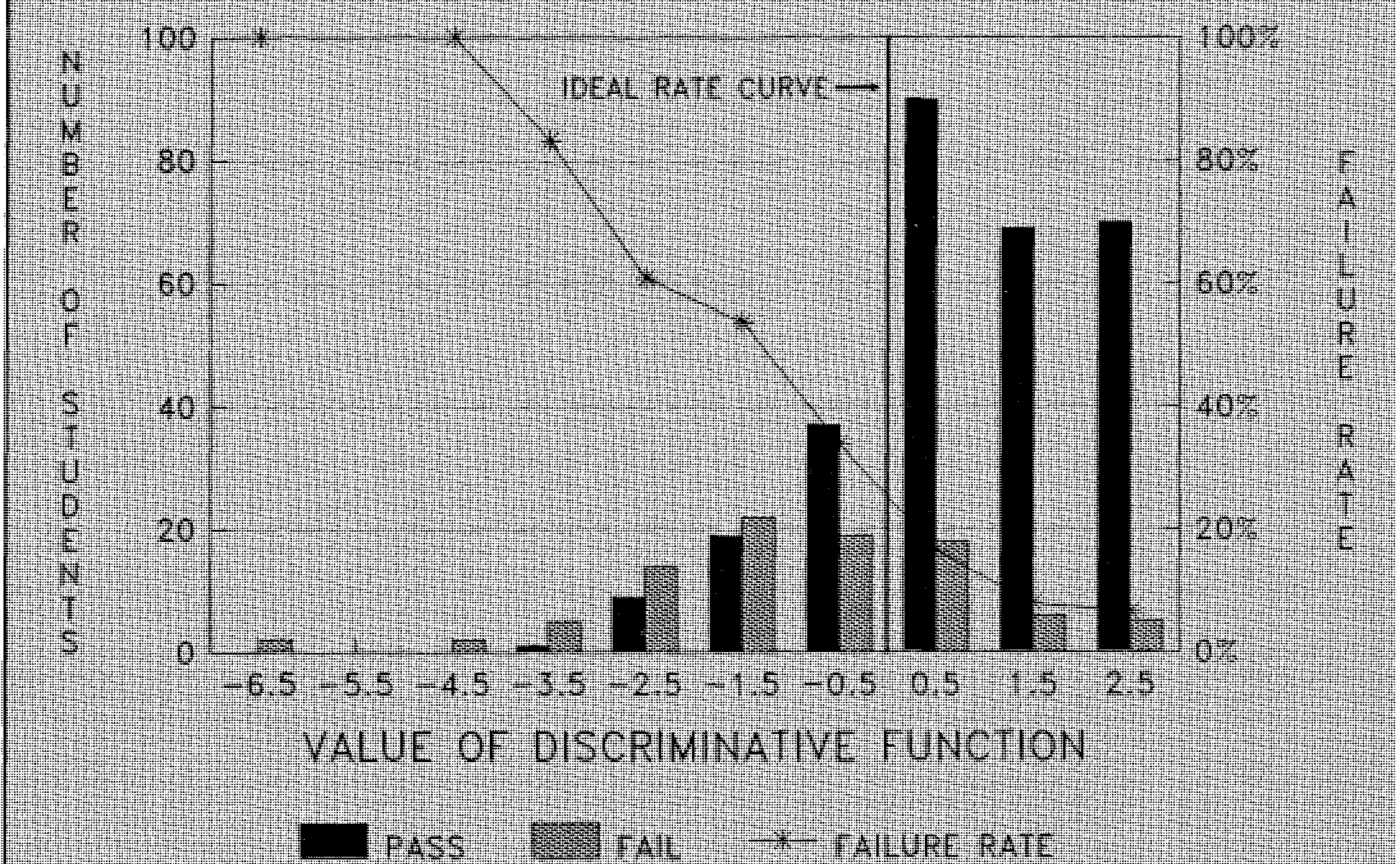

FIGURE 2

BARS. Frequency distributions of those students who passed all their courses (PASS) and those who failed one or more courses (FAIL) versus the value for their discriminative function (DF). LINE. Percent of students in the failing group. The vertical line at DF=0 represents what the ideal DF should be.

variables having the optimal predictive power, 2) they do not rely on the assignment of arbitrary weights to the variables, and 3) they contain different variables and hence give the admissions committee two different views of a candidate's academic ability. In spite of these advantages they cannot be used as absolute determinants of whether a particular applicant should be admitted or not. The only thing that is possible is to assign a probability of success to any given applicant.

How then are they best used in making admissions decisions? The PFIRST by itself gives the admissions committee a predicted grade point average and some idea of where an applicant would rank in his or her class if admitted. The DF by itself gives the committee an indication of the probability that a student will run into academic difficulty. Together they can be used to improve the prediction of whether or not a student is likely to have academic difficulty. This is shown in Table III. The numbers across the top of the table are ranges of values for PFIRST, while those in the first column are ranges of DF. The numbers in the body of the table represent the fractions of students failing for each combination of DF and PFIRST. The column and row labeled "ALL" are the total fractions for each row and column, respectively. As an example of how to use this table consider the row where $0 < DF < 1$. The fraction of students with a DF value in that range who failed was 0.17 as shown in the "ALL" column. However, the fraction failing decreases as PFIRST increases. Thus, to make the best use of the two predictors the admissions committee should look at where an applicant falls in this table and determine the probability from the corresponding cell.

While it is easy to determine a probability of failing for a given individual, it is not easy to interpret such a number on an individual basis. What does it mean to say that someone has a 50% probability of failing, for example? It is easier to interpret the probabilities on a group basis. Suppose there are 10 students with a 10% probability of failing. It is easier to think of the probability as indicating that 1 out of those 10 students will have problems than it is to say which one of the group it will be. The goal of the admissions committee should therefore be to minimize the average probability of failure while maximizing the predicted first year grade point average across an entering class. There is evidence[13,14] that, if the committee relied exclusively on these predictors to make its admissions decisions, it would at least do as well as, and probably better than, it would do if it used these predictors in conjunction with an interview and the letters of recommendation. Neither of the latter have been shown to predict academic success.

Summary

In the ideal, admissions committees would like to have a single number which indicates by its value whether to admit a student or not. Implicit in this binary decision would be both the judgments that the student will succeed and, if so, where in the possible range of outcomes that student will fall. It is clear from the above analysis that no such number in which to have such absolute confidence can be generated; it is only possible to indicate a probability of success and a potential range of outcomes on an individual basis. The difficulty, of course, is that we are dealing with real, unpredictable human beings in complex settings and trying to make these judgments on limited information and a limited understanding of the information that we do have. However, the proper use of well-founded statistical probabilities in conjunction with the informed and experienced judgments of the admissions committee about the intangibles that cannot be quantified will improve the chances of success for everyone concerned.

The two equations described above were derived using fairly sophisticated statistical techniques. What does an admissions officer do without a knowledge of statistics or access to someone who has that knowledge? Studies[13,14] have shown that, if one can at least identify the appropriate variables, it is possible to combine them into an equation similar to Equation 4 above using arbitrary weights of the appropriate sign. These studies have shown that unit weights, i.e., +1 and −1, in such equations do better at predicting outcomes than human judges trying to integrate all the same information. Furthermore, tables similar to Table III can be constructed using any combination of variables without recourse to any sophisticated statistical methods. For example, a two-way table using SGPA and an OAT score might work very well at predicting who will succeed. The point is that the task of the admissions committee can be made a little easier, and their predictive abilities increased, when the members are faced with fewer variables to take into account when evaluating applicants.

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(continued)

TABLE III
Contingency Table for Students in Failing Group as a Function of the Predicted First Year Grade Point Average and the Distriminative Function

	VALUES OF THE PREDICTED FIRST				
DF	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	ALL
-5 TO -4	1.00				1.00
-4 TO -3	0.67	1.00			0.83
-3 TO -2	0.67	0.50			0.61
-2 TO -1	0.67	0.42	0.00		0.54
-1 TO 0	0.33	0.37	0.14		0.34
0 TO 1	0.33	0.16	0.14	0.00	0.17
1 TO 2	1.00	0.09	0.05	0.00	0.08
2 — 3	0.00	0.14	0.06	0.05	0.07
ALL	0.64	0.26	0.08	0.04	0.24

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If education in the non-biological sciences remains static and these basic sciences are thought of as the "old science" or the "traditional science," the profession will lose. There is new knowledge in these areas which must be incorporated into optometric education. I am not proposing that non-biological science needs a larger chunk of the curriculum, which is already hard pressed. Rather, I am arguing that the non-biological sciences need the same critical evaluation as the biological sciences.

