Report of the Staff to the Federal Trade Commission

A Comparative Analysis of Cosmetic Contact Lens Fitting by Ophthalmologists, Optometrists, and Opticians

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Bureau of Consumer Protection
Bureau of Economics

December 1983

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(Note: This report has been prepared by staff members of the Bureau of Consumer Protection and Bureau of Economics of the Federal Trade Commission. The Commission has reviewed the report and authorized its publication.)

Acknowledgements

The authors owe an enormous debt of gratitude to the many ophthalmologists, optometrists, and opticians who assisted in the design and performance of this study out of a sense of responsibility to their professions and to the public. Not all of them can be listed here. But the following individuals, who represented their respective professions at all stages of the study, deserve special mention: Oliver H. Dabezies, Jr., M.D., of the Contact Lens Association of Ophthalmology and the American Academy of Ophthalmology; Earle L. Hunter, O.D., of the American Optometric Association; and Frank B. Sanning and Joseph W. Soper, of the Contact Lens Society of America and the Opticians Association of America. Of course, none of these individuals or associations necessarily endorses the ultimate conclusions of this report.

A number of current and former FTC staff members have contributed to the study in important ways. Members of the Bureau of Consumer Protection's Impact Evaluation Unit, including Tom Maronick, Sandy Gleason, Ron Stiff, Michael Sesnowitz, and Ken Bernhardt, helped answer innumerable technical questions related to the design and administration of the study. Christine Latsey, Elizabeth Hilder, Janis Klurfeld, Scott Klurfeld, Erica Summers, Matthew Daynard, Terry Latanich, and Gail Jensen interviewed study subjects, supervised the field examinations, prepared data for analysis, wrote preliminary drafts, and helped with a number of other tasks. Elaine Lucas and Duane Fink were primarily responsible for the typing of the report, with assistance from Gwendolyn Williams, Phyllis Ferguson, Gwendolyn Jones, Cynthia Meredith, Stephen Pevenstein, and Deborah Payne. Ron Bond, Michael McCarey, and Michael Pollard provided assistance and comment on methodological, substantive, and editorial matters.

Finally, we wish to thank our statistical consultants, Susan W. Ahmed, Ph.D., and Leonard Chiazze, Jr., Sc.D. Their work for us demonstrated not only great expertise but also great patience and diligence.

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I. Introduction

The Bureau of Consumer Protection of the Federal Trade Commssion is examining the effects of certain public and private restrictions on vision care professionals. The purpose of that examination is to determine to what extent those restrictions protect the public by improving the quality of vision care goods and services or harm the public by unnecessarily limiting competition.

A. The "Eyeglasses II" Investigation

On September 16, 1975, the Commission authorized its staff to initiate the "Eyeglasses I" investigation, which culminated in the promulgation of the Trade Regulation Rule on the Advertising of Ophthalmic Goods and Services (the "Eyeglasses Rule").[1] In the course of conducting that investigation, the staff discovered several restrictions on vision care providers -- ophthalmologists, optometrists, and opticians[2] -- other than advertising bans that

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[1] 16 C.F.R. §456 (1982). See Bureau of Consumer Protection, Federal Trade Commission, Staff Report on Advertising of Ophthalmic Goods and Services and Proposed Trade Regulation Rule (1977), for a discussion of the issues and evidence examined in that rulemaking proceeding.

[2] Ophthalmologists are physicians who specialize in diagnosing and treating diseases of the eye. They may prescribe drugs and perform surgery. Many ophthalmologists fit and dispense eyeglasses and contact lenses.

Optometrists are doctors of optometry (O.D.'s) who conduct eye examinations to determine refractive error, prescribe corrective eyewear, or use vision training or therapy to preserve or restore maximum visual efficiency. Optometrists are permitted by law to detect, but not diagnose, eye disease; they refer patients who manifest signs of eye disease to ophthalmologists. They are generally not permitted to administer or prescribe therapeutic (footnote continued)

appeared to increase costs and decrease consumption of vision care, but did not seem to offer consumers offsetting benefits in the form of increased quality of care or protection from incompetent or unscrupulous sellers.

The "Eyeglasses II" investigation focuses on two different types of public and private restrictions on optometrists and opticians: form of practice and scope of practice restrictions. Form of practice restrictions include laws and regulations that control the business aspects of a professional's practice. Such restrictions may prohibit optometrists from working for corporations, using a trade name, practicing in a department or drug store, or opening branch offices. Scope of practice restrictions limit the range or services which may be delivered by a particular type of provider. Such restrictions may prohibit opticians from duplicating eyeglasses or fitting contact lenses.

B. The Contact Lens Wearer Study

In 1978, the staff began to examine the effects on consumers of state laws that prohibit contact lens fitting by opticians. Because little reliable evidence concerning the effects of those restrictions on prices and quality existed, the staff decided to conduct a study of contact lens wearers. The staff worked

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drugs or to perform surgery. Most optometrists fit and dispense eyeglasses and contact lenses. Optometrists are frequently classified as either "commercial" or "non-commercial" practitioners. For a definition of those terms, see infra notes 64-65.

Opticians are technicians who dispense corrective eyewear pursuant to prescriptions written by optometrists and ophthalmologists. They may not examine eyes or prescribe lenses. In some states, opticians may fit contact lenses or duplicate existing eyeglasses or contact lenses.

closely with representatives of organized ophthalmology, optometry, and opticianry to design and administer that study.

As reported below, the study found that there were few, if any, meaningful differences in the quality of cosmetic contact lens fitting provided by ophthalmologists, optometrists, and opticians. The study also showed that, on average, commercial optometrists fitted contact lenses at least as well as other fitters, but charged significantly lower prices. That finding lends support to the staff's previous recommendation that the Commission take action to remove restrictions on the business practices of optometrists.[3]

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[3] That recommendation appears in Bureau of Consumer Protection, Federal Trade Commission, State Restrictions on Vision Care Providers: The Effects on Consumers (1980)(hereinafter cited as "Eyeglasses II Staff Report").

II. Background

A. The Contact Lens Market[4]

Approximately 20 million Americans wear contact lenses. The average contact lens wearer today is 30 years old, up from an average age of 22 in 1973. About 70% of contact lens wearers are female, but the percentage of male wearers is increasing.

Contact lens sales have increased dramatically in the past few years. About twice as many contact lenses were dispensed at the retail level in 1980 as in 1977. Consumers spent about $700 million for lenses, lens care products, and related professional services in 1980.

Most, if not all, of the increase in contact lens sales is due to the growing popularity of soft lenses.[5] About 65% of the three million wearers who were first fitted with contact lenses in 1980 were fitted with soft lenses, compared with 24% of those first fitted in 1975. Industry observers attribute the increase in soft lens sales to intensified promotional efforts, widespread discounting, and technological improvements, including the development of "extended wear" lenses.[6]

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[4] The figures which appear in this subchapter were provided by several industry sources.

[5] Bausch & Lomb dominates the soft lens manufacturing industry with a 55% market share. The three next largest firms have market shares of 10%, 8%, and 7%. About 20 smaller firms also manufacture soft lenses.

[6] "Extended wear" lenses can be worn day and night for as long as two weeks. Such lenses are roughly twice as expensive as conventional soft lenses, which are removed at night, cleaned, and reinserted in the morning. The FDA originally limited the (footnote continued)

Independent optometrists dispensed just over half the contact lenses sold in 1980, but their share of the retail contact lens market is declining. Entrepreneurial optical outlets (including commercial optometrists and opticians) now have almost a 30% market share, which is about double their 1978 share. Ophthalmologists dispense about 20% of all contact lenses; their market share has remained relatively unchanged in recent years.

B. The Uses of Contact Lenses

Contact lenses have been successfully used to correct many visual conditions, including: myopia, (nearsightedness); hypermetropia (farsightedness); corneal astigmatism (an irregular or aspherical cornea); presbyopia (an age-related inability to focus on near objects); keratoconus (a progressive thinning of the center of the cornea which results in a bulging or nipple-shaped cornea); aphakia (lack of the natural crystalline lens, usually due to cataract surgery); aniseikonia and anisemetropia (conditions where there is a difference in size or shape between the two retinal images); strabismus (crossed eyes); and amblyopia ("lazy eye").[7] Contact lenses provide superior vision correction or therapy in many of these conditions, and may be the only means of correcting certain visual problems satisfactorily.

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use of "extended wear" lenses to those who had had cataract surgery, but has now approved the more general use of these lenses.

7. Definitions of these and other optical and ophthalmic terms used in this section are paraphrased from those which appear in H. Solomon & W. Zinn, The Complete Guide to Eye Care, Eyeglasses and Contact Lenses 235-43 (1977).

For the millions of Americans who have moderate to high degrees of myopia, hypermetropia, or astigmatism, the use of contact lenses may result in a more normally-sized retinal image, a larger visual field, and freedom from the discomfort caused by wearing thick, heavy spectacles. Contact lenses offer even more dramatic advantages to the keratoconic wearer. Patients with keratoconus are usually unable to obtain satisfactory vision with spectacles. Contact lenses provide the only satisfactory alternative to keratoplasty (corneal transplantation) for those with keratoconus.[8]

Cataract surgery patients also can benefit from wearing contact lenses. Compared to aphakic vision with thick cataract spectacles, aphakic vision with contact lenses is much less distorted, the visual field is greatly enlarged, and near vision is improved. Most importantly, the contact lens magnifies image size only 7%, while cataract spectacles increase image size 30%. Although image size magnification of this magnitude causes problems to all aphakic patients ("aphakes"), it is particularly troublesome for those patients who have had cataract surgery on only one eye. With cataract spectacles, a monocular aphake perceives two images that differ in size by 30%. But with contact lenses, the image size difference is only 7%, a difference to which many monocular aphakes can accommodate comfortably.[9]

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[8] Girard, Indications and Contraindications for the Use of Corneal Contact Lenses, in Corneal Contact Lenses 108-09 (L. Girard 2d ed. 1970).

[9] Id. at 109-14.

Most contact lenses are worn primarily for cosmetic reasons. Cosmetic wearers range from those who suffer from albinsim (absence of eye pigment) and aniridia (complete or partial absence of the iris) to those who simply dislike their appearance in eyeglasses. The importance of appearance to contact lens wearers should not be categorized as mere vanity. The use of an opaque contact lens rather than an eye patch to occlude the eye of a six-year old amblyopic child may be termed "cosmetic," but may avert serious psychological damage. Even in less dramatic cases -- adolescent myopes who wear contact lenses simply because they do not want to wear glasses -- the use of contact lenses has been associated with better grades in school and increased participation in extracurricular activities.[10] And teenagers who wear contact lenses wear their corrective lenses more frequently than do those who wear eyeglasses.[11]

C. How Contact Lenses are Fitted

Anyone who wishes to wear contact lenses must first have an eye examination. That examination includes an evaluation of the health of the consumer's eyes and a refraction, which is a determination of the amount of correction necessary to achieve the

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[10] Glatt & Schwarz, Contact Lenses for Children and Adolescents -- A Survey, 32 J. Am. Optometric A. 43 (1960).

[11] A 1976 study of 1300 adolescent females found that those who had contact lenses wore them for an average of 14.3 hours per day, while eyeglass wearers averaged only 8.6 hours of wear a day. Only 62.4% of those with eyeglasses wore them every day, while 94% of those who had contact lenses were daily wearers. Contact Survey Eyes Teenage Girls, Am. Optometric A. News, Dec. 15, 1976, at 1, col. 1.

best possible visual acuity.

If the eye examination reveals nothing that would prevent the consumer from wearing contact lenses, the next step is a keratometric examination. The keratometer is an instrument which is used to take "k-readings," or measurements of the radius (or radii) of curvature of the cornea.[12] The keratometer never comes in contact with the cornea; k-readings are obtained by reflecting light off the front surface of the cornea.[13]

With the results of the eye examination and k-readings in hand, the contact lens fitter can determine what physical specifications the lenses should have. Soft lenses are either selected from the fitter's inventory or ordered from the manufacturer; hard lenses, which are made to order, are ordered from an optical laboratory.

When the contact lenses arrive, the consumer must be taught how to insert and remove the lenses and how to clean and care for them. The fitter evaluates the fit of the lenses, usually through the use of a biomicroscope (also known as a "slit lamp"), both when the lenses are first inserted and on subsequent follow-up visits to the fitter's office.

As long as a consumer continues to wear contact lenses, he

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[12] Bausch & Lomb has patented its particular instrument as the "Keratometer." Similar devices made by other manufacturers are known generically as ophthalmometers. Since the measurement of corneal curvatures is more accurately described as keratometry than as ophthalmometry, contact lens fitters usually refer to all such instruments as keratometers.

[13] For a detailed explanation of keratometry, see Sampson & Soper, Keratometry, in Corneal Contact Lenses 64-92 (L. Girard 2d ed. 1970).

or she will occasionally need to replace lost or damaged lenses. Most consumers who need replacement lenses obtain them from the original fitter. Those who wish to purchase replacement lenses from another source either must obtain the lens specifications from the original fitter or must be completely refitted.

D. State Restrictions on Contact Lens Fitting by Opticians[14]

Licensed ophthalmologists and optometrists are permitted in all 50 states and the District of Columbia to perform all the procedures necessary to prescribe and fit contact lenses. Opticians may never prescribe contact lenses,[15] and are prohibited from independently performing some or all of the acts necessary to fit contact lenses in many states.

Opticians are licensed in 21 states.[16] In order to be licensed, an optician must complete a formal educational program

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[14] The Food and Drug Administration regulates the manufacture of contact lenses, but that regulation has little or no impact on who may fit or dispense lenses at retail. The Federal Trade Commission's "Eyeglasses Rule," 16 C.F.R. §456 (1982), requires ophthalmologists and optometrists to offer a written eyeglass prescription to each consumer whose eyes they examine. That rule does not require the release of k-readings or contact lens specifications. Whether or not a consumer with only an eyeglass prescription may be fitted for contact lenses by an optician is determined by state law.

[15] In no state are opticians permitted to test or measure the refractive status of the eye. Whether they are fitting and dispensing eyeglasses or contact lenses, opticians must work pursuant to the prescription prepared by an ophthalmologist or optometrist.

