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Early Recollections Of Women In Mathematics

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EARLY RECOLLECTIONS OF WOMEN IN MATHEMATICS

A Dissertation

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by

Michael R. Elmore

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APPROVAL SHEET

The dissertation of Michael R. Elmore, Contribution to the School of Graduate Studies, Indiana State University, Series III, Number 635, under the title Early Recollections of Women in Mathematics is approved as partial fulfillment of the requirements for the Doctor of Philosophy Degree.

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ABSTRACT

This study investigated whether the content of early recollections distinguishes between women in mathematics and women not directly associated with the study of mathematics. More specifically, this study attempted to determine whether significant differences exist between women math majors/minors and women nonmath majors with respect to manifest content of early recollections as scored employing the Manaster-Perryman Manifest Content Early Recollections Scoring Manual (Manaster & Perryman, 1974). Variables were selected in conformity with known determinants associated with mathematics predilection in women: the roles of mothers and fathers, degree of self-confidence, nonconformity, spatial/visual orientation, school, active or passive tendencies, internal locus of control, and positive attitude.

The sixty female subjects consisted of 30 women enrolled as college majors or minors in mathematics; the comparison group consisted of 30 women enrolled in fields of study typically not associated with mathematics.

The results indicated no significant differences between the women-in-mathematics group and the nonmath women group with respect to the variables selected from the Manaster-Perryman Manifest Content Early Recollections Scoring Manual: Mother, Father, Mastery, New or unfamiliar situation causing excitement, Visual (Concern with Detail),

School (Setting), Active/Passive, Internal/External (Control), and Positive/Negative/Neutral (Affect). A Post-hoc analysis using the remaining 29 Manaster-Perryman Manifest Content Early Recollections Scoring Manual variables suggested that a significant difference exists between the two groups studied with respect to the variable Attention-getting.

Results suggest that determinants identified in previous studies on women in mathematics, which have almost exclusively dealt with women subjects at the elementary, junior high school, and high school levels, may no longer operate significantly once women are enrolled at the college level.

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Special gratitude needs to be expressed to my daughter, Jennifer C. Elmore, whose extraordinary gift for mathematics aroused in me a curiosity about the conditions, attitudes, beliefs, and perceptions which attract some women to pursue careers in mathematics while others find themselves distanced from mathematics-related fields. Jennifer helped enormously with the logistics of gathering the data for this study.

To my wife, Constanza Elmore, and my son, John-Michael Elmore, and, again, my daughter, Jennifer Elmore, I wish to express my deepest gratitude for their encouragement, assistance, and patience as I worked on this dissertation.

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Chapter 1

INTRODUCTION

Super (1980), in describing the origins of counseling psychology, gave vocational guidance a foundational preeminance. Today the specialty of counseling psychology continues to include vocational guidance as part of its domain. The counseling psychologist helps individuals towards the development of their optimum potential in many areas of life, including their personal development while in the educational setting and within the work setting (Bordin, Hahn, Super, Wrenn, & Pepinsky, 1956). Samler (1980), in a report delivered at the Greyston Conference in 1964, called on counseling psychologists to restore vocational counseling to its central place.

Fundamental to the ongoing involvement of counseling psychologists in the area of vocational counseling is a commitment to research. Counseling psychologists can bring to research in vocational counseling those interests which have also become a part of the domain of counseling psychology: knowledge of interpersonal, familial, and contextual influences on decision-making, personal and career development, and the techniques employed to identify

such saliences in individuals. Among techniques employed are found the projective techniques; one such technique which has been applied to vocational questions is the identification of content of early recollections (Fakouri, Fakouri, & Hafner, 1986; Elliott, Amerikaner, & Swank 1987).

In this study, early recollections were used as a projective technique to determine what saliences, if any, are associated with the inclination or disinclination of women towards mathematics, specifically as represented by comparing math-majors/minors with nonmath majors in college. The study was based on the assumption that, generally, individuals involve themselves academically with and pursue careers in those fields towards which they have a felt inclination and that such an inclination can be measured in terms of attitudes towards that field. Mathematics is a field which has been studied in relation to attitudinal variables (Armstrong, 1985; Casserley & Rock, 1985; Eccles, Adler, Futterman, Goff, Kaczala, Meece, & Midgley, 1985; Fennema, Reyes, Perl, Konsin, & Drakenberg, 1980; Fennema & Sherman, 1976; Meyer & Koehler, 1990).

Mathematics is regarded as critical to the vocational advancement of women, as it acts as a filter which prevents many women from entering the various fields which are mathematics-related (Sells, 1980). There remains a need to study those underlying individual characteristics associated with attitudes of women towards mathematics: this study was about those characteristics.

