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RELATION OF FIBER RESILIENCE TO THE CONSUMER SELECTION OF CARPETING

by

Nancy Jane Sears

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Approved by

Pauline E. Keeney
Dissertation Adviser

APPROVAL SHEET

This dissertation has been approved by the following committee of the Faculty of the Graduate School at The University of North Carolina at Greensboro.

Dissertation Adviser — Pauline E. Keeney

Oral Examination Committee Members — Eunice M. Keemer

Naomi G. Albanese

Ida Gordon Shivers

Ernest C. Lumsden Jr.

February 22, 1969
Date of Examination

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The major purpose of this study was to investigate compressional resilience as a factor contributing to the selection of carpeting. The factor of specific interest was the ability of consumers to recognize resilience of carpeting and to detect differences in resilience which might be due to fiber content.

The data collection for this study required four different aspects of investigation. The four different parts were:

1. A survey of information available to the consumer at the time of carpet purchase.
2. Laboratory testing to measure differences in fiber resilience.
3. A subjective test to indicate differences in fiber resilience.
4. A questionnaire to determine factors that consumers consider important for carpet purchase.

The survey of information available to the consumer at the time of carpet purchase was made by four home economists, assuming the roles of consumers interested in purchasing carpet for their living areas. Much of the sales emphasis centered around aesthetic aspects of carpeting such as color, texture, and beauty. Sales personnel stressed fiber properties and resilience as reasons for a carpet to wear well and suggested acrylic and nylon fibers more frequently than other carpet fibers.

Twelve carpets were used for the objective and subjective evaluations of fiber resilience. These carpets were all of tufted construction and included high and low pile heights, cut pile and level loop pile types, and wool, acrylic, and nylon fiber types.

Laboratory tests were made to determine pile height, pile density and compressional resilience of the carpets. An analysis of variance for a 3 x 2 x 2 factorial design was performed on the measurements of compressional resilience of the carpets. Significant differences in compressional resilience between fibers showed nylon carpeting to be most resilient. Wool carpeting and acrylic carpeting were second and third in resilience. Significant differences in compressional resilience between pile heights and between pile types were found. Loop pile carpets in each fiber group were more resilient than the cut pile carpets. Level loop pile showed little difference in resilience between high and low pile heights. Whereas, the cut pile carpets of low pile height showed considerably greater resilience than those of high pile height.

One hundred women participated in the subjective evaluation of fiber resilience of the test carpets. Two replications of each of the 12 carpets were used for this evaluation of fiber resilience. The majority of these subjects chose as most resilient the wool carpets of low pile height and the acrylic carpets of high pile height in both cut pile and level loop carpets. Subjects consistently ranked nylon as the least

resilient of the three fibers being tested.

The 100 women, who made the subjective evaluation of fiber resilience of the test carpets, also answered a questionnaire concerning factors considered important for carpet purchase. When asked to indicate the first six factors considered most important to them in the purchase of a carpet, at least 50 per cent of these consumers selected each of the following factors: durability, does not show dirt or soil easily, quality, color, price, and fiber content. "Springiness" or resilience was selected by 25 per cent of these subjects.

The results of this study would seem to indicate that

1. The selection and purchase of carpeting must be based largely upon the consumer's subjective evaluations of the carpetings.

2. Generally speaking, greater resilience can be achieved through the selection of level loop carpeting of low pile height than through the selection of the other combinations of pile type and pile height tested.

3. "Springiness" or resilience was mentioned less frequently than a number of other factors considered most important for carpet purchase.

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CHAPTER I

INTRODUCTION

Rapid changes in the carpet industry during the past few years have contributed to increases in the sale of carpeting. Each year, millions of square yards of carpetings are manufactured. According to a 1968 report, tufted carpeting represented about 90 per cent of the total carpet output.[1] The combination of the accelerated production using the tufting method and the availability of a greater variety in carpet fibers and textures has made carpeting available in large volume at lowered cost. Consequently, the American consumer is faced with an almost overwhelming variety of carpets from which to make a selection.

Dollar-wise, carpeting is one of the largest single home furnishing expenditures. The purchase of carpeting should involve the critical evaluation of many of the factors which contribute to durability in use. Such construction features as fiber content, yarn structure, pile height, type of pile, and density of pile influence the durability that a consumer derives from carpeting. However, literature related to the consumer selection of carpeting indicates

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[1]"Tufting in the U. S.," Textile Month, p. 75, February, 1968.

that color is the first and major key to the sale of carpeting.[2]

I. STATEMENT OF THE PROBLEM

This research was designed to investigate those factors influencing the consumer selection of carpeting. The area of specific interest to this study was that of resilience, particularly as it concerns the ability of consumers to recognize the resilience of carpeting and to detect differences which may be due to fiber content.

One of the major problems in contemporary carpet research is the development of suitable methods for relating the consumers' subjective evaluation of carpeting to the objective laboratory evaluation of the same carpetings. The problem is two-fold. First, the consumer selection of carpetings on the basis of certain features such as appearance or color is believed to reflect, or to be influenced by, certain sociological and psychological phenomena. Such subjective evaluations should be able to be translated into measurable terms so that the results can be applicable to a large group of consumers. Second, a comparison should be made between the subjective consumer information and the objective laboratory data to indicate the relationships between these two sets of data.

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[2]"Color Plays Important Part in Guide to Care of Carpet," 1967 Tufting Industry Review, (Dalton, Georgia: Tufted Textile Manufacturers Association, 1967), p. 148.

The major purpose of this study was to investigate compressional resilience as it pertains to the ability of consumers to recognize resilience and to detect differences in resilience which might be due to fiber content. In relation to this subject, the following three hypotheses were established and tested:

Hypothesis 1. Differences exist in the resilience of carpeting made of three different fibers.

Hypothesis 2. A relation exists between the laboratory evaluation of resilience and the consumer evaluation of resilience of carpeting made of three different fibers.

Hypothesis 3. The consumer selection of carpeting is influenced by the consumer evaluation of differences in the resilience of carpeting made of different fibers.

It was assumed that, while differences in dyeing and finishing processes may affect fiber resilience to some extent, all test carpets used in the study were affected to a similar degree.

The specific objectives of this study were:

1. To determine whether differences exist in the resilience of carpeting made of three different fibers.
    a. Differences as expressed by laboratory evaluation of compressional resilience.
    b. Differences as expressed by consumer reaction.
    c. Comparison of laboratory and consumer reaction data.
2. To determine the importance of fiber resilience as a factor influencing consumer selection of carpeting.

II. DEFINITION OF TERMS

The following definitions have been included for clarification of terms used in relation to both physical testing and subjective evaluations of the carpetings.

Work. Work is a common physical term which is closely related to the action which takes place in the measurement of compressional resilience. In the terms of the physicist, work is ". . . the force times the distance through which the force acts."[3]

Compression. Compression is defined as the amount of work required to depress the carpeting using a pressure equivalent to 12.48 pounds per square inch, expressed in thousandths of an inch. These measurements will be referred to throughout the study as 0.001 inch.

Recovery. Recovery is the amount of work recovered after release of pressure equivalent to 12.48 pounds per square inch.

Compressional Resilience. Compressional resilience refers to a percentage ratio between compression and recovery, derived by dividing recovery in inches by compression in inches.

Carpet Thickness. This term refers to the combined thickness of pile height and carpet backing. It was determined by measuring to the nearest 0.001 inch the distance between the two plane surfaces of

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[3]Harvey E. White, Modern College Physics (Princeton, New Jersey: D. Van Nostrand Co., Inc., 1966), p. 80.

the carpet.[4]

Pile Height. Pile height is the difference between carpet thickness and the thickness of the carpet backing.[5]

Participants. The term participants refers to the four married home economists who assumed the role of consumers to collect the data concerning information available to the consumer at the time of carpet purchase.

Subjects. The term subjects applies to the one hundred women who answered the questionnaire concerning factors considered important for carpet purchase and ranked the test carpets according to a subjective evaluation of fiber resilience.

Test Carpets. Test carpets refers to the 27 inch by 60 inch carpetings used for the subjective evaluation of fiber resilience.

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[4]American Society for Testing and Materials, 1966 Book of ASTM Standards (Philadelphia: American Society for Testing and Materials, October, 1966), p. 356.

[5]Ibid., p. 357.

CHAPTER II

REVIEW OF LITERATURE

Students and writers of varied professional interests have studied carpeting as an ancient craft and art form through the economic development of power looms for commercially-made carpeting to the present emphasis upon volume and variety in production.

The prominence of the British carpet industry has been reflected in the numerous writings of British textile personnel, particularly as concerned with wool carpetings. This chapter includes literature prepared by British and Canadian research personnel, as well as that of American researchers and writers.

The review of literature is divided into three parts. Part I includes literature related to fibers used in the face of carpeting. Part II presents the research pertaining to methods of testing fiber resilience. Part III includes literature describing various consumer aspects of carpeting. Of the literature reviewed, only the studies which seemed most pertinent to this particular investigation were cited.

I. FIBERS USED IN THE FACE OF CARPETING

In the past, the carpet industry utilized wool almost exclusively

as the fiber for the yarns which would make the face of the carpet. In the last few years, revolutionary changes have taken place in the carpet industry. A number of circumstances have contributed to the recent trend toward the utilization of man-made fibers in the manufacture of carpeting. The insufficient supply of carpet wool has resulted in increased prices for wool carpet fibers. The development of new man-made fibers and improved modifications of existing fibers have contributed to the growth of the carpet industry. New, and less expensive carpet manufacturing methods, to which man-made fibers are readily adaptable, have been developed.

Several man-made fibers have shown rapid growth and importance in terms of volume usage. In 1967, of a total fiber consumption of 563 million pounds, nylon accounted for approximately 45 per cent; acrylics, 26 per cent; and wool, 15 per cent. Two more recently developed fiber groups used in carpeting include polypropylene and polyester with seven per cent and five per cent of the market, respectively. The combined total for cotton and rayon represented one per cent of the market. According to this report, man-made fibers comprised approximately 84 per cent of the market in carpet fiber consumption during 1967. [1]

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[1] "ManMade Fibers Dominate Carpet Industry," Modern Textiles Magazine, 49:74, May, 1968.

Comparison of Physical Properties of Fibers Used as Carpet Pile

The major portion of this section pertains to those properties emphasized as relating to resilience since this fiber property would be related to the compressional resilience of the carpeting. General fiber properties are reviewed to a certain extent because of the influence which other fiber properties might have on the resilience of carpeting.

Many references have discussed the properties that carpet fibers should possess. Angus, a consultant with the Federation of British Carpet Manufacturers, has cited the following general properties:

> The desirable properties in a fibre suitable for use in the pile of a carpet, not necessarily in order of importance, are generally agreed to be as follows:
>
> > durability; resilience; non-soiling; non-burning; decorative value (ability to be dyed satisfactorily)[;] warmth; moth-proof;[2]

One of the fiber properties frequently referred to in the literature as being highly desirable for carpet pile was resiliency. Palfreeman and Brindley, Canadian textile researchers, maintain that "the softness and resiliency of a carpet depend upon its construction and upon the properties of the pile fibres. . . ."[3]

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[2]G. B. Angus, "Basic Structures and Fibres Used in Carpet Manufacture," Textile Institute and Industry, 3:315, December, 1965.

[3]Harry Palfreeman and Bernard Brindley, "Evaluation of Carpets in the Laboratory," Seventh Seminar Book of Papers, Seventh Canadian Textile Seminar, (Montreal, Quebec: Canadian Association of Textile Chemists and Colourists, September, 1960), p. 155.

Wool Fibers. Wool has long been recognized and accepted as the traditional carpet fiber and a standard for assessment of other carpet fibers. In a paper presented to the American Association for Textile Technology and subsequently published, Reynolds reviewed the importance of wool to the English and Scottish industries and asserted that, ". . . as recently as 1950 . . . virtually all of the 86 million square yards of broadloom carpets and rugs produced in the United States were made of wool."[4]

Several writers agree with Robinson's statement that "undoubtedly wool is as yet the nearest approach to the ideal fibre for spinning into carpet yarns. . . ."[5] Crone, reviewing the advantages and disadvantages of wool as a carpet fiber in 1952, called attention to the following properties of wool:

> . . . wool is not a completely ideal fibre, . . . wool, being a natural fibre, is variable in physical and chemical properties, for which allowances must continually be made in the mechanical and chemical processes through which it passes; it is subject to biological attack, being degraded by moth larvae and similar bodies; it is subject to chemical attack and has the inherent weakness that the main structural support in the molecule--the cystine linkage--is readily attacked by several agencies.[6]

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[4]William Reynolds, "Some Facts About Carpet Fibers," Modern Textiles Magazine, 40:47, May, 1959.

[5]George Robinson, Carpets (London: Sir Isaac Pitman & Sons, Ltd., 1966), p. 25.

[6]H. R. Crone, "Fibre Blends as Carpet Surface Yarns," Journal of the Textile Institute, 43:P533, August, 1952.