[16] Alaska, Arizona, California, Connecticut, Florida, Georgia, Hawaii, Iowa, Kentucky, Massachusetts, Nevada, New Jersey, New York, North Carolina, Ohio, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, and Washington.

or an apprenticeship (or both), and must pass written and clinical examinations.[17] However, states that license opticians do not necessarily also permit opticians to fit contact lenses. Some states explicitly authorize opticians to perform the post-refraction procedures necessary to fit contact lenses. Opticians in those states may take k-readings, order the appropriate lenses, and evaluate the fit of the lenses.[18] In other states, opticians are expressly forbidden to fit contact lenses.[19]

Several states permit opticians to fit contact lenses only when directed to do so and supervised by an ophthalmologist or optometrist.[20] Some of those states further require opticians to tell those whom they fitted with contact lenses to return to the prescribing ophthalmologist or optometrist for evaluation.[21]

A few states allow opticians to sell contact lenses, but require that all lens specifications must be determined by an ophthalmologist or optometrist.[22]

In some states, it is unclear whether or not opticians may legally fit contact lenses. In most such states, opticians are not licensed, so there is no express statutory definition of

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17 In a few states, opticians who wish to fit contact lenses must pass an additional examination.

18 E.g., Ariz. Rev. Stat. Ann. §32-1671(3)(West Supp. 1977-1982).

19 E.g., N.J. Rev. Stat. §52:17B-41.1 (1970).

20 E.g., Tenn. Code Ann. §62-14-102(2)(1982).

21 E.g., S.C. Code Ann. §40-37-151 (Law. Co-op. Supp. 1981).

22 E.g., Ala. Code §34-22-4 (1975).

their scope of practice. The state courts (and state attorneys general) that have had to decide what role, if any, opticians could play in contact lens fitting have come to inconsistent conclusions.[23]

E. Justifications for Restrictions on Contact Lens Fitting by Opticians

Contact lenses almost always produce changes in the physiology of the wearer's eyes. Some physiological changes are considered acceptable, while others are not. Most unacceptable changes, such as corneal abrasions (erosion of the cell layers on the surface of the cornea) and corneal edema (swelling caused by the accumulation of fluid in corneal tissues), are reversible. Other changes, such as fungal infections and corneal neovascularization (extension of blood vessels into the normally avascular cornea), may lead to permanent damage.[24]

Some ophthalmologists and optometrists believe that opticians do not have sufficient knowledge and skill to fit contact lenses safely and effectively.[25] They point out that opticians

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[23] Compare, e.g., State ex rel. Londerholm v. Doolin & Shaw, 209 Kan. 244, 497 P. 2d 138 (1972) (interpreting an ambiguous state optometry practice act to permit opticians to fit contact lenses) with, e.g., State ex rel. Danforth v. Dale Curteman, Inc., 480 S.W. 2d 848 (Mo. 1972) (interpreting a very similar state optometry practice act to forbid the fitting of contact lenses by opticians). See generally, Annot., 77 A.L.R. 3d 817 (1977).

[24] S. Sherman, A Consumer's Guide to Contact Lenses 11, 39-40, 130 (1982); Dixon, Physiopathology of the Cornea as Related to Contact Lenses, in Corneal and Scleral Contact Lenses 30-39 (L. Girard ed. 1967).
(footnote continued)

have much less formal education than ophthalmologists and optometrists have. They fear that the removal of restrictions on the fitting of contact lenses by opticians would lead to an increase in the undesirable physiological changes mentioned above.

The medical literature does contain accounts of harm resulting from overwear of contact lenses or wearing dirty or damaged lenses.[26] Researchers also have reported cases of adverse reactions to the chemical solutions used in cleaning and caring for contact lenses.[27] The staff could find no accounts of harm due to improperly fitted lenses, probably because such lenses are generally so uncomfortable that most wearers remove them before any real damage is done. However, the possibility of harm from improperly fitted contact lenses -- perhaps in cases involving people who should not be fitted with contact lenses at all -- is real.[28]

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[25] Some ophthalmologists also believe that optometrists are unqualified to fit contact lenses, and vice versa. Compare Honan, Indiana M.D. Describes "Short Route to Medicine," The Pen, June 1, 1978, at 3 with Globus, Meaningful Communications Marketing from Optometry -- Part 3, Optometric Monthly, Apr. 1978, at 63.

[26] See, e.g., Weinstock, Contact Lenses, 246 J.A.M.A. 161 (1981).

[27] See, e.g., Newsom & Harper, Disulfiram -- Alcohol Reaction Caused by Contact Lens Wetting Solution, 6 Contact and Intraocular Lens Med. J. 407 (1981).

[28] Telephone interview with Oliver J. Dabezies, M.D., New Orleans, La. (Dec. 16, 1981); telephone interview with Louis A. Wilson, M.D. Atlanta, Ga. (Dec. 17, 1981).

F. State Restrictions on the Business Practices of Optometrists[29]

State statutes and licensing board regulations often restrict the business conduct of optometrists (and, less frequently, other contact lens fitters) by limiting the use of trade names,[30] prohibiting employer-employee or other relationships between laymen (or lay corporations) and professionals (or professional corporations),[31] restricting the number of branch offices a professional may operate,[32] or forbidding professionals to practice in mercantile locations (such as drug or department stores).[33]

G. Justifications for Restrictions on the Business Practices of Optometrists

Proponents of controls on commercial practice by optometrists believe that restrictions are necessary to protect the public from low-quality vision care. High-volume commercial practitioners, they claim, care more about profits and less about their professional responsibilities than do

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29 A detailed description of restrictions on commercial practices by vision care providers appears in "Eyeglasses II Staff Report," supra note 3, at 9-28. See also Bureau of Economics, Federal Trade Commssion, Effects of Restrictions on Advertising and Commercial Practice in the Professions: The Case of Optometry 34-36 (1980)(hereinafter cited as "BE Study").

30 E.g., N.M. Stat. Ann. §61-2-13(D)(1981).

31 E.g., Fla. Stat. Ann. §463.014(c)(West 1981).

32 E.g., Ky. Rev. Stat. Ann. §320.310(3)(Bobbs-Merrill 1977).

33 E.g., Del. Code Ann. tit. 24 §2113(a)(7)(d)(1981).

non-commercial practitioners, so they will "cut corners" on quality. In addition, the presence of low-cost commercial practitioners will force quality-oriented practitioners to lower their standards in order to remain competitive.[34]

Recent studies of business practice restrictions on optometrists indicate that such restrictions raise the price but do not improve the quality of eyeglasses and eye examinations.[35] However, none of these studies compared the price and quality of contact lens fitting by commercial and non-commercial practitioners.

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[34] A detailed discussion of the justifications for restrictions on commercial practices by vision care providers appears in "Eyeglasses II Staff Report," supra note 3, at 29-43. See also "BE Study," supra note 29, at 31-33.

[35] "BE Study," supra note 29; J. Begun & R. Feldman, A Social and Economic Analysis of Professional Regulation in Optometry (NCHSR Research Report No. 80-61, 1981); Benham & Benham, Regulating through the Professions: A Perspective on Information Control, 18 J. & Econ. 421 (1975).

III. The Contact Lens Wearer Study

A. How the Study's Methodology Was Developed

In July 1978, the staff wrote to the American Academy of Ophthalmology, the American Optometric Association, and the Opticians Association of America to ask them to assist us in performing a study comparing contact lens wearers fitted by ophthalmologists, optometrists, and opticians. After preliminary conversations, the staff sent a memorandum suggesting a tentative methodology for evaluating the relative quality of contact lens fitting to the representatives of those three national professional associations in September 1978.[36] That memorandum served as the basis for discussions with the associations' representatives, which were held in Washington in October 1978.[37] These meetings marked the beginning of approximately six months of ongoing discussions -- by letter, by telephone, and in person -- about how the relative quality of contact lens fitting could be judged. The tentative methodology was modified extensively in response to criticism offered by the associations' representatives. A final methodology was then circulated to the representatives, who offered no further objections to it.

The examination procedures that the associations' repre-

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[36] That tentative methodology was based on the Food and Drug Administration's procedure for evaluating new kinds of contact lenses.

[37] At that time, the representatives also signed contracts to assist the FTC staff in designing, performing, and evaluating the study.

sentatives decided were most appropriate for the study closely resemble those used by contact lens fitters to perform "follow-up" evaluations of their patients.[38] The representatives agreed that the standards that are applied to those who wear contact lenses for cosmetic reasons should be different from the standards that are applied to those who wear contact lenses to correct unusual visual problems (such as aphakia or keratoconus), and that the results for hard and soft lens wearers should be analyzed separately. They also agreed that an ophthalmologist, an optometrist, and an optician should examine each study subject.

While the discussions about quality criteria which are described above were taking place, the associations' representative identified qualified members of each of their respective professions who were willing to serve as field examiners. They also helped the staff locate well-equipped clinical facilities in which field examinations could be held. A training session for field examiners was held in Washington in May 1979.

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[38] Some exceptions to this general rule of thumb were necessitated by practical considerations. As part of the follow-up examination, many contact lens fitters observe to what extent a contact lens moves when the wearer blinks or moves his or her eye. But when it was suggested that lens motion be used as one of the quality of fit criteria in the study, the associations' representatives were unable to devise a workable method of quantifying and recording lens motion. The representatives agreed that even an extreme degree of lens mobility was not in itself a cause for alarm. Since other examination procedures would detect any problems associated with abnormal lens motion, the lens motion test had no indepedent significance and could safely be omitted from the examination of the study subjects.

B. How the Study's Subjects Were Identified

Soon after the discussions concerning the quality evaluation methodology began, the staff asked the expert statisticians and market researchers in the Bureau of Consumer Protection's Impact Evaluation Unit to help identify a representative sample of contact lens wearers who would be the subjects of the study. The Impact Evaluation Unit recommended that the staff employ two national consumer panel firms[39] to help accomplish that task.

The consumer panel firms mailed a "screener" questionnaire to 31,219 households in 18 urban areas to identify the desired number of study subjects.[40] The screener questionnaire asked if any member of the household had been fitted with contact lenses within the past three years and, if so, if he or she were still wearing the lenses.[41] If the answer to both questions was "yes," that household member (or members) was offered a modest sum if he or she agreed to be an examination subject.[42] The panel firms

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[39] Such firms are commercial research organizations that provide market research information to their clients by surveying thousands of individuals who have agreed in advance to respond to mail questionnaires or telephone interviews from the firm. Each firm's panel is demographically balanced to ensure that it is representative of the population as a whole.

[40] The urban areas chosen were Atlanta, Boston, Chicago, Cincinnati, Cleveland, Detroit, Houston, Kansas City, Los Angeles, Minneapolis/St. Paul, Nashville, Phoenix, Pittsburgh, Rochester (New York), St. Louis, San Diego, San Francisco, and Winston-Salem/Greensboro. They were selected after consideration of factors such as the number of panel members residing in the urban area, applicable state laws concerning contact lens fitting by opticians, and geographic balance.

[41] A blank copy of this questionnaire appears at Appendix A, p. A-1.

[42] Some 330 of those who responded to the
(footnote continued)

called those who agreed to be examined, scheduled examination appointments, and mailed maps showing the location of the field examination facility (usually the contact lens clinic of a medical or optometric school).

C. How the Field Examinations Were Conducted[43]

When a study subject arrived at the field examination facility, he or she was first interviewed by an FTC staff member. This interview included questions about who fitted the subject's lenses, how long ago the lenses were fitted, how much the lenses (and related goods and services) cost,[44] whether the lenses caused any discomfort, and so on. The interview was taped and the subject's answers were recorded on a "Patient Interview Form."[45] The FTC staff member then instructed the subject not to tell the examiners anything about his or her contact lens history, especially the name of the practitioner who fitted the lenses.

The first examination procedure was a test for visual

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questionnaire had been fitted with contact lenses within the past three years, but had stopped wearing them. Each of those former wearers was asked why he or she stopped wearing contact lenses, the name of his or her fitter, and several other questions. Appendix B discusses in more detail the data we gathered about these former wearers.

[43] This section describes the examination sequence followed in the majority of cases. The order of the examination procedures was occasionally changed to minimize waiting time for both the subjects and the examiners.

[44] Appendix C contains our analysis of this price data.

[45] A blank "Patient Interview Form" is reproduced at Appendix A, pp. A-2 - A-10.

acuity, using a Snellen chart, while the subject was wearing his or her lenses. This test was performed by a contact lens technician or assistant employed by the examination facility or one of the examiners. The results were recorded on the "Assistants' Form."[46]

Next, a spherical manifest refraction was performed over the contact lenses by the optometrist-examiner or ophthalmologist-examiner (or both) to test whether the subject's visual acuity could be improved if the lens power was increased or decreased.[47] The best attainable visual acuity and the amount of change in lens power, if any, needed to achieve that acuity[48] were recorded on Part I of the "Examiners' Form."[49]

After these vision tests were completed, the subject removed his or her lenses and the assistant checked the physical condition of the lens. Each lens was graded for cleanliness, warpage, and damage (such as chips, tears, or scratches) on a 0-1-2-3

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[46] A blank copy of this form appears at Appendix A, p. A-11. (Visual acuity is recorded for each eye as "20/20," "20/30," or whatever.)

[47] Since opticians are never permitted by state law to perform refractions, the optician-examiners did not perform this test during the field examinations.

[48] Our analysis of this data revealed no statistically significant differences in the overall corrective efficacy of contact lenses fitted by ophthalmologists, optometrists, and opticians. About 88% of all the study subjects needed no change at all or a change of less than 0.50 diopter in sphere to bring their visual acuity to the best obtainable level. More than 98% of the subjects were within 1.00 diopter of the spherical correction needed to achieve the best possible visual acuity.

[49] A blank copy of this form is reproduced at Appendix A, p. A-12.

scale. Results were recorded on the "Assistants' Form."

After removing his or her lenses, each subject underwent biomicroscopic and keratometric examinations by each of the three examiners. These examinations were performed independently, with no consultation among the examiners.

The biomicroscope was used to examine the surface of the eye for a variety of potentially pathological conditions, including: epithelial and microcystic edema (intercellular accumulation of fluids which causes the cornea to swell); corneal staining (abrasions or lesions of the cornea); corneal neovascularization (impingement of blood vessels into the normally avascular cornea, which may cause part or all of the cornea to become opaque); corneal striae (ridges or furrows on the cornea); and injection ("bloodshot" eyes or eyelids). Each of the six conditions was graded on a 0-1-2-3-4 scale according to an illustrated grading manual given to each examiner.

The grading manual, which was designed by the groups' representatives, was used to minimize inconsistency and subjective differences among the several dozen field examiners. For each of the conditions, the examiner was instructed to determine which of five illustrations of that condition in the grading manual most closely resembled the actual appearance of the subject's eye, and then to record the number of that illustration on Part II of the "Examiners' Form." A grade of 0 meant that the condition was absent; a grade of 4 signified that the condition was present in an extreme degree.

The keratometer was used to take k-readings (measurements of

the steepest and flattest curvatures of the corneal surface) and to evaluate corneal distortion (irregularity in the curvatures of the cornea). Corneal distortion (or warpage) was graded on a 0-1-2-3 scale according to the grading manual. Results were recorded on Part III of the "Examiners' Form."