Statement of the Problem

Projections of the requirements in the workplace in the U.S. for persons possessing mathematics and mathematics-related skills far exceed projections of the number of persons who will possess these skills. McDaniels (1990) reported a current and projected shortage of individuals in the U.S. in the field of mathematics and in mathematics-related fields, such as the physical sciences and engineering. McDaniels maintained that action must be taken to promote the study of mathematics, which is the foundation of these fields. Traditionally, mathematics and mathematics-related fields have been the domain of males (Jagacinski, 1987; Tobin & Fox, 1980). Apart from questions of social inequalities, females in mathematics and related fields are needed to fill the requirements of our society and our economy now and in the future. A need exists therefore for counseling psychologists, especially those working in career counseling, to be cognizant of factors which impact on women's decisions to involve themselves in mathematics and mathematics-related fields. Counselors need to be informed about the interpersonal, familial, and contextual factors related to women's attitudes about and involvement in mathematics if they are to provide assistance to those seeking career opportunities in mathematics-related fields and to those avoiding such opportunities despite

their abilities in mathematics or their potential for developing such abilities.

In studies of the various factors influencing the perceptions women have about mathematics, there has been little study of the antecedents of these perceptions about mathematics (Lopez & Lent, 1992). The current study, which utilizes early recollections of subjects to investigate (Adlerian) "style of life," "frame of reference," or "perception" variables, was an attempt to understand such antecedents.

Purpose of the Study

The purpose of the study was to investigate whether the content of early recollections is consistent with known determinants associated with mathematics predilection in women. It was anticipated that the results of this research would contribute to further understanding of the factors which impact on women's decisions about participation in mathematics and that the results may lead to recommendations which can be used by counseling psychologists, guidance counselors, and career counselors to promote the participation of women in mathematics and mathematics-related courses and careers.

To date, no known research has been conducted in which early recollections of women who are math majors/minors have been investigated.

Hypothesis

The following hypothesis was tested in the study: The content of early recollections distinguishes women math majors/minors from women nonmath majors.

Delimitations

1. The study was delimited to those variables selected for investigation.

2. The sample was delimited to volunteers from among female students at four Midwestern colleges and universities.

3. Mathematics performance and achievement was not taken into account in this study.

4. Genetic factors were not considered in this study.

5. This was an intragender study limited to females. Intergender comparisons were not investigated.

Definition of Terms

To facilitate a better understanding of the various terms to be used in the study, operational definitions are presented below.

Early recollections. Visualized and vividly recalled single incidents in one's life which are arbitrarily defined as having occurred prior to age eight (Mosak, 1958).

Manifest Content. Clearly recognized, evident content of early recollections nomothetically treated (Manaster & Perryman, 1974).

Mastery. Variable which is scored if there is a focus in the early recollection on an attempt to control oneself, others, or the environment by physical or psychological acts.

Attention-getting. Variable which is scored if there is a focus in the early recollection on seeking attention from others.

Internal. Variable which is scored if there is a focus in the early recollection on acceptance of responsibility for what occurs in the early recollection.

External. Variable which is scored if there is a focus in the early recollection on dissociation from any responsibility for the consequences or outcomes depicted in the early recollection.

Positive. Variable which is scored if the overall feeling tone of the early recollection is pleasant.

Negative. Variable which is scored if the overall feeling tone of the early recollection is unpleasant.

Neutral. Variable which is scored if there is no apparent indication of affect in the early recollection.

Other terms, including the terms employed to designate the remaining variables used in this study, are assumed to represent their conventional meanings.

Chapter 2

REVIEW OF RELATED LITERATURE AND RESEARCH

Women and Mathematics

The flourishing of published studies on women and mathematics which took place between 1977 and 1981 followed the announcement of a special grants competition sponsored by the National Institute of Education (NIE). In a review of research which resulted from this grants competition, Chipman et al. (1985) listed 17 studies. Six of these studies were focused primarily on identifying factors influencing enrollment in mathematics courses (Casserly & Rock, 1979; Fox, 1979; Lantz & Smith, 1981; Parsons, 1980; Stallings, 1979). Four were focused principally on achievement--especially with respect to sex-related differences (Armstrong, 1979; Fennema & Sherman, 1977; Fennema & Sherman, 1978; Wise, Steel, & MacDonald, 1979). Two of the NIE studies focused on spatial visualization (Connon & Serbin, 1980; Sherman, 1980b).

The remaining five studies concentrated on what were variously termed as attitudinal or affective factors believed to be associated with predicting or explaining women's involvement or success in mathematics (Boswell,

1980; Brush, 1979; Brush, 1980; Sherman, 1980a; Sherman, 1979).