However, in defense of wool as a carpet fiber, Crone indicated that,

> . . . Those are serious disadvantages, but it has been the case that to counteract them has been easier than to simulate resilience and strength in another fibre. Wool, by virtue of its possessing these two desirable properties, has remained until now almost unchallenged for carpet surface yarns.[7]

Acrylic Fibers. With a decline in acrylic prices and an increase in wool prices, the acrylic fibers have gained in popularity. The acrylic fibers are generally considered to resemble wool more closely in hand and resilience than any of the other man-made fibers. This similarity of acrylic fibers to the wool fibers has been summarized by Jeffrey, a representative of Courtauld's, Ltd., as follows:

> The acrylic fibres. . . are . . . basically wool-like in their handle and in most textile applications are used where wool would formerly have been used. They have a low density and reasonable stiffness and this, together with secondary properties of crimp confers properties of bulkiness and cover. The resilience of acrylic carpet pile is good and because a moderately high fibre strength is allied to high extensibility, the work of rupture is high and the abrasion resistance is good, better, in fact, than that of a good quality carpet wool. . . .[8]

In comparing the properties of acrylic fibers with wool fibers, Eggleston and Angus concur that the resilience of acrylic fibers is not as good as that for wool in terms of recovery from prolonged

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[7] Ibid.

[8] G. M. Jeffrey, "Carpet Fibres: The Choice for Tufters," Skinner's Record, 38:70, January, 1964.

compression.[9] Although Angus hesitated to endorse acrylics as fibers which would be as good as wool in every respect, he indicated that the acrylic fiber is ". . . as good a synthetic carpet fibre, used 100 per cent, as has yet been produced."[10]

Nylon Fibers. In the field of man-made fibers, nylon makes its unique contribution as an abrasion-resistant fiber. It is generally agreed that nylon contributes to an increased wear life for a carpet. Advantages of the continuous filament nylon carpet yarn which have been cited include ". . . excellent resiliency and covering power, easy cleanability, elimination of fiber migration. . . increased bulk, and soft hand."[11]

Some disagreement exists in the literature concerning the resilience of nylon carpet fibers. In opposition to the endorsements for the resilience of nylon, Press wrote:

> . . . Matting in service can occur in an improperly designed carpet construction because nylon is actually slightly poorer than wool with respect to compressional recovery characteristics. . . .[12]

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[9]P. W. Eggleston, "The Development of Man-Made Fibres that Compete with Wool," Textile Institute and Industry, 6:49, February, 1968.

[10]Angus, op. cit., p. 317.

[11]"ManMade Fibers in Home Furnishings," Modern Textiles Magazine, 40:67, September, 1959.

[12]J. J. Press (editor), Man-Made Textile Encyclopedia (New York: Textile Book Publishers, Inc., 1959), p. 392.

The lack of agreement concerning the resilience of nylon may be due, at least partially, to conclusions based on the testing of different nylon fibers. Nylon fibers currently produced are designed for use as carpet pile and differ from those which were used in carpets and were available for testing several years ago.

Other Man-Made Fibers Used in Carpeting. While not included in the present study, polyester and polypropylene fiber groups have shown sufficient potential in the carpet market to be worthy of mention. It has been predicted that the polyester group will become major carpet fibers since they offer features of durability, styling, cleanability, colorfastness, resilience, and excellent appearance retention.[13] The polypropylene carpet fiber has been described as a tough fiber of low density with tendencies toward pile flattening from deformations of prolonged duration.[14]

II. METHODS OF TESTING FIBER RESILIENCE

Throughout many years resilience has been important to carpet research personnel. However, from the beginning there have been many different procedures and many different interpretations of procedures relative to the measurement of the compressional resilience of carpetings. Some of the writers have not used the term

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[13]J. B. Arthur, "Polyester in Carpets," Textile Industries, 131:88-B, September, 1967.

[14]Jeffrey, op. cit., p. 71.

resilience. Instead, they have used other descriptive terms related to that property which, in recent years, has been interpreted as resilience.

Interpretations and Definitions of Resilience

One of the many concepts which has been related to resilience has been expressed as follows:

> The thickness of the pile into which one sinks when one walks is part of the appeal of a good carpet. . . . If the pile is compressed the carpet will lose in appearance and texture. . . . If the compressibility decreases, it means that there has been a loss in the luxury 'feel', found in treading on the carpet. . . .[15]

According to his early article concerning the resilience of fibers and fabrics, Dillon indicated that there were almost as many different definitions of resilience as there were authors.[16]

Robinson has described resilience in the following terms:

> Resilience (the power of recovery from compression) and resistance to compression are valuable properties which influence the performance of carpets, and have a strong bearing on their comfort or luxury value. . . .[17]

Softness is a term which is found in the literature relating to the compressional resilience of carpetings. Anderson described this property as follows:

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[15]"The Crush Resistance of Carpets," Skinner's Silk and Rayon Recorder, 30:961, September, 1956.

[16]J. H. Dillon, "Resilience of Fibers and Fabrics," Textile Research Journal, 17:207, 212, April, 1947.

[17]Robinson, op. cit., p. 166.

> An important property of a carpet is softness (dictionary definition: "yielding to pressure") and this is appreciated subjectively by the amount and the way one's foot sinks into a carpet pile when walking over it. . . .[18]

Benson referred to softness as related to compressional resilience in the following terms:

> . . . a carpet's cushion-like quality is not due to the height of the pile, nor to its compressional resiliency, but rather it is due to compression (the actual work done) and recovery (work recovered). Compression is mechanical, but is caused by an urge within the fiber to 'spring back' to its original position.[19]

Technical Methods of Determining Fiber Resilience

Until about 20 years ago, little research had been conducted concerning carpet testing, perhaps because wool and cotton were the main carpet fibers. In recent years, with the addition of man-made fibers into the carpet industry, there has been an increased demand for laboratory tests to predict carpet performance and to assess the suitability of a fiber to a particular carpet end-use. A number of methods have been developed for the purpose of testing the fiber resilience of carpetings.

Cusick has described the device developed by Wool Industries Research Association and known in the literature as the WIRA.

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[18]S. L. Anderson, "Recent Developments in the Testing of Carpets," Wool Science Review, 29:4, April, 1966.

[19]Elizabeth Wells Benson, "An Evaluation of Selected Types of Synthetic, Wool and Synthetic, and Wool Carpeting," (Unpublished Master's thesis, Michigan State College of Agriculture and Applied Science, Lansing, Michigan, 1952), p. 57.

According to Cusick,

> The WIRA Dynamic Loading Machine is a laboratory instrument for assessing the loss of thickness properties of carpets. The rectangular feet of the instrument are allowed to drop freely on a specimen which is continuously traversed so that a compressed area is produced. Results from this instrument have shown good correlation with floor trials.[20]

Another instrument in research concerning the laboratory measurement of the compressional resilience of carpets is the Tetrapod Walker. Onions has described the operation of the Tetrapod Walker as follows:

> . . . The specimen is fitted as the lining to the curved inner surface of a drum of 8-in. internal diameter, the pile pointing inwards. A tetrapod, weighing 950 g, is placed inside the drum, which is then rotated at about 52 rev/min, the rotation causing the tetrapod to 'walk' or 'stagger' around the inside of the drum. The specimens are inspected at intervals. . . .[21]

Other methods of testing believed to measure various aspects of fiber resilience have been developed. A Canadian research team, Palfreeman and Brindley, has indicated that the resilience and softness of a carpet depend upon the properties of the pile fibers and upon the carpet construction. In a Canadian publication, these writers discussed a procedure for testing loss of resiliency and for indicating the tendency of the pile to flatten in use. Fatiguing of the carpet pile

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[20]G. E. Cusick, "Carpet Testing: The Influence of Construction and Fibre Types," Skinner's Record, 40:430, June, 1966.

[21]W. J. Onions, "An Assessment of Methods of Test of Carpets for Flattening, Change of Appearance, and Long-Term Wear," Journal of the Textile Institute, 58:489, October, 1967.

may be achieved by the following method:

> . . . The load of 16 pounds per square inch is applied to the carpet for 1/2 second periods of time at intervals of 2 seconds. The standard test has been set at 2,000 fatigue cycles which depresses the pile as far as it will go in a reasonable period of time and which is considered to be representative of the amount of fatiguing a carpet will receive over an appreciable part of its wear life. . . .[22]

The Good Housekeeping Institute has established a standard and test procedures for the measurement of the resilience of rugs and carpets. The standard requires that the carpet sample must regain 70 per cent of its original thickness after being subjected to the following laboratory test:

> A load equivalent to the traffic of a 180 pound person is applied to the carpet 360 times at the rate of 6 times per minute, after which the load is removed. After five minutes the thickness is accurately measured with a compressometer (0.1 lbs./sq. in.) in accordance with ASTM Method.[23]

In recent years, methods for the laboratory measurement of fiber resilience have been broadened to include some different techniques and procedures. Such methods include the study of carpets under cyclic compressive loading and unloading using an Instron instrument[24] and the use of acrylic resins to determine

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[22]Palfreeman and Brindley, op. cit., p. 155.

[23]Good Housekeeping Institute, Good Housekeeping Institute's Standards and Test Procedures for Rugs and Carpets (New York: Good Housekeeping Institute, [n. d.]), p. 3.

[24]Kenneth C. Laughlin and Gordon E. Cusick, "Carpet Performance Evaluation Part II: Stress-Strain Behavior," Textile Research Journal, 38:78, January, 1968.

bending strains in carpet fibers.[25]

Research Reports Pertaining to Fiber Resilience

In 1947, Beckwith and Barach asserted the primary purpose of a carpet to be a floor covering which is both luxurious to the feel and appealing to the eye. They designated one of the most important luxury factors to be resilience and defined resilience as ". . . the ratio of the work returned upon release of a compressional load to the total work done in compression."[26]

Testing procedures for the research conducted by this team consisted of loading the carpet in steps of 0.5 pound to 5.0 pounds per square inch and unloading the carpet by the same amount. Density and pile thickness of the samples were considered since these factors were believed to influence resilience. According to these research personnel, when carpet density is low, the force of a load causes the pile to collapse quickly and the backing absorbs most of the applied force. The greater the density of the carpet, the more the force is dissipated by the resistance of the pile to bending. Findings of this research team indicated that:

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[25]D. W. Hadley and D. Preston, "A Casting Technique for the Determination of Bending Strains in Carpet Fibres," Journal of the Textile Institute, 58:194, 199, May, 1967.

[26]O. P. Beckwith and J. L. Barach, "Notes on the Resilience of Pile Floor Coverings," Textile Research Journal, 17:311, 306, June, 1947.

> . . . an important service characteristic directly related to what the user wants in a pile floor covering is the amount of work done in compressing the pile with a given force.[27]

Barach, in his study reported in 1949, used high speed photography to show the effects of walking upon a carpet. Barach indicated that a person walking on a carpet subjects it to rapid loading up to a peak load of 12 pounds per square inch which is withdrawn at the same rate. An examination of photographs showed that carpet fibers bend in groups rather than singly.[28]

Crone, in his study of fiber blends as carpet surface yarns, described the action of walking on a carpet as involving considerations in addition to those concerning compression alone. According to Crone, foot action

> . . . takes place in three main phases. First, the edge of the heel comes down on the carpet, subjecting fibres over a small area to severe compression. Second, the whole foot rests on the surface, which is compressed, less severely, over a comparatively large area. Third, the toe imparts a tearing movement as it leaves the carpet. There are secondary actions; it is probable, for instance, that a certain amount of tearing takes place on the initial impact of the heel and that during the second phase, some abrasion may result from slight twisting of the foot.[29]

In the same discussion of foot actions, Crone maintained that the

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[27] Ibid., p. 309.

[28] J. L. Barach, "Dynamic Studies of Carpet Resilience," Textile Research Journal, 19:355, June, 1949.

[29] Crone, op. cit., p. P549.

different fibers in a fiber blend react differently to the foot actions and described this as follows:

> . . . Normal woollen carpet yarns are highly resilient and recover rapidly from compression and, due to the action of the scale structure, can progressively resist the tearing action. Blends containing, or wholly of, man-made fibres may react very differently. Their lower resilience and, in some cases, the low elasticity of the fibres, makes them slower to recover from compression and the smooth, scaleless nature of the fibres means that they are inherently unable to resist the tearing action. . . .[30]

Ainsworth and Cusick, in a study to determine the loss of thickness of carpets, have reported using the Tetrapod Walker equipment. Findings of this research team indicate a linear relation between the loss of carpet thickness and the logarithm of the number of revolutions of the Tetrapod Walker between 100 and 300,000 revolutions. This linearity was found for loop, cut, and combined loop and cut pile types.[31]

Research Reports Involving Floor Trials

The British research team of Anderson and Clegg made a comparison of practical wear trials with laboratory tests using several methods of assessment including thickness, weight loss, rubs to end point and observer ranking. The following conclusions were obtained:

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[30] Ibid.

[31] Elizabeth A. Ainsworth and G. E. Cusick, "Loss of Thickness of Carpets in the Tetrapod Walker Carpet-Testing Machine," Journal of the Textile Institute, 57:T24, T29, January, 1966.

> Both practical and laboratory trials give greater thickness loss for the lowest tuft density and a shorter wear life for the lowest pile weight, . . . There was slightly greater loss in thickness for dyed than undyed carpet in the practical trials.[32]

Clegg and Anderson maintain that the greatest decrease in carpet thickness occurs during the first few months of wear with a lower steady decrease during the remainder of its use. Since carpets exist in this compressed state during the greater part of their use, this research team attempted to develop a laboratory test that would yield information concerning the initial changes in carpet thickness due to compression.