When each of the examination procedures was completed, the examiner initialed a card carried by the subject. Because some of the conditions which were evaluated by the examiners were time-related -- that is, a condition that was present to a certain degree when the first biomicroscopic examination was performed a short time after the subject removed his or her lenses might be present to a somewhat lesser degree by the time the third examination was performed -- the FTC staff member recorded the order in which the various examination procedures were done.

The first field examinations took place in Winston-Salem, North Carolina, on June 2, 1979. The last field examinations were performed in Rochester, New York, on February 25, 1980. A total of 502 contact lens wearers were examined.[50] Table III-1 relates the final sample to the total population who received the original screener questionnaire.

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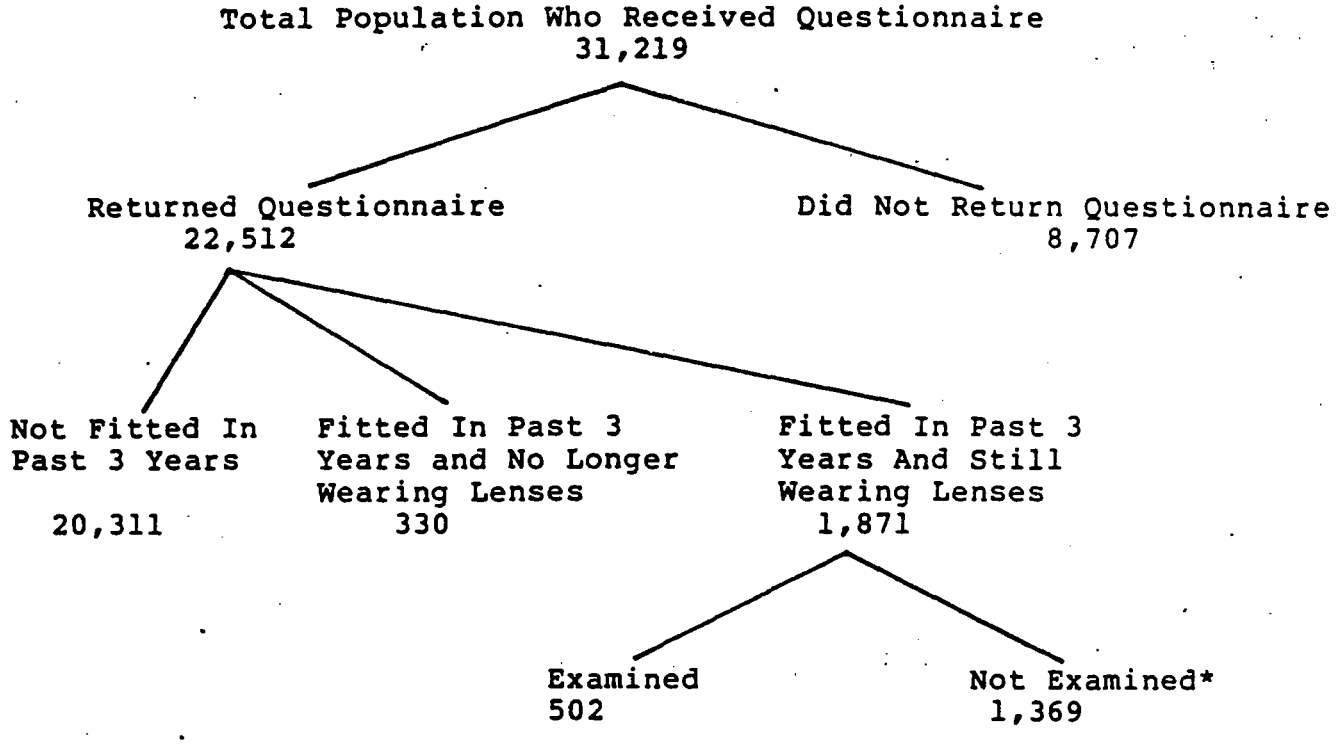
[50] Further screening and missing observations reduced the final sample to as low as 402 wearers for parts of the quality of fit analysis and 388 wearers for the price analysis. Of the 388 wearers used for the price analysis, 20.9% purchased their lenses in 1979, 36.9% in 1978, 24.7% in 1977, 14.4% in 1976, and 3.1% in 1975.

Table III-1

Relationship of the Examined Sample to the Population Receiving the Initial Screener Questionnaire



* - the "Not Examined" group includes both those who did not agree to be examined and those who did agree to be examined but who never showed up at the examination site.

D. Post-Examination Data Collection

Soon after the field examinations were finished, the staff mailed an "Original Fitter Questionnaire"[51] to the practitioner whom each subject had named as the source of his or her contact lenses. The main purpose of the questionnaire was to obtain information which would enable us to determine whether the subject had been fitted by an ophthalmologist, optometrist, or optician. The questionnaire also sought certain data from each fitter's records (such as the subject's contact lens specifications and his or her original and most recent k-readings) which were to be compared to data from the field examinations.[52]

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[51] A blank copy of this questionnaire appears at Appendix A, pp. A-13 - A-16.

[52] Change in k-readings over time was one of the measures of eye health which the associations' representatives agreed should be included in this study. Any significant change from the original k-readings is a strong indication that the lenses do not fit properly and should be replaced or modified. We intended to use that data to compare groups of subjects classified by fitter type, but much of it was of questionable reliability. The three field examiners rarely agreed on the correct k-readings for a subject. Only about 70% of the questionnaires that were mailed to the subjects' original fitters were filled out and returned. Many of the readings on those questionnaires were incompletely recorded, or recorded in nonstandard fashion. The associations' representatives could suggest no satisfactory formula for converting the incomplete or nonstandard data into a form that could be used to compare groups of subjects classified by fitter type.

Although the results of the k-readings comparisons would have been of interest, the absence of those results is not of great importance. The relative presence (or absence) of the seven potentially pathological conditions provides a comprehensive measure of the relative health of a contact lens wearer's eye.

IV. Study Findings

The contact lens wearer study was designed to produce information that would enable us to compare the contact lens fitting performance of ophthalmologists, optometrists (both commercial and non-commercial), and opticians. This chapter presents the results of statistical tests for differences in quality among these groups.

The bulk of this chapter is devoted to a discussion of the results of the tests for differences in relative fitter competence. The fitter groups were compared to one another, not to some arbitrary standard; in other words, our analysis does not purport to determine that any particular fitter group does a "good" or "bad" job of contact lens fitting in any absolute sense.[53]

A. The Relative Health of the Subjects' Eyes

1. How the Relative Health of Each Subject's Eyes Was Determined

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[53] Many of the field examiners did remark that the study subjects' eyes were, on the whole, quite healthy. A mere handful of the subjects exhibited serious ocular abnormalities, most of which did not seem to be related to contact lens wear.

a. The Summary Quality Scores

The biomicroscope and keratometer were used to assess the health of the subjects' eyes. As stated above, each of the three examiners who examined every subject with those two instruments individually recorded the relative presence (or absence) of each of seven potentially pathological conditions by circling a number on his "Examiners' Form."

These three scores were then transformed into a single final score that was used to denote the relative presence of each condition in each eye. In the majority of cases, all three examiners recorded the same score, and this consensus score became the final score. But where there was some disagreement among the examiners, the three scores had to be averaged to produce the final score.[54] If two of the three examiners agreed, the final score was the one that was recorded by the two who

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[54] Subjective differences in perception, particularly in borderline situations, probably explain most of the disagreements.

Several of the seven conditions are time-related -- that is, a condition which was present to a certain degree when the first examiner saw a subject may have lessened in severity (or disappeared altogether) by the time the third examination was performed. However, an analysis of the data failed to reveal any correlation between the examination sequence and scoring variations.

agreed.[55] If all three scores were different and equally spaced, the average of the three was used. If all three were different but not equally spaced, the extreme score was dropped and the final score was the average of the other two.[56]

Fourteen individual final scores (seven for each eye) were calculated for each subject.[57] These fourteen final scores were then added together to create an "unweighted summary quality score" for each subject. A "weighted summary quality score" was also calculated for each subject because all of the seven conditions do not necessarily represent equally serious threats to contact lens wearer's health. The relative weight assigned to each of the seven conditions was determined by asking a panel of representatives appointed by the three national professional associations for their assessment of the relative potential harm

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[55] For four of the seven conditions, at least two examiners agreed on the proper score for over 98% of the eyes. The two-examiners agreement rates for the other three conditions were 94%, 88%, and 79%.

[56] Dropping the extreme score in this rare situation (as well as when two examiners agreed) minimizes the effect of examiner error.

[57] The individual scores recorded by the examiners were negatively related to eye health -- that is, a low score meant that a particular pathological condition was absent, while a high score meant that the condition was present to a relatively serious degree. Before the regression analysis described below was performed, the sign of each score was reversed in order to make the scores positively related to eye health.

posed by the presence of these conditions.[58] The weighted summary score was calculated by multiplying the fourteen individual final scores by the appropriate factor and then adding them together.

The results of an analysis using the unweighted summary scores did not differ appreciably from those which used the weighted summary scores. All the results that are reported in this chapter are based on an analysis of the weighted scores.[59]

b. The Dichotomous Higher/Lower Quality Score

The summary quality scores are indicators of the overall health of a subject's eyes. Those scores take into account all seven of the potentially pathological conditions simultaneously. The "dichotomous higher/lower quality score" was used to analyze the data pertaining to each of those seven conditions individually.

Obviously, it is always better if a contact lens wearer exhibits no degree of a potentially pathological condition than if he or she exhibits some degree of that condition. Consequently, a "higher quality" score was assigned if the examination

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[58] The weights assigned to the seven conditions were: conjunctival hyperemia/injection, 1.0; central corneal clouding, 2.0; microcystic edema, 2.0; corneal staining, 2.5; corneal striae, 3.5; corneal distortion, 5.0; corneal neovascularization, 5.0.

[59] The summary score regression results appear in Tables D-2, D-3, and D-4 at Appendix D, pp. D-9 - D-11.

revealed that a particular condition was absent. A "low quality" score was assigned if the examination revealed that a particular condition was present.

2. The Results of the Ophthalmologist/Optometrist/Optician Comparison[60]

Table IV-1 lists how many study subjects were fitted with contact lenses by each of the three principal fitter groups. As that table shows, about three times as many study subjects were fitted by optometrists as were fitted by either ophthalmologists or opticians.

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[60] Later in this analysis, we divide the optometrists into three subgroups: commercial optometrists, non-commercial optometrists, and unclassified optometrists. The relative mix of commercial and non-commercial optometrists in our optometrist group may not correspond to that in the nationwide optometrist population because the subjects and, consequently, the fitters were selected in a non-random fashion. If that relative mix of commercial and non-commercial optometrists is in fact different, the estimated price and quality averages presented in this section of the analysis for the aggregate optometrist group may also be different than they otherwise would be. It should be understood that this qualification in no way affects tests for quality differences between opticians and ophthalmologists.

TABLE IV-1

Distribution of Subjects Among Fitter Groups

Fitter	Total	Hard Lenses	Soft Lenses
Ophthalmologists	95 (21.6%)	49 (21.1%)	46 (22.1%)
Optometrists	265 (60.2%)	140 (60.3%)	125 (60.1%)
Opticians	80 (18.2%)	43 (18.6%)	37 (17.8%)
	440 (100%)	232 (100%)	208 (100%)

As stated above, our statistical analysis focused on differences in performance among different types of fitters. If the mean summary quality scores and the dichotomous higher/lower quality scores for the subjects fitted by ophthalmologists, optometrists, and opticians were equal, it would be an indication that members of all three groups were equally competent contact lens fitters. But if the subjects fitted by one of the three groups exhibited a greater degree of some or all of the seven potentially pathological conditions -- that is, they had lower mean summary scores or relatively more "lower quality scores" -- it would indicate that that group did not fit contact lenses as well as did the other groups.

A number of factors other than fitter competence could have affected the relative health of the study subjects' eyes and, consequently, the quality scores. Examples of such factors are lens cleanliness and lens wearing time on the day of the examination. The multivariate regression technique which was utilized in our analysis accounts for the possible effects of those factors.[61]

a. Summary Quality Score Results

Table IV-2 presents the regression estimates of differences

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[61] A complete list of the factors which were accounted for in the regression analysis appears at Appendix D, p. D-5.

in the mean summary quality scores of subjects fitted by opticians versus those fitted by other fitter groups.[62] An analysis of those estimates reveals no statistically significant differences among the subjects fitted by opticians, optometrists, and ophthalmologists.

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[62] The estimates in Tables IV-2 and IV-5 are derived from a multivariate least squares regression equation in which lens and wearer characteristics that are hypothesized to influence the summary scores are accounted for explicitly. Estimates of the full equation appear at Appendix D, pp. D-9 - D-11.

Table IV-2

Regression Estimates of Differences in Mean Summary Quality Scores: Opticians Versus Other Fitter Groups

Hard Lenses:	
Opticians v. Ophthalmologists	-0.62
Opticians v. Optometrists	-0.48
Soft Lenses:	
Opticians v. Ophthalmologists	+0.96
Opticians v. Optometrists	+0.10

Note: The sign of the numbers in this table indicates whether the mean summary scores of subjects fitted by opticians were better or worse than those fitted by the other fitter groups. A negative sign indicates that the reference group (i.e., opticians) has a worse score on the average than the comparison group (i.e., ophthalmologists or optometrists). However, none of the differences in this table are significant at even the marginal 10% level of significance. (The above estimates are derived from a multivariate least squares regression equation. Estimates of the full equation appear at Appendix D, pp. D-9).

b. Higher/Lower Quality Score Results

In 21 of 24 possible comparisons, the percentage of optician-fitted subjects exhibiting any measurable degree of a particular condition -- that is, the opticians' "lower quality" percentage -- did not differ to a statistically significant extent from that of the group to which it was compared. Table IV-3 lists the conditions for which there were at least marginally significant differences and indicates which fitter group had better (or worse) scores.[63]

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[63] The results in Tables IV-3 and IV-6 are based on estimation of a logistic regression in which the dependent variable is based on a dichotomous quality variable which takes on either a value of one (if the subject exhibited no sign of the particular condition) or a value of zero (if the subject exhibited any degree of the condition). Independent variables included in the equation are the same lens and wearer variables utilized in the summary quality score regressions. The complete logistic regression estimates appear at Appendix D, pp. D-15 - D-18. Logistic estimates could not be calculated for corneal striae because so few of the study subjects exhibited any degree of that condition.