In all areas of basic science education, optometry needs to examine our teaching methods. Often optometric education is very traditional. We cannot teach the students of the nineties with the pedagogy of the sixties and remain effective. We need to evaluate methods for integrating basic and clinical sciences. Although there is no need for basic science to be immediately applicable to a clinical situation, we do want to deliver basic science education in a way that enables the clinicians to draw upon it when needed. Could we be doing a better job of this integration in optometric education? We also need to avoid the pressure from optometry students to teach only facts, and thereby reduce the basic sciences to the level of a trivia contest.

In summary, the educational emphasis of the basic biological sciences which underlie optometry is now being expanded. It is important that the intense focus we are giving the biological sciences also be directed to the non-biological sciences. Furthermore, optometric education needs to research better methods for teaching the integration of basic and clinical science because this integration is critical to the delivery of excellent patient care throughout the doctor's professional career.

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Problem Based Learning: Use of the Portable Patient Problem Pack (P4)

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Steve Whittaker, Ph.D.

Abstract

The portable patient problem pack (P4) is a patient simulation method designed to be used for problem based learning. This paper describes the P4 format and provides details about producing P4s for use in optometric education. Clinical and didactic applications are briefly discussed.

Key Words: Problem based learning, self-directed learning, patient simulation, clinical reasoning process, clinical problem solving, optometric education.

Introduction

Problem based learning is an innovative instructional method designed to overcome some of the shortcomings of the traditional lecture or subject based approach.[1] It is a teaching method designed to allow the student to use a particular problem as a focus for the study of a variety of subjects. In contrast to traditional education in which facts and principles are presented first, clinical problems are presented initially in problem based learning.

In a recent paper, Scheiman et al.[2] reviewed the historical development of problem based learning in medical education, and presented an introduction to this approach for optometric educators. They emphasized that problem based learning is a broad term and does not refer to any specific educational method. It must by definition, however, involve the use of a problem as a stimulus for learning.

The method generally utilized in problem based learning to present problems is patient simulations. Many formats for patient simulations have been developed.[3-21] These include the use of live actors,[3-4] written simulations,[5-15] and computer simulations.[16-21]

It is important to consider that very different simulators may be designed to accomplish very different teaching objectives. For example, schematic eyes have long been used to simulate the eye for the purpose of introducing retinoscopic techniques. A flight simulator attempts to closely duplicate the flying experience to teach piloting techniques, especially the handling of emergency situations. Representational simulators like these are specifically designed to teach techniques and in clinical education require either live actors or sophisticated, highly graphic and interactive simulators.

Although desirable, representational simulation is not necessary to teach fundamental clinical reasoning skills. To teach clinical reasoning the simulator requires that the student be able to access information in the same manner that information is obtained clinically. The clinician takes a discrete action such as asking a question or performing a procedure, and the corresponding outcome is obtained. On the basis of the most recent and prior findings, the clinician chooses a subsequent action and so forth, until a diagnosis is ascertained.

The primary purpose of this paper is to describe one popular written simulation called the portable patient problem pack (P4). We will describe the P4 format and provide step-by-step instructions about producing P4s appropriate for optometric education.

Description of the P4

Since the objectives of problem based learning are to develop clinical reasoning skills and stimulate self-directed learning,[2] the format utilized to present a patient problem is critical. The following eight principles are based on suggested necessary features of patient simulations.[1]

1. The problem should be presented with the type of information normally available to the practitioner at the outset, not a predigested summary containing information that usually would result only from further inquiry by the practitioner (e.g. written case summaries).

2. The problem format should allow for sequential, interdependent actions to be taken in the evaluation and treatment of the patient problem. These actions may be taken in any order, with only the constraints normally imposed in a clinical situation. Students should be free to take inappropriate actions.

3. The student should be provided with immediate information regarding the results of these actions. Feedback may take two forms: realistic or didactic. Realistic feedback is in the form of the succession of discrete outcomes as they would occur in the clinic. To provide didactic feedback, the simulator acts as a teacher, bluntly informing the student of the "correctness" of an action, directing the student toward certain actions, asking the student additional

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questions, etc. Didactic feedback may be useful in the first few simulations, but should be avoided for realistic simulation.

4. The student should not be able to retract an action that is revealed to be ineffective or harmful.

5. The format should allow for different strategies for managing a patient's problem that lead to different outcomes.

6. The design of the problem also should allow the student to re-examine and evaluate the important stages or segments of the clinical reasoning process, including
   a. hypothesis generation
   b. data interpretation and hypothesis selection
   c. detailed diagnostic and therapeutic management
   d. the efficiency of the management process.

7. The units should incorporate as much visual and auditory representation as can be conveniently featured by the use of photographs, slides, films, audio and video of patients, X-rays, specimens, and the like. The clinically relevant features should not be highlighted. Rather, students should select relevant information.

8. Feasibility or ease of use by the student, as well as the cost and reproducibility, must be considered. For instance, the mechanics of the simulator should not distract the student from the problem.

The P4 is one method of simulating a patient problem while adhering to most of the above principles.

The P4 system originally described by Barrows and Tamblyn[13] for use in medical education consisted of a deck of 280 three-by-five inch cards in five colors, a collection of 35mm slides, printed instructions, and evaluation materials. Each card represents an action and the corresponding outcome. We have modified the P4 described by Barrows and Tamblyn for use in optometric education.[14]

The P4 format which we developed for optometric use consists of a deck of 346, 4 1/4 inch by 3 3/4 inch action cards in five different colors. The first or top card describes the opening scene or how the patient happens to present to the optometrist. An example of an opening scene is the following:

"Jimmy, a 10-year-old, is brought to your private office by his mother for an evaluation. She is concerned because she recently received a letter stating that Jimmy failed the school vision screening."

The remainder of the deck consists of cards of five different colors representing five different action categories. The five available action categories and their respective colors are:

1. Interview questions (white)
2. Examination procedures (blue)
3. Special Testing (pink)
4. Consultations (salmon)
5. Treatment (yellow)

Different colors are used for the 5 categories to make the different actions easy to locate. The cards are numbered in each category to help maintain order and facilitate selection of action categories. (i.e. Interview: I1, I2, I3, . . ., Examination: E1, E2, E3 . . .)

Included in Appendix A is a sample list of some of the 346 actions which are available in the P4 we have designed. It is important to understand that the 346 cards represent all actions which could possibly be carried out on any patient presenting for an optometric evaluation. The same deck of cards, for example, would be appropriate for an infant with a large angle esotropia, a 70 year old with a unilateral cataract, a 20 year old with conjunctivitis, or a 12 year old with myopia.

On the front of each card the specific action is printed along with a series of questions or issues the student should consider before selecting the card. Figure 1 provides examples of the front of the cards from the 5 categories listed above. The questions or issues printed on the front portion of the card are designed to stimulate the clinical reasoning process and are similar to those suggested by Barrows.[2] For instance, the interview cards prompt the student to consider the issues listed below:

—Hypotheses?
—Information needed?
  —interview
  —examination
  —investigations
  —consultations
—Study needed?
—Next move?

The back portion of the cards provides the result or outcome for the action selected. Figure 2 provides examples of the back of the cards. Whenever possible, the result provided for a given action is presented in a manner requiring the student to analyze the data as in a true clinical situation. For example:

Action: direct ophthalmoscopy
Outcome: refer to fundus slide 15

Action: Threshold fields
Outcome: Refer to threshold fields slide 2

Action: Bagolini striated lenses
Outcome: Refer to Bagolini slide 18

Action: 3 Step procedure
Outcome:
  Primary gaze — 6 right hyper
  Gaze right: — 2 right hyper
  Gaze left: — 12 right hyper
  Tilt right: — 12 right hyper
  Tilt left: — 2 right hyper

FIGURE 1
Composition of the Candidate Population

I47. IS THE EYE TURN GETTING BETTER, WORSE, OR STAYING ABOUT THE SAME?

HYPOTHESES?
INFORMATION NEEDED?
  INTERVIEW
  EXAMINATIONS
  INVESTIGATIONS
  CONSULTATIONS
STUDY NEEDED?
NEXT MOVE?

E2. VA (DISTANCE)—SNELLEN SINGLE LETTER (visual)

1. WHY SELECT THIS CARD?
2. CAN YOU INTERPRET THE RESULT FROM THIS EVALUATION?
3. HOW WOULD A POSITIVE OR NEGATIVE RESULT INFLUENCE YOUR HYPOTHESIS?
4. DO YOU UNDERSTAND THE PRINCIPLES IN PHYSIOLOGICAL OPTICS NECESSARY TO EVALUATE ANY FINDINGS?

C7. NEURO EYE CONSULTATION

1. WHY SELECT THIS CARD?
2. COULD YOU MAKE A DIAGNOSIS WITHOUT THIS REFERRAL?

D4. CENTRAL FIELDS

1. WHY SELECT THIS CARD?
2. COULD YOU REACH A DIAGNOSIS WITHOUT THIS INFORMATION?
3. CAN YOU INTERPRET THE RESULTS OF THIS TESTING?