The laboratory results were correlated with corridor wearing trials. The main factors of importance in carpets, apart from the type of fiber, were found to be pile density and pile height. If all other factors were held constant, loss of carpet thickness might be expected to vary directly with pile height and to vary inversely with pile density. Clegg and Anderson recognized that the factors of fiber diameter and yarn construction might be important parameters for consideration.[33]

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[32]S. L. Anderson and Dorothy G. Clegg, "Physical Test Methods for Carpets," Textile Institute and Industry, 1:7-8, February, 1963.

[33]Dorothy G. Clegg and S. L. Anderson, "A Test for the Assessment of Carpet Compression During Wear," Journal of the Textile Institute, 53:T351-T352, July, 1962.

Colledge and Bradley have reported results of tests comparing floor-test information with thickness measurements on carpets cycled in the Tetrapod Walker. Thickness loss measurements were made following 20,000 treads in the floor tests. Laboratory measurements were made following 50,000 cycles in the Tetrapod Walker. The results indicate that this instrument can be used to obtain a meaningful assessment of both thickness loss and appearance retention simultaneously.[34]

Inter-laboratory research, in which six British laboratories participated, has been reported by Onions. The carpet floor trial was designed to investigate the following three developments in the carpets tested: (1) wear to the backing, (2) change of texture, and (3) flattening. Machines used included the WIRA Carpet-Abrasion Tester, the Tetrapod Walker and the WIRA Dynamic Loading Machine.[35]

Conclusions indicate a close correlation between the Tetrapod results and the floor trial results concerning the retention of carpet appearance. Subjective evaluations of change of color and change of texture of the carpets were made by ten judges using a 1 to 4 scale.

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[34]R. Colledge and K. Bradley, "Correlation Between Floor Trials on Carpets and Thickness-Loss Measurements on the Tetrapod Walker Carpet-Testing Machine," Journal of the Textile Institute, 58:445, September, 1967.

[35]Onions, op. cit., pp. 488-490.

With the exception of three carpets, the findings indicated that

> . . . the correspondence between the scores for colour change and those for change of texture appears strong. Among the possible implications may be:
>
> (a) that the change of colour is physically dependent on the change of texture; and
>
> (b) that the change of colour associated with flattening may influence the judgement of texture at any rate, in the early stages of service.[36]

III. CONSUMER SELECTION OF CARPETING

Attitudes, values, and actions of consumers have been studied extensively to investigate underlying patterns of consumer behavior. Through collaboration between behavioral scientists and distributors, attempts have been made to solve marketing problems. Portis, a behavioral scientist who has worked closely with marketing personnel, discussed the relationship between consumer behavior and the social environment in the following statement:

> . . . Some changes in consumer needs are related to changing social conditions and ways of life. Population shifts to the cities or suburbs, increase in leisure time, increase in women working, and the rising level of education are all going to have substantial effects upon individuals' way of life, and therefore also their buying habits. . . .[37]

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[36] Ibid., p. 500.

[37] Bernard Portis, "The Behavioral Sciences and Marketing Research," The Business Quarterly, 29:35, Fall, 1964.

Consumer behavior is a complex part of human behavior, resulting from an attempt to satisfy the desire for luxuries, wants or needs. For example, through an appropriate carpet selection, one may satisfy the psychological need for beauty, the sociological need for status, and the economic need for lower maintenance costs. In this section of the literature, an attempt has been made to recognize some of the sociological, psychological, and economic factors influencing the consumer selection and purchase of carpeting.

Sociological and Psychological Aspects of Carpet Selection

Ernest Dichter, an individual well-known in the area of consumer motivational research, has investigated aspects of human motivation as they apply to consumers of goods and services. Dichter claims that people have emotional investments in carpets. The selection of a carpet reflects certain qualities which characterize the purchaser. Carpeting suggests that the owner is ready for expensive, luxury items. Dichter emphasizes this importance by asserting that carpeting is ". . . a commitment and is considered a more or less permanent purchase. Once it has been laid, it cannot easily be changed. If it turns out to be a mistake, it must be lived with."[38]

According to Dorothy Liebes, a noted textile designer, emotional

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[38]Ernest Dichter, Handbook of Consumer Motivations (New York: McGraw-Hill Book Company, 1964), p. 123.

factors play an important role in determining the consumer's carpet purchase. The motivation to select a particular carpet may reside in the recall of pleasant memories associated with a certain type of carpet. On the other hand, the consumer selection of carpeting may be influenced by anticipation of the future.[39]

Jennings, an American textile executive, in reviewing changes in buying patterns, sees the consuming public as young, better educated and more affluent than ever before. Jennings claims that carpet sales are affected by subtle cultural influences and has reflected on the situation in the following terms:

> . . . Our citizens today possess a pride and interest in the home unparalleled in recent history. . . . Other subtler influences include the dying-out of the desire to buy furnishings for life, and a willingness to explore new fashions and to furnish for the season; a dying-out of old traditions, and a fragmenting of fashion trends into a rich diversity. Carpeting has become a fashion-centered, style-conscious business; style, in fact, has become one of its most saleable and profitable factors.[40]

Other influences cited by Jennings include the noisy machine civilization, the monotonous jobs, and the impersonal culture. Several sources concur with the opinion expressed by Jennings as he focused attention on the importance of the home and stated:

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[39]Dorothy Liebes, "Emotional Factors Determine Carpet/Rug Purchases Today," 1967 Tufting Industry Review (Dalton, Georgia: Tufted Textile Manufacturers Association, 1967), p. 34.

[40]Robert B. Jennings, "No Magic in Merchandising," 1967 Tufting Industry Review (Dalton, Georgia: Tufted Textile Manufacturers Association, 1967), p. 88.

". . . The home has become, for many Americans, the personal retreat, the center for self-expression; and carpeting is one of the more important means for achieving those goals."[41]

Joyce Brothers, a currently popular psychologist, has related the social practices of the times to the selection of home furnishings, particularly with respect to the carpet industry. She has indicated that the consumer selection of carpeting may be influenced by such factors as the aspirations and tastes of the social class to which the consumer belongs.[42]

Hurley reported the results of a study to determine factors influencing the selection of rugs and carpetings and resulting satisfactions. She found sources of information used by 47 homemakers prior to a carpet purchase to be as follows: 32 shopped around, 11 talked with friends or relatives, 8 used articles, 4 relied on the salesman, and 3 depended on advertisements.[43] When asked what they particularly liked about their carpet, 42 reportedly liked the color.[44]

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[41]Ibid.

[42]Joyce Brothers, "Youth The Single Most Challenging Factor in the Floorcovering Market," 1968 Tufting Industry Review (Dalton, Georgia: Tufted Textile Manufacturers Association, 1968), p. 24.

[43]Patricia G. Hurley, "Factors Influencing the Selection of Rugs and Carpets and the Resulting Satisfactions," (Unpublished Master's thesis, University of N. C. at Greensboro, 1961), p. 48.

[44]Ibid., p. 55.

Literature related to the consumer selection of carpeting indicates that color is the first and major key to the sale of carpeting. According to one source, "Color is undoubtedly the biggest single factor in the sale of carpeting. . . ."[45] In training programs for retail carpet salesmen, the American Carpet Institute asserts that "Carpet salesmanship begins with color."[46] Findings of an extensive study conducted by the American Carpet Institute indicated that all income, age, and education groups rated color and texture, the appearance factors, more than twice as important as any other factor as the reason for selecting a specific piece of merchandise.[47] Roper, reporting the results of 6,122 interviews, indicated that 56 per cent of the respondents cited color as the reason for selecting the carpet which they owned at the time of his study.[48]

Several textile executives have recognized the challenge and opportunity facing the carpet industry to persuade the customer that carpeting is not a luxury but a necessity. A factor pointing favorably

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[45]"Color Plays Important Part in Guide to Care to Carpet," 1967 Tufting Industry Review (Dalton, Georgia: Tufted Textile Manufacturers Association, 1967), p. 148.

[46]American Carpet Institute, Salesmanship from the Customer's Point of View Session #2 (New York: American Carpet Institute, [n.d.]), p. 3.

[47]American Carpet Institute, How to Sell the Future Market Profitably (New York: American Carpet Institute, 1966), p. 18.

[48]Elmo Roper, "A Report on Habits and Attitudes Concerning Rugs and Carpets," Carpet Institute, Inc., Journal of the Textile Institute, 42:P815-P816, August, 1953.

in this direction is the 1966 decision to permit carpeting to be included as a part of the basic Federal Housing Administration mortgage.[49]

Need for Consumer Information

Although much has been written on carpeting and how to buy carpeting, several writers and research personnel have recognized the need for more consumer information concerning carpets. According to one source,

> The principal types of carpets are made in wide ranges of qualities in an ever-changing variety of colour and design, and the choice of a carpet is not a simple matter. Height of pile and pile density are important, also other characteristics arising from the method of manufacture, and the type and quality of pile yarn have a strong bearing on resistance to wear and retention of appearance, but cannot be assessed from a visual examination.[50]

Carpets have been recognized as products which are difficult for a lay person to evaluate without the benefit of informative labeling. As early as 1952, Benson recognized the need for informative labeling of carpets to aid the consumer in making an appropriate selection.[51] In an article on carpet grading, Angus has discussed the need for labeling to permit the customer to choose a carpet with the qualities

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[49]James W. McCarty, "FHA Mortgages: What They Mean to the Carpet Industry," Modern Textiles Magazine, 48:105, May, 1967.

[50]George Robinson, Carpets (London: Sir Isaac Pitman & Sons, Ltd., 1966), p. 169.

[51]Benson, op. cit., p. 74.

most desired.[52]

IV. SUMMARY

A wide variety of fibers are used in the manufacture of commercially-made rugs and carpets. Two man-made fiber groups, nylons and acrylics, have surpassed wool in total carpet consumption. The polypropylene and polyester carpet fibers appear to hold a potential for growth in carpet consumption.

Sources agree that one of the important properties for carpet fibers is resilience. Good resilience adds not only to the comfort of the carpet but is essential for the maintenance of a good carpet appearance. Fiber resilience influences the degree to which the carpet regains its original pile height and appearance following deformation.

Wool fibers have been recognized as possessing excellent resilience. Some sources indicate acrylic fibers to be similar to wool in resilience while others say these man-made fibers are inferior to wool in this quality. Disagreement exists concerning the resilience of nylon carpet fibers. Some references indicate nylon to be poorer than wool while others take the opposite view. Polyester and polypropylene have been recognized as upcoming competitors in the carpet market.

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[52]G. B. Angus, "Carpet Grading," Textile Institute and Industry, 2:235, October, 1964.

Based on recent literature, 90 per cent of the carpeting is of tufted construction. The remainder may be of woven, knitted, flocked, or needle punched construction.

A number of different procedures and devices have been developed for the measurement of the compressional resilience of carpeting. However, lack of agreement apparently exists concerning which procedure provides the most accurate measure of compressional resilience.

The selection and purchase of carpeting is believed to be influenced by, and to reflect, underlying values, attitudes, and characteristics of the purchaser. The literature indicates that color is the first and major key to the sale of carpeting and reveals the lack of controlled scientific inquiry into the matter of fiber resilience as one of the motivating factors influencing the consumer selection and purchase of carpeting. Several sources emphasized a need for informative labeling of carpets to aid the consumer in selecting carpets according to the qualities most desired.

CHAPTER III

PROCEDURE

I. DEVELOPMENT OF THE INVESTIGATION

This research study developed from an interest in consumer preferences as they relate to carpeting and particularly as they relate to fiber resilience. Interest in this topic was an outgrowth of an exploratory study in which several retailers of carpeting were interviewed concerning the amount of information made available to the consumer at the time of carpet purchase. Based on this small study and on a review of the literature, it seemed that there was a lack of accurate information available on the label or from the sales person that would aid consumers in the wise selection of carpeting. Encouragement and cooperation by members of the carpet industry contributed to the development of this investigation.

The data collection for this study required four different aspects of investigation. The four different parts were:

1. A survey of information available to the consumer at the time of carpet purchase.
2. Laboratory testing to measure differences in fiber resilience.
3. A subjective test to indicate differences in fiber resilience.

4. A questionnaire to determine factors that consumers consider important for carpet purchase.

The procedure for each of the aspects of investigation is described in detail in the sections of this chapter.

II. SURVEY OF INFORMATION AVAILABLE TO THE CONSUMER AT THE TIME OF CARPET PURCHASE

A survey of carpet retailers, in Greensboro, North Carolina, was conducted to indicate the kinds of information available to the consumer. It was believed that carpeting sold in the Greensboro area would be representative of carpeting available to any other geographical area having middle to higher incomes. From the 28 dealers in the city of Greensboro, a random sample of ten retail carpet establishments was selected to provide this information.

Four graduate home economists were asked to participate in gathering information for this survey. The four participants were married women with homes and were interested in purchasing carpeting. Through consultation with these participants, mutual agreement concerning terminology and procedures was reached. Each participant, assuming the role of a consumer interested in purchasing carpeting for her living area, called upon each of the ten randomly selected retail carpet establishments.

