DOCUMENT RESUME

ED 173 175 **SE 028 444**

AUTHOR Elmore, Patricia B.; Vasu, Ellen S.

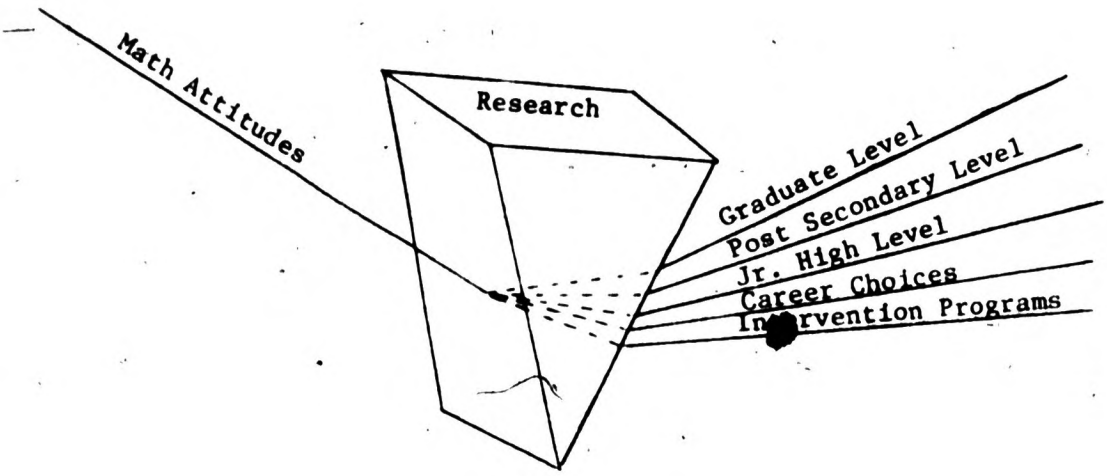
TITLE A Spectrum Analysis of Attitudes Toward Mathematics: Multifaceted Research Findings.

PUB DATE Apr 79
NOTE 16p.; Paper presented at the annual meeting of the American Educational Research Association (San Francisco, California, April 8-12, 1979); Contains occasional light and broken type

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Achievement; *Anxiety; *Attitudes; *Career Opportunities; Higher Education; Mathematics Curriculum; *Mathematics Education; Mathematics Instruction; *Research; Secondary Education; Statistics; Symposia
IDENTIFIERS *American Educational Research Association

ABSTRACT

This symposium includes five presentations of studies of mathematics attitudes at three educational levels: junior high, postsecondary, and graduate school. The studies have implications in the fields of mathematics education, educational research, academic advisement, and career counseling. The studies identify the extent of the problem of mathematics anxiety of avoidance. Abstracts of the papers are presented. Paper topics include: (1) a study of the attitudes of junior high school students toward mathematics; (2) student's attitudes toward mathematics and their relationship to learning in required mathematics courses in selected postsecondary institutions; (3) mathematics attitudes: an intervention study; (4) math anxiety: its impact on graduate level statistics achievement; and (5) math avoidance and pursuit of fantasy careers. (MP)



A SPECTRUM ANALYSIS OF ATTITUDES TOWARD MATHEMATICS:

MULTIFACETED RESEARCH FINDINGS

by

Patricia B. Elmore

&

Ellen S. Vasu

A Symposium Presented at the Annual Meeting of

The American Educational Research Association,

San Francisco, California, April 8-12, 1979

TABLE OF CONTENTS

LIST OF SYMPOSIUM PARTICIPANTS

A SPECTRUM ANALYSIS OF ATTITUDES TOWARD MATHEMATICS: MULTIFACETED RESEARCH FINDINGS

Organizer: Patricia B. Elmore
Guidance and Educational Psychology Department
Southern Illinois University
Carbondale, IL 62901

Chairperson: Ellen S. Vasu
Institute for Research in Social Science
University of North Carolina
Chapel Hill, NC 27514

Participants: Katherine Pedersen
Mathematics Department
Southern Illinois University
Carbondale, IL 62901
"A Study of the Attitudes of Junior High School Students toward Mathematics"

Dorothy R. Bleyer
School of Technical Careers
Southern Illinois University
Carbondale, IL 62901
"Students' Attitudes toward Mathematics and Their Relationship to Learning in Required Mathematics Courses in Selected Post-Secondary Institutions"