T8. RX—GLASSES: FULL SUBJECTIVE

1. WHY SELECT THIS CARD?
2. IF THIS TX APPROACH IS REJECTED BY THE PATIENT, WHAT ELSE COULD YOU RECOMMEND?
3. IF THIS TX DOESN'T WORK, WHAT ELSE COULD YOU RECOMMEND?

To accomplish this objective, slides, photographs, and illustrations are provided in a separate binder. The binder we use includes:

1. anterior segment slides
2. Fundus slides
3. copies of visual field tests
4. Hess Lancaster screen results
5. Illustration of patient responses for ARC testing
6. Illustration of patient responses for EF testing
7. Illustration of patient responses for contrast sensitivity testing
8. Illustrations of results of perceptual testing

Thus instead of simply providing an outcome such as "normal fundus, normal fields, ARC or left superior oblique paresis," the student must interpret information just as if he/she were examining a real patient.

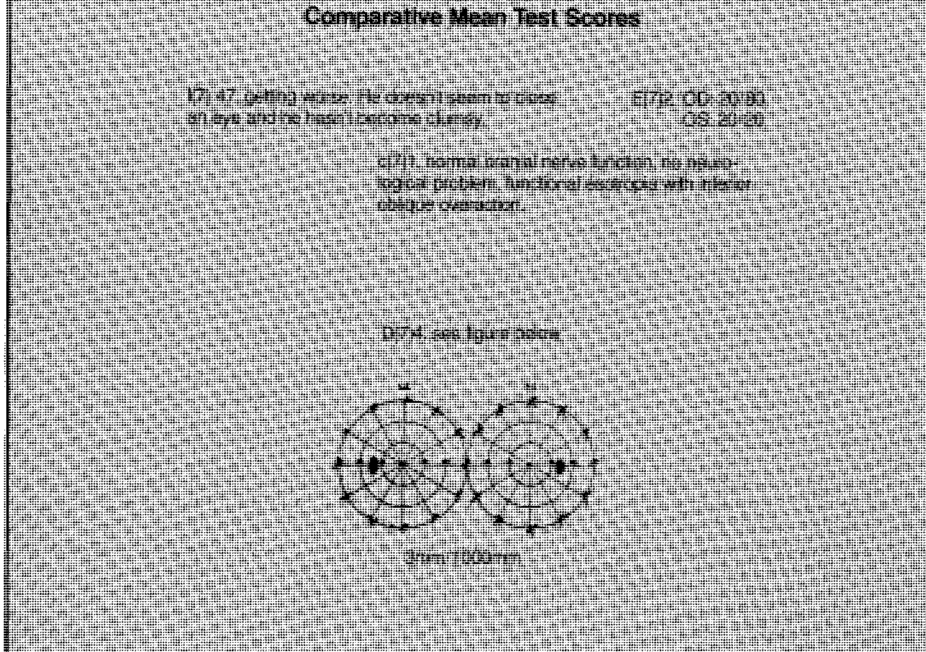
While the front portion of the P4 cards (the action description) is identical for all patient problems, the back (outcome description) is specific for the particular problem being presented. For example, in Figure 1, card E2 represents the action of assessing visual acuity at distance using a Snellen chart. The front of this card will be the same for all patients. The back of the card, Figure 2, specifies the outcome for the specific patient.

How is the P4 Used?

The student is told that the P4 represents a simulation of an actual patient. All of the information necessary to assess, diagnose and treat the patient is available in the P4 action deck. After reading the opening scene, the student is free to choose any action in any sequence desired. The student can ask any interview questions, perform any examination technique, order additional diagnostic or laboratory tests, or send the patient for outside consultations.

After any action is selected, the student first records the action and then turns the card over and receives the result of the action selected. Based upon the information provided on the back of the card selected, the student can choose to select additional actions. This process continues until the student feels comfortable that he/she understands the patient's problem(s). Once the student has reached a diagnosis he/she is free to select treatment cards which would be appropriate to manage the patient's condition. The student could treat the patient with lenses, prism, vision therapy, contact lenses, low vision devices, medication, reassurance or any other form of appropriate treatment. When finished the student has recorded the precise sequence of cards or actions selected (appendix B). This sequence represents the inquiry strategy and can be used by the course instructor or clinical instructor to assess the student's clinical reasoning skills, understanding of test results, ability to analyze optometric data, ability to formulate a diagnosis, and treatment strategy.

FIGURE 2
Comparative Mean Test Scores



Evaluation of student performance

Within the framework of our course, the P4 was used to encourage self-directed, independent learning. It served as the basis for small group and class discussion. Students received feedback about their performance in the context of these discussions. They had the opportunity to compare their approach to that of other students and the course instructors.

Our objective was not to utilize the P4 as an evaluative instrument. This can be done, however. Barrows[2] has described in detail, five scoring formulas which can be applied to the P4 format. Table 1 provides two examples of scoring formulas. In a large class, use of this method is time consuming and may be impractical. However, in a clinical setting where one instructor is supervising a small group of students, this system may have merit.

To utilize Barrows' scoring formulas, each card must be assigned a value on a +2 to –2 weighted scale. These values can be determined by the instructor or a panel of experts in the particular clinical area being investigated. The score rates the relevance of each action described on the card in working with the patient's problem. Table 2 provides a description of the criteria used by Barrows to assign values from +2 to –2.

These formulas can then be used to calculate the student's economy of actions, proficiency, and the relevance to the problem.

Using this scoring system the instructor can quantify student performance. A qualitative assessment can be obtained by reviewing the sequence of selected actions taken by the student compared to that selected by the panel of experts or the instructor.

An important feature of problem based learning and the use of the P4 technique is the facilitation of self-directed learning skills. The student may be asked to confront this unknown patient problem without any specific prior preparation. When the student is unable to comfortably proceed based upon his current knowledge base, he/she is encouraged to stop the P4 temporarily and seek the additional information necessary to continue. This could mean reading a chapter, an article, consulting with faculty, or discussing the case with a fellow student. Appendix C is a copy of the handout we use to introduce students to the P4 system and includes five recommendations that students are encouraged to follow as they work through the P4.

How to Make a P4

The system we designed allows us to "author" a P4 case in approximately 45 minutes. Efficient authoring requires word processing software. We use Wordstar release 4.0 and an IBM compatible computer, but any word processing software is suitable as long as it permits operations such as search and find, and search and replace.

Once a case has been authored, a hard copy must be produced and is then sent to a printer for duplication. The following section describes the process in detail.

1. Selection of a case

Selection of a case depends upon the behavioral objectives for the particular course and the level of the students. For example, a P4 can be used to direct study and discussion around basic science issues, clinical evaluation and treatment or a combination of issues.

We have used both real clinical cases and cases in which we simulated findings to make a specific point. In our experience the use of actual patients as a basis for the P4 is highly desirable, particularly with more advanced students. The inconsistency and unexpected findings which can be characteristic of actual patients creates greater realism and a better learning experience.

2. Authoring the P4

We developed an authoring system in an attempt to:

Minimize the time and effort necessary to author a case.

Enable the author to easily generate multiple copies of the case.

Minimize the cost of reproduction.

Using Wordstar 4.0 and an IBM compatible computer, we developed a template for the front of the cards. The template is identical for all P4s and only has to be done once. We obtained six cards from each page or sheet of paper to minimize the cost of production. To accomplish this we set up the left side of each page with actions and duplicated these actions on the right side of each page.

A template was also designed for the back of the cards. We established the normal or typical response for each of the interview, examination, special testing and consultation actions and created a "normal patient." To author an actual case, one opens a copy of the original document and modifies those actions that are different from the "normal patient." Thus instead of authoring a response for all 346 actions, the system only requires modification of a select group of actions. In our experience with this system, about 45 minutes are necessary to author a case.

Printing

Once the modifications to the outcomes (back of the cards) have been made, the following must be done:

1. The "Front of Card" file is printed to create a hard copy.
2. The "Back of the Card" file is printed to create a hard copy.
3. Both are brought to a printer. The printer must use index card stock and prints the front on one side and the corresponding back on the other side.
4. The printer cuts the 8 1/2 by 11 inch stock into six, creating six cards.
5. The cards are sorted, creating two copies of the P4.

Our approximate cost for printing was $4.00 per P4.

Applications

Clinical

In clinical optometric education one of the problems we experience is assuring both the quality and quantity of student's clinical encounters. The P4 can be utilized to supplement both of these needs. It can be used to provide additional simulated patient care experiences. The cases can be routine to reinforce concepts at an early stage, or they can be complicated and unusual cases to supplement a student's clinical exposure.