Table IV-3

Differences in Individual
Higher/Lower Quality Scores: Opticians
Versus Other Fitter Groups

Hard Lenses

Condition	Superior Group	Inferior Group	Significance
Corneal distortion	Ophthalmologists	Opticians	*

Soft Lenses

Condition	Superior Group	Inferior Group	Significance
Central corneal clouding	Opticians	Ophthalmologists	*
Corneal staining	Optometrists	Opticians	**

* - Differences is significant (5% level of significance)
** - Differences is marginally significant (10% level of significance)

Note: This table summarizes Tables D-5 and D-6 which appear at Appendix D, pp. D-15 and D-16.

3. The Results of the Commercial Optometrist/Non-Commercial Optometrist Comparison

In 1980, the FTC's Bureau of Economics published the results of its study of commercial practice by optometrists.[64] That study compared the price and quality of eye examinations and eyeglasses provided by commercial and non-commercial optometrists. In this study, we carried that analysis one step further by comparing the price and quality of contact lens fitting by these two kinds of practitioners.

Each optometrist who had fit one or more of the study subjects was classified as a "commercial," "non-commercial," or "unclassified" optometrist.[65] Table IV-4 lists how many study

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[64] "BE Study," supra note 29. "Commercial" (or "entrepreneurial") optometric practices are those that employ several optometrists, use a trade name, advertise heavily or are located in a department or drug store. "Non-commercial" (or "traditional") practices are usually solo practitioners who practice in non-mercantile settings and who do not advertise or use trade names.

[65] This classification was based on information obtained from the subjects and the fitters and from an examination of a nationwide optometric directory ("The Blue Book of Optometrists") and the relevant "Yellow Pages" volumes. For example, optometrists who worked for large chain firms or who purchased display ads in local "Yellow Pages" volumes were classified as commercial optometrists. Optometrists who were members of the American Optometric Association and who did not purchase "Yellow Pages" ads were classified as non-commercial optometrists.

The unclassified group includes optometrists about whom there was insufficient information to permit classification as commercial or non-commercial. For example, in some cases, the wearer gave a name of an optometrist that we could not find in our (footnote continued)

subjects were fitted with contact lenses by each of those kinds of optometrists. As that table shows, about half of the subjects who were fitted by optometrists were fitted by non-commercial optometrists.

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source materials. In other cases there were optometrists who were not listed as members of the AOA; however, there was also no indication that they were commercial providers (e.g., no advertising or no apparent commercial location). The unclassified group also includes optometrists who practice in health maintenance organizations ("HMOs"), the military, or other settings which are neither commercial nor non-commercial.

TABLE IV-4

Distribution of Subjects Among Optometrist Groups

Optometrists	Total	Hard Lenses	Soft Lenses
Commercial	86 (32.4%)	52 (37.1%)	34 (27.2%)
Non-Commercial	139 (52.5%)	63 (45.0%)	76 (60.8%)
Unclassified*	40 (15.1%)	25 (17.9%)	15 (12.0%)
	265 (100%)	140 (18.6%)	125 (100%)

*- "Unclassified" optometrists are those whom the staff could not classify with certainty as commercial or non-commercial practitioners. See supra note 13.

a. Summary Quality Score Results

Table IV-5 presents the regression estimates of differences in the mean summary scores of subjects fitted by commercial optometrists versus those fitted by other fitter groups.[66] An analysis of those estimates reveals that subjects fitted by commercial optometrists had better scores than those fitted by ophthalmologists, opticians, or non-commercial optometrists, but that those differences are either not statistically significant or only marginally significant. Commercial optometrists did score significantly better than optometrists who could not be classified as either commercial or non-commercial practitioners.

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66 See supra note 62.

TABLE IV-5

Regressions Estimates of Differences in Mean Summary Quality Scores: Commercial Optometrists Versus Other Fitter Groups

Hard Lenses:

Commercial Optometrists v. Ophthalmologists	+2.17
Commercial Optometrists v. Opticians	+3.70**
Commercial Optometrists v. Non-Commercial Optometrists	+2.95**
Commercial Optometrists v. Unclassified Optometrists	+4.93*

Soft Lenses:

Commercial Optometrists v. Ophthalmologists	+2.81
Commercial Optometrists v. Opticians	+2.84
Commercial Optometrists v. Non-Commercial Optometrists	+1.17
Commercial Optometrists v. Unclassified Optometrists	+7.37*

* - Difference is significant (5% level of significance)
** - Difference is marginally significant (10% level of significance)

Note: As in Table IV-2, the sign of the numbers in this table indicate whether the mean summary scores of subjects fitted by commercial optometrists were better or worse than those fitted by other fitter groups. The positive signs indicate that the reference group (i.e., commercial optometrists) had better scores on the average than the comparison groups (i.e., ophthalmologists, opticians, non-commercial optometrists, and unclassified optometrists). As indicated above, some of the differences were statistically significant. (The above estimates are derived from a multivariate least squares regression equation. Estimates of the full equation appear at Appendix D, pp. D-10 - D-11.)

b. Higher/Lower Quality Score Results

In 41 of 48 possible comparisons, the percentage of commercial optometrist-fitted subjects exhibiting any measurable degree of a particular condition -- that is, the commercial optometrists' "lower quality" percentage -- did not differ to a statistically significant extent from that of the group to which it was compared. Table IV-6 lists the conditions for which there were at least marginally significant differences and indicates which fitter groups had better (or worse) scores.[67] In every case in which there was a significant difference, the commercial optometrists' score was better.

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67 See supra note 63.

Table IV-6

Differences in Individual
Higher/Lower Quality Scores:
Commercial Optometrists Versus Other Fitter Groups

Hard Lenses

Condition	Superior Group	Inferior Group	Significance
Central corneal clouding	Commercial Optometrists	Non-commercial Optometrists	**
Central corneal clouding	Commercial Optometrists	Opticians	**
Microcystic edema	Commercial Optometrists	Non-commercial Optometrists	**
Microcystic edema	Commercial Optometrists	Unclassified Optometrists	**
Corneal staining	Commercial Optometrists	Opticians	**

Soft Lenses

Condition	Superior Group	Inferior Group	Significance
Corneal staining	Commercial Optometrists	Ophthalmologists	**
Corneal staining	Commercial Optometrists	Opticians	*

* -- Difference is significant (5% level of significance)
** -- Difference is marginally significant (10% level of significance)

Note: This table summarizes Tables D-7 and D-8, which appear at Appendix D pp. D-17 and D-18.

V. Summary and Conclusions

Opponents of restrictions on contact lens fitting by opticians and commercial optometrists believe that such restrictions limit competition and force consumers to pay more for contact lenses. Supporters of such restrictions claim that they are needed to protect the public from low-quality contact lens fitting.

To analyze empirically the effects of these restrictions, the Federal Trade Commission's staff -- with the assistance of national professional associations representing organized ophthalmology, optometry, and opticianry -- designed and administered a study of contact lens wearers. About 500 contact lens wearers from 18 cities were interviewed by FTC staff and examined for potentially pathological eye conditions by experts nominated by the professional associations.

The findings of the study call into question claims that restrictions on contact lens fitting opticians and commercial optometrists are necessary to protect the public. Among the contact lens wearers examined in this study, the quality of contact lens fitting provided by opticians and commercial optometrists was not lower than that provided by ophthalmologists and non-commercial optometrists.

Restrictions on opticians and commercial optometrists may increase costs to consumers by limiting the choices available to them. Members of those groups often practice in convenient locations, such as shopping centers, and many are open nights or weekends. Restrictions may also result in higher prices for

contact lens fitting by limiting consumers access to relatively low-cost providers[68] or by reducing competition in the marketplace. An earlier FTC staff report concluded that restrictions on commercial optometrists affected prices for eyeglasses and eye examinations in both of those ways.[69]

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[68] Our price analysis, which is described in Appendix C, indicates that commercial optometrists charged significantly less for both hard and soft lenses than did any other fitter group. That finding, which must be qualified for the reasons that are discussed in Appendix C, is consistent with the hypothesis that restrictions on commercial optometrists result in higher prices because they limit access to low-cost contact lens fitters.

[69] "BE Study," supra note 29.

Appendix A

Data Collection Forms

1. Has anyone in your household acquired contact lenses for the first time during the past three years?

☐ YES - (CONTINUE) ☐ NO - (STOP HERE - RETURN QUESTIONNAIRE? THANK YOU.)

Approved by GAO B-180229 ($78020) Expires 6/30/79

Please complete a column down for each family member who acquired contact lenses for the first time during the past three years.

	FAMILY MEMBER #1	FAMILY MEMBER #2	FAMILY MEMBER #3
2. What is this family member's AGE and SEX?	AGE:____ ☐ Male ☐ Female	AGE:____ ☐ Male ☐ Female	AGE:____ ☐ Male ☐ Female
3. In which year did you buy your contact lenses? (✓ ONE)	☐ 1978 ☐ 1977 ☐ 1976	☐ 1978 ☐ 1977 ☐ 1976	☐ 1978 ☐ 1977 ☐ 1976
4. Did you buy hard or soft lenses?	☐ Hard ☐ Soft	☐ Hard ☐ Soft	☐ Hard ☐ Soft
5a. How much did you pay for them? (Round the amount to the nearest dollar.)	$_____	$_____	$_____
b. Did this price include the cost of an eye examination?	☐ YES - (GO TO QU. 5d) ☐ NO - (CONTINUE)	☐ YES - (GO TO QU. 5d) ☐ NO - (CONTINUE)	☐ YES - (GO TO QU. 5d) ☐ NO - (CONTINUE)
c. How much extra was the eye examination?	$_____	$_____	$_____
d. Was there a seperate charge for follow-up care, such as adjusting the lenses?	☐ YES - (CONTINUE) ☐ NO - (GO TO QU. 5f)	☐ YES - (CONTINUE) ☐ NO - (GO TO QU. 5f)	☐ YES - (CONTINUE) ☐ NO - (GO TO QU. 5f)
e. How much was the charge for follow-up care?	$_____	$_____	$_____
f. Did the price include replacement lenses if your original ones were lost or damaged?	☐ YES - (CONTINUE) ☐ NO - (GO TO QU. 6)	☐ YES - (CONTINUE) ☐ NO - (GO TO QU. 6)	☐ YES - (CONTINUE) ☐ NO - (GO TO QU. 6)
g. How much was the additional charge for each replacement lens?	$_____	$_____	$_____
6. Did you buy contact lenses because you needed them for medical reasons (such as, after cataract surgery, for keratoconus, or to help heal diseased eyes)?	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO
7. Where did you buy your contact lenses? (Write in name, street address, city and state. For example: Smith's Opticians, 10th & Main Streets, Centerville, Ohio.)	NAME STREET ADDRESS CITY & STATE		
8a. Did you previously buy contact lenses from a different place than that shown in Question 7?	☐ YES - (CONTINUE) ☐ NO - (GO TO QU. 9)	☐ YES - (CONTINUE) ☐ NO - (GO TO QU. 9)	☐ YES - (CONTINUE) ☐ NO - (GO TO QU. 9)
b. Why did you change from one place to the other for your contact lenses?			
9. Are you still wearing your contact lenses?	☐ YES - (CONTINUE) ☐ NO - (GO TO QU. 11)	☐ YES - (CONTINUE) ☐ NO - (GO TO QU. 11)	☐ YES - (CONTINUE) ☐ NO - (GO TO QU. 11)
10a. We would like to arrange to check the fit of your lenses. Would you be willing to go to a downtown location in your city to have an expert examine your eyes? It will take approximately 30 minutes and we will reimburse you $10 for your expenses.	☐ YES - (CONTINUE) ☐ NO - (GO TO TOP OF NEXT COLUMN)	☐ YES - (CONTINUE) ☐ NO - (GO TO TOP OF NEXT COLUMN)	☐ YES - (CONTINUE) ☐ NO - (STOP HERE - THANK YOU)
b. Would you prefer to do this in the morning, afternoon or evening?	☐ Morning ☐ Afternoon ☐ Evening → GO TO TOP OF NEXT COL.	☐ Morning ☐ Afternoon ☐ Evening → GO TO TOP OF NEXT COL.	☐ Morning ☐ Afternoon ☐ Evening → PLEASE STOP HERE
11a. If you are no longer wearing contact lenses, please write in the number of months or years after you bought them that you stopped using them.	Number of Months:____ Number of Years:____	Number of Months:____ Number of Years:____	Number of Months:____ Number of Years:____
b. If you returned your lenses to your fitter, how much (if any) of the purchase price was refunded to you?	$_____	$_____	$_____
12. Which of the following reasons describes why you stopped wearing your contact lenses? (✓ ALL THAT APPLY)			
a. Lenses were too uncomfortable to wear	☐	☐	☐
b. I developed severe eye pain or other medical problems	☐	☐	☐
c. I lost or broke them and didn't buy new ones	☐	☐	☐
d. I like glasses better	☐	☐	☐
e. My vision was not adequate with contact lenses	☐	☐	☐
f. They were too much trouble to clean and take care of	☐	☐	☐
g. I couldn't see well with my glasses after taking out my contact lenses	☐	☐	☐
h. I didn't have confidence in the person who fitted the lenses	☐	☐	☐
i. I just lost interest in wearing contact lenses	☐	☐	☐
j. Other (WRITE IN)	_____	_____	_____

National Family Opinion, Inc. 90098

Patient Interview Form

Patient ID Number _____

Time of Interview _____

Interviewer _____

1. What type of lenses do you wear, hard or soft?

_____ hard

_____ soft

2. What time today did you insert your lenses?

_____

3. When did you purchase them? (MONTH and YEAR)

_____

Now, I'd like to ask you a few questions about how you like your lenses.

4. Do they cause you any discomfort?

No - - - -PROBE: What about when you first put them in, or late at night after you have been wearing them for a long time?

_____ No/Very Rarely (Only under unusual circumstances)

_____ Minimal (on insertion; after very long wearing period)

Yes - - - PROBE: Are you able to wear them all day, or only for short periods of time?

_____ Moderate (throughout the day)

_____ Severe (only intermittant wear possible)

5. How about your vision? In general, would you say that you are very satisfied, satisfied, or not satisfied with your vision when you wear your lenses?

_____ Very satisfied

_____ Satisfied

_____ Not satisfied

6. Do you notice any difference at night? (E.G., GLARE PROBLEMS)

_____ Yes (Specify) _____

_____ No--PROBE ON GLARE

Now I'd like to get some information about where you bought your lenses.

7. First, who fit and sold you your lenses? Do you recall his/her address?

_____

_____

_____

INTERVIEWER: IF RESPONDENT GIVES NAME OF M.D. OR O.D., CHECK APPROPRIATE LINE BELOW (IF KNOWN - OTHERWISE CHECK LATER IN YELLOW PAGES). IF RESPONDENT GIVES TRADE NAME, E.G., "THE CONTACT LENS CLINIC", PROBE TO GET IDENTITY OF FITTER.