Carol Freeman
Mathematics Department
Fontbonne College
St. Louis, MO 63101
"Mathematics Attitudes: An Intervention Study"

Patricia B. Elmore
Guidance and Educational Psychology Department
Southern Illinois University
Carbondale, IL 62901
"Math Anxiety: Its Impact on Graduate Level Statistics Achievement"

Barbara L. Benton
Counseling and Consultation Service
Ohio State University
Columbus, Ohio 43210
"Math Avoidance and Career Fantasy Pursuits"

Discussants: William G. Miller
Industrial Education Department
Iowa State University
Ames, Iowa 50010

Virginia Britton
Counseling Center
Southern Illinois University
Carbondale, IL 62901

A SPECTRUM ANALYSIS OF ATTITUDES TOWARD MATHEMATICS: MULTIFACETED RESEARCH FINDINGS

Symposium Summary

The symposium includes five presentations of studies of mathematics attitudes at three educational levels--junior high, post-secondary, and graduate school. The participants' experience in teaching and using mathematics at all these educational levels has made them aware of the symptoms of mathematics anxiety and avoidance. Observations of students at the college level, including the distribution of males and females in advanced mathematics courses and the separation of sexes by choice of major field, have supported researchers' (Aiken, Fennema and Sherman, Fox and Tobias) declaration of mathematics and science-related fields as a male domain and Lucy Sells' identification of mathematics as the "critical filter" to career choices.

The studies have implications in the fields of mathematics education, educational research, academic advisement, and career counseling. The studies identify the extent of the problem of mathematics anxiety or avoidance at the junior high, post-secondary and graduate school levels. The results provide a basis for reevaluating mathematics education at the elementary and secondary levels and for designing intervention techniques at those levels to alleviate negative attitudes toward mathematics.

The Chairperson is Ellen S. Vasu, Associate Director of the Institute for Research in Social Science at the University of North Carolina at Chapel Hill. She will introduce the presenters and provide a review of the literature pertinent to the studies presented.

The first presentation, "A Study of the Attitudes of Junior High School Students toward Mathematics," will be given by Katherine Pedersen, Assistant Professor of Mathematics at Southern Illinois University at Carbondale. The objectives of this study were to assess cognitive and affective mathematics related variables and demographic data using 7th and 8th grade students enrolled in junior high schools located in Southern Illinois; and to assess parental attitudes and career data which have been hypothesized as affecting the attitudes of students toward mathematics.

The second presenter, Dorothy Bleyer, Acting Chairperson of Graphic Communications in the School of Technical Careers at Southern Illinois University at Carbondale, will discuss "Students' Attitudes toward Mathematics and Their Relationship to Learning in Required Mathematics Courses in Selected Post-Secondary Institutions." The findings support those researchers who report predominantly negative attitudes toward mathematics among college students. There were observable differences in the response patterns of students according to sex and to type of institution.

The third study, "Mathematics Attitudes: An Intervention Study," will be presented by Carol Freeman, Chairperson of the Mathematics Department at Fontbonne College in St. Louis, Missouri. This study concerned the effects of an intervention on undergraduate students in a remedial mathematics course and adults from an urban area. The two main components of the intervention were the teaching of mathematics skills and assertive training.

The fourth presentation, "Math Anxiety: Its Impact on Graduate Level Statistics Achievement," will be given by Patricia B. Elmore, Associate Professor of Guidance and Educational Psychology at Soutern Illinois University at Carbondale. The study investigated the effect of mathematics attitudes, previous mathematics coursework, mathematics and spatial abilities, and

masculinity-femininity of interest pattern on achievement in applied statistics for men and women students.

Barbara L. Benton of the Counseling and Consultation Service at Ohio State University, will discuss "Math Avoidance and Career Fantasy Pursuits." The primary focus of this study was to investigate the relative influence of several constructs hypothesized to affect academic major/career choice of college students. The secondary focus of this study included examining discrepancies between pursued and rejected careers and assessing the occurrence and magnitude of discrepancies across career characteristics.

The discussants are William C. Miller, Professor of Industrial Education at Iowa State University; and Virginia Britton, Coordinator of the Women's Studies Program at Southern Illinois University at Carbondale. Dr. Miller's expertise in measurement and experimental design and Ms. Britton's special interest in women's programs provide diversity in the focus of their discussion of the symposium.