If a clinical instructor transforms his/her interesting patients into P4s on a routine basis, a very valuable library of simulated cases can be accumulated in a short period of time. Students can be required to examine a simulated patient using the P4 format if a patient is not available or does not show up for an appointment. An instructor can establish that each student must complete a given number and selection of P4s to complete a clinical rotation.

The results of the student's actions can be reviewed as if an actual patient had been examined. The student presents the case and discusses his/her assessment and management plans with the instructor. For a quantitative assessment, Barrows' formulas can be used.

Didactic

Using the P4 format as the basis for didactic optometric education is both innovative and challenging for both the instructor and the students. This approach has been well-described previously in medical education. We also reported on our experience using problem based learning in a large group, didactic course using the P4 method and a computer simulation.[14,22]

Critique and Summary

The advantages of the P4 over the use of live actors or computer simulations are:

1. The P4 is less expensive.
2. The P4 is portable.
3. The P4 lends itself to either individual or group participation.
4. The P4 is not affected by software or hardware problems.

We did identify certain problems with the P4 format.

TABLE 1
Examples of Formulas which Can be Used to Assess Student Performance

A. Overall Economy Formula

$$1 \quad \frac{\text{Number of cards selected}}{\text{Number of cards available}}$$

The maximum score would be 1. This formula assesses the student's ability to reach a diagnosis and management plan quickly and with as few actions as possible. The use of this formula would not be appropriate if the student is asked to perform a comprehensive visual examination.

B. Proficiency Formula

$$\frac{[2(+2\text{ selected}) + (+1\text{ selected})] - [-2(-2\text{ selected}) + (-1\text{ selected})]}{\text{number of cards selected}}$$

This formula assesses the ability of the student to select appropriate actions. Actions which are considered problem related are rated a +2, while actions considered to be of no value and potentially harmful are rated -2. A maximum score of 2 can be achieved.

1. Locating cards was time consuming and distracting at first. Having an "action index list" was, therefore, necessary. Unfortunately, students would often scan these lists for "cues," selecting actions from a menu rather than from their heads as they would in a clinical setting. With more practice, students were able to locate actions directly.

2. Formal evaluation is cumbersome and impractical for a large class or group. We encouraged students to prepare cases and bring the results to class where they could compare their results with others and learn from a discussion of the case. We found that the better students took advantage of this opportunity.

3. Mixing of the cards was a problem that occurred and can be avoided by punching holes in one corner and binding them on a ring.

In summary, the P4 is one very useful method of simulating patient or basic science problems. It can be used as a stimulus for problem based, self-directed learning in both clinical and didactic settings. ☐

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TABLE 2
Description of Criteria Used to Assign Values to Actions

+2	— This score is assigned to an action when it is problem related and directly helps confirm or deny a clinical hypothesis.
+1	— Used when the action is related to gathering a comprehensive data base although it may not be directly related to defining or managing the patient's problem.
0	— Used when the action is neither harmful or helpful.
-1	— This score is assigned to actions that are neither problem related nor data base related.
-2	— Used when the action is not only unrelated to the patient's problem or gathering of a data base, but is also time consuming, painful or dangerous.

ASCO Awarded Grant From Administration on Aging

The Association of Schools and Colleges of Optometry (ASCO) has been awarded the grant, "Issues in Aging and Minority Health: Training Optometric Preceptors" by the Administration on Aging, Department of Health and Human Services. Seventy three and one half percent ($74,719) of the total cost of the program ($101,593.00) will be financed with federal money and 26.5 percent ($26,874.00) will be financed by non-governmental sources.

ASCO recently completed the highly successful training grant entitled "Geriatric and Gerontology Enhancement of Optometric Faculty and Students to Serve the Vision Care Needs of the Aging Patient." An outcome of that grant was the manual, *Optometric Gerontology: A Resource Manual for Educators*. The manual has been distributed to the optometric educators trained at the ASCO Optometric Gerontology Workshops held in the fall of 1988, to ASCO member schools, and to national and state eye care and aging organizations and associations.

The focus of the new grant is to improve the knowledge and skills of optometric preceptors, clinicians, faculty, and students with regard to caring for low income and minority elderly through workshops and educational materials. Two two-day workshops for practicing optometrists and clinical preceptors will be held in the summer of 1991 and will include selected topics from the earlier funded project with emphasis on low-income and minority elderly. In addition, the optometric gerontology manual produced by the original grant will be updated and a new module will be added on "Managing Low Income and Minority Elderly Patients," to be disseminated to the individuals and organizations listed above.

The grant's project consultants are: Gary Marrol, O.D., Chairperson (Gottlieb Vision Group, Stone Mountain, GA), Denise DeSylvia, O.D. (Ferris State University College of Optometry), and Gregory Good, O.D. (The Ohio State University College of Optometry). The advisory committee members are: Su Wong, O.D., Chairperson (Indian Health Service), Sheree Aston, O.D. (Pennsylvania College of Optometry), and Ruth Mayer, M.S. (The National Council on the Aging).

APPENDIX A
Sample of Available Actions for P4 Cards

INTERVIEW QUESTIONS

I1 : Reason for the visit. (Why is the patient here at this particular time? Chief complaint, initial presentation)
I2 : How did the problem begin? (Mode of onset, how did problem start)
I3 : When did the problem start? (Onset, when did problem begin)
I4 : When does it bother you and/or what makes the problem worse?
I5 : What alleviates the problem?
I6 : What is the pattern of the symptoms over time, specifically, their frequency and severity? Does the problem change over time?
I7 : Severity of symptoms?
I8 : Location of symptoms (locus, radiation)?
I9 : Associated symptoms (What other symptoms occur along with the patient's chief complaint)?
I10 : Did you ever have this problem before?
I11 : Were you ever treated for this problem before?
I12 : How were you treated for this problem in the past?
I13 : Seasonal variation in problem or symptoms?
I14 : What effect does this problem have on your daily life, school, work, sports?
I15 : Have there been any changes in your daily routine, or activities?
I16 : Patient's perceptions (What do you think is going on?)
I17 : Do you have blurred vision? If yes, at distance (far), when looking at the blackboard, when driving, at near, when reading or other times?
I18 : Do you have blurred vision when looking from near to far or far to near?
I19 : Do you have double vision (diplopia)? If yes, when, how often, precipitating factors? What happens if you cover one eye?
I20 : Do you have eyestrain (asthenopia)? If yes, when, how often, precipitating factors?
I46 : What is your current health status?
I47 : Are you currently taking any medication? If yes, specify.
I48 : Have you had any previous treatment for your vision problem? (glasses, prism, vision therapy, surgery, patching, eye drops)
I49 : Has there been any previous neurological testing? (If yes, what were the results)
I60 : Obstetrical history? Mother's health, birth weight, gestational age.
I71 : Allergies?
I72 : Appetite?
I73 : Balance difficulty?
I74 : Clumsiness?
I75 : Fainting?
I76 : Falls?

EXAMINATION ACTIONS

E1 : VA (distance) — Snellen single line (habitual)
E2 : VA (distance) — Snellen single letter (habitual)
E5 : VA (distance) — Broken Wheel (habitual)
E6 : VA — S-chart (Flom Chart) acuity (habitual)
E8 : VA — operant preferential looking acuity (OPL) (habitual)
E9 : VA — near (habitual)
E10 : Pinhole acuity (habitual)
E11 : Laser interferometry
E19 : External evaluation
E21 : Swinging flashlight test (Marcus Gunn Pupil test)
E22 : Color saturation and brightness tests
E24 : Near point of convergence (NPC)
E25 : Color vision evaluation
E30 : Cover test (distance) (habitual)
E31 : Cover test (near) (habitual)
E36 : Stereopsis (near) — random dot test (habitual)
E38 : Corneal curvatures (Keratometry, K's)
E39 : Objective refraction (Static, retinoscopy, skiascopy)
E40 : Subjective refraction (dry refraction)
E41 : VA (distance) — Snellen single line (with subjective)
E59 : Cycloplegic refraction (wet refraction)
E65 : Near lateral phoria (NLP) (von Graefe)
E66 : Near vertical phoria (NVP) (von Graefe)
E67 : Near lateral phoria — +1.00 (gradient, AC/A ratio)
E68 : Base in @ near (BI, adduction, negative fusional vergence)
E69 : Base out @ near (BO, abduction, positive fusional vergence)
E70 : NRA (negative relative accommodation)
E71 : PRA (positive relative accommodation)
E73 : Fixation disparity evaluation at near
E74 : Accommodative amplitude (push up)
E75 : Accommodative amplitude (minus lenses)
E76 : Mem retinoscopy
E77 : Accommodative facility (monocular)
E78 : Accommodative facility (binocular)
E79 : Direct Ophthalmoscopy
E80 : Slit lamp evaluation (external, biomicroscopy)
E81 : Anterior chamber angle (estimated, non-gonioscopic)
E82 : Tear assessment (Breakup time)
E83 : Blood pressure
E88 : Gonioscopy, detailed assessment of anterior chamber angle (gonioscope)
E90 : Intraocular pressure (IOP, tonometry)
E91 : Bielschowsky head tilt test
E93 : Hess Lancaster screen
E94 : Bagolini striated lenses
E102 : 90D lens test
E103 : Neutralize current prescription
E104 : Palpation of bony margins of orbit
E105 : Transillumination of sinuses
E106 : Palpate lids for edema, masses, tenderness
E107 : Express Zeiss, Moll, Meibomian glands
E108 : Evert upper eyelids
E109 : Evaluate blink function (rate, magnitude, Bells phenomenon)