CHECK ONE:

_____ Ophthalmologist

_____ Optometrist

_____ Optician

8. Before you were fitted for contact lenses you had an eye examination. Was that examination done by the person who fitted your lenses, or did you first have an examination by someone else at a different location?

_____ Fitter (Skip to #10)

_____ Someone else was "prescriber"

NAME: _____ ____ O.D. ____ M.D.

ADDRESS: _____

_____

9. Did Dr. [PRESCRIBER] suggest that you go to [FITTER] to get your lenses?

_____ Yes

_____ No

10. Thinking back to when you were trying out your lenses,

(a) were you instructed how to insert and remove them?

(b) were your taught how to clean and care for them?

[GO THROUGH ENTIRE SERIES ON INSERTION/REMOVAL, THEN REPEAT FOR CLEANING/CARE]

insertion/removal	cleaning/care	
_____	_____	Yes
_____	_____	No

11. Who taught you, [FITTER] or his/her assistant?

insertion/removal	cleaning/care	
_____	_____	Fitter
_____	_____	Assistant
_____	_____	Both
_____	_____	Don't remember

12. Were you taught individually, or were you in a group?

insertion/removal	cleaning/care	
_____	_____	Individual instruction
_____	_____	Group Instruction

13. Were any materials used? For example, were you given any written insturctions (OTHER THAN WEARING SCHEDULES) or did you see a movie? [IF RESPONDENT ONLY MENTIONS WEARING SCHEDULE - PROBE TO SEE IF IT CONTAINED ANY INFORMATION ON INSERTION, CARE, ETC.]

_____ Printed materials

_____ Manufacturer's instructions (package inserts)

_____ Audio-visual instruction

_____ None

[MAKE SURE YOU'VE GONE THROUGH ABOVE SERIES TWICE]

14. Now I'd like to ask about follow-up care. By "follow-up care," I mean care you received while you were getting used to wearing your lenses. How many times did you return to [FITTER] for follow-up care after you were first given your lenses to take home.

(INTERVIEWER: INQUIRE ABOUT THE TIME INTERVALS OF VISITS TO CHECK THAT THEY'RE FOLLOW-UP CARE AND NOT ROUTINE CHECK-UPS. VISITS MORE THAN 6 MONTHS AFTER DISPENSING ARE NOT CONSIDERED FOLLOW-UP CARE.)

_____ (number of visits)

15. We've just discussed follow-up visits. After you finished that sequence, were you instructed to come back after a certain time period for a check-up? [PROBE TO GET SPECIFIC RESPONSE]

_____ Instructed by fitter to return to fitter

_____ Instructed by fitter to return to prescriber

_____ Instructed by fitter to return to both fitter and prescriber

_____ No instruction by fitter

_____ Instructed by prescriber to return for re-examination

16. How often were you told to come back? [IF TOLD TO GO TO BOTH, NOTE TIME RECOMMENDATION FOR BOTH]

Every _____ months (to fitter)

Every _____ Months (to prescriber)

17. Have you gone back for regular check-ups? [PROBE]

_____ Yes, to fitter

_____ Yes, to prescriber (if other than fitter)

_____ Yes, to both

_____ No, did not have re-examination

_____ No, not time to go yet (recently fitted)

18. Now, I'd like to ask you about how you take care of your lenses. Specifically, what do you do to clean and care for them?

SOFT LENS WEARERS		HARD LENS WEARERS	
_____	Heat sterilization/ saline solution	_____	Cleaning solution
_____	Chemical sterilization	_____	Wetting solution
_____	Neither	_____	Soaking solution
		_____	Tap water
		_____	Other (baby shampoo?)
		_____	"Dry" storage

19. Can you tell me the brand names of the products that you use?

_____

[INTERVIEWER: IF NOT EASILY ANSWERED, DO NOT PROBE]

20. Do you wear lenses every day, or nearly every day?

_____ Yes

_____ No

21. In general, about how many hours a day do you wear them?

_____ hours a day

22. Do you usually wear them continuously, or do you remove and reinsert them during the day?

_____ One continuous wearing period

_____ Two wearing periods

_____ Three or more wearing periods

23. How much did you pay for your lenses?

$_____ (Amount)

24. Does that amount include:

a. The eye examination?

_____ Yes

_____ No, extra charge was $_____

b. Follow-up care?

_____ Yes - PROBE: Were you told that you would have to pay extra if follow-up visits exceeded a set number?

_____ Yes

_____ No

_____ Don't remember

_____ No, extra charge was $_____

c. Initial care kit, solutions, equipment, etc.

_____ Yes

_____ No, extra charge was $_____

d. Insurance?

_____ Yes (Skip to #25)

_____ No

Did you buy any insurance?

_____ No

_____ Yes, at a cost of $_____

25. Have you ever tried to wear contact lenses before?

_____ No (Skip to #29)

_____ Yes - PROBE: How many times?

_____ Once

_____ More than once (RECORD INFORMATION FOR EACH ATTEMPT)

26. What happened? Why weren't you satisfied? Any other reasons?

(INTERVIEWER: DO NOT READ RESPONSES. CHECK ALL REASONS MENTIONED BY RESPONDENT.)

Experience #1		Experience #2
_____	Discomfort	_____
_____	Abrasion/Medical Problem	_____
_____	Liked eyeglasses better	_____
_____	Unsatisfied with vision	_____
_____	Spectacle blur	_____
_____	Too much trouble to care for	_____
_____	Didn't replace lost lenses	_____
_____	Didn't trust fitter	_____
_____	Other (specify) _____	

27. When did this previous fitting occur?

_____ _____

28. Do you recall the name and address of the person who fit your lenses that time?

Experience #1	Experience #2
_____	_____
_____	_____
_____	_____

29. Have you ever lost or scratched a lens (or pair of lenses) and had to buy a replacement?

_____ No (TERMINATE INTERVIEW)

_____ Yes

30. How much did it cost you (per lens)? If you've replaced a lens/lenses more than once, let's just take the most recent replacement.

$_____

31. Did you have any insurance coverage?

_____ No

_____ Yes, policy paid $_____ per lens

32. Where did you buy your replacement lens?

_____ Original fitter (Skip to #35)

_____ Other - NAME :_____

ADDRESS:_____

_____

33. Did [SUPPLIER - NAMED IN QUESTION 32]:

a. examine your eyes?

_____ Yes

_____ No

b. instruct you to have the fit evaluated by someone else?

_____ Yes

_____ No

34. Why didn't you go back to [FITTER] to buy the replacement lens?

_____ Price

_____ Convenience (consumer had changed residence, etc.)

_____ Other (specify)_____

TERMINATE INTERVIEW

35. When you got your new lens/lenses, were your eyes examined or did you simply pick it up at [FITTER'S OFFICE]?

_____ Fitter examined consumer when new lens was dispensed

_____ No exam

36. Did you try to buy a replacement lens/lenses from someone other than [FITTER]?

_____ No (TERMINATE INTERVIEW)

_____ Yes

37. What happened?

_____ Original fitter would not release contact lens specifications

_____ Other (specify)_____

ASSISTANTS' FORM

Location: _____

Patient: _____

Examiner: _____

	O.D.	O.S.
I. VISUAL ACUITY	_____	_____
II. POWER OF LENS (if applicable)	_____	_____

III. LENS STATUS

	O.D.	O.S.
Cleanliness	0 1 2 3	0 1 2 3
Damage (Chips, tears, or scratches)	0 1 2 3	0 1 2 3
Warpage	0 1 2 3	0 1 2 3

0 = no dirt, damage, or warpage (or condition not applicable)
1 = minimal dirt, damage, or warpage
2 = moderate dirt, damage, or warpage
3 = considerable dirt, damage, or warpage

Location:_____

Patient:_____

Examiner:_____

EXAMINERS' FORM

	O.D.	O.S.
I. MANIFEST REFRACTION		
Plus power lens / Minus power lens } needed to achieve ____/____ acuity (O.D. / O.S.)	0 1 2 3 0 1 2 3	0 1 2 3 0 1 2 3

0 = no additional power needed
1 = up to ± .50 sphere needed
2 = up to ± 1.00 sphere needed
3 = more than ± 1.00 sphere needed

II. BIOMICROSCOPY		
Epithelial edema	0 1 2 3 4	0 1 2 3 4
Microcystic edema	0 1 2 3 4	0 1 2 3 4
Corneal staining	0 1 2 3 4	0 1 2 3 4
Corneal neovascularization	0 1 2 3 4	0 1 2 3 4
Corneal striae	0 1 2 3 4	0 1 2 3 4
Injection	0 1 2 3 4	0 1 2 3 4

(Refer to manual for illustrations of relative gradations)

III. KERATOMETRY		
Warpage	0 1 2 3	0 1 2 3

0 = clear mires
1 = minimal distortion of mires
2 = moderate distortion
3 = extreme irregularity of mires

Readings:	____/____x____	____/____x____

Code: _____

Part One

Please answer the following questions to the best of your ability. If you have no record of having fitted this person, please check this box ☐ and return the questionnaire in the envelope provided.

	O.D.	O.S.	Date (Month/Year)
1. **Original** contact lens prescription (*i.e.*, sphere, cylinder, and axis which were used to determine contact lens specifications at the time of initial contact lens fitting). Please express in **minus cylinder** form.			
2. Prescription used for **most recently** dispensed eyeglasses. If the same as in question 1, check this box ☐			
3. **Most recent** visual acuity with contact lenses.			
4. **Most recent** visual acuity with eyeglasses. If the same as in question 3, check this box ☐			
5. **Original** keratometer readings. (*i.e.*, those taken at initial fitting session and used to determine contact lens specifications).			
6. **Most recent** keratometer readings. If the same as question 5, check this box ☐			
7. **Current** lens specifications. (*i.e.*, those which were used to order the most recently provided contact lenses).			
A. C.P.C./Base Curve. If not applicable, please check this box ☐			
B. Power			
C. Diameter			

D. For soft lens wearers only:

1) What is the name of the lens manufacturer? _____

2) What is the series letter and/or number of the lens? _____

8. Did you deliberately over- or under- correct this wearer? Please check appropriate boxes.

	O.D.	O.S.
A. Yes—Overcorrected	☐	☐
Yes—Undercorrected	☐	☐
No	☐	☐
B. If yes, by what amount?		

Part Two

We need to determine whether the following procedures were performed, and who performed them. Please indicate whether the person performing the procedure was an optometrist, ophthalmologist or other. If "other", please specify (*i.e.*, optometric assistant or technician, ophthalmic assistant or technician, etc.).

Procedure	Procedure Not Performed	Procedure Performed by:			
		No Record/ Don't Know	O.D.	M.D.	Other (Specify)
A. Refraction and Initial Examination	☐	☐	☐	☐	☐ _____
B. Initial Keratometry	☐	☐	☐	☐	☐ _____
C. Lens Design (*i.e.*, determination of lens curves, diameter, etc.)	☐	☐	☐	☐	☐ _____
D. Lens handling and care instructions (how to insert, remove, clean, etc.)	☐	☐	☐	☐	☐ _____
E. Initial fitting evaluation (check of lens-cornea relationship with biomicroscope or other device when lenses first placed on wearer's corneas)	☐	☐	☐	☐	☐ _____
*F. "Follow-up" refraction and/or over-refraction	☐	☐	☐	☐	☐ _____
*G. "Follow-up" keratometry	☐	☐	☐	☐	☐ _____
*H. "Follow-up" lens-cornea evaluations (check of condition of corneas and lens-cornea relationship with biomicroscope or other device	☐	☐	☐	☐	☐ _____

* The "follow-up" procedures F, G, and H refer to those performed after the patient first takes the lenses home during the adaptive period.

Part Three

In order that we may obtain complete records, please provide as much of the following information as possible for each person and/or firm that performed any of the procedures for this wearer.

Person and/or Firm No. 1

Name of Person _____

Name of Firm _____

Primary Work Address _____

_____

Telephone No. ( ) _____

Please check each procedure performed by this person/firm.

- ☐ A. Refraction and Initial Examination
- ☐ B. Initial Keratometry
- ☐ C. Lens Design
- ☐ D. Lens Handling and Care Instructions
- ☐ E. Initial Fitting Evaluation
- ☐ F. "Follow-up" refraction and/or over-refraction
- ☐ G. "Follow-up" Keratometry
- ☐ H. "Follow-up" lens-cornea evaluation

Person and/or Firm No. 2

Name of Person _____

Name of Firm _____

Primary Work Address _____

_____

Telephone No. ( ) _____

Please check each procedure performed by this person/firm.

- ☐ A. Refraction and Initial Examination
- ☐ B. Initial Kerastometry
- ☐ C. Lens Design
- ☐ D. Lens Handling and Care Instructions
- ☐ E. Initial Fitting Evaluation
- ☐ F. "Follow-up" refraction and/or over-refraction
- ☐ G. "Follow-up" Keratometry
- ☐ H. "Follow-up" lens-cornea evaluation

Person and/or Firm No. 3

Name of Person _____

Name of Firm _____

Primary Work Address _____

_____

Telephone No. ( ) _____

Please check each procedure performed by this person/firm.

- ☐ A. Refraction and Initial Examination
- ☐ B. Initial Keratometry
- ☐ C. Lens Design
- ☐ D. Lens Handling and Care Instructions
- ☐ E. Initial Fitting Evaluation
- ☐ F. "Follow-up" refraction and/or over-refraction
- ☐ G. "Follow-up" Keratometry
- ☐ H. "Follow-up" lens-cornea evaluation

Person and/or Firm No. 4

Name of Person _____

Name of Firm _____

Primary Work Address _____

_____

Telephone No. ( ) _____

Please check each procedure performed by this person/firm.

- ☐ A. Refraction and Initial Examination
- ☐ B. Initial Kerastometry
- ☐ C. Lens Design
- ☐ D. Lens Handling and Care Instructions
- ☐ E. Initial Fitting Evaluation
- ☐ F. "Follow-up" refraction and/or over-refraction
- ☐ G. "Follow-up" Keratometry
- ☐ H. "Follow-up" lens-cornea evaluation

Approved by GAO
B-180229 (S80012)
Expires 81-1-31

Appendix B

A Comparison of Current and Former Contact Lens Wearers

The findings reported in Chapter IV of this report are based on examinations and interviews of 502 contact lens wearers. We also attempted to gather data about former contact lens wearers. The professional associations' representatives who helped design and administer the study agreed that information about contact lens "dropouts" -- that is, former wearers who had stopped wearing contact lenses -- would be a useful supplement to our data on current wearers. It was hypothesized that many former contact lens wearers were "failures" due to the lack of skill of their fitters. If we could gather reliable information about former wearers as well as current wearers, we would be better able to compare the overall quality of contact lens fitting by different groups of fitters.