As a part of the shopping experience, each participant was instructed to ask leading questions in order to obtain information from

the sales person. Questions which the participants were instructed to ask were: (1) "What fiber do you suggest?" (2) "Why did you recommend this fiber?" (3) "Does this carpet wear well, and why?"

Following each shopping experience, participants recorded the responses of the sales person to the questions and noted additional information volunteered by the sales person. An example of a completed Survey Check Sheet is included as Appendix A.

Certain procedures were established to reduce error which might be present in the early interviewing technique of each individual. The participants were instructed to work independently of each other and to record data immediately following each visit. The data from the first two store visits of each participant, in which eight different retail carpet establishments were represented, were not included in the results. After the first two store visits, terminology was clarified and questions answered through consultation with each individual. Each participant was permitted to complete the remaining eight store visits without further guidance. Therefore, the data for this section of the study represents information from a total of 32 store visits.

III. LABORATORY TESTING TO MEASURE DIFFERENCES IN FIBER RESILIENCE

The 12 carpets used in this study were all of tufted construction and included three fiber types - wool, acrylic, and nylon. Each of

these carpet fibers was to be manufactured in two pile types and two pile heights within each pile type.

A. Plush cut pile
   1. Cut pile with high pile height (0.4 to 0.6 inch).
   2. Cut pile with low pile height (0.2 to 0.4 inch).

B. Level loop pile
   1. Uncut pile with high pile height (0.4 to 0.6 inch).
   2. Uncut pile with low pile height (0.2 to 0.4 inch).

Two replications of each of the 12 carpets were used for the subjective evaluation of fiber resilience.

The company, which manufactured the carpets, provided sufficient yardage from which the samples for laboratory testing and the test carpets were cut. All laboratory tests were performed under standard conditions of 70 ± 2 degrees Fahrenheit and 65 ± 2 per cent relative humidity.

Measurement of Compressional Resilience

Compressional resilience of the carpet fibers was tested using ten readings of the original height, compressed height, and recovered height for each of the 12 different carpets. Two measurements were made on each of five samples which measured five inches by eight inches.

The comparison of the degree of compressional resilience in wool, acrylic, and nylon carpet fibers was based on the compression under an indenting load equivalent to 12.48 pounds per square inch.

The selection of the indenting load was based on information provided by the manufacturer of the C & R Tester, Custom Scientific Instruments, Incorporated. The combination of a 22 ounce weight with a 3/8 inch pressure foot were the factors which would be equivalent to 12.48 pounds per square inch pressure.[1] Barach, in an early study of the physical properties of carpets, indicated that compression of 12 pounds per square inch per second approximates the compression exerted by a person walking on a carpet.[2]

The C & R Tester was used for measuring carpet thickness and compressional resilience. The manufacturer described the mechanical operation of the C & R Tester as follows:

> The thickness measurement is made with a preload of one-half ounce on the sample. The indenting load is transferred from a ball-bearing support to the indenting plunger by means of a screw, and handwheel. With this arrangement the indenting load (dead weight) may be applied to the sample without impact to measure the compression and removed to measure the recovery.[3]

The original carpet thickness measurement was obtained prior to the application of the weight. The indenting weight of 22 ounces was lowered without impact to rest on the carpet sample and measurement

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[1]Custom Scientific Instruments, Inc., C & R Tester, (Whippany, New Jersey: Custom Scientific Instruments, Inc., [n.d.]), p. 2.

[2]J. L. Barach, "Dynamic Studies of Carpet Resilience," Textile Research Journal, 19:355, June, 1949.

[3]Custom Scientific Instruments, Inc., op. cit., p. 1.

of the carpet thickness was recorded as the compressed thickness. The 22 ounce weight was then removed and a third measurement of thickness taken following a 30 second recovery period.

In order to determine the amount of work done by the fibers due to the indenting load and the amount of work recovered after release of the indenting load, the recovery in inches was divided by the compression in inches and expressed as a percentage.

Measurement of Pile Height and Pile Density

Pile height was measured by laboratory tests based on ASTM methods and using the C & R Tester. Eight inch squares of carpeting were used. The original carpet thickness was determined from the average of ten readings taken at different places distributed over the area of the surface. Various methods were used to remove pile yarn from a six inch square area on the carpetings. The larger portion of the pile was removed by cutting. The remainder was removed by burning, brushing, or by the use of chemicals to degrade or remove the remaining face yarn. The thickness of the remaining back construction was determined from the average of ten readings. All readings were measured to the nearest 0.001 inch. The net pile height was considered to be the difference between the total thickness and the back thickness.[4]

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[4]American Society for Testing and Materials, 1966 Book of ASTM Standards (Philadelphia: American Society for Testing and Materials, October, 1966), pp. 356-357.

Density was determined by dividing the ounces per square yard of pile weight by the pile height in 0.001 inch using the following equation:

$$\frac{\text{Ounces per square yard}}{\text{Pile height}} = \frac{X}{0.001 \text{ inch}}$$

Density was expressed in terms of ounces per square yard per 0.001 inch pile height.

IV. SUBJECTIVE TEST TO INDICATE DIFFERENCES IN FIBER RESILIENCE

The 12 carpets used in this study were subjected to laboratory testing to determine compressional resilience. Two replications of each of the 12 carpets were used for the subjective evaluation of fiber resilience. The 24 test carpets measured 27 inches by 60 inches. All were tufted carpeting and represented three fibers, (wool, acrylic, and nylon), two pile heights, and two pile types. These 24 test carpets were arranged in eight groupings. One test carpet of each of the three different fibers, wool, acrylic, and nylon, was included in each grouping.

Consultation with research personnel of the company manufacturing the test carpets indicated problems that would affect the construction of the carpet samples. Because of the inherent differences between wool, acrylic, and nylon fibers, it was not possible to construct carpets of the same yarn structure and density in terms of weight.

They were constructed to be as nearly comparable as possible in terms of color, appearance, performance, and texture.

The test carpets were coded with letters A (wool), B (acrylic), and C (nylon) to indicate the fiber content. Each code letter was combined with a meaningless letter as a means of disguising the code so that subjects would be less likely to be aware of any consistency which might exist in fiber rankings as the test carpets were evaluated.

Subjects were one hundred women selected from Extension Homemakers Clubs, church groups, homemakers, University of North Carolina at Greensboro faculty and staff, and faculty wives. Both rural and urban areas were represented in the sample. Subjects were limited to those women who had owned, or owned at the time of the study, soft floor covering in the form of commercially-made rugs or carpetings.

Subjects evaluated the test carpets by walking on them and ranking the test carpets in each grouping on a scale of most resilient or "springy" to least resilient. An example of the Carpet Evaluation Sheet is included as Appendix B. Flat-heeled slippers were provided for subjects to wear while evaluating the test carpets. The attempt to standardize footwear was based on the belief that footwear was an important variable which could be controlled.

Subjects were assigned randomly to the order in which they evaluated the test carpets. This was accomplished through the use

of ten different instruction sheets, each of which described a randomized sequence in which to evaluate the test carpet groupings. By following this procedure, the varying condition of the test carpets was randomized for each subject.

The test carpets were placed end-to-end to require that the subject walk from one test carpet to another for evaluation of the test carpets. Consequently the subject could stand on two of the three carpets in a grouping at the same time. The order of presentation of the three test carpets in a grouping could occur in any of six sequences: ABC, CBA, CAB, BAC, BCA, ACB. Since responses might be influenced by a subject's response set, the test carpets in each grouping were rearranged for each testing session, using all six sequences in a planned order.

The subjective carpet evaluation data and questionnaire information were collected at a single testing session. Each subject responded first to the questionnaire and then to the subjective test.

V. QUESTIONNAIRE TO DETERMINE FACTORS THAT CONSUMERS CONSIDER IMPORTANT FOR CARPET PURCHASE

The subjects who participated in the subjective test of fiber resilience also answered the questionnaire concerning factors considered important for carpet purchase. The subjects were given a questionnaire on which they were asked to indicate selected

information concerning carpets or rugs they owned and factors they considered important for the wise purchasing of carpeting. Each subject was asked to number in the order of importance the first six factors which would influence her in any future selection of carpeting. An example of the Carpet Owners' Questionnaire is included as Appendix C.

VI. ANALYSIS OF THE DATA

Descriptive statistics were employed for treatment of the survey data, the questionnaire data, and the laboratory data concerning pile height and density.

The basic design for the analysis of the laboratory data concerning fiber resilience was a 3 x 2 x 2 factorial plan with three fibers, two pile types, and two pile heights. An analysis of variance, as described by Edwards, was performed on the compressional resilience measurements of the 12 different carpetings.[5] Differences at the 0.01 level were considered to be significant. Table I shows the model for this analysis.

Rank-order correlations were considered for comparison of the laboratory data and the data obtained from the subjective evaluation of carpet compressional resilience. However, the number

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[5]Allen L. Edwards, Experimental Design in Psychological Research (New York: Holt, Rinehart and Winston, 1960), pp. 201-207.

of pairs of data were insufficient to make such a correlational analysis. Therefore, the comparison between the objective and subjective evaluations of fiber resilience was shown by graphic representations of the data.

TABLE I

DESIGN FOR A THREE LEVEL FACTORIAL ANALYSIS OF CARPET COMPRESSIONAL RESILIENCE

Carpet Characteristics	Fibers			Totals
	Wool	Acrylic	Nylon	
	(Number of measurements)			
Cut Pile				
High pile	10	10	10	30
Low pile	10	10	10	30
Level Loop Pile				
High pile	10	10	10	30
Low pile	10	10	10	30
Totals	40	40	40	120

CHAPTER IV

ANALYSIS OF THE DATA

Since this investigation was quite broad in scope, the data collection required several different aspects of investigation. The analysis and interpretation of the data will be presented in five parts:

1. Specifications and construction characteristics of the carpets.
2. Information available to the consumer at the time of carpet purchase.
3. Laboratory analysis of fiber resilience.
4. Comparison of fiber rankings by subjective evaluation with objective, laboratory measurement of compressional resilience.
5. Factors which consumers consider important for carpet purchase.

I. SPECIFICATIONS AND CONSTRUCTION CHARACTERISTICS OF THE CARPETS

Through the cooperation of a major carpet manufacturer, the 12 carpets for this study were manufactured to be as nearly comparable as possible in terms of appearance, performance, and texture. All were of tufted construction. It was decided that due to their importance in the carpet industry, wool, acrylic, and nylon

carpetings would be included. However, inherent differences between wool, acrylic, and nylon fibers make it impossible to construct carpets of the same yarn structure and density in terms of weight. Nylon has a lower specific gravity than either acrylic or wool fibers. Carpets composed of fibers with lower specific gravity are lighter in weight than carpets made of fibers with higher specific gravity providing other factors in the carpet construction are identical.

Specifications supplied by the manufacturer are shown in Table II. In order to eliminate color as a variable which might influence consumer reactions, all test carpets were gold in color. This color was suggested by the manufacturer as one which might be matched more successfully than other colors currently popular. Also, the current market situation indicated that gold was a popular color and one which would be pleasing to the subjects.

Each of the carpet fibers was manufactured in two pile types and two pile heights within each pile type.

A. Plush cut pile
   1. cut pile with high pile height (0.4 to 0.6 inch).
   2. cut pile with low pile height (0.2 to 0.4 inch).

B. Level loop pile
   1. uncut pile with high pile height (0.4 to 0.6 inch).
   2. uncut pile with low pile height (0.2 to 0.4 inch).

Two replications of each of the 12 carpets were used for the subjective evaluation of fiber resilience.

TABLE II

MANUFACTURER'S SPECIFICATIONS FOR CONSTRUCTION OF TEST CARPETS

Fibers	Pile Weight (ounces per square yard)	Courses Per Inch	Stitches Per Inch
Cut Pile			
Wool			
High	44.00	5.33	8.0
Low	28.00	5.33	8.0
Acrylic			
High	42.00	5.33	9.0
Low	26.50	5.33	9.0
Nylon			
High	30.00	6.40	9.0
Low	20.00	6.40	7.0
Level Loop Pile			
Wool			
High	46.00	8.00	6.7
Low	30.00	8.00	6.0
Acrylic			
High	40.00	8.00	6.7
Low	26.00	8.00	6.0
Nylon			
High	23.23	8.00	6.5
Low	18.66	8.00	7.0

Laboratory Analysis of Pile Height and Pile Density

A laboratory check of the pile height and pile density of the finished carpeting was made prior to the subjective evaluation. Results of these laboratory measurements of pile height and pile density of the test carpets are shown in Table III.

The mean pile height of the test carpets ranged from .174 inch (acrylic low level loop) to .579 (wool high cut). All test carpets of the cut pile type conformed to the predetermined specifications. The mean pile height of the cut pile carpets ranged from .296 inch (nylon) to .579 inch (wool). The mean pile height of the level loop carpets ranged from .174 inch (acrylic low) to .336 inch (wool high).

The density of the level loop carpet samples tested indicated a wider variation among the acrylic carpets and the nylon carpets than among the wool carpets. Differences in density between pile heights of the cut pile carpet samples were consistent for all three fibers. The wool carpets and acrylic carpets were more dense than the nylon carpets of the corresponding pile height and pile type as would be expected due to the specific gravity of each of the fibers.