SPECIAL TESTING

S1 : VEP (visual evoked potential, VER, VECP)
S2 : ERG (electroretinogram)
S3 : EOG (electroculography)
S4 : Manual central fields (tangent screen)
S5 : Manual peripheral fields (Goldmann fields)
S6 : Objective eye movement recording (Visigraph, Eyetrack)
S7 : Radiographic evaluation
S8 : Dark adaptation
S9 : CT scan, MRI
S10 : Spinal fluid examination
S11 : Tensilon test
S12 : Forced duction test
S13 : Cocaine test
S14 : Paredrine test
S15 : Pilocarpine test
S16 : Ultrasonagraphy — A-Scan
S17 : Lacrimal patency evaluation
S18 : Flourescein angiography
S19 : Cultures and sensitivities
S20 : Blood glucose testing

S21 : Automated visual field (screening))
S22 : Automated visual field (threshold)
S23 : Ultrasonagraphy — B-Scan

CONSULTATION

C1 : Neuro eye consultation
C2 : Surgical consultation
C3 : Psychological consultation
C4 : Internal medicine consultation
C6 : Cardiological consultation

TREATMENT

T1 : Re-assurance
T2 : Follow up — specify when patient will be seen next.
T3 : Prescribe glasses (Rx, spectacles, eyeglasses). (Be specific about prescription and when patient is to wear Rx in comment section)
T4 : Soft Contact lenses: spherical, single vision
T8 : Hard (PMA or Gas permeable) Contact lenses: spherical, single vision
T12 : Direct occlusion — specify how many hours per day
T16 : Rx — prism: correcting prism
T18 : VT — home
T19 : VT — in office
T34 : Antibiotic
T35 : Antiviral
T36 : Antifungal
T37 : Anti-inflammatory
T45 : Lid scrubs and hygiene
T47 : Magnification Near: specify
T48 : Illumination control: specify

APPENDIX B
Sample P4 Recording Sheet

NAME ______________________ **CASE #** __________ **DATE** ___/___/___

Please use this form in order to record the sequence of actions which you selected for the patient simulation of the week.

1. Record the exact order and action number.
2. Retain a copy of this form for yourself. You will be asked to present and defend your approach during the Tuesday class.
3. This form must be brought to class on Tuesday and will be collected at that time.
4. You can write in specific comment about treatment or any other issue on the bottom or back of the page.

1.	16.	31.
2.	17.	32.
3.	18.	33.
4.	19.	34.
5.	20.	35.
6.	21.	36.
7.	22.	37.
8.	23.	38.
9.	24.	39.
10.	25.	40.
11.	26.	41.
12.	27.	42.
13.	28.	43.
14.	29.	44.
15.	30.	45.

ASSESSMENT **OTHER COMMENTS**

APPENDIX C
Portable Patient Problem Pack (P4)
Getting Started

INTRODUCTION TO THE PORTABLE PATIENT PROBLEM PACK (P4)

The importance of problem based learning as an educational method is being increasingly recognized in optometric education. The emphasis this method places on development of clinical problem solving skills and self-learning skills makes it particularly relevant to the study of strabismus and amblyopia. In an attempt to begin incorporating such methods into this course, we used P4 cards (**P**ortable **P**atient **P**roblem **P**ack or **P4**).

These techniques allow a student to take any action possible with a real patient in the sequence he feels is appropriate. As in a real clinical situation, the student is able to see the result of each action before deciding on the next. This method allows the freedom to manage the problem effectively or make mistakes, perform unnecessary tests, and recommend inappropriate treatment.

The objective of using the P4 simulations is to facilitate the development of problem-solving skills consistent with those of an experienced clinician.

SPECIFIC INSTRUCTIONS FOR P4 PROBLEM BASED LEARNING

This simulation is designed to allow you to examine the patient with the same freedom that exists in the real clinical situation. You will be able to take virtually any action that would be available with a real patient. 364 actions are included in the simulation. These include actions in the following categories:

1. Interview/case history
2. Examination
3. Referral: special tests
4. Referral: Consultation
5. Treatment

Before proceeding, review the **MASTER ACTION LIST** so that you will be familiar with the various available actions.

The most effective strategy for working with the P4 simulation is the clinical reasoning process discussed in class.

1. It is important to develop a list of clinical hypotheses based upon the information you gather from the chief complaint and subsequent interview.

2. Based upon these hypotheses you should then select actions which are considered **PROBLEM RELATED.** A problem related action is one which would reveal data or information which would be expected to either confirm or deny one of the clinical hypotheses you established. The most efficient approach is to begin with the "most likely" hypothesis and gather all the clinical data to either confirm or deny its relationship to the patient's problem, then move to the next most likely hypothesis. Establishing the initial hierarchy of hypotheses, and then uncovering the associated critical clinical data as "problem related," helps confirm or reject your initial diagnosis from the interview as you proceed in examining the patient.

   In the course of uncovering clinical data you may find that you need to re-work your list of hypotheses, adding, deleting or modifying them.

3. After selecting all actions that you feel are problem related, you should then select all actions that may be **DATA BASE RELATED OR SCAN TYPE ACTIONS.** These are actions that you would take in the course of any comprehensive evaluation of a patient. These actions may not specifically contribute to confirming or denying a hypothesis.

4. In the course of performing a scan or data base related action, you may find that the information obtained does relate to the clinical problem or reveals a new clinical problem. If this should occur you would make a *re-assessment* and state that this was actually a *problem related action*. For example, the patient is a 55-year-old complaining of intermittent diplopia which occurs after reading for 10 minutes. You find that there is a receded near point and intermittent exotropia at near. In the course of doing routine IOP, you find pressures of 28 mm/hg in each eye. Although you originally selected this as a scan or data base related action, you would reassess this as *problem related* after receiving the outcome.

5. Whenever you select actions, whether they be problem related or data base related, it is important to be very aware of the sequence of your action selection. Clinically, we know that certain procedures require a *"prerequisite"* action. For example, before performing a cover test with subjective, you must do the subjective.

6. Once you feel that you have gathered enough information to properly diagnose and manage the patient's problem(s), you can proceed to the diagnosis category and select the diagnosis or diagnoses you feel apply to the patient.

7. Finally, based upon your diagnosis, you should select the treatment options you would recommend for the patient.

Comparative Performance on National Board Basic Science and Clinical Science Tests

Leon J. Gross, Ph.D.

Abstract

This study was conducted to determine the relationship between performance on Basic Science (BS) and Clinical Science (CS) National Board examinations, since many students do well on CS, despite having failed BS. The assumption of BS being a building block for CS is therefore challenged. To evaluate this relationship, analyses were conducted for the candidates taking the August 1988 CS examination. Their examination performance was compared with performance on their initial taking of BS. The results indicated a high correlation between scores on both examinations, and a much higher probability of success in CS if BS is passed on the initial attempt. These data underscore the relevance of BS, and its usefulness in predicting subsequent CS performance.

Background

The relationship between Basic Science (BS) and Clinical Science (CS) is both perplexing and elusive. Optometric educators and state board members have cited the importance of BS as a building block for professional practice.[1] Certainly, BS provides the basis for life-long learning (i.e., continuing education).

As a licensed health care profession, optometry is concerned with continuing education because of three major factors.

- The profession's knowledge base is changing.
- The profession's scope of practice is expanding.
- Optometrists must be able to maintain their competence independently, since most are independent practitioners.

BS is also regarded as a building block for CS. Therefore, in the academic curricula of the doctoral level licensed health care professions, BS usually precedes most of CS. Similarly, BS also precedes CS in the examination sequence of the professions' national boards. BS is targeted for students completing their second year of education, while CS is intended for students completing their third year.

In optometry, CS is designed as a third-year examination. BS is meant to precede, and serve as a building block for CS, although students are allowed to defer sitting for the examinations, and to take them in reverse order. However, students who fail the BS National Board examination should also be expected to have difficulty passing the CS examination.

In optometry, however, although the failure rates in BS have been relatively high, failure rates for CS have been relatively low. If BS is indeed a building block, then poor performance similarly should be expected in CS, and perhaps be compounded. Therefore, the reasonably good aggregate performance in CS, *despite* poor performance in BS, challenges the relevancy of the BS examination as a building block for CS.