Unfortunately, the associations' representatives found it impossible to devise a means to evaluate directly the quality of fit of contact lenses that have not been worn for months or even years. Some potentially troublesome conditions associated with improper fitting disappear very quickly once the lenses are removed.[1] Even more long-lasting conditions will usually be impossible to detect a few weeks or months after a former wearer stops wearing lenses. In the vast majority of cases, there would be no way to tell whether a former wearer's lenses had been

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[1] For example, even a moderate to severe degree of central corneal clouding may disappear only a few minutes after contact lenses are removed.

fitted improperly. Neither would it be useful to ask former wearers to be examined while wearing their old lenses.[2] Any long-term problems related to improper fitting that may have caused those wearers to stop wearing their lenses would not develop the first day the lenses were worn again. On the other hand, many conditions would appear in greatly exaggerated form. Some of these conditions would be considered normal adaptation symptoms in new wearers (or in former wearers who have not worn lenses for some time), but abnormal in those who had worn lenses regularly for some time.

Although we could not directly examine former contact lens wearers, we did attempt to gather some information about why they were not successful wearers. The screener questionnaires asked former wearers to record who fitted their lenses and why they stopped wearing their lenses. Some 330 former wearers answered those questionnaires.

We at first chose not to include an analysis of the former wearers' responses to the screener in the report. First, the subjective perceptions of an unhappy former wearer, as recorded on the screener, did not provide the kind of information we needed to determine whether that wearer "failed" due to his or her fitter's lack of skill or for a reason totally unrelated to the fitter's competence.[3] For current wearers, the in-person

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[2] Of course, many former wearers return or discard their lenses. Others are so averse to the thought of wearing contact lenses that they would not agree to be examined if they were required to wear their lenses.

[3] All contact lens wearers experience at least some discomfort (footnote continued)

examinations by three expert contact lens fitters provided a reliable and objective basis for rating the relative quality of contact lens fitters' skills. No such reliable and objective body of data existed for former wearers. For example, quite a few former wearers said that they had stopped wearing lenses because they were too uncomfortable. That discomfort could have been caused by a poorly-fitted lens or by the wearer's failure to clean and care for the lens properly. For current wearers, the data gathered in the course of the examinations enabled us to determine whether the discomfort was more likely the fault of the fitter or the wearer. For former wearers, there was no principled way to make that determination.

Second, limiting the analysis to current wearers does not mean that our findings about relative contact lens fitting quality are based only on data from satisfied wearers with healthy eyes and well-fitted lenses. Quite a few of the current wearers complained of discomfort, poor vision, or other problems, and some of them were unable to wear their lenses for more than a few hours at a time.

Third, it proved impossible to identify or classify with certainty a large number of the former wearers' fitters. The only available information we could use in identifying the former wearers' fitters was that which appeared on the self-administered

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and inconvenience related to the lenses. A highly-motivated wearer may be quite willing to continue to wear poorly-fitted lenses that cause moderate discomfort. A less-motivated wearer may stop wearing well-fitted lenses because it is too much trouble to clean them properly. In other words, "success" or "failure" in contact lens wear often is influenced as much by the wearer's personality as by the fitter's abilities.

screener questionnaire, which asked for the name and address of each former wearer's fitter. Many who responded to the questionnaire did not supply that information at all; others gave only fragmentary information (e.g., "Dr. White," or "Optical shop on Main Street"). By contrast, we had much more information about the current wearers' fitters. We interviewed those wearers in person and were able to probe them for more detailed information ("Do you know Dr. White's first name? What street is his office on?"). We also mailed a questionnaire to each of the fitters who was named by a current wearer to verify that he or she had actually fitted that wearer, and to ask for additional data that enabled us to classify the fitter as optometrist, optician, or ophthalmologist with certainty. Given that additional information about the current wearers' fitters, it is not surprising that we were more often able to identify and classify them with certainty.

At the suggestion of some of the professional associations who helped design and administer the study, we did attempt to tabulate and compare the distributions of current and former wearers among the different fitter groups. It was hypothesized that the distribution of former wearers among the different fitter types would be markedly different from the distribution of current wearers. Those who put forward that hypothesis believed that certain fitter groups might have fitted a disproportionate number for former (or "unsuccessful") wearers.[4] We tentatively

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[4] Even if that distribution had been different, it would not necessarily be correct to conclude that a fitter group with a (footnote continued)

concluded that the percentage of current wearers fitted by each fitter group was not significantly different from the percentage of the former wearers fitted by that group. While this finding offers no support for the hypothesis stated above, we do not claim that it provides much, if any, additional support for our conclusion that the quality of contact lens fitting provided by opticians and commercial optometrists was not lower than that provided by ophthalmologists and non-commercial optometrists.

One of the professional associations that suggested we try to analyze the former wearers data later questioned the tentative conclusion we came to as a result of that analysis. That group believed that we had misclassified several of the former wearers' fitters. While we feel that our classifications were nearly always accurate, we admit that, for the reasons discussed above, it was often impossible to make those classifications with absolute certainty. Clearly, reasonable men could differ over how some of the former wearers' fitters should be categorized.

For that reason, among others, we feel that little weight should be given to any conclusions about relative contact lens fitting quality based on our former wearers data. Of course,

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greater percentage of former wearers provided lower-quality fitting. As previously stated, many factors totally unrelated to the fitter's ability affect whether a contact lens wearer becomes a contact lens "dropout." For example, it is reasonable to hypothesize that a wearer who paid less for his or her lenses is more likely to stop wearing lenses. Some wearers who purchase lenses from less expensive fitters are willing to pay the higher prices charged by other fitters; others would do without lenses altogether if they had to pay more for them. Members of the second group obviously place a lower value on the benefits of contact lens wear. Therefore, they are less likely to accept the at least occasional discomfort, inconvenience, and expense that accompany regular contact lens wear.

that caveat does not apply to our conclusions about the quality of contact lens fitting provided by the fitters of the current wearers we examined.[5]

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[5] The association that questioned the correctness of our classifications of several of the former wearers' fitters did not question the accuracy of any of our classifications of the current wearers' fitters.

Appendix C

Tests for Differences in Prices Charged by Contact Lens Fitters

This appendix describes the results of tests for differences in the average prices charged by the different types of contact lens fitters to subjects in the FTC sample. Our analysis indicates that commercial optometrists appear to charge significantly less for both hard and soft lenses than any other fitter group. That finding must be qualified due to our inability to fully control for certain factors other than type of fitter that may have influenced overall price levels in the different cities of the FTC sample.

1. Development of the Data Base:

The price information we analyzed was obtained from the sample of contact lens wearers utilized in the quality of fit analysis. The following questions concerning cost were asked during the patient interview:

- -- How much did you pay for your lenses?
- -- Does that amount include:
  - -- Eye exam? If not, what was extra charge?
  - -- Follow-up care? If not, what was extra charge?
  - -- Initial care kit? If not, what was extra charge?
  - -- Insurance? If not, what was extra charge?[1]

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[1] Some of the wearers we interviewed were unable to answer all these questions. Our price analysis is based on upon the responses of those wearers who were able to answer all the questions concerning cost.

Since various items were included in the prices given by different persons, a uniform package price that included the following items was established: the lenses themselves, the eye exam, follow-up care, and initial lens care kit. In other words, the package price included all items except insurance.

The package price was calculated as follows:

1. If a price was quoted for all items except insurance, that price was taken as the package price.
2. If a price was quoted for all items including insurance, the package price was taken to be the quoted price minus the estimated price of insurance in that city for that lens type. (The cost of insurance was estimated from a regression equation describing cost of insurance as a function of city, fitter, and lens type.)[2]
3. If an item other than insurance was not included in the quoted price and the extra amount charged was given,

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[2] The estimated regression equation is:

Cost of insurance = 13.979 + 3.058 (OPH) + 1.556 (COM-OPTOM) +393 (NC-OPTOM) - 0.150 (OPTIC) - 0.525 (CITY1) + 6.676 (CITY2) + 4.301 (CITY3) + 2.717 (CITY4) + 12.704 (CITY5) + 6.890 (CITY6) - 3.829 (CITY7) + 0.311 (CITY8) + 6.173 (CITY9) + 0.644 (CITY10) + 0.624 (CITY11) + 5.699 (CITY12) - 4.001 (CITY13) + 0.579 (CITY14) + 7.002 (CITY15) + 7.747 (CITY16) - 4.757 (CITY17) + 7.428 (SOFT).

The first four variables are the fitter dummies described below at p. C—4. The "city" variables refer to dummy variables designating city #1, #2, etc. The numerical coding scheme for the cities is described in Table C-3. The variable "SOFT" is a dummy taking on the value of one if the fit was made with a soft lens, and zero if it was a hard lens.

that charge was added to the quoted price to obtain the package price. If the amount of the extra charge was not given, that subject was dropped from the price analysis.

4. If a subject indicated that he or she did not know if a particular item was included (and no extra charge was indicated), it was assumed that the item was included in the quoted price.

The contact lens package price based on the above calculations was then adjusted for cost of living differences due to variations in the year of purchase and in the city of purchase.[3]

2. Statistical Analysis:

Of the 435 wearers utilized in the quality-of-fit-analysis, 388 were able to answer all the questions concerning cost. Our price analysis is based on the information obtained from those 388 wearers. Tests for differences in price among the provider groups is based on estimation of the following linear regression model:

$$PRICE_i = a + b_1OPH_i + b_2OPTIC_i + b_3NC_i + b_4MISC_i + c_1D77_i + c_2D78_i + c_3D79_i + e$$

3 The contact lens package price charged to each subject was deflated by a cost of living index derived from a Bureau of Labor Statistics (BLS) survey of family budgets for 39 cities. Indices were keyed to both the city of fit and year of fit. These adjustments are described in further detail in Bureau of Economics, Federal Trade Commission, Effects of Restrictions on Advertising and Commercial Practice in the Professions: The Case of Optometry 91-93 (1980).

where:

$PRICE_i$ - adjusted price charged to the i th subject

OPH_i - ophthalmologist dummy
= one if the i th subject was fitted by an ophthalmologist; zero otherwise

$OPTIC_i$ - optician dummy
= one if the i th subject was fitted by an optician; zero otherwise

NC_i - non-commercial optometrist dummy
= one if the i th subject was fitted by a non-commercial optometrist; zero otherwise

$MISC_i$ - miscellaneous optometrist dummy
= one if the i th subject was fitted by an optometrist that could not be further classified; zero otherwise

$D77_i$ = one if i th the subject was fitted in 1977; zero otherwise

$D78_i$ = one if i th the subject was fitted 1978; zero otherwise

$D79_i$ = one if i th the subject was fitted in 1979; zero otherwise

e - random error term

i - subject

The time of fit dummy variables (D77, D78, and D79) are included to control for differences in price over the 1975-79 period. Since the commercial optometrist and 1975-76 time-of-fit dummy variables enter implicitly (i.e., a subject that was fitted by a commercial optometrist 1975 or 1976 is defined as one where the values of the explicitly entered fitter and time-of-fit dummy variables all equal zero), that group becomes the standard to which the average prices of the other fitter groups are compared. Thus, for example, the coefficient of the ophthalmologist variable (OPH) is defined as the average price charged by ophthalmologists minus the average price charged by commercial

optometrists, after taking account of the effect of the year of fitting on price.

Table C-1 presents the regression estimates of the above equation; these results are used to generate the average prices for the fitter groups that are displayed in Table C-2. All of the fitter coefficients are positive and statistically significant, which implies that the average price charged by commercial optometrists for both hard and soft lenses was significantly lower than that charged by any other fitter group. In relative terms, commercial optometrists charged from 15 to 55 percent less than other fitter groups for hard lenses. The corresponding range of percent differences for soft lenses was 30 to 56 percent.

The meaning of the regression results is somewhat ambiguous due to the possible existence of non-fitter influences on price that are not taken into account in the above equation. The most relevant potential influences here are specific market elements operating in each city that influence the prices that all fitters charge. The wide variance in the distribution of wearers fitted by the optometrist groups, as shown in Table C-3, indicates that the omission of city-class-specific influences may be important.[4] Of most importance in this regard is the competitive environment in which contact lens fitters practice.

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[4] We did account for differences in the costs of operation by adjusting the price variable by a cost- of-living index specific to each city in the sample.

Table C-1

Regression Esimates of Differences in Package Prices: Commercial Optometrists Versus Other Fitter Groups

Variable	Regression Coefficient (t value in parentheses) Hard Lenses	Soft Lenses
Intercept	134.57	194.37
OPH	64.46* (5.8)	75.53* (5.2)
OPTI	41.76* (3.7)	46.31* (2.9)
NC	34.81* (3.3)	36.24* (2.7)
MISC	17.20 (1.5)	53.39* (3.1)
D77	-2.12 (0.2)	-4.27 (0.3)
D78	-29.34* (3.1)	-27.40* (2.1)
D79	-36.39* (2.9)	-79.34* (5.8)
R^2	0.26	0.33
F	9.77	12.68
df	196	176

*- Difference is significant (5% level of significance)

Table C-2

Average Adjusted Package Prices (Based on Regression Estimates in Table C-1)

Fitter	Hard Lenses	Soft Lenses
Ophthalmologists	$183.85	$234.54
Opticians	160.66	205.52
Non-commercial Optometrists	154.00	195.33
Commercial Optometrists	119.21	150.07
Unclassified Optometrists	136.41	212.48

Table C-3

Distribution of Subjects
by City and Type of
Optometrist that Fitted Them

Code Number	City	Number of subjects fitted by: commercial optometrist	Number of subjects fitted by: non-commercial optometrists	Total number of subjects	Percent of total number of subjects fitted by commercial optometrists
1	Atlanta	2	3	13	15.4
2	Boston	3	12	21	14.3
3*	Chicago	5	15	29	17.2
4	Cincinnati	2	10	33	6.1
5	Cleveland	3	3	22	13.6
6*	Detroit	22	10	45	48.8
7	Greensboro	0	0	6	0.0
8	Houston	0	5	19	0.0
9	Kansas City	2	6	22	9.1
10	Los Angeles	0	9	27	0.0
11*	Minneapolis	6	10	30	20.0
12	Nashville	0	0	7	0.0
13	Phoenix	2	2	14	14.3
14*	Pittsburgh	11	12	35	31.4
15	Rochester	4	19	56	7.1
16	St. Louis	3	16	26	11.5
17	San Diego	0	1	8	0.0
18	San Francisco	3	4	22	13.6
	Total	68	138	435	15.6

* Cities with high commercial optometrist presence.