The density of the level loop carpets of low pile height exceeded that of the corresponding carpet of high pile height in all three fibers. On the other hand, density of high cut pile carpets was slightly higher than that for the low cut pile carpets of the same fiber content.

TABLE III

LABORATORY MEASUREMENTS OF TEST CARPETS

Fibers	Mean Pile Height (Inches)		Mean Density (Ounces per square yard per 0.001 inch pile height)	Compressional Resilience (Per cent)
	Laboratory measurements	Manufacturer's specifications		
Cut Pile				
Wool				
High	0.579	0.6	.076	28.46
Low	0.395	0.4	.071	47.16
Acrylic				
High	0.546	0.6	.077	29.62
Low	0.362	0.4	.073	38.36
Nylon				
High	0.423	0.4	.071	38.09
Low	0.296	0.3	.068	42.12
Level Loop Pile				
Wool				
High	0.336	0.3	.137	68.66
Low	0.218	0.2	.138	64.42
Acrylic				
High	0.298	0.3	.134	57.39
Low	0.174	0.2	.149	62.02
Nylon				
High	0.245	0.2	.095	61.81
Low	0.181	0.2	.103	68.15

II. INFORMATION AVAILABLE TO THE CONSUMER AT THE TIME OF CARPET PURCHASE

During the interaction with the participants, 81 per cent of the sales personnel suggested acrylic fibers while 77 per cent suggested nylon carpet fibers. Twenty-eight per cent of the sales personnel suggested wool; 27 per cent, polyester; and 12 per cent, olefin.

Table IV shows the order of suggestion of carpet fibers by the sales personnel. An examination of the order of suggestion of fibers indicated that 31 per cent of the sales personnel suggested acrylic fibers first whereas 34 per cent suggested nylon fibers first. The percentages for the second fiber suggested by the sales personnel were identical to that for the first fiber in two instances; 31 per cent, acrylic and 34 per cent, nylon.

The sales personnel stressed a number of factors to support the fibers which each had suggested. The data for these properties are expressed in numbers since it was possible to have multiple responses from the same sales person. Table V shows reasons given by the sales personnel for recommending specific carpet fibers. Durability was the reason most frequently stated for the recommendation of a carpet fiber by the sales personnel. Other frequently cited reasons were related to both the aesthetic and the functional aspects of carpetings.

"Fiber properties" was the most frequently stated reason for a

TABLE IV

PERCENTAGES OF SALES PERSONNEL SUGGESTING CARPET FIBERS, IN ORDER OF SUGGESTION

Fibers	Order of Suggestion					
	First	Second	Third	Fourth	Fifth	Total
	(Per cent of personnel)					
Acrylic	31	31	19	0	0	81
Nylon	34	34	9	0	0	77
Olefin	6	3	0	3	0	12
Polyester	6	9	9	3	0	27
Wool	16	6	3	0	3	28

TABLE V

REASONS GIVEN BY SALES PERSONNEL FOR RECOMMENDING SPECIFIC CARPET FIBERS

Reasons	No Specific Fiber	Fibers Recommended					Total
		Acrylic	Nylon	Olefin	Poly-ester	Wool	
		(Number of Responses)					
Beauty	3	7	3	1	2	5	21
Texture	2	7	6	1	1	4	21
Color	3	5	6	1	2	2	19
Durability	6	10	14	2	3	5	40
Pattern	0	2	1	0	1	0	4
Does not show footprints	0	8	11	0	2	4	25
Does not show soil	0	6	9	2	2	3	22
Good value	2	1	4	1	1	0	9
Inexpensive	0	0	4	1	0	0	5
Quality	3	5	4	0	3	0	15
Cleanability	0	2	3	0	2	0	7

carpet to wear well. According to the sales personnel, the carpet being recommended would wear well for the following reasons:

Reasons	Number of Responses
Fiber properties	25
Resilience	14
Texture including loop and cut construction	11
Thickness	10
Pile height	8
Density	4
Color	2

On 14 of the 32 store visits, the sales person asked for the participant's color preference prior to asking any other questions or making suggestions. On six store visits, color preference was requested at a later time in the interaction. The question asked by the sales person which was second in frequency pertained to the extent to which the room or area to be carpeted was used. Sales personnel requested information concerning the fiber desired by the participant on eight store visits and the type of carpet desired on five occasions. None of the sales personnel requested information concerning the price range desired by the "customer" or the number and ages of family members.

On 21 of the 32 store visits, the sales person told features of several carpets and left the decision to the customer. In nine instances,

the sales person tried to sell a specific carpet.

Specification information was volunteered on 21 of the 32 store visits. Since it was possible to have multiple responses from the same sales person, these data are expressed in numbers. Yarn structure or yarn twist was mentioned on 13 store visits; resilience, on 11 visits; and method of carpet construction on eight visits. Specification information concerning density and pile height of the carpet in which the participant showed the most interest was volunteered on approximately 15 per cent of the store visits.

III. FINDINGS CONCERNING LABORATORY ANALYSIS OF FIBER RESILIENCE

Statistical Significance of Results

Table VI shows the mean scores of the raw data for the laboratory measurement of fiber resilience. Table VII shows significance of the various factors and interactions at the 0.01 level of probability.

The major factor, fibers, contained two degrees of freedom since there were three fibers. Based on findings of prior research, it was believed that the wool carpets would show a higher degree of compressional resilience than either the acrylic carpets or the nylon carpets. Orthogonal comparisons were made (1) to compare the compressional resilience of the wool carpeting versus the combined average of that for the acrylic and nylon carpetings, and (2) to compare the compressional resilience of acrylic carpetings versus that for nylon carpetings.

TABLE VI

MEAN SCORES OF RAW DATA FOR LABORATORY MEASUREMENT OF FIBER RESILIENCE EXPRESSED IN 0.001 INCH CARPET THICKNESS*

Fiber Pile Type and Pile Height	Thickness in 0.001 Inch		
	Original Carpet	Compressed Carpet	30 Second Recovery
Cut Pile			
Wool			
High	.667	.077	.245
Low	.433	.078	.246
Acrylic			
High	.645	.077	.245
Low	.468	.074	.225
Nylon			
High	.554	.076	.258
Low	.430	.066	.219
Level Loop Pile			
Wool			
High	.514	.088	.381
Low	.376	.067	.266
Acrylic			
High	.470	.090	.308
Low	.339	.081	.241
Nylon			
High	.419	.066	.284
Low	.338	.072	.253

*Mean scores based on ten measurements.

TABLE VII

ANALYSIS OF VARIANCE OF COMPRESSIONAL RESILIENCE OF TEST CARPETS BY LABORATORY TEST

Sources of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F
Fibers	2	812.67	406.34	21.16*
Comparison 1	1	164.01	164.01	8.54*
Comparison 2	1	648.66	648.66	33.78*
Pile Height	1	1216.03	1216.03	63.33*
Pile Type	1	20972.20	20972.20	1092.30*
Fibers x Pile Height	2	22.43	11.22	0.58
Fibers x Pile Type	2	82.20	41.10	2.14
Pile Height x Pile Type	1	510.06	510.06	26.57*
Fibers x Pile Height x Pile Type	2	861.12	430.56	22.43*
Error	108	2073.63	19.20	
Total	119			

Comparison 1 - Wool versus combined average of Acrylic and Nylon
Comparison 2 - Acrylic versus Nylon

Number of measurements 120

*Significant at the 0.01 level

Differences in compressional resilience between fibers were significant at the 0.01 level. The compressional resilience of wool carpeting was found to be greater than the combined average resilience of acrylic and nylon carpetings. The comparison of resilience of nylon carpetings versus resilience of acrylic carpetings showed a highly significant difference (0.01 level) with nylon having the greater resilience. Based on total scores of compressional resilience measurements for each carpet fiber, the laboratory evaluation of compressional resilience showed nylon to be highest in resilience; wool, second; and acrylic, third in resilience.

Differences in compressional resilience between pile heights and between pile types were significant at the 0.01 level of probability. Mean scores showing the relation between pile heights and pile types are plotted in Figure 1. Loop pile showed consistently greater resilience for all fibers than cut pile. Level loop pile showed little difference in resilience between high and low pile heights. Whereas, the cut pile carpets of low pile height showed considerably greater resilience than those of high pile height.

Triple interactions between fibers, pile heights, and pile types were found to be significant at the 0.01 level of probability. Mean scores showing the triple interactions are plotted in Figure 2. Cut pile carpets of low pile height consistently showed higher resilience than those of high pile height. This difference was greater in wool

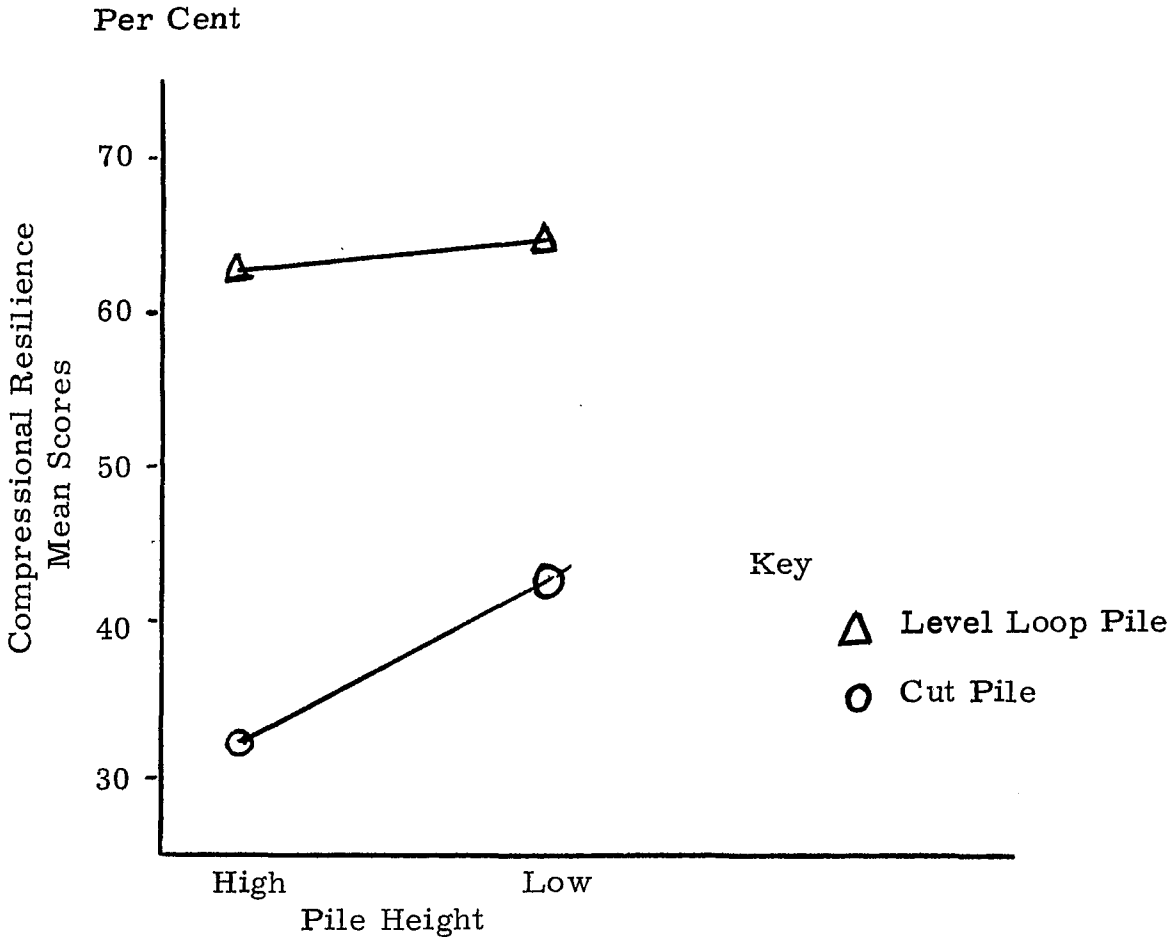


FIGURE 1

LABORATORY MEASUREMENTS OF THE PERCENTAGE COMPRESSIONAL RESILIENCE OF CARPETINGS SHOWING INTERACTIONS BETWEEN TWO PILE HEIGHTS AND TWO PILE TYPES