This phenomenon has been of concern to the National Board for several years. An analysis of BS and CS data was needed in order to gain a better understanding of their interrelationship. However, this report was prompted by another phenomenon: performance on the August 1988 CS examination was at the lowest level of any CS or equivalent examination (i.e., old Part IIB), as measured by the mean percentage of correct responses, and the percentage of candidates passing. Although these statistical indices were not substantially below the previously lowest levels, it was the first CS examination (or equivalent) in which the mean score was below 70% (actual mean was 68.1%). Furthermore, with the failure rate approaching 20%, the National Board wished to determine if the results in August were a statistical aberration, or the beginning of a trend. Thus, the investigation was initiated.

In isolating the candidates who sat for the August 1988 CS examination, a startling statistic quickly emerged that changed the course of the investigation. Specifically, 18% of the CS candidates were also taking the BS examination during the same administration. Clearly, candidates sitting for two examinations during the same administration must ration their study time for each test, which may detract from their performance on each. This is certainly not an optimal test taking condition, and an approach that is not recommended by the National Board. However, it is also a reflection of the relatively high failure rates in BS where unfortunately, students are retaking BS at the same time they are first eligible to sit for CS.

The relatively high percentage of candidates taking two examinations suggested that the somewhat depressed mean score and pass rate on the CS examination was an aberration caused by too many candidates "spreading themselves too thin." However, this relatively high percentage of 2-test candidates provided a unique database for comparing performance between both examinations. Thus, the study was refocused on the comparative perfor-

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mance on the BS and the CS examinations. The focus of this analysis was to determine whether performance in BS is related to performance in CS.

Results

From the complete candidate database of the National Board, a limited database was formed consisting of all candidates who took the August 1988 CS examination. The following data were included: total scaled score and pass-fail status on the CS examination, the number of times BS had been taken, the administration in which BS was taken for the first time, and the total scaled score and pass-fail status on BS during the first administration in which it was taken.

In order to further isolate the comparative performance between BS and CS, the database was refined to include only candidates taking CS for the *first time,* and who had taken BS *at least once* (including sitting for BS during the August 1988 administration). The final refined database excluded 56 candidates who had previously taken CS, and 13 candidates who had never taken BS. Thus, the final database consisted of 501 of the 570 total candidates (88%). Of the 501 candidates in this database, 104 (21%) were also taking BS. The composition of the database is graphically depicted in Figure 1.

The correlation between BS performance and CS performance is the best indication of a relationship. Therefore, the Pearson product-moment correlation was computed for the CS total scaled score, and the BS total scaled score, for the first administration of the latter examination for which each candidate sat. The correlation was .75, which is relatively high, and statistically significant ($p < .01$). This relatively high correlation indicates that candidates with high scores in BS tend to receive high scores in CS, and that candidates with low scores in BS tend to perform poorly in CS.

Of further interest was the correlation between the number of times the candidates sat for the BS examination, and performance on their first BS examination, and the CS examination. These correlations were -.61 for BS, and -.53 for CS; both correlations were statistically significant ($p < .01$). These correlations indicate that the lower the candidates' scores were on their first BS examination, the more times they failed and had to repeat the examination. Furthermore, the more times they have had to repeat the BS examination, the lower their scores were on the CS examination. A matrix displaying these correlations is shown in Table 1. These correlations suggest that BS is indeed related to CS, even though candidates generally perform better in CS.

Additional analyses were conducted to further explore the comparative performance. Candidates were divided into four groups, based on the number of times they had taken BS. This group approach enabled an analysis of variance (ANOVA) to be conducted, with a correlational interpretation.

The August 1988 administration was the fourth in which BS and CS were offered. Therefore, it was possible for candidates to have sat for the BS examination as many as four times. For twelve candidates, this administration was their fourth attempt at this examination. Table 2 displays the number of candidates in each of the four groups, and includes their mean scaled score for their first attempt on the BS examination, and their first attempt on the CS examination (i.e., August 1988). These performance comparisons are also shown graphically in Figure 2.

For both the BS and CS examinations, there was a significant difference in performance among the four groups, with the greatest difference between candidates who had taken the BS examination only once, and those who had taken it twice. For both examinations, the differences were statistically significant ($p < .01$). These analyses corroborate the previous cited correlations; however, by conceptualizing the rela-

TABLE 1
Test Score Correlations

	Basic	Clinical	BS Times
Basic	1.00		
Clinical	.75	1.00	
BS Times	-.61	-.53	1.00

TABLE 2
Test Score Means

BS Times	Count	BS Mean*	CS Mean
1	285	415.0	494.1
2	135	278.6	384.2
3	69	269.5	356.0
4	12	256.6	321.7

*first attempt

TABLE 3
Cross Tabulations of Pass-Fail Status

		Basic Science* Fail	Basic Science* Pass	
Clinical Science	Fail	n = 66 column % = 28.6 row % = 94.3 CS mean = 275.0	n = 4 column % = 1.5 row % = 5.7 CS mean = 288.0	n = 70 row % = 14.0 CS mean = 276.6
	Pass	n = 165 column % = 71.4 row % = 38.3 CS mean = 401.7	n = 266 column % = 98.5 row % = 61.7 CS mean = 509.3	n = 431 row % = 86.0 CS mean = 456.1
		n = 231 column % = 46.1 CS mean = 365.7	n = 270 column % = 53.9 CS mean = 506.0	

*first attempt

tionship in terms of group means, the practical significance of performance in BS becomes more evident.

With the comparative performance by total score established, further analyses were conducted to examine the relationships in terms of pass-fail status. Cross tabulations were computed for this purpose, and are displayed in Table 3.

The columns in this table represent candidates' pass-fail status on their first BS examination. The rows represent candidates' pass-fail status on their first CS examination (i.e., August 1988). The cells or boxes in the table display the four combinations of possible outcomes based on failing both examinations, passing both examinations, passing BS and failing CS, and failing BS but passing CS. Within each cell is the number of candidates attaining that combination of pass-fail outcomes during the first attempt at the respective examinations, and the corresponding percentages based on either a BS perspective, or a CS perspective. The cells also contain the corresponding CS mean score.

Perhaps the most interesting interpretation is a column-wise one, which has a predictive context. Of the 231 candidates who failed BS during their first attempt, 28.6% failed CS during their first attempt, while 71.4% passed. This finding is consistent with performance in CS having generally been higher than performance in BS. Clearly, failure to pass BS does *not* preclude candidates from passing CS. However, the data in the companion column are more indicative of the underlying relationship. Of the 270 candidates who passed BS on their first attempt, only 1.5% failed CS, while 98.5% passed! Thus, although failure on BS does not "doom" candidate performance on CS, successful performance on BS nearly guarantees successful performance on CS. There were only four candidates in the entire database who, in spite of having passed BS, failed CS.

Interpreting the data on a row-wise basis reinforces these findings. Of the 70 candidates who failed CS in their first attempt, 94.3% had failed BS, while only 5.7% had passed. Of the 431 candidates who passed CS on their first attempt, 38.3% had failed BS, and 61.7% had passed. These findings provide further evidence of the strong, underlying relationship, where BS is a building block for CS. Table 3 also displays the CS mean scores corresponding to each cell. Candidates who passed BS on their first attempt performed significantly better than candidates who failed ($p < .01$). The column totals indicate a mean of 509.3 for candidates passing BS on their first attempt, and 401.7 for those who failed.