The majority of such studies took place within a span of a few years, as was pointed out above, because most were funded by the National Institute of Education in a special grants competition in the late 1970s. Chipman et al. (1985) referred to these studies as a "cohort" of research studies (p. 276). The general purpose of the competition was to address issues related to participation of women in mathematics; specifically, all competing researchers were to address the following research question: "What are the major positive and negative factors related to the participation and achievement of women in the study of mathematics and to their preferences for occupations requiring mathematical competence?" (Chipman et al., 1985, pp. 275-276). Sex differences regarding mathematics were emphasized throughout these studies; little attention was given to intragender differences that might exist in explaining why some women--often of equal mathematics competency--chose not to continue in mathematics, i.e., by enrolling in non-compulsory math courses.

Another characteristic of these NIE studies was that they concentrated on pre-college academic levels. According to Chipman et al. (1985), of the 17 studies whose final reports were submitted to and accepted by the NIE, one employed an elementary school sample (grades 3 through 6), 11 included middle school samples, 13 included high school

samples, and one employed Ph.D. in mathematics candidates. Prior to the NIE grants competition in the late 1970s, only one major attempt had been made to deal with the issues of women in mathematics: Two longitudinal studies (initiated in 1960) involved a national sample of 9th graders, who were retested as 12th graders (n = 7,500), and a national sample of 12th graders (n = 12,759), from whom follow-up data were collected at ages 19, 23, and 29 (Wise, Steel, and MacDonald, 1979). No research in the study of women in mathematics of the magnitude of that promoted by the NIE grants competition in the late 1970s has taken place since.

Fennema (1977), Fox (1977), and Sherman (1977) were commissioned by the National Institute of Education to provide reviews of the state of research and theoretical understanding current at that time with regard to women and mathematics. Chipman et al. (1985) pointed out that at the time these studies were initiated there existed a general consensus that sex differences in mathematics achievement were explained primarily by differences in mathematics course participation. "Consequently, the prediction of course participation was the primary focus of these studies" (p. 276). Achievement, a cognitive variable, was, until the "cohort" of research studies in the late 1970s, by far the over-riding research issue related to course participation.

What the research "cohort" brought more forcefully and clearly into the forefront was the study of attitudinal or motivational variables--the more subjective side of the

question, one might phrase it. "Because cognitive differences between the sexes are known to be minimal, explanations of the sex difference in mathematics participation were sought primarily in attitudinal or motivational variables such as mathematics anxiety or the sex-stereotyping of mathematics" (Chipman et al. 1985, p. 276). Looking at another area of attitude/motivation, Eccles, Adler, Fitterman, Goff, Kacgala, Meece, and Midgley (1985) made a similar point: "Past research has shown that girls do as well in math as boys throughout their formative years, yet they do not expect to do as well in the future nor are they as likely to go on in math. This apparent paradox is less puzzling if we acknowledge that it is the subjective meaning and interpretation of success and failure that determine an individual's perceptions of the task and not the objective outcomes themselves" (p. 98). Again, focusing on what might be seen as equivalent to internal over external locus of control, Eccles et al. (1985) stated: "Although females may receive less encouragement from parents and teachers, it is not the case that they are being systematically excluded through discriminatory course availability. On the contrary, all too frequently females choose not to take more advanced mathematics courses" (p. 95).

The point here is that, beginning with the studies reported to the NIE, researchers were concentrating their efforts more towards identifying what variables beyond

achievement scores and comparative data on course enrollment might underlie the phenomenon of women's progressive disengagement from mathematics and mathematics-related careers.

Just when and where does this disengagement occur and to what degree in comparison with men? Armstrong (1985) neatly summarized the process: "It is generally accepted that elementary school girls excel in arithmetic and science. However, the picture begins to change in junior high school as boys overtake and pass their female contemporaries in mathematics achievement. From the eighth grade on, female participation in mathematics declines steadily until, by high school graduation, male students outnumber women in mathematics classes" (pp. 59-60). By how much, though, do men outnumber women at point of graduation? Armstrong (1985) provided data which were collected in 1978 on twelfth grade students from 71 schools across the United States (n = 1,788: about 35 students per school). The results of this nationwide study showed that in the 12 math courses surveyed only in Accounting/Business math did women significantly outnumber men (percent of students having taken the course: males, 32.6%; females, 40.2%). On the other hand, in Algebra II men significantly outnumbered women (males, 53.7%; females, 42.2%) and in Probability/Statistics likewise (males, 9.5%; females, 4.9%). In General Mathematics, Consumer Mathematics, Algebra I, Geometry, Trigonometry, Computer Programming,

Pre-Calculus, and Calculus, men indeed outnumbered women but not by a statistically significant difference (at .05 level). In Pre-Algebra, men and women were equally represented.