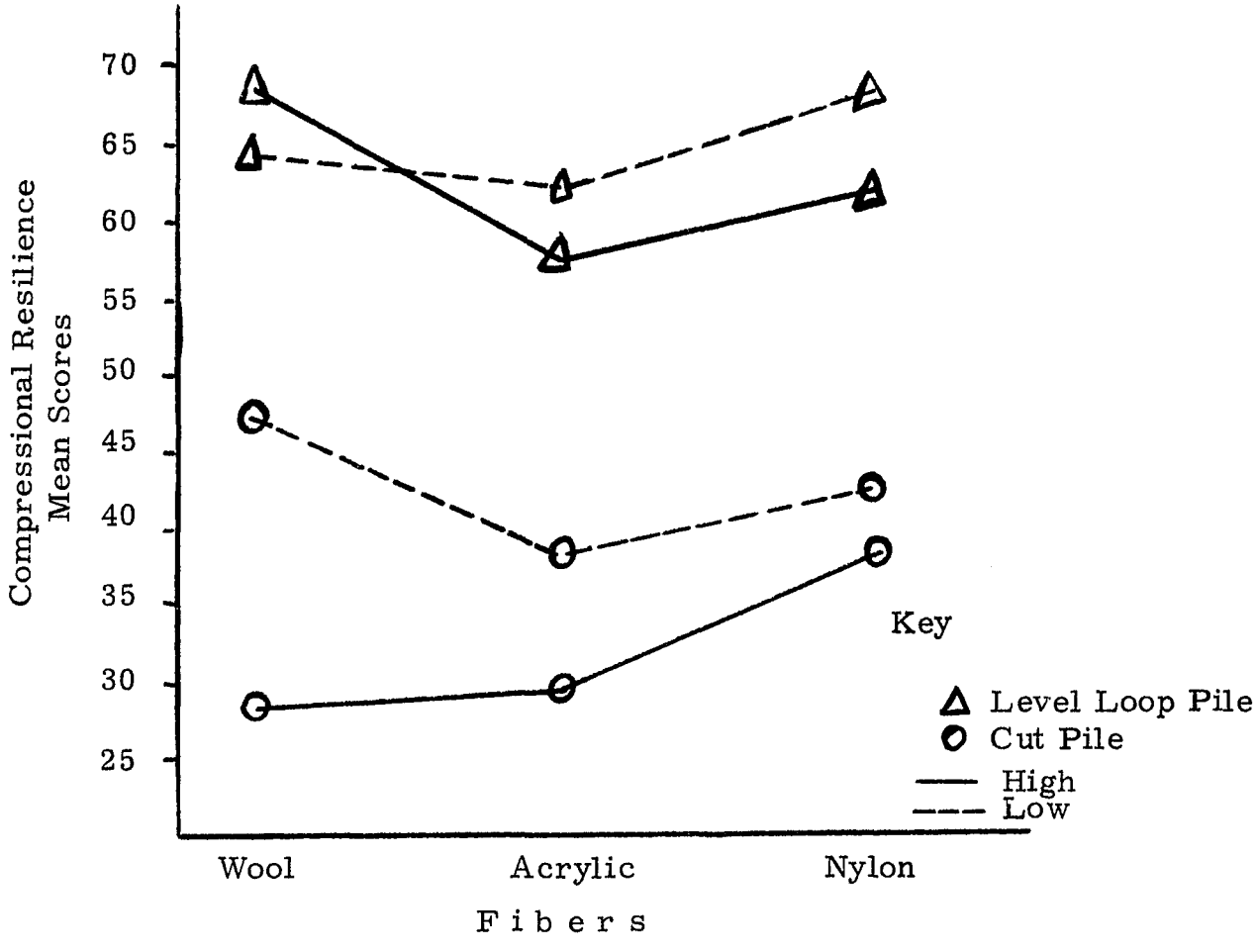


FIGURE 2

LABORATORY MEASUREMENTS OF THE PERCENTAGE COMPRESSIONAL RESILIENCE OF CARPETINGS SHOWING INTERACTIONS BETWEEN THREE FIBERS, TWO PILE HEIGHTS, AND TWO PILE TYPES

fibers than any other fiber. There was greater variation among the carpets of level loop construction. In this group, high pile height yielded higher compressional resilience for wool fibers. In the acrylic and nylon fibers, loop carpets of low pile height showed higher compressional resilience.

IV. COMPARISON OF FIBER RANKINGS BY SUBJECTIVE EVALUATION WITH OBJECTIVE, LABORATORY MEASUREMENT OF COMPRESSIONAL RESILIENCE

Table VIII shows the numbers of subjects ranking fibers by subjective evaluation of compressional resilience. Subjects consistently ranked nylon as the least resilient of the three fibers being tested. The majority of the subjects chose as most resilient, the wool carpets of low pile height and the acrylic carpets of high pile height for both pile types.

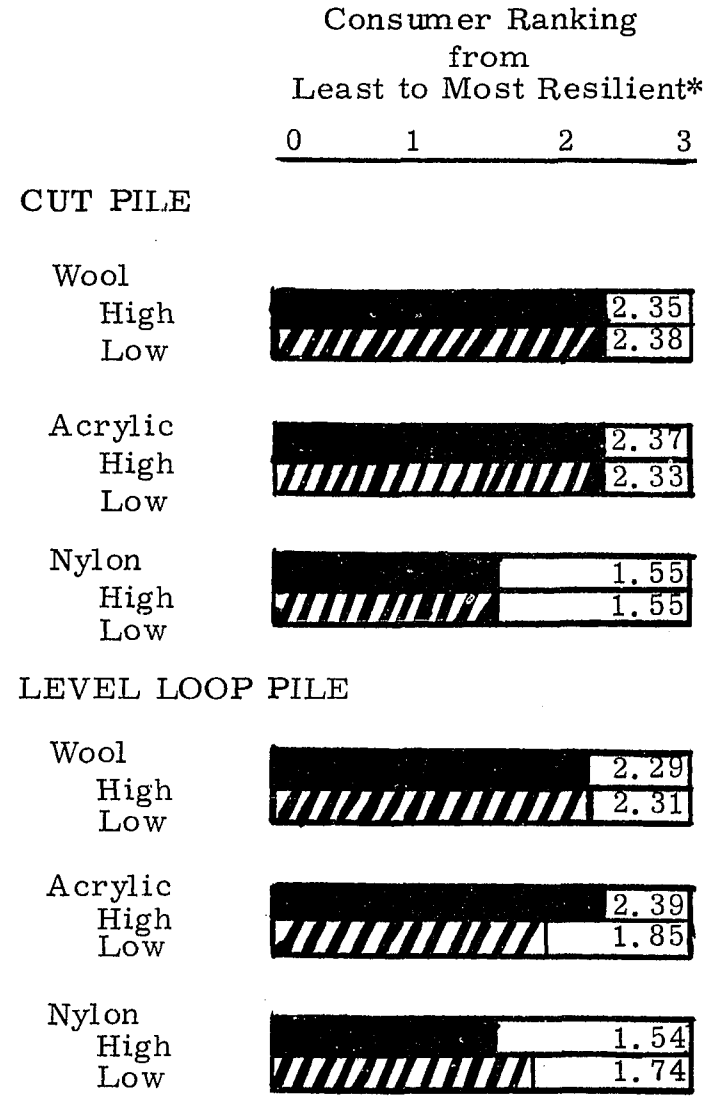
Rank-order correlations were considered for comparison of the laboratory data and the data obtained from the subjective evaluation of carpet compressional resilience. However, due to the insufficient number of pairs of data to be correlated, such a procedure was impossible. A graphic representation of the computed modes of the subjective rankings is shown as Figure 3. The percentage compressional resilience of the same carpetings is shown as Figure 4.

TABLE VIII

NUMBERS OF INDIVIDUALS RANKING FIBERS BY SUBJECTIVE EVALUATION OF COMPRESSIONAL RESILIENCE*

Construction Pile type Pile height	Ranking of Compressional Resilience	Fibers Wool	 Acrylic	 Nylon
		(Number of individuals)		
High cut pile	Most resilient	73	118	9
	In-between	114	65	21
	Least resilient	13	17	170
Low cut pile	Most resilient	101	90	9
	In-between	85	92	23
	Least resilient	14	18	168
High level loop	Most resilient	94	100	6
	In-between	81	88	31
	Least resilient	25	12	163
Low level loop	Most resilient	131	38	31
	In-between	38	91	71
	Least resilient	31	71	98

*Number of respondents 100
Number of carpet replications 2



*Based on computed modes for evaluations of 100 consumers.

Key: High Pile Height
Low Pile Height

FIGURE 3

CONSUMER RANKING OF FIBER RESILIENCE
OF CARPETS MADE OF
THREE FIBERS

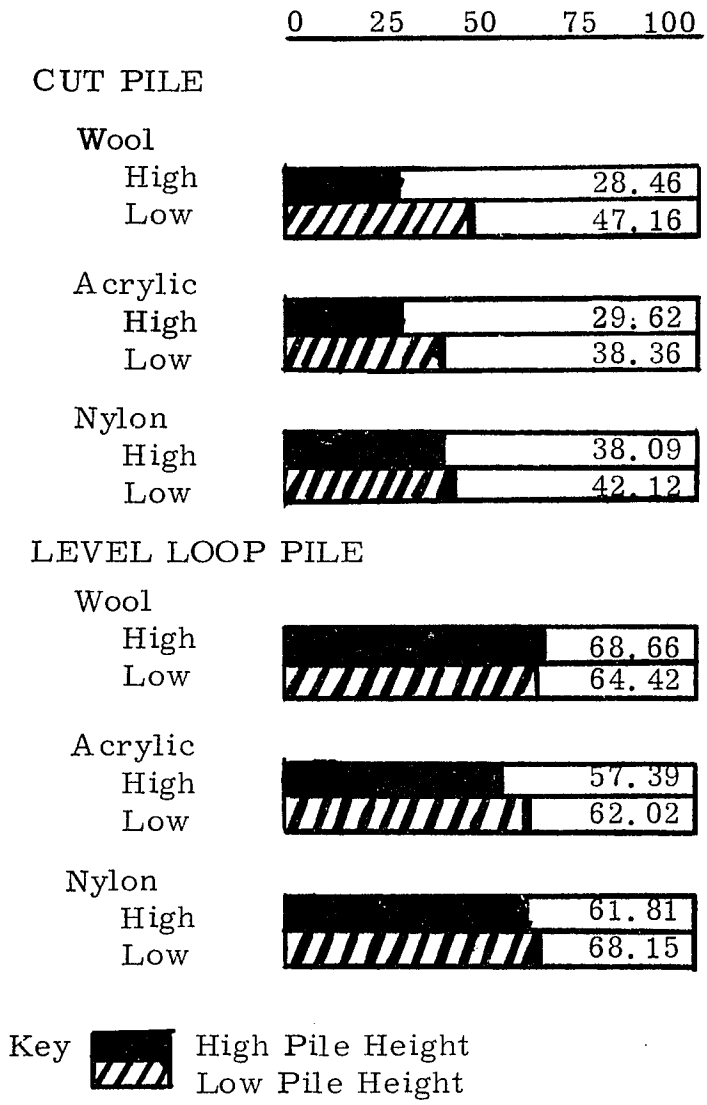


FIGURE 4

LABORATORY MEASUREMENT OF THE PERCENTAGE COMPRESSIONAL RESILIENCE OF CARPETS MADE OF THREE FIBERS

V. FACTORS WHICH CONSUMERS CONSIDER IMPORTANT FOR CARPET PURCHASE

Information Concerning the Subjects

Table IX shows data pertaining to the size of family groups represented by 100 consumers. The number of members in the families of the respondents averaged 2.8. Forty-three per cent of the respondents were members of two-person families while 20 per cent lived in four-person families. Twelve per cent of the respondents lived alone. The remaining 25 per cent were members of either three, five, or six-person families.

Of the 100 respondents, 51 per cent were engaged in work outside the home with 37 per cent of the total, employed full-time. The remaining 49 per cent were considered full-time homemakers.

Information Concerning Carpets Owned by the Subjects

All of the information supplied by these respondents reflected practices they had followed prior to the time of this study. Subjects were asked to indicate information concerning the rug or carpet which represented their last purchase. Table X shows the fiber content and recency of last carpet purchase for these respondents.

Eighteen per cent of these consumers reported their last carpet purchase to have occurred more than ten years prior to the time of the present study. Forty per cent of these consumers had purchased

TABLE IX

SIZE OF FAMILY GROUPS REPRESENTED BY ONE HUNDRED CONSUMERS

Size of Family	Per cent of Consumers Surveyed	Number in Family According to Age Level			
		Adults	13-18	Under 12	Total
One	12	12	0	0	12
Two	43	83	1	2	86
Three	12	29	4	3	36
Four	20	50	16	14	80
Five	9	23	11	11	45
Six	4	10	6	8	24
Totals	100	207	38	38	283

carpeting five years prior to this study. Twenty-eight per cent had purchased carpeting as recently as two years, while 23 per cent made their most recent carpet purchase within one year of the time the survey was made. Of this 23 per cent, two per cent had purchased carpets within one month of the time of data collection.

Table X shows the data concerning the fiber content of the last rugs and carpets purchased by the 100 consumers. Several individuals recorded information concerning two or more carpets which they owned, accounting for the total of 119 responses.

Forty-three per cent of the respondents reported wool carpeting as the last carpeting purchased. Forty-two per cent of these respondents had last purchased nylon carpeting; and 14 per cent, acrylic. Four respondents had purchased olefin carpeting. Five of the 100 respondents did not know the fiber content of their carpeting. Apparently none of the respondents owned polyester carpeting.

Eighty-seven per cent of these consumers reportedly received good service from these rugs and carpetings. The remaining 13 per cent gave various reasons for their reported lack of satisfaction. Cleanability and wear were factors causing the most dissatisfaction among these respondents. Eleven per cent of these consumers indicated that their carpeting was difficult to clean. Nine per cent complained that their carpeting showed worn areas, while eight per cent reported that their carpet did not seem to be as thick as when

TABLE X

FIBER CONTENT AND RECENCY OF LAST CARPET PURCHASE

Fiber Content	Recency in Years of Last Carpet Purchase					
	0-1	2	5	10	More than 10 years	Total*
	(Number of Consumers)					
Acrylic	4	7	3	0	0	14
Cotton	0	2	0	2	1	5
Nylon	10	13	15	4	0	42
Olefin	2	1	1	0	0	4
Polyester	0	0	0	0	0	0
Rayon	1	1	1	2	1	6
Wool	5	3	20	2	13	43
Do not know	1	1	0	0	3	5
Totals	23	28	40	10	18	119

*A number of the 100 consumers recorded information concerning more than one carpet.

purchased.