FIGURE 1
Composition of the Candidate Population

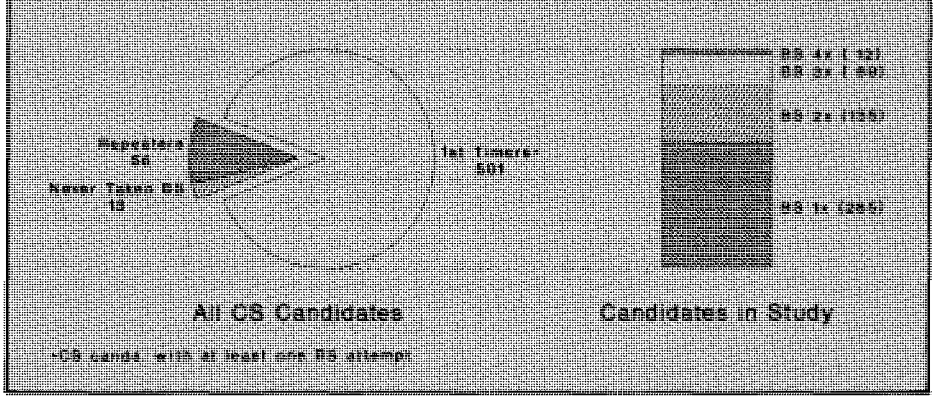
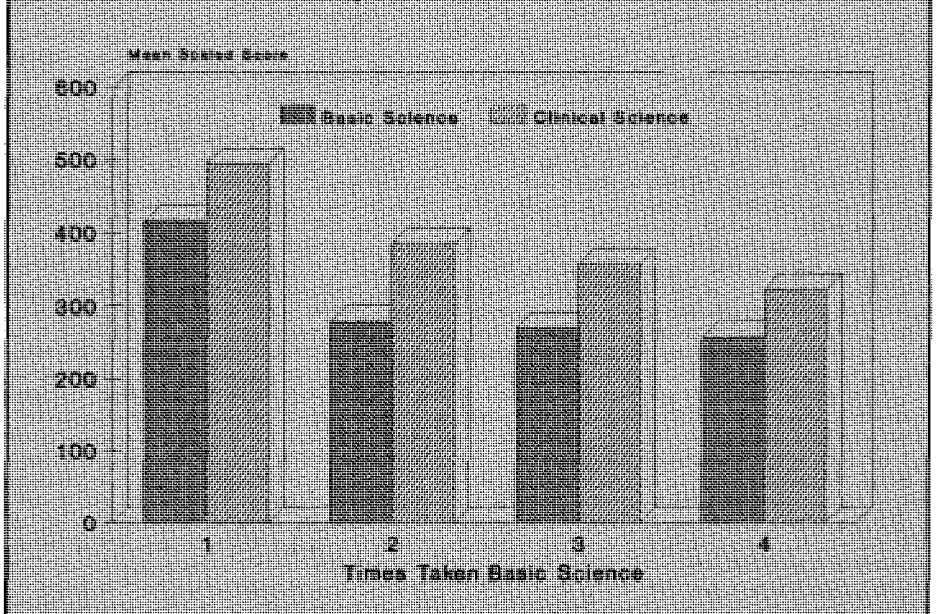


FIGURE 2
Comparative Mean Test Scores



Summary and Conclusions

The curriculum design and logic of BS as a prerequisite for CS suggests that National Board performance in these two areas would be highly correlated. However, the consistently higher performance in CS, compared to BS, has obscured this relationship. The analyses that are described in this report reveal that BS and CS are indeed highly correlated, and that performance in BS is a useful predictor of subsequent performance in CS. Candidates who perform well in BS tend to perform well in CS, and candidates who fail BS are much more likely to fail CS. With these relationships clearly established, and performance in BS unsatisfactorily low, it is very desirable for the aggregate performance on future BS examinations to improve.

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Role Modeling for Clinical Educators

Ellen Richter Ettinger, O.D., M.S.

Abstract:
Role modeling is a basic component of the educational process. In order to become better role models, clinical educators should be conscious of the behaviors they demonstrate, and the broad range of activities and attitudes that students observe and emulate.

Key Words: Role model, teaching by example, professional demeanor.

Introduction

Students learn from what they see. Do clinical educators serve as positive role models?

Research has shown the significance of role modeling in the development of professionals in many areas. In medicine,[1-3] nursing,[4] administration,[5] and education,[6-8] for example, the impact of role modeling has been recognized. A program at the Indiana University School of Medicine[1] presented faculty members, staff, students, and administrators with an opportunity to discuss and share thoughts, attitudes and techniques of role modeling. It was hoped that following the program, "the participants would be more cognizant of their influence as role models and would be motivated to become better role models."

Role modeling is a basic component of the learning process. As students observe clinical educators, they learn more about how a health professional works and behaves, and as they observe, they begin to emulate what they see. The basic definition of role modeling (Table 1) is a function of teaching by example. The clinical educator teaches, in part, by *demonstrating* polished clinical skills, sharp analytical reasoning, effective decision-making, comprehensive record-keeping, and caring doctor-patient interactions. The student looks to the educator, in a position of authority, and learns how one functions as a clinician.

Educators are not always aware of the influence that they have, by their example, in developing their students' skills, competence and professionalism. Although faculty members may be *most* conscious of demonstrating good clinical care, the student may be observing many other aspects of the clinican's behavior and performance, as well. By virtue of their authorized and respected position as educators, they may be looked upon as examples and models of how the clinician should act; their behaviors, attitudes and actions are looked upon as standards.

It should be noted that role models can be positive or negative. The educator who approaches patient care hurriedly, who writes incomplete records, or who acts insensitively to patients is as much an example to students as the one who demonstrates patience, competence, and sensitivity. Even if they are carried out inadvertently, the former behaviors can be seen by students and mistakenly interpreted as appropriate, usual, acceptable professional responses.

To students, interns, and residents, the manner in which educators carry themselves is a reflection of the profession; as students learn more about the clinical discipline they are entering, doctors with whom they come into contact are likely to be used in the formation of the image they develop of their profession.

By becoming more aware of their influence as role models, clinical educators can be more conscious of (1) the behaviors they demonstrate, (2) the broad range of activities that students observe in authority figures, and (3) improvements they can make to become better role models.

Role Modeling vs. Mentoring

The terms role modeling and mentoring are often used synonymously, although there are some important differences (Table 1). The role model is a person who is observed by others, as an example. In theory, a learner may watch someone's actions and performance intently, without ever speaking to that person individually. (Athletes and prominent leaders, for example, are often thought of as role models for children, although they may never meet in

TABLE 1
Terms Associated With Modeling

Role Model — a person in a position to set an example for others (usually someone in a position of authority).

Mentor — an expert in a particular field (or fields) who works to develop the skills and abilities of another person.

Mentee — the person who works, under the guidance of a mentor, to develop his or her skills.

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person). In addition, the person functioning as the role model may not always be aware that he or she is being observed, and may not be conscious of all the behaviors that are being monitored. Thus, whether or not the role model is aware of it, his or her function as model continues because the observer is watching.

The mentor[9-10] is an expert who spends designated time with a learner, the mentee. He or she is usually very observant in identifying the mentee's strengths and weaknesses, and helpful in providing direction and support. The mentor must be accessible to meet with the mentee, and provides guidance and feedback.

One may serve as both a mentor and a role model, if both functions are carried out; the two terms, however, are not equal and there are important characteristics that differentiate them. Mentoring is more of an *active* process, in which the mentor deliberately takes the time to meet with the mentee to work on specific skills or projects. Role modeling, on the other hand, frequently is more of a *passive* process on the side of the professional. By virtue of his or her position, the role model is observed by the student, who learns from the model's example, *whether or not the model is conscious of this.*

Within institutions of clinical education, there are many faculty members who take on the active responsibility as trusted mentors. *All* faculty members, however, have a significant—though not always obvious—function as role models. Students are attentive onlookers, carefully analyzing, and often "shadowing," emulating, echoing, imitating and following the actions, attitudes, and behaviors they observe.

Components of Role Modeling for the Clinical Educator

1. *Clinical Competence* — The clinical educator must emit a strong sense of competence, confidence and proficiency in the clinic. There is no substitute for competence. The educator must consistently demonstrate mastery and facility in carrying out clinical tests, analyzing test results, and advising patients.

The educator should demonstrate the act of being a "life-long" learner. By bringing recent articles and journals into the clinic, applying relevant findings from the current literature to patient care, discussing continuing education lectures they have attended, and describing other post-graduate learning experiences, the educator can show, by example, that the most capable clinician is one who continues to learn throughout the years of one's professional career.

2. *Professional Demeanor* — Everything the educator says or does in the clinic can be interpreted by students as a model of how one *ought* to act. From the way he or she dresses, to the attitudes displayed towards patients, the educator reflects an image of appropriate conduct and behavior for the clinician. Areas of professional demeanor that students observe include:

- Appearance and dress
- Attitudes towards patients and students
- Punctuality
- Attendance Record
- Organization of equipment, records and physical space
- Clinical habits

What sense of professional conduct does the clinical teacher display? By watching the instructors in their clinics, students build on their developing image of how one should practice as a health professional. Does the educator arrive on time for clinical care and proceed in a timely manner? Does he or she introduce him- or herself to the patient personably, and appear open and receptive to patient concerns? Does he or she maintain an organized examination room, with a neat working space and clean equipment? Does he or she always display good clinical habits, such as washing hands between patients?

The educator must demonstrate a sense of professionalism.

One of the best ways students have of learning about "professionalism" is by watching doctors in the clinic. It would be difficult to start a course in the didactic curriculum of our schools and colleges of optometry called "Professionalism 101: A Guide to Professional Conduct." Such a course would probably only be able to touch the surface of certain clinical practices which may seem logical and obvious, but which are not always carried out, in the ideal form, in reality. Discussing these areas may be beneficial, but what students discuss in theory is not always applied, in practice. By observing appropriate professional behavior in the clinic, students gain a sense of *how* these behaviors fit in with the delivery of clinical care.