One key aspect of competition is the degree of advertising allowed in a market.[5] An earlier FTC study found that the existence of advertising in a city tended to lower prices charged by all eyeglass providers.[6] If, as appears probable, the existence of advertising also lowers contact lens prices, it is necessary to hold constant the effect of advertising when making price comparisons across cities. It is particularly important to control for advertising when making comparisons involving commercial optometrist groups since members of that group advertise heavily and are almost certain to be found only in cities where advertising restrictions are minimal.

We attempted to take the presence of advertising into account by estimating the price equation for the following set of cities that were determined to have the most favorable environment for the practice of commercial optometry during the test period:[7] Chicago, Detroit, Minneapolis-St. Paul, and Pittsburgh. Based on the interconnection between commercial optometry and advertising, we infer that these cities also exhibited a high degree of advertising when compared to the

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5 Two others are the size distribution of providers in a market and the restrictions placed on opticians.

6 Bureau of Economics, Federal Trade Commission, Effects of Restrictions on Advertising and Commercial Practice in the Professions: The Case of Optometry (1980).

7 A city was identified as having a favorable environment for commercial optometry if it exhibited a share of total fits made by commercial optometrists that was greater than the corresponding average for all cities in the FTC sample (see Table C-3).

remaining cities in our sample. These four cities account for 64.7% of all commercial optometrist fits and 32% of the total number of fits in our sample. By estimating the price regression equation for this subset, we test for the existence of price differences among fitter groups in a set of cities in which, by assumption, all fitters operate in a similar competitive environment (at least to the extent that it is affected by advertising).

The resulting regression estimates are reported in Tables C-4 and C-5. An analysis of those estimates show that commercial optometrists in the four-city subsample as well as those in the complete 18-city sample charged less for both hard and soft lenses than any other fitter group.[8] There are two principal difference in the four-city results: (1) the difference in the average price charged for soft lenses by commercial and non-commercial optometrists in the four-city subsample was only marginally significant; (2) the difference in the average price charged for hard lenses by commercial optometrists and opticians in the four-city subsample was not significant.

In conclusion, the above findings suggest that commercial optometrists on the average appear to charge significantly less

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[8] In five of eight possible comparisons, the magnitude of the commercial optometrists' average price advantage was somewhat smaller in the four-city subsample; in the other three instances, it was larger.

Table C-4

Comparison of Price Regression Estimates: Full Sample vs High Commercial Optometrist Presence Sample

(Hard Lenses)

Variable	Regression Coefficient (t value in parentheses)	
	Full sample (18 cities)	High commercial optometrist presence sample (4 cities)
Intercept	134.57	130.57
OPH	64.46* (5.8)	45.75* (2.4)
OPTIC	41.76* (3.7)	27.80 (0.8)
NC	34.81* (3.3)	27.84* (2.0)
MISC	17.20 (1.5)	34.47 (1.9)
D77	-2.12 (0.2)	2.68 (0.1)
D78	-29.34* (3.1)*	-28.24 (1.7)
D79	-36.39* (2.9)	-60.64 (3.0)
R^2	0.26	0.33
F	9.77	4.32
df	196	61

* Difference is significant (5% level of significance)

Table C-5

Comparison of Price Regression Estimates: Full Sample vs High Commercial Optometrist Presence Sample

(Soft Lenses)

Variable	Regression Coefficients (t value in parentheses)	
	Full sample (18 cities)	High commercial optometrist presence sample (4 cities)
Intercept	194.37	168.80
OPH	75.53* (5.2)	70.19* (2.9)
OPTIC	46.31* (2.9)	81.37* (2.5)
NC	36.24* (2.7)	35.10** (1.7)
MISC	53.39* (3.1)	70.89* (2.7)
D77	-4.27 (0.3)	15.52 (0.6)
D78	-27.40* (2.1)	-22.05 (0.9)
D79	-79.34* (5.8)	-70.82* (2.7)
R^2	0.33	0.40
F	12.68	5.02
df	176	52

* Difference is significant (5% level of significance)

** Difference is marginally significant (10% level of significance

than other contact lens fitters. That finding must be qualified due to our inability to control fully for certain factors other than type of fitter that may have influenced prices.

APPENDIX D

Statistical Analysis of the Quality of Fit Data

APPENDIX D

Our statistical analysis used two analytical techniques to test the hypothesis that differences in the quality of contact lens fit are explained by the type of contact lens fitter. The primary approach used was a multivariate regression analysis where the summary quality score of a subject's eye condition is utilized as an index of fit quality. Additional tests based on a dichotomous higher/lower quality index were also employed. A five percent level of significance was adopted for testing purposes. (At times, reference is also made to a "marginal" significance level of ten percent. That significance level is outside of the commonly accepted standard for hypothesis testing but is useful in pointing out possible patterns which, upon further refinement of the data or model, may prove to be real.)

1. Multiple Regression Using Summary Quality Score (SUMM) as a Quality Measure

The regression model to be estimated takes the following general form:

$$QUAL_i = a + b\ FITTER_i + c\ WEARER_i + d\ LENS_i + e$$

where:

QUAL -- weighted and unweighted summary quality scores of the study subject's eye condition

FITTER -- a series of dummy variables identifying each of the principal provider groups

WEARER -- characteristics of the subject that may influence fit quality: age, sex, wearing time prior to the exam, hours worn per day

LENS -- characteristics of the lens worn by the subject that may affect the fit quality variable: lens type (hard or soft), cleanliness of the lens, damage, warpage, time since purchase

e -- random error term

i -- subject

Two summary scores were derived from the examiner quality observations, so that each subject could be assigned one overall eye health-quality of fit measure. The first (SUMM-U) is an unweighted sum of all quality scores for a subject:

$$\text{SUMM-U} = \sum_{j=1}^{7} \text{QUAL}_{ij}$$

where:

i -- subject

j -- eye condition category

The second (SUMM-W) is a weighted sum of an individual's quality scores, where the weights reflect the relative threat of an eye condition presence to a person's health:

$$\text{SUMM-W}_i = \sum_{j=1}^{7} a_j \, \text{QUAL}_{ij}$$

where the a_j are weights assigned to each of the seven eye condition categories. The weighting scheme was determined on the basis of ratings given by a panel of consultants consisting of opticians, optometrists, and ophthalmologists. The consultants were asked to rate each condition with respect to its seriousness, using a scale of 0 to 5. The weights used were an average of these ratings and are defined as follows:

Eye condition category	Weighting factor
Central corneal clouding	2.0
Microcystic edema	2.0
Corneal neovascularization	5.0
Corneal striae	3.5
Corneal distortion	5.0
Conjunctival hyperemia/injection	1.0
Corneal staining	2.5

The LENS and WEARER variables serve as controls, holding constant possible non-fitter influences on the quality of fit variable. This allows coefficients of the FITTER variables to provide a straightforward indication of the effect of fitter type on the quality of fit for the sample of subjects. Table D-1 lists the control variables used in the regression analysis.

Table D-1

Definitions of the Control Variables
Used in the Regression Analysis

AGE - age of subject

SEX - female = one; male = zero

WEARTIME - number of hours the lens was worn on the day of exam

PURTIME - number of months from purchase date to date of exam

HRS - average number of hours per day the subject wore the lens

CLEAN - a lens cleanliness index developed by the examiners

DAMAGE - a lens damage index developed by the examiners

WARP - a lens warpage index developed by the examiners

Two separate sets of fitter variables are utilized, necessitating somewhat different interpretations of the relevant coefficients in each case.

Set A compares three fitter groups: ophthalmologists, optometrists, and opticians. Dummy variables for the first two catergories are entered explicitly in the equation as:

OPH_i - ophthalmologist dummy

= one if the i th subject was fitted by an ophthalmologist; zero otherwise

$OPTOM_i$ - optometrist dummy

= one if the i th subject was fitted by an optometrist; zero otherwise

The opticians variable is not entered directly into the equation, being implicitly defined as the case where OPH = OPTOM = 0.[1] Under this formulation, the OPH and OPTOM coefficients measure differences in average quality scores between the group of subjects fitted by the respective fitter group and that of the optician group. Specifically, the OPH coefficient measures the

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[1] For a discussion of the use of dummy variables in regression analysis, see G. Maddala, Econometrics 132-47 (1977).

amount by which the average summary score of the ophthalmologist group is greater than (+) or less than (-) that of the optician group. In like manner, the OPTOM coefficient measures the difference between the average score of optometrists versus that of opticians. In all cases, these estimated differences are adjusted for the effects of variations in the characteristics of the subjects relating to their wearing habits, the condition of their contact lenses, and vital statistics relating to age and sex. The null hypothesis being tested for each variable is that no significant difference in average quality scores exists between the group specified by the dummy variable and the optician group.

Set B compares five fitter groups: ophthalmologist, opticians, commercial optometrists, non-commercial optometrists, and unclassified optometrists. The ophthalmologist and optician variables are defined as in Set A. The optometrist group is now divided into three subgroups: non-commercial, commercial, and a residual category consisting of optometrists that could not be more specifically classified. The variables defining these groups and used in the regression equations as follows:

NC - non-commercial optometrist dummy

= one if the subject was fitted by a non-commercial optometrist; zero otherwise

COM - commercial optometrist dummy

= one if the subject was fitted by a non-commercial optometrist; zero otherwise

MISC - miscellaneous optometrist dummy

= one if the subject was fitted by an optometrist tha could not be further classified; zero otherwise

Two regression equations are estimated for the Set B group of FITTER variables. In the first, the COM variable is omitted in order to test for differences in average quality scores between commercial optometrists and the four alternative fitter groups whose variables are entered explicitly in the equation. The OPTIC variable is omitted in the second equation, leading to a test for significant differences between opticians and the remaining four fitter groups.

Table D-2 displays the regression estimates for the three-way analysis (i.e., Set A). Tables D-3 and D-4 report the estimates of regression equations for the five-group configuration. Each equation is estimated twice, first utilizing the weighted summary quality score (SUMM-W) and then with the unweighted summary quality score (SUMM-U) as the dependent variable.

TABLE D-2

Quality of Fit Regression Results Using
A Summary Score Index: Three-Group Comparison

	regression coefficients (t value in parentheses)			
	Hard Lens Wearers		Soft Lens Wearers	
Variable	Dependent variable: SUMM-W	Dependent variable: SUMM-U	Dependent variable: SUMM-W	Dependent variable: SUMM-U
Intercept	1.74	0.44	0.95	-0.67
AGE	-0.25 (4.0)	-0.09 (3.6)	-0.13 (1.6)	-0.05 (1.7)
SEX	2.47 (1.8)	0.74 (1.3)	1.67 (1.0)	0.53 (0.8)
WEARTIME	-0.47 (1.5)	-0.25 (2.0)	-1.01 (2.5)	-0.34 (2.3)
CLEAN	-1.30 (1.6)	-0.42 (1.2)	-3.59 (3.3)	-1.35 (3.4)
DAMAGE	0.33 (0.4)	0.05 (0.1)	2.83 (2.2)	1.09 (2.3)
WARP	-0.29 (0.3)	-0.27 (0.8)	3.57 (1.1)	1.67 (1.3)
PURTIME	0.03 (0.5)	0.004 (0.2)	-0.003 (0.1)	0.01 (0.3)
HRS	-0.42 (2.6)	-0.16 (2.3)	-0.07 (0.3)	0.01 (0.2)
OPH	0.62 (0.3)	0.33 (0.4)	-0.96 (0.4)	-0.55 (0.6)
OPTOM	0.48 (0.3)	0.31 (0.5)	-0.10 (0.05)	-0.02 (0.2)
R^2	0.15	0.14	0.14	0.13
F	3.88	3.543	2.62	2.56
df	211	211	165	165

Table D-3

Quality of Fit Regression Results Using A Summary Score Index: Five-Group Comparison, Hard Lens Wearers

	regression coefficients (t value in parentheses)			
	Dependent variable SUMM-W		Dependent variable SUMM-U	
Variable	(1)	(2)	(3)	(4)
Intercept	4.25	1.46	1.61	0.27
AGE	-0.25* (4.1)	-0.25* (4.0)	-0.09* (3.7)	-0.09* (3.6)
SEX	2.12 (1.5)	2.05 (1.5)	0.61 (1.1)	0.57 (1.0)
WEARTIME	-0.40 (1.3)	-0.41 (1.3)	-0.22 (1.7)	-0.22 (1.7)
CLEAN	-1.38 (1.7)	-1.41 (1.7)	-0.45 (1.3)	-0.47 (1.4)
DAMAGE	0.63 (0.7)	0.65 (0.7)	0.19 (0.5)	0.20 (0.6)
WARP	-0.46 (0.5)	-0.41 (0.5)	-0.32 (0.9)	-0.29 (0.8)
PURTIME	0.03 (0.6)	0.03 (0.6)	0.01 (0.4)	0.01 (0.4)
HRS	-0.42* (2.6)	-0.43* (2.7)	-0.15* (2.3)	-0.16* (2.4)
OPH	-2.17 (1.1)	0.79 (0.4)	-0.99 (1.3)	0.42 (0.5)
OPTIC	-3.70** (1.9)	-- --	-1.70* (2.1)	-- --
NC	-4.93* (2.2)	-2.00 (0.9)	-1.74* (1.9)	-0.34 (0.4)
COM	-- --	2.99 (1.5)	-- --	1.48 (1.8)
MISC	-2.95** (1.7)	-0.03 (0.0)	-1.49* (2.1)	-0.10 (0.1)
R^2	0.18	0.17	0.17	0.16
F	3.81	3.68	3.53	3.41
df	209	209	209	209

*-Difference is significant (at 5 percent level of significance)
**-Difference is significant (at 10 percent level of significance)

Table D-4

Quality of Fit Regression Results Using A Summary Score Index: Five-Group Comparison, Soft Lens Wearers

	regression coefficients (t value in parentheses)			
	Dependent variable SUMM-W		Dependent variable SUMM-U	
Variable	(1)	(2)	(3)	(4)
Intercept	1.44	-0.08	-0.45	-1.04
AGE	-0.12 (1.5)	-0.13 (1.6)	-0.05 (1.6)	-0.05 (1.7)
SEX	2.43 (1.3)	2.09 (1.1)	0.79 (1.1)	0.69 (1.0)
WEARTIME	-0.88* (2.2)	-0.86* (2.1)	-0.30* (2.0)	-0.29* (1.9)
CLEAN	-3.44* (3.2)	-3.47* (3.2)	-0.32* (3.3)	-1.33* (3.3)
DAMAGE	2.70* (2.1)	2.79* (2.2)	1.04* (2.2)	1.06* (2.2)
WARP	4.48 (1.3)	4.50 (1.3)	1.98 (1.6)	1.99 (1.6)
PURTIME	0.001 (0.02)	0.0003 (0.002)	0.1 (0.4)	0.1 (0.4)
HRS	-0.05 (0.2)	-0.05 (0.2)	0.02 (0.3)	0.02 (0.2)
OPH	-2.81 (1.1)	-0.95 (0.4)	-1.24 (1.3)	-0.55 (0.6)
OPTIC	-2.84 (1.0)	-- --	-0.98 (0.9)	-- --
NC	-7.37* (2.1)	-5.43 (1.7)	-2.57* (2.0)	-1.85 (1.5)
COM	-- --	1.09 (0.4)	-- --	0.51 (0.5)
MISC	-1.17 (0.5)	0.75 (0.3)	-0.48 (0.5)	0.24 (0.3)
R^2	0.16	0.16	0.16	0.15
F	2.67	2.58	2.54	2.48
df	163	163	163	163

*-Difference is significant (at 5 percent level of significance)
**-Difference is significant (at 10 percent level of significance)

The estimates reported in Table D-2 indicate no significant difference in average quality scores between the optician groups and that of either the ophthalmologist or optometrist groups. In neither the hard nor soft lens samples were any of the fitter coefficients significant at even a 90 percent confidence level (i.e., ten percent level of significance). On the other hand, the regression results using the more disaggregated set of fitters (tables D-3 and D-4) suggest the possibility of some differences among fitter groups. This is especially so in the hard lens wearer sample for those equations where the commercial optometrist variable is omitted (columns 1 and 3). The pattern of negative fitter coefficients indicate cases where the quality score of the commercial optometrists is higher than that of the other groups. The coefficient of the opticians group (OPTIC) is negative and significant at better than the five percent level for SUMM-U and at the ten percent level for SUMM-W; the same is true for the non-commercial optometrist coefficient (NC). Any generalization based on this latter statistic must be qualified due to the estistence of the group of unclassified optometrists (MISC).