Other reasons cited less frequently were:

	Per Cent
Difficult to clean	6
Not pleased with color	6
Poor appearance after cleaning	4
Shows footprints	4
Matted areas under furniture do not regain original appearance	4
Noticeable fading	3

Factors Which Consumers Consider Important for Carpet Purchase

The third section of the questionnaire was designed to obtain information concerning factors which consumers consider important for carpet purchase. These 100 respondents were asked to indicate on the questionnaire (Appendix C) the first six factors they would consider to be most important to them if they purchased a carpet. Their responses were based on their knowledge obtained through their experiences with rugs and carpetings. Table XI shows the results obtained.

Seventy-six per cent of these 100 consumers indicated durability to be among the first six factors they would consider most important for future carpet purchase. Other factors cited were: does not show dirt or soil easily (74 per cent), quality (71 per cent), color (67 per

TABLE XI

PERCENTAGE DISTRIBUTION OF ONE HUNDRED CONSUMERS SELECTING SIX FACTORS CONSIDERED MOST IMPORTANT FOR FUTURE CARPET PURCHASE

Factor	Rank in Order of Importance						
	1	2	3	4	5	6	Total
	(Per Cent Distribution)						
Fiber content	19	5	10	5	4	7	50
Cut pile	1	2	1	1	0	1	6
Uncut pile	0	0	1	0	3	2	6
Sculptured appearance	1	1	0	0	0	3	5
Luxury look	0	2	2	3	1	2	10
Durability	11	18	16	12	12	7	76
Texture	1	2	7	5	7	7	29
Color	18	14	13	6	9	7	67
Price	3	14	9	12	8	14	60
Softness	0	2	1	1	1	3	8
Quality	30	19	7	6	5	4	71
General appearance	5	7	7	13	11	2	45
Springiness	1	2	3	5	9	5	25
Does not show footprints	1	3	2	13	7	3	29
Will not mat when shampooed	0	0	2	1	1	8	12
Does not mat under pressure	1	2	2	4	7	10	26
Does not show dirt and soil easily	8	7	16	13	15	15	74

cent), price (60 per cent), and fiber content (50 per cent). "Springiness" or resilience was chosen as one of the six most important factors by 25 per cent of the respondents.

CHAPTER V

DISCUSSION OF FINDINGS

Characteristics of the Carpets

The mean pile height of the cut pile carpets ranged from .296 inch for nylon to .579 inch for wool. The mean pile height of the level loop carpets ranged from .174 inch for acrylic of low pile height to .336 inch for wool of high pile height. Level loop pile measurements expressed in amounts of 0.001 inch appear to be inconsistent with the manufacturer's specifications. However, when expressed in tenths of an inch as were the manufacturer's specifications, only the level loop carpeting of high pile height of all three fibers differed from the manufacturer's specifications. These slight variations noted in pile height could result from the degree of twist in each loop or from the fact that an undetermined amount of pile height was not measurable due to the configuration of a loop surface as opposed to a cut pile surface.

Survey Information

Findings from the survey of information made available to the consumer at the time of carpet purchase indicate that the sales personnel recognized the need to appeal to the customer's desire for practicality. Sales personnel stressed such features as durability,

does not show footprints, and does not show dirt or soil. They placed emphasis on fiber properties and resilience as reasons for a carpet to wear well. Sales personnel volunteered some specification information during two-thirds of the store visits. In terms of total store visits, approximately 15 per cent of the sales personnel volunteered information concerning pile density. Such a percentage would seem low as compared with information supplied by a reputable carpet manufacturer which indicates that an increase of 50 per cent in carpet density increases carpet wear units by 125 per cent.[1]

The sales personnel avoided asking direct questions concerning the price range desired by these "customers". It may be interesting to note that this trend is in agreement with recommendations provided by a Salesman's Manual published by the American Carpet Institute.[2]

It would seem that much of the sales emphasis centers around aesthetic aspects of carpeting including color, texture, and beauty. Such factors are not subject to scientific laboratory analysis. The selection and purchase of carpeting on the basis of aesthetic features depends upon the subjective evaluation of the customer. From the data, it appears that the customer has few concrete, scientifically-based

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[1]Trend Mills, Inc., Trend Contract (Rome, Georgia: Trend Mills, Inc., [n.d.]), pp. 6-7.

[2]American Carpet Institute, Salesmanship From the Customer's Point of View, Session #2 (New York: American Carpet Institute, Inc., [n.d.]), p. 14.

facts at his or her disposal. Therefore, the selection and purchase of carpeting must be based largely upon the consumer's subjective evaluation of the carpeting.

Laboratory Measurement of Fiber Resilience

The findings concerning the laboratory measurement of fiber resilience indicate that of the three carpet fibers tested, the nylon fibers showed the greatest compressional resilience; wool, second; and acrylic, third in compressional resilience. The level loop pile carpets of all three fibers showed greater compressional resilience than the corresponding cut pile carpets. With one exception, carpets of low pile height showed greater resilience than high pile height in both cut pile and level loop carpets. The level loop wool carpet of high pile height showed greater resilience than the level loop wool carpet of low pile height.

These findings would suggest that for the three fibers tested, wool, acrylic, and nylon, greater resilience can be achieved through the selection of level loop pile as opposed to plush cut pile. If cut pile carpeting is selected, low pile height would be expected to show greater resilience than high pile height provided other variables were controlled. If wool carpeting of cut pile is selected, and if higher compressional resilience is considered important, low pile height should be selected in preference to high pile height.

Comparison of the Subjective and Objective Evaluations of Resilience

The majority of the subjects chose as most resilient, the wool carpets of low pile height and the acrylic carpets of high pile height for both the cut pile construction and the level loop construction. Of the three fibers being tested, subjects consistently ranked nylon fibers as the least resilient. Based on the findings concerning the subjective evaluation of the test carpets, it would appear that subjects had greater difficulty in ranking the fiber resilience of the wool carpets and the acrylic carpets than with determining the ranking for the nylon carpets.

In Benson's study comparing wool and rayon carpeting, ". . . wool carpets tend to gain in their ability to 'spring back' after the application of pressure and synthetic carpets tend to lose their 'springiness'"[3] over a period of time. In the present study, nylon was evaluated as least resilient by subjective evaluation and as most resilient by laboratory measurement. It would appear that although the nylon carpet fibers showed superior initial springiness, fatigue might have occurred when the nylon carpetings were subjected to repeated pressure over a longer period of time.

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[3]Elizabeth Wells Benson, "An Evaluation of Selected Types of Synthetic, Wool and Synthetic, and Wool Carpeting," (Unpublished Master's thesis, Michigan State College of Agriculture and Applied Science, Lansing, Michigan, 1952), p. 64.

Consumer Questionnaire Information

A number of factors which might have some relation to the resilience or springiness of carpeting were included in the questionnaire list of reasons for a carpet not wearing well. These factors and the frequencies with which the consumers named these factors are indicated below. Of the 100 respondents, four per cent complained that their carpeting showed footprints while four per cent mentioned matted areas under furniture which did not regain the original appearance. Eight per cent of these respondents indicated that their carpeting did not seem to be as thick as it was when purchased. None of the respondents reported their carpeting to be hard to walk on or tiring.

As reported in Chapter II, literature related to the consumer selection of carpeting indicates that color is the first and major key to the sale of carpeting.[4] However, based on the data obtained from carpet owners, the factors of durability, soilability, and quality slightly outweighed color in apparent importance.

In terms of the present study, the key factor included in the list was springiness or resilience. "Springiness" or resilience was chosen as one of the six most important factors by 25 per cent of the

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[4]"Color Plays Important Part in Guide to Care of Carpet," 1967 Tufting Industry Review (Dalton, Georgia: Tufted Textile Manufacturers Association, 1967), p. 148.

respondents. Included in the list of factors considered important for future carpet purchase, were other factors which may have some relation to the springiness or resilience of carpet pile. Other factors which may contribute to this quality were rated by the consumers as follows: does not show footprints (29 per cent), will not mat when shampooed (12 per cent), and does not mat under pressure (26 per cent).

The results of this aspect of investigation suggest that the quality of fiber resilience has importance in terms of the consumer selection of carpeting. It may be that such factors as durability and quality are general terms which include such features as resilience or springiness. It may be that resilience is not a factor which is frequently verbalized in describing desirable carpeting but which may nevertheless influence to some degree the consumer selection and purchase of carpeting.

CHAPTER VI

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

I. SUMMARY AND CONCLUSIONS

This investigation was undertaken because of an interest in those factors influencing the consumer selection of carpeting. To the extent that the consumer selection of carpeting is influenced by considerations other than the scientific aspects, an understanding of factors motivating the consumer's subjective evaluation of carpeting appears to be important to an interpretation of their significance in the actual selection and purchase of carpeting.

The present study was designed to investigate those factors influencing the consumer selection of carpeting. The major purpose of this study was to investigate compressional resilience as a factor contributing to the selection of carpeting. The factor of specific interest was the ability of consumers to recognize resilience of carpeting and to detect differences in resilience which might be due to fiber content.

The data collection required four different aspects of investigation. These four parts were:

1. Survey of information available to the consumer at the time of carpet purchase.

2. Laboratory testing to measure fiber resilience.

3. Subjective test to indicate differences in fiber resilience.

4. Questionnaire to determine factors which consumers consider important for carpet purchase.

Summary and conclusions are presented for each of the four aspects of investigation.

Survey of Information Available to the Consumer at the Time of Carpet Purchase

Four married home economists, assuming the roles of consumers interested in purchasing carpet for their living areas, called upon each of ten randomly selected retail carpet establishments in Greensboro, North Carolina. Each participant was instructed to ask leading questions in order to obtain information from the sales person concerning suggested fibers and wearing qualities of the suggested fibers and carpets. Following each shopping experience, the participants recorded the responses of the sales person to the questions and noted additional information volunteered by the sales person. Certain procedures were established to reduce error which might be present in the early interviewing technique of each individual. One such procedure required that the data from the first two store visits of each participant, in which eight different retail carpet establishments

were represented, would not be included in the results. Therefore, the data for this section of the study represents information from a total of 32 store visits.

Eighty-one per cent of the sales personnel suggested acrylic fibers while 78 per cent suggested nylon fibers. Other fibers which were suggested less frequently included wool, polyester, and olefin fibers. Sales personnel stressed such fiber features as "durability," "does not show footprints," and "does not show dirt or soil." They placed emphasis on fiber properties and resilience as reasons for a carpet to wear well.

The sales person asked for the participant's color preference prior to requesting other information which might guide him in suggesting an appropriate carpet during 14 of the 32 store visits. Sales personnel volunteered various specification information during two-thirds of the store visits. In terms of total store visits, approximately 15 per cent of the sales personnel volunteered information concerning pile density.

It seems that the carpet sales personnel recognized the need to appeal to the consumer's desire for practicality by mentioning such features as durability, fiber properties and resilience. In addition, much of the sales emphasis centered around aesthetic aspects of carpeting such as color, texture, and beauty. The selection and

purchase of carpeting on the basis of aesthetic features depends upon the subjective evaluation of the customer. From the data, it would appear that the customer has few concrete, scientifically-based facts at his or her disposal. Therefore, the selection and purchase of carpeting must be based largely upon the consumer's subjective evaluation of the carpetings.

Laboratory Testing to Measure Fiber Resilience

The 12 carpets used in this study were all of tufted construction and included three fiber types - wool, acrylic, and nylon. Each of these carpet fibers was to be manufactured in two pile types and two pile heights within each pile type.

A. Plush cut pile
   1. Cut pile with high pile height (0.4 to 0.6 inch).
   2. Cut pile with low pile height (0.2 to 0.4 inch).

B. Level loop pile
   1. Uncut pile with high pile height (0.4 to 0.6 inch).
   2. Uncut pile with low pile height (0.2 to 0.4 inch).

Two replications of each of the 12 carpets were used for the subjective evaluation of fiber resilience.

Pile height and compressional resilience measurements were taken with the C & R Tester. Results of laboratory tests to determine pile height and pile density of the carpets were included.

Analysis of compressional resilience of the carpetings was based

on ten measurements for each carpet or a total of 120 measurements of compressional resilience. An analysis of variance for a 3 x 2 x 2 factorial design was performed on the measurements of compressional resilience of the carpets. Two orthogonal comparisons were made: the first to compare the resilience of wool carpeting versus the combined average resilience for acrylic and nylon carpetings and the second to compare the resilience of acrylic carpeting versus that for nylon carpeting.

Differences were analyzed between fibers, between pile types and between pile heights. Interactions were also analyzed between fibers x pile types, fibers x pile heights, pile types x pile heights, and between fibers x pile types x pile heights.

There was a significant difference at the 0.01 level between fibers. Based on total scores, the laboratory evaluation of compressional resilience showed nylon to be highest; wool, second; and acrylic, third in resilience.