A STUDY OF ATTITUDES OF JUNIOR HIGH SCHOOL STUDENTS TOWARD MATHEMATICS

Katherine Pedersen
Patricia B. Elmore
Dorothy R. Bleyer
Southern Illinois University at Carbondale

Research has indicated that the junior high years are a critical period for the formation of attitudes toward mathematics and for evidence of their influence upon further course-taking decisions and career choices. The purpose of this study was to investigate, at the junior high level, the effects of selected student variables and parent variables upon student attitudes toward mathematics, achievement in mathematics, subsequent academic choices and career interests.

The sample was drawn from thirteen junior high schools in a predominantly rural midwestern area. The school population ranged in ethnicity from all-white to predominantly black and from upper-middle to lower socioeconomic levels. A general assessment of all students in grades 7 and 8 was made to measure the following variables: mathematics achievement, spatial visualization ability, attitudes toward mathematics, intentions for mathematics course-taking at the secondary level, and course interest. A questionnaire for the parents assessed their perceptions of their child as a learner of mathematics and of mathematics as a male domain.

The statistical treatment of the data was designed to answer the following questions:

1. What was the effect of the sex of a junior high student on attitudes towards mathematics, math achievement, spatial visualization ability, career interests, and parent variables?
2. What was the effect of the cognitive variables and demographic data on attitudes toward mathematics?

3. What percentage of the variance in mathematical achievement was accounted for by the variance in the other variables?

STUDENTS' ATTITUDES TOWARD MATHEMATICS AND THEIR RELATIONSHIP TO LEARNING IN REQUIRED MATHEMATICS COURSES IN SELECTED POST-SECONDARY INSTITUTIONS

Dorothy R. Bleyer
Southern Illinois University at Carbondale

The purpose of this study was threefold: 1) to identify those attitudes toward mathematics that initially exist among students in selected first-level required mathematics courses at the tertiary level; 2) to assess the relationship of those attitudes to other subject variables such as sex, age, and institutional type; and 3) to study the effect of those attitudes upon learning in the selected courses. Specifically, the study attempts to answer the following questions:

1. Do college students entering freshman-level required mathematics courses generally hold positive or negative attitudes toward the subject matter?
2. Are attitudes toward mathematics related to sex, age, or institutional type?
3. Do the initial attitudes affect the learning of mathematics in the respective courses?

The sample (N=420) was comprised of students enrolled in first-level required mathematics courses in three types of post-secondary institutions in the Midwest--a state university, a technical institute, and a community college. It consisted of 320 males and 100 females.

The instruments used included Dutton's Mathematics Attitude Scale (1954) supplemented with demographic items, and pretest and posttest forms for each of the mathematics courses used in the study.

The attitude scale and pretests were administered to all subjects at the beginning of Fall Semester, 1976. The posttest was included as a

portion of the final examination to the 232 students remaining in the courses. Demographic data including age, sex, and ACT mathematics subscores were retrieved from the students' records with their written consent. Appropriate SPSS programs were used to compute additional measures, to analyze the data, and to test the hypotheses. Individual attitude scores and measures of learning were calculated for each subject. The measures of learning were adjustments of raw gain scores to relative gains in order to negate the ceiling effect of high pretest scores. Prerequisite knowledge in mathematics (represented by ACT math subscore) was controlled when assessing the relationship between attitudes and learning.

Analyses revealed that a majority of the subjects (58%) held attitudes toward mathematics that were significantly negative ($p < .05$). Separate analyses by institutional subgroups showed that predominantly negative attitudes toward mathematics were held by a majority of both the university and technical institute students, while negative and positive attitudes were fairly equally distributed among the community college group. However, a chi-square test of the relationship between attitudes and institutional type failed to reveal significant differences in attitudes among groups.

The differences in math attitudes between the sexes was found to be significant with the males holding the more positive attitudes. Sex differences in math attitudes were further substantiated by a frequency distribution of responses to attitude items by sex. Statements relating to math anxiety or avoidance were more strongly endorsed by females, while those relating to usefulness of mathematics and its enjoyment were embraced by substantially more of the males.

For the analysis of attitude by age the subjects were separated into two age groups: 1) those under 23 years of age which should include the students in the regular "college-age" group, and 2) those 23 years of age and

older which should include the adult learners and/or those who have interrupted the regular educational sequence for some reason. The difference in attitude means of the two groups was found to be significant, with the older group holding the more positive attitudes.

In the study of the relationship of attitude to learning, the coefficient of partial correlation, controlling for prerequisite math knowledge ($r=.10$), was found to be non-significant. Further analyses of this relationship by sex and by attitude levels which had been recommended by other researchers failed to yield a significant correlation. Although the coefficients were not significant at the required level, they were, however, consistently positive and relatively stable in value.