The education of professionalism is probably taught very effectively where it can be observed and applied most readily and directly - in the clinic.

3. *Doctor-Patient Interactions* — It has been said that "patients don't care how much you know, until they know how much you care."

Experienced clinicians know that the effectiveness of the doctor-patient relationship can actually elevate the quality of the care provided by making the patient more relaxed, cooperative, responsive and confident in the doctor. The level of patient compliance also may be enhanced.

When they first start working in the clinics, students are often more concerned with the mechanical aspects of clinical care than with their communication skills and interpersonal interactions; their ability to reach patients, however, relies so heavily upon their ability to form a successful doctor-patient rapport. In addition to mastering the technical and analytical components of clinical care, students also must recognize how important it is to provide a supportive, sensitive environment for their patients, and to exhibit caring, compassionate attitudes.

All patients deserve sensitive, humane, compassionate health care. By demonstrating these qualities *in our own actions*, clinical educators can help our students learn more about the art of caring for patients.

4. *Ethical Values* — One of the difficulties of teaching medical ethics is that it would be difficult to present every situation and decision that students will ever encounter in their careers; even if one could do so, it would be inappropriate to establish "correct responses" or "standard answers" because the area of ethics involves deeply personal decisions. One cannot dictate the decisions of others; however, one can *demonstrate* the *processes* of ethical decision-making and clinical performance as students train in the health care environment.

Educators must be respectable (worthy of the respect of others) and respectful (showing respect to other people). They must display a sense of integrity, honesty, decency and trustworthiness. By demonstrating ethical values in the decisions and recommendations made, instructors can facilitate the development of ethical and moral attitudes in their students.

Areas of medical and biomedical ethics have been examined,[11-15] and there is strong support for educating students about ethics during their clinical training programs.[16-19] As discussed, one way students learn about ethics is by watching their instructors. Educators should be conscious of the messages they convey to students with respect to the following questions.

Do I:

- always act in the best interests of the patient?
- see that my patient has access to all necessary services, and that *only* those services that are necessary for the patient are provided?
- make appropriate referrals, when necessary, and choose competent and qualified referral sources?
- provide the patient with truthful, adequate information about the status of his or her health?
- maintain the confidentiality of my patient's medical status and clinical data?
- stay up-to-date with new clinical and scientific findings so I can provide my patients with modern, high quality clinical care?

5. *Social Consciousness* — Health professionals should care about other individuals, and should possess an interest in the social issues within our society. The economic, social, political, environmental, and medical dilemmas within our communities require involvement and action by those trained in the health professions.

The major focus of clinical education is on the patient-doctor encounter, and the development of good clinical skills. Such attention and rigorous training is appropriate, but often little (or no) attention is given to the social concerns of the community. Students graduate, often in significant debt as a result of the high costs of clinical education, with substantial financial pressures and obligations. Often, though, no notice is paid to the problems of the world. The resulting disposition is frequently referred to as the "me first" generation, or the sentiment of "looking out for number one."

Although new graduates and practicing clinicians must respond to the realistic personal pressures and responsibilities that exist, a sense of concern for humanity, and for the problems of others, must also exist. In the community, the nation, and the world, problems abound. The plight of the homeless, the poor, and the abused continues to grow, and patients with AIDS and other debilitating illnesses look for answers to their daily hurdles. Such challenges within communities warrant the attention of involved individuals.

The development of social consciousness should be part of the education of clinical students. The significance of faculty role models in demonstrating responsible, committed actions must be recognized. A new "Faculty Committee on Social Concerns and Community Relations" has been established at the State University of New York—State College of Optometry, under the leadership of Dr. Martin Birnbaum, to recognize this facet of clinical education. Faculty on the committee meet to discuss and identify the problems that exist in our area, and they consider how members of our college community can contribute to the needs of our local community. Through special projects (e.g. food and clothing drives, with collection baskets in our lobby; lecture programs on social issues and concerns; volunteer vision screenings and eye care for underserved and needy populations in our vicinity), faculty members demonstrate *through their actions* that aside from being good doctors and educators, they are also concerned citizens.

Summary

Patterning one's behavior after a respected individual is a common behavior. Clinical instructors should be aware of the five important areas, discussed here, in which they serve as role models for their students:

- Clinical Competence
- Professional Demeanor
- Doctor-Patient Interactions
- Ethical Values
- Social Consciousness

Educators should be aware that part of their role, as teachers, is to teach by example.

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RESOURCE REVIEWS

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

Public Health and Community Optometry, Robert D. Newcomb and Edwin C. Marshall, eds., 2nd edition, Butterworths, Stoneham, Massachusetts, 1990. 408 pages, $54.95

The long anticipated second edition of *Public Health and Community Optometry,* edited by Bob Newcomb and Ed Marshall, has been published and the wait was definitely worthwhile. Twenty-eight authors contributed to the comprehensive text, providing interesting and useful information on the foundations of public health, basic sciences for public health practice, management of public health programs and the delivery of optometric services within a public health context.

Every optometry student, and perhaps other health professional students, as well as practitioners, should own a copy of this book. Contemporary issues in public health relating to accessibility to care and quality of care are well covered. Although this text can be considered more theoretical than practical, in that backgrounds or explanations of health issues are described and not protocols or methods for resolving health issues "handbook" style, many serious problems in public health are reviewed, for which optometrists can share responsibility for remedying. Assurance of eye care for urban and rural disenfranchised populations in the United States and elsewhere, optometry vis-a-vis the health consumer movement, and optometry's role in health risk assessment are issues which informed optometrists can pursue in order to help resolve contemporary public health problems. The potential impact of preventing vision disorders and eye disease is also considered in this book. Specific courses of action and delineated roles for optometrists in general primary health care, however, would be found in other works.

Tables and very useful information are provided on ophthalmic materials in environmental vision, health economics and optometric organizations around the world. The book will continue to be a major resource on public health information for many years. All aspects considered, *Public Health and Community Optometry* is an excellent textbook, well-researched, well-organized, well-written, and well worth purchasing for those concerned about the profession.

Guest Reviewer:
Ian B. Berger, M.P.H., Ph.D.
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Clinical Visual Optics, 2nd ed., by Arthur G. Bennett and Ronald B. Rabbetts, Butterworths, Stoneham, Massachusetts, 1989, 519 pages + index, $90.

As the authors point out, this book has been produced as the successor to the two-volume *Visual Optics,* by Harold Heaton Emsley, which was a standard text in North America and the United Kingdom for thirty years, starting in the early 1930s.

The original two volumes contained 812 pages of text, while the successor is roughly 300 pages shorter. Bennett and Rabbetts have decided to leave out the chapters on radiation, photometry, color measurement, specification, and sensation. They have added much new material relating to vision screening, distribution of ametropia in the general population, and clinical instrumentation. The use of problems has been retained, which greatly enhances the teaching value of the book. A welcome improvement over Emsley's version is the inclusion of generous reference sections at the conclusion of each chapter. References in the original text were sparse in the extreme.

Clinical Visual Optics is much more generously illustrated than its predecessor was. Some figures from the original are still to be seen. Curiously, however, photographs of the external eye, cataract, and (since it is mentioned in the text) Scheimpflug photography are lacking. Their addition to a projected third edition would be welcome.

The authors are not shy about expressing their opinions on matters extraneous to the text. This is certainly their prerogative; however, in a text intended for undergraduates this could cause confusion. I do not share the authors' enthusiasm for automated perimetry, for one thing. When discussing the size of the visual field, the authors do not comment on the importance of specifying stimulus parameters.

They also comment about widescale damage to the cornea by contact lenses, but make no parallel statement in connection with intraocular lenses either in the same section or anywhere else in the book. This is a rather unbalanced outlook, I would suggest.

Their coverage of the optics and magnification effects of intraocular lenses is excellent.

Coverage of an important aspect of optics related to binocular vision, namely aniseikonia, is disappointing. The American Optical eikonometer to which the authors refer has been unavailable for many years. There is no mention of the newer concepts of dynamic aniseikonia and anisophoria.[a] The authors give the impression that calculation of iseikonic corrections is a daunting, difficult process, while it can be accomplished (from data obtained with the Remole multimeridional horopter apparatus) readily. The authors do not mention a number of simple tests for both static and dynamic aniseikonia which can be carried out using equipment found in any optometric office.

There is little to fault in the authors' coverage of the foundations of optometry; the novice in optics will be rapidly drawn into the solution of problems relating to object and image space.

Regarding subjective techniques, there is much detail regarding use of the Fan and Block charts, which are in limited use in North America.

The book provides a wealth of information for the clinician and researcher alike, regardless of their backgrounds. Like the original volumes, it will probably benefit from revision on a shorter interval than 5 years. All in all, it is a worthy successor to Emsley's book, and should enjoy an equally long career.

Guest Reviewer:
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