2. Statistical Analysis Utilizing a Dichotomous Higher/Lower Quality Variable

In order to provide a more disaggregated analysis of quality

differences among fitter groups, tests were performed utilizing the following dichotomous quality variables.

$DICHOT_{ij}$ = one if the condition was not found to be present for the i th subject; zero otherwise

A DICHOT value of one (condition not present) thus corresponds to a "higher quality" fit rating, while a value of zero (condition present to some degree) implies that the provider who fit the subject gave a "lower quality" fit. This variable was utilized to estimate a logistic regression equation[2] for each of the seven eye condition categories. The independent variables are entered as in the summary regressions. Thus the estimated coefficients for the included fitter variables can be used to calculate inter-group differences in the probability of providing a higher quality fit. Tables D-5 through D-8 report the results of the logistic regression analysis. Equations for the six of the seven eye condition categories were estimated for each of the hard and

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[2] A logistic regression is of the form:

$$\log \frac{P_i}{1 - P_i} = \alpha + \Sigma B_h X_{ih} + e_i$$

where P_i is the probability that an event will take place, given the experience of conditions X_h. See R. Pindyke & R. Rubinfeld, Econometric Models and Economic Forecasts, 245-55 (1976). For an application of this technique to consumer decisionmaking, see H. Theil, Economics and Information Theory (1967).

soft lens wearer subsets, resulting in a total of twelve regression equations. Thus the coefficient for each of the included fitter variables represents an estimate of the extent to which that fitter group displayed a higher (+) or lower (-) likelihood of providing a high quality fit than did the reference group (opticians in Tables D-5 and D-6, commercial optometrists in Tables D-7 and D-8).[3]

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[3] Logistic estimates could not be calculated for the corneal striae eye condition category due to the low number of observations in the lower quality fit group. Only five of 231 hard lens wearers and two of 184 soft lens wearers exhibited any degree of that condition.

Table D-5

Logistic Regression Estimates of Probability of Supplying A Higher-Quality Contact Lens Fit: 3-Group Comparison with Opticians as Reference Group, Hard Lens Wearers

Variable	Parameter Estimates (Chi-square values in parentheses)					
	Central Corneal Clouding	Microcystic Edema	Corneal Staining	Corneal Neovas-cularization	Hyperemia Injec-tion	Corneal Distor-tion
Intercept	2.54 (9.8)	5.18 (15.0)	0.91 (1.3)	4.34 (5.4)	1.23 (2.7)	2.02 (4.4)
AGE	-0.02 (2.4)	-0.04* (3.8)	-0.03* (4.6)	-0.05** (2.7)	-0.02 (2.4)	-0.04 (4.3)
SEX	-0.43 (1.5)	0.11 (0.04)	0.41 (1.5)	2.05* (5.4)	0.65* (4.3)	0.98* (6.1)
WEARTIME	-0.16 (5.1)	0.08 (0.4)	-0.13 (2.6)	0.35 (1.8)	-0.04 (0.3)	0.10 (1.1)
CLEAN	-0.48* (5.9)	-0.26 (0.8)	-0.17 (0.8)	-0.23 (0.2)	0.25 (1.7)	-0.23 (0.8)
DAMAGE	0.12 (0.3)	-0.26 (0.7)	-0.03 (0.03)	0.31 (0.3)	-0.20 (1.0)	-0.05 (0.04)
WARP	0.13 (0.4)	-0.23 (0.6)	0.10 (0.3)	0.80 (0.9)	-0.14 (0.5)	-0.24 (0.9)
PORTIME	-0.0002 (0.0)	-0.01 (0.7)	0.001 (0.0)	-0.01 (0.2)	-0.01 (0.4)	0.03** (3.2)
HRS	-0.05 (1.4)	-0.02 (0.2)	-0.07** (2.9)	-0.13 (1.3)	-0.02 (0.3)	-0.09** (2.8)
OPH	0.13 (0.1)	-1.00 (1.6)	0.23 (0.3)	-0.20 (0.03)	0.01 (0.0)	1.34* (4.1)
OPTOM	0.41 (1.3)	-0.98 (2.0)	0.47 (1.6)	-0.16 (0.03)	-0.04 (0.01)	0.49 (1.3)
LIKELI-HOOD RATIO	268.6	135.5	277.0	56.72	290.1	181.5
df	216	216	216	216	216	216

Significance levels for the parameter estimates:

Chi-square value	Level of significance
2.71	10%
3.84	5%

* Difference is significant (5 percent level of significance)
** Difference is marginally significant (10 percent level of significance)

Table D-6

Logistic Regression Estimates of Probability of Supplying A Higher-Quality Contact Lens Fit: 3-Group Comparison with Opticians as Reference Group, Soft Lens Wearers

Variable	Parameter Estimates (Chi-square values in parentheses)					
	Central Corneal Clouding	Microcystic Edema	Corneal Staining	Corneal Neovas-cularization	Hyperemia Injec-tion	Corneal Distor-tion
Intercept	3.31 (5.9)	3.71 (3.4)	-0.55 (0.5)	4.41 (6.7)	0.58 (0.5)	5.33 (8.0)
AGE	-0.01 (0.1)	-0.03 (0.7)	-0.01 (0.3)	-0.03 (1.6)	-0.01 (0.2)	-0.06* (4.9)
SEX	0.23 (0.2)	0.51 (0.3)	0.09 (0.1)	0.91 (2.0)	0.64** (3.0)	0.45 (0.3)
WEARTIME	-0.21 (0.02)	0.18 (0.4)	0.05 (0.4)	-0.01 (0.0)	-0.10 (1.5)	-0.12 (0.6)
CLEAN	-0.94* (7.9)	-0.63 (1.4)	-0.31 (2.0)	-0.19 (0.2)	-0.21 (1.0)	-0.34 (0.6)
DAMAGE	-0.12 (0.0)	-0.19 (0.1)	0.53* (4.4)	0.63 (0.9)	0.52** (2.9)	0.42 (0.4)
WARP	10.57 (0.0)	9.76 (0.0)	-0.68 (0.6)	10.33 (0.0)	10.92 (0.01)	10.32 (0.0)
PURTIME	0.02 (0.7)	0.02 (0.4)	0.01 (0.3)	-0.01 (0.2)	-0.01 (0.5)	-0.03 (0.9)
HRS	0.03 (0.2)	0.04 (0.1)	-0.03 (0.5)	-0.13 (1.3)	0.05 (0.9)	0.01 (0.01)
OPH	-1.78* (4.2)	-1.27 (1.0)	0.25 (0.3)	0.27 (0.1)	-0.59 (1.5)	-0.31 (0.1)
OPTOM	-0.73 (0.7)	-0.46 (0.1)	0.74** (3.3)	0.86 (1.2)	-0.19 (0.2)	0.004 (0.0)
LIKELI-HOOD RATIO	102.6	54.0	234.6	77.3	218.3	65.2
df	173	173	173	173	173	173

Significance levels for the parameter estimates:

Chi-square value	Level of significance
2.71	10%
3.84	5%

* Difference is significant (5 percent level of significance)
** Difference is marginally significant (10 percent level of significance)

Table D-7

Logistic Regression Estimates of Probability of Supplying A Higher-Quality Contact Lens Fit: Commercial Optometrist Hard Lens Wearers

Variable	Parameter Estimates (Chi-square values in parentheses) Central Corneal Clouding	Microcystic Edema	Corneal Staining	Corneal Neovascularization	Hyperemia Injection	Corneal Distortion
Intercept	3.27 (16.3)	5.82 (15.2)	1.46 (3.8)	4.24 (4.6)	1.44 (4.1)	2.83 (8.7)
AGE	-0.02** (2.7)	-0.04** (3.5)	-0.04* (4.8)	-0.04 (1.2)	-0.02 (2.6)	-0.04 (4.6)
SEX	-0.45 (1.6)	0.0003 (0.0)	0.40 (1.4)	2.27* (5.1)	0.62* (3.9)	0.97* (5.9)
WEARTIME	-0.15* (4.4)	0.10 (0.7)	-0.13 (2.4)	0.46 (2.6)	-0.03 (0.1)	0.12 (1.5)
CLEAN	-0.51* (6.4)	-0.33 (1.2)	-0.17 (0.7)	-0.61 (0.8)	0.25 (1.6)	-0.25 (0.9)
DAMAGE	0.16 (0.5)	-0.13 (0.2)	-0.02 (0.01)	0.96 (1.3)	-0.16 (0.7)	-0.003 (0.0)
WARP	0.16 (0.6)	-0.24 (0.7)	0.08 (0.2)	0.27 (0.1)	-0.14 (0.5)	-0.27 (1.1)
PURTIME	0.002 (0.03)	-0.01 (0.5)	0.0001 (0.0)	-0.02 (0.2)	-0.01 (0.3)	0.03** (3.4)
HRS	-0.05 (1.5)	-0.03 (0.2)	-0.06 (2.6)	-0.16 (1.6)	-0.02 (0.4)	-0.09** (2.9)
OPH	-0.65 (1.9)	-1.78 (2.5)	-0.34 (0.6)	-0.23 (0.03)	-0.21 (0.2)	0.51 (0.5)
NC	-0.76** (2.8)	-2.05** (3.6)	-0.05 (0.02)	12.48 (0.0)	-0.59 (2.1)	-0.83 (1.9)
MISC	-0.09 (0.02)	-2.26** (3.7)	-0.37 (0.5)	-2.09 (2.3)	-0.17 (0.1)	-0.67 (1.4)
OPTI	-0.90** (3.4)	-1.11 (0.9)	-0.80** (2.8)	-0.39 (0.1)	-0.09 (0.04)	-0.44 (0.4)
LIKELIHOOD RATIO	264.8	130.5	274.9	47.9	287.5	180.6
df	214	214	214	214	214	214

Significance levels for the parameter estimates:

Chi-square value	Level of significance
2.71	10%
3.84	5%

* Difference is significant (5 percent level of significance)
** Difference is marginally significant (10 percent level of significance)

Table D-8

Logistic Regression Estimates of Probability of Supplying A Higher-Quality Contact Lens Fit: Commercial Optometrist Comparison, Soft Lens Wearers

Variable	Parameter Estimates (Chi-square values in parentheses) Central Corneal Clouding	Microcystic Edema	Corneal Staining	Corneal Neovascularization	Hyperemia Injection	Corneal Distortion
Intercept	2.60 (3.9)	3.28 (3.1)	0.31 (0.2)	16.85 (0.01)	0.56 (0.5)	5.13 (7.4)
AGE	-0.01 (0.0)	-0.02 (0.5)	-0.004 (0.1)	-0.03 (1.1)	-0.01 (0.2)	-0.05* (4.1)
SEX	0.27 (0.2)	0.44 (0.3)	0.28 (0.5)	1.33** (3.5)	0.74** (3.7)	0.40 (0.3)
WEARTIME	0.03 (0.1)	0.16 (0.3)	0.04 (0.3)	0.002 (0.0)	-0.08 (0.9)	-0.11 (0.4)
CLEAN	-0.91* (7.5)	-0.60 (1.4)	-0.32 (2.1)	-0.09 (0.04)	-0.21 (0.9)	-0.33 (0.6)
DAMAGE	-0.02 (0.0)	-0.20 (0.1)	0.50* (3.8)	0.58 (0.6)	0.51 (0.7)	0.50 (0.5)
WARP	10.61 (0.0)	11.66 (0.0)	-0.63 (0.5)	12.41 (0.0)	10.99 (0.01)	10.23 (0.0)
PURTIME	0.02 (0.8)	0.02 (0.4)	0.01 (0.5)	-0.01 (0.04)	-0.01 (0.3)	-0.03 (0.8)
HRS	0.04 (0.2)	0.03 (0.1)	-0.03 (0.3)	-0.12 (1.1)	0.05 (1.0)	0.01 (0.01)
OPH	-1.29 (2.2)	-0.78 (0.4)	-0.91** (2.9)	-12.73 (0.0)	-0.74 (1.7)	-0.25 (0.04)
NC	0.38 (0.1)	0.06 (0.0)	-0.48 (1.0)	-11.97 (0.0)	-0.32 (0.3)	0.40 (0.1)
MISC	-1.48 (1.9)	11.34 (0.0)	-0.72 (1.0)	-13.68 (0.0)	-1.19 (2.5)	-0.14 (0.01)
OPTI	0.19 (0.03)	0.26 (0.03)	-1.50* (6.4)	-13.40 (0.0)	-0.11 (0.03)	-0.24 (0.03)
LIKELIHOOD RATIO	99.6	53.6	230.4	71.2	215.5	64.8
df	171	171	171	171	171	171

Significance levels for the parameter estimates:

Chi-square value	Level of significance
2.71	10%
3.84	5%

* Difference is significant (5 percent level of significance)
** Difference is marginally significant (10 percent level of significance)