MATHEMATICS ATTITUDES: AN INTERVENTION STUDY

Carol Freeman
Fontbonne College

The purpose of the study is to investigate the effects of an intervention treatment within a basic arithmetic skills course in college upon the variables: student attitudes toward mathematics, achievement in mathematics, and levels of math anxiety.

The review of the literature suggests that mathematics anxiety exists in a college population and involves feelings of tension that can interfere with the student's learning of basic skills in arithmetic. Literature reviews also substantiate that students who must take a remedial mathematics course or an arithmetic course in college have frequently met failure in math courses or have avoided math for a period of years. These persons generally suffer from an anxiety associated with the single area of mathematics and have a poor attitude toward mathematics. Reviews do not indicate if the student's level of math anxiety and attitude toward math can be changed significantly in a remedial arithmetic course and if the degree of change is greater for students in a treatment group to which behavior modification procedures are applied to specifically reduce the anxiety and improve the attitude toward mathematics.

Students attending a private liberal arts college in an urban area in St. Louis, Missouri, who scored below the 29th percentile on the McGraw Hill Basic Skills Test, part I, were required to take the arithmetic skills course. One section was randomly selected as experimental and the other was the control group. Both sections were taught by the same instructor.

The intervention consisted of the following components:

1) counselor, student role model, and instructor

2) group discussion led by the counselor

3) techniques for reducing anxiety

4) assertive training involving situations dealing with mathematics and courses in mathematics.

Differences between the groups' pre and post measures of the variables were analyzed by the statistical technique of analysis of covariance. Differences between the pre and post measures within the groups were analyzed by t-tests.

MATH ANXIETY: ITS IMPACT ON GRADUATE LEVEL STATISTICS ACHIEVEMENT

Patricia B. Elmore
Southern Illinois University at Carbondale

Ellen S. Vasu
University of North Carolina at Chapel Hill

The study investigated the effect of attitudes toward mathematics related coursework, previous mathematics coursework, mathematics ability, spatial ability, and masculinity-femininity of interest pattern on the achievement in applied statistics for men and women students. Subjects were 188 student volunteers from the inferential statistics classes taught in the College of Education at Southern Illinois University at Carbondale during the fall and spring semesters of the 1977-78 academic year. The instruments administered were the Masculinity-femininity scale of the MMPI, Fennema-Sherman Mathematics Attitudes Scales, Attitudes Toward Feminist Issues Scale, Subtests S1, S2, VZ1, VZ2, and VZ3 of the Kit of Factor-Referenced Cognitive Tests (five spatial ability and visualization subtests), and a biographical data sheet.

Results indicated that there was a significant difference between male and female students on two of the Fennema-Sherman Mathematics Attitude Scales. Women students had more positive math attitudes on the Attitude Toward Success in Mathematics Scale and on the Mathematics as a Male Domain Scale. Women received a significantly higher mean number of total points in the course than men. Men received higher scores on three of the five spatial visualization ability subtests: the card rotations, cube comparisons, and form board tests. Regression analyses were performed to determine 1) the amount of variance in statistics achievement that could be accounted for by five variable sets: a) attitudes toward mathematics related coursework b) previous mathematics coursework, c) student sex, d) spatial ability, and e) masculinity-femininity of interest pattern and 2) the contribution of each variable set over and above the contribution of the other four variable sets in combination.

MATH AVOIDANCE AND PURSUIT OF FANTASY CAREERS

Barbara L. Benton
The Ohio State University

Math avoidance has been hypothesized as related to career choice restrictions. Few attempts have been made, however, to assess the relative importance of the various components of math avoidance to career choice. Furthermore, it has been implied that persons fearful of math not only avoid specific careers but also reject careers that are otherwise seen as desirable.

The purpose of this study was to examine the relative influence of several hypothesized correlates of math avoidance on academic major and career choice; and on fantasy career pursuit and rejection for men and women. One hundred twenty-nine undergraduate students responded to a personal data sheet and to two questionnaires: 1) The Mathematics Attitudes Scales (Fennema and Sherman, 1976); and 2) the Career Aspiration Scales, developed for this study.

Five MAS scales discriminated groups by sex and major. Pursuers and rejectors differed by sex and major but not by attitudes toward math. Males and females differed on reasons for rejection of fantasy careers and on career discrepancies.