The differences among the two levels of pile type were significant at the 0.01 level. Level loop pile showed consistently greater resilience for all fibers than cut pile.

There was a significant difference at the 0.01 level between the compressional resilience for the two levels of pile height. Low pile height consistently showed higher resilience than high pile height for

cut pile carpets. The same was true for level loop carpets with one exception. The level loop wool carpet of high pile height showed greater resilience than the level loop wool carpet of low pile height. These findings suggest that, generally speaking, greater resilience can be achieved through the selection of level loop carpeting of low pile height than through the selection of the other combinations of pile type and pile height tested.

Subjective Test to Indicate Differences in Fiber Resilience

The subjects for this portion of the investigation were 100 women selected from Extension Homemakers, garden clubs, church groups, University faculty members, staff, and faculty wives. All subjects were owners of soft floor covering in the form of commercially-made rugs or carpetings. The women were selected from both rural and urban areas and were almost equally divided between working women and homemakers.

The 12 carpets used in this study were subjected to laboratory testing to determine compressional resilience. Two replications of each of the 12 carpets were used for the subjective evaluation of fiber resilience. The 24 test carpets were arranged in eight groupings. One test carpet of each of the three different fibers was included in each of the eight groupings. Subjects evaluated the test carpets by walking on them while wearing standardized footwear and ranking the

test carpets in each grouping on a scale of most resilient or "springy" to least resilient.

Rank-order correlations were considered for comparison of the laboratory data and the data obtained from the subjective evaluation of carpet compressional resilience. However, due to the insufficient number of pairs of data to be correlated, such a procedure was impossible. Therefore, graphic representations of the computed modes of the subjective rankings and the percentage compressional resilience of the same carpetings were made.

The majority of the subjects chose as most resilient, the wool carpets of low pile height and the acrylic carpets of high pile height. These findings applied to both cut pile and level loop pile carpets. Subjects consistently ranked nylon as the least resilient of the three fibers being tested. It would appear from the findings that subjects experienced greater difficulty in ranking the fiber resilience of the wool carpets and the acrylic carpets than with ranking the nylon carpets.

Questionnaire to Determine Factors Which Consumers Consider Important for Carpet Purchase

The 100 consumers participated in two aspects of the present study. First, they responded to the questionnaire concerning factors which consumers consider important for carpet purchase. Second, these same subjects responded to the subjective test to evaluate the fiber resilience of the test carpets.

Forty-three per cent of these respondents were members of two-person families while 20 per cent lived in four-person families. Twelve per cent of the respondents lived alone.

Of the 100 respondents, 51 per cent were engaged in work outside the home with 37 per cent of the total, employed full-time. The remaining 49 per cent were considered full-time homemakers.

The majority of these respondents had made their most recent carpet purchase from two to five years prior to the time of data collection. Thirty-six per cent of these consumers had purchased carpeting five years prior to this study while 22 per cent has purchased carpeting as recently as two years prior to the time of data collection. Seventeen per cent of these consumers made their most recent carpet purchase within one year of the time of the present study.

Forty-three per cent of the respondents indicated that wool carpeting represented the last carpeting purchased prior to the time of the study. Forty-two per cent had last purchased nylon carpeting; and 14 per cent, acrylic.

Eighty-seven per cent of these consumers reportedly received good service from these rugs and carpetings. Cleanability and wear seemed to be the factors causing the most dissatisfaction among the remaining 13 per cent who reported lack of satisfaction with their rugs or carpetings.

When asked to indicate the first six factors they would consider

to be most important to them if they purchased a carpet at some time after the present study, 76 per cent chose durability. Other factors cited frequently were: does not show dirt or soil easily (74 per cent), quality (71 per cent), color (67 per cent), price (60 per cent), and fiber content (50 per cent). "Springiness" or resilience was selected as one of the six most important factors by 25 per cent of the respondents.

Based on the hypotheses tested, the following conclusions were drawn:

Hypothesis 1: Differences exist in the resilience of carpeting made of three different fibers.

Differences in compressional resilience of carpeting between the three fibers tested were significant at the 0.01 level. The compressional resilience of wool carpeting was found to be significantly greater than the combined average resilience of acrylic and nylon carpetings. The comparison of resilience of nylon carpetings versus resilience of acrylic carpetings showed a highly significant difference (0.01 level) with nylon having the greater resilience. Based on total scores of compressional resilience measurements for each carpet fiber, the laboratory evaluation of compressional resilience showed nylon to be highest in resilience; wool, second; and acrylic, third in resilience.

Hence, Hypothesis 1 was confirmed.

Hypothesis 2: A relation exists between the laboratory evaluation of resilience and the consumer evaluation of resilience of carpeting made of three different fibers.

An examination was made of the graphic representations showing the computed modes of the subjective rankings and the percentage compressional resilience of the same carpetings. The laboratory measurement of compressional resilience showed nylon to be most resilient; wool, second; and acrylic, least resilient. The consumer ranking of the same carpetings showed wool fibers to be most resilient in the low pile height, and acrylic, in the high pile height for both the cut and the level loop carpets. Subjects consistently ranked nylon as least resilient.

It should be recognized that laboratory conclusions were based on 0.001 inch measurements which tend to magnify minute differences. In cases where subjects experienced difficulty in ranking the three carpets in a grouping, subjects were forced to make an arbitrary choice by the very nature of the subjective test. Such responses not based on true conviction of differences in resilience could distort the findings to the extent that the differences were not distinguishable to an individual walking on the test carpets. The extent to which the subjective analysis data could have been subject to distortion is not known.

Hypothesis 3. The consumer selection of carpeting is influenced by differences in the resilience of carpeting made of different fibers.

"Springiness" or resilience was chosen by 25 per cent of the respondents as one of the six factors considered most important for future carpet purchase. Findings suggest that the quality of fiber resilience has importance with respect to the consumer selection of carpeting. It may be that such factors as durability and quality are general terms used by consumers to include many features such as resilience or springiness. It may be that resilience is not a factor which is frequently verbalized in describing desirable carpeting but which may nevertheless influence to some degree the consumer selection and purchase of carpeting.

Thus, utilizing the methods available to us at the time of the present study, Hypotheses 2 and 3 were unconfirmed.

II. RECOMMENDATIONS FOR FURTHER STUDY

Further research in the area of the consumer selection of carpeting is recommended as a result of this study.

1. Additional research involving floor trials of the carpetings used in this study might provide more information concerning relations which may exist between the objective, laboratory evaluation and the subjective consumer evaluations of the same carpetings.

2. Studies could be conducted to determine similarities and

differences in factors considered important for carpet purchase by various age groups and persons of different socioeconomic levels.

3. Research could be undertaken to investigate whether each subject's responses concerning factors considered important for future carpet purchase are reflected in the carpeting owned by the subject.

4. Study might be done to determine whether the responses of consumers to factors considered important for carpet purchase would differ if tested prior to the time of carpet purchase and retested immediately following actual carpet purchase.

5. Research could be undertaken to investigate the continuous relation between the subjective and objective evaluations of carpetings by making periodic measurements of the resilience of the same carpetings undergoing subjective evaluation.

6. The more sensitive scaling methods of paired comparisons or magnitude estimation might detect systematic relations between factors to be investigated which less sensitive methods fail to disclose. The number of subjects and time per subject required by these two methods were prohibitive for this study.

As the link between the manufacturer and the consumer, the carpet retailer can influence consumer opinion concerning the products of a particular carpet manufacturer. Such influence can be transmitted to the consumer by personal endorsement or by the

retailer recommending and selling a carpet which is unsuited to the needs and desires of the consumer. If the retail sales person has an adequate understanding of different carpet fibers and different carpet constructions and their influence on the satisfaction derived from carpeting, he is better able to assist the consumer in making an appropriate carpet selection which is tailored to the needs and desires of that consumer. The following recommendations are made in the interest of both the consumer and the carpet manufacturer:

1. The carpet manufacturing industry might find it profitable to conduct training programs to assist retail sales personnel in acquiring a greater knowledge of carpet fibers and carpet constructions and a greater understanding of ways in which these factors affect the varied aspects of carpeting.

2. It is recommended that carpet manufacturers establish comprehensive labeling practices. It is felt that informative labels could be helpful in assisting both the consumer and the retail sales personnel. Carpet labels might include specification information to give the consumer a concrete objective basis by which to compare different carpetings. Data concerning fiber content, pile height in relation to ounces of pile yarn per square yard, compressional resilience, cleanability, and fading characteristics might represent suitable information which could be provided.

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APPENDIX

APPENDIX A

SURVEY CHECK SHEET

1. Fiber content suggested by salesperson:

1	Acrylic		Polyester
	Cotton		Rayon
2	Nylon		Wool
	Olefin		Other

2. Why did the salesperson suggest this fiber?

1, 2	Beauty	1, 2	Does not show footprints
1, 2	Texture		Does not show dirt or soil
1, 2	Color		Good value for money
1, 2	Durability		Inexpensive
	Pattern		Quality

Other (1, 2) Cleanability

3. Does this carpet wear well? If yes, why?

1	Thickness	1, 2	Texture
1	Density	1, 2	Pile height
	Fiber properties	1	Resilience
	Color		

Other

4. Salesperson asked:

x	For color preference first
	For color preference but later in interaction
	What color the room or area was
	What fiber was desired
	Number in family and ages
	For price range desired
	How much this room or area is used

Other: x Size of room

	Salesperson suggested a color first
	Salesperson tried to sell specific carpet

x Salesperson told features of several carpets and left decision up to customer

____ Salesperson had obvious bias but did not try to hard-sell one carpet

5. Did salesperson offer specification information?

Yes x ; No ____. If so, what information was volunteered?

x Density of carpet in which you show most interest

x Pile height of carpet in which you show most interest

____ Yarn structure

x Woven or tufted

x Resilience

Other: please specify Salesman (owner) was very talkative. He really didn't have any detailed knowledge of fiber differences. When asked the differences between polyester, acrylic and nylon he said "They are about the same - different companies use different names for similar fibers." He offered to show samples in the home. Gave considerable literature to read.

APPENDIX B

CARPET EVALUATION SHEET NAME_____

So that everyone will have the same footwear, flat-heeled slippers in assorted sizes are provided for you to wear while evaluating the carpet samples. Please select a comfortable pair and wear them while you evaluate the carpet samples.

Don't let your neighbor know how you are rating the carpets. We value your opinion!

The carpet samples before you are placed in groups I, II, III, IV, V, VI, VII, and VIII. The individual carpets within each group are labeled with two letters. As you walk on the carpet samples, please choose the carpet in each group which feels most resilient (springy) to you. Place the two-letter label of that carpet in the appropriate blank below. Then rate the remaining two samples in that group on their resilience (springiness). Use this same procedure as you evaluate the remaining seven groups of carpet samples.

Please evaluate the groups of carpet samples in the following order:

1. GROUP _____
   Most resilient _____
   In-between _____
   Least resilient _____

2. GROUP _____
   Most resilient _____
   In-between _____
   Least resilient _____

3. GROUP _____
   Most resilient _____
   In-between _____
   Least resilient _____

4. GROUP _____
   Most resilient _____
   In-between _____
   Least resilient _____

5. GROUP _____
   Most resilient _____
   In-between _____
   Least resilient _____

6. GROUP _____
   Most resilient _____
   In-between _____
   Least resilient _____

7. GROUP _____

Most resilient	_____
In-between	_____
Least resilient	_____

8. GROUP _____

Most resilient	_____
In-between	_____
Least resilient	_____

APPENDIX C

CARPET OWNERS' QUESTIONNAIRE NAME_____

Please answer the following questions by checking the appropriate blank or blanks.

Have you owned, or do you presently own, a rug or carpeting (soft floor covering)? Yes ____ No ____

Number in your family living at home _____
Adults_____ Under 12 years_____ 13-18_____ Pets_____

If you work outside the home, please check the following:
Part-time_____ Full-time_____

When did you last buy carpeting?
Last month_____; within the last year_____; 2 years ago_____
5 years ago_____; 10 years ago_____; more than 10 years ago_____

What was the fiber content?

_____acrylic _____polyester

_____cotton _____rayon

_____nylon _____wool

_____olefin (indoor-outdoor) _____don't know

Other fiber - Please specify _____

Has it given good service? Yes_____; No_____

If not, why?

_____ poor appearance after cleaning
_____ soils easily
_____ difficult to clean
_____ shows footprints
_____ shows worn areas
_____ noticeable fading
_____ matted areas under furniture do not regain original appearance

_____ not pleased with color
_____ hard to walk on; tiring
_____ doesn't seem to be as thick as it was when purchased

Other - Please specify _____

_____

Knowing what you know, through experience with carpets, what would you look for in buying a carpet for your living area?

Please number in order of importance to you the first six factors considered most important for future carpet purchase. Number 1 would be most important to you.

_____ Specific fiber content

_____ Cut pile (plush appearance)

_____ Uncut pile (loops)

_____ Sculptured appearance (high-low effect)

_____ Luxury look

_____ Texture

_____ Does not show footprints

_____ Color

_____ Springiness (resilience)

_____ Price

_____ Softness

_____ Quality

_____ Will not mat when shampooed

_____ Durability

_____ General appearance

_____ Does not show dirt and soil easily

_____ Does not mat under pressure