Armstrong (1985) cautioned about misunderstanding these percentages. Percent of students surveyed having taken a course is not synonymous with the male-female enrollment split in the classroom: "[T]he fact that only 1.8% more men took either precalculus or calculus can be somewhat deceiving because this represents almost a 3:2 ratio of men to women in these higher-level courses. Fully 60% of the students in precalculus/calculus are men and only 40% are women, according to the NAEP [National Assessment of Educational Progress, 1975] survey" (Armstrong, 1985, p. 75). Yet, a 60-40 split, while significant on a statistical level and on an educational/social level, does not appear to account for the much deeper split seen in the mathematics-related fields by the time students enroll in college: at the time of Armstrong's study one-tenth of 1% of engineers were women, 2% were physicists, and 5% were chemists. This split was relatively consistent, however, with the percent of women enrolled in mathematics (40.7%) and women awarded BAs in mathematics (41.5%). Chipman and Thomas (1985) posited an explanation for this mathematics major vs. mathematics-related major difference: "We . . . suggest that mathematics itself may be a liberal arts major that is selected primarily because of liking for the subject and

that this helps explain why women are well represented in mathematics, in contrast to their low representation in most math-related majors" (p. 15). Women are perhaps well enough represented at the undergraduate level in some institutions of higher learning (in one of the colleges from which the sample was drawn for this current study, out of 115 undergraduate mathematics students only four were women), but at Masters and Ph.D. levels women are vastly underrepresented (Chipman et al., 1985, pp. 19-22).

It is clear from all of the preceding that change in women's attitudes and motivation with respect to involvement in mathematics takes place over time and across educational institutional levels. There is strong evidence that something happens to women's commitment to achievement and participation in mathematics around the ninth grade; there is weaker evidence that changes may also take place around the age of 17 or 18 (as women graduate from secondary school and begin college studies). How do women themselves compare with men when asked to rank order factors which have influenced their decision to take more mathematics? Armstrong's (1985) study found that between males and females only two factors were in a different order when ranked by twelfth graders (females placed "How good or bad in mathematics" over "How much math is liked or disliked"; males reversed that order). (Between males and females at age 13 there was no difference at all in rank ordering of relative importance of these factors.) The factors in

question were: a. How useful mathematics will be; b. How good or bad in mathematics; c. How much math is liked or disliked; d. What math teachers think; e. What mother thinks; f. What father thinks; g. What school counselor thinks; h. Whether friends take mathematics; and i. Whether classmates approve. Equally students in twelfth grade (generally 17-18 year olds) and students aged 13 ranked usefulness of mathematics as the most important factor. Both groups also ranked peer influence last. Among 13 year olds, parents and teachers--as might be expected--had a stronger influence than among twelfth graders.

Looking further into affective/motivational variables, the NAEP study results (Armstrong, 1985) suggested that at the twelfth grade level "Fathers (but not mothers) as role models and the active encouragement of both mothers and fathers were significantly correlated with participation for both males and females" (p. 81). The NAEP study results also suggested that: "Another form of parental encouragement was parents having high academic expectations for their children. Those students, especially males, whose parents had high expectations for them took more mathematics" (p. 81). Again, with reference to twelfth graders, the NAEP study results suggested that: "Students who perceived their teachers as encouraging tended to take more mathematics. Teachers differential treatment was one of the few variables for high school seniors that was significantly correlated with course-taking for males, but

not for females. Males who perceived mathematics teachers as treating males the same as females tended to take more mathematics" (p. 81).

Other variables included in the NAEP study on twelfth graders (Armstrong, 1985) were counselor influence, peer/sibling influences, and socioeconomic status (SES). Female and male students alike were more likely to take further math courses if encouraged to do so by a counselor. (Stallings [1985], however, suggested that counselors may tend not to do much encouraging in the case of women, as counselors appeared to perceive mathematics in a sex-stereotypic manner and advised on advanced math course selection accordingly.)

NAEP results suggested that peer influence had a significant correlation with further course enrollment, but the correlation was low ($r = .20$). As to sibling influences, Armstrong (1985) stated: "For females, having an older brother who was good in mathematics was related to taking more mathematics. This was not true for either males or females having an older sister who was good in mathematics" (p. 82). Armstrong goes on to say that this finding may not be surprising "because males have traditionally taken more mathematics so it would be more likely to have an older brother, rather than an older sister, who was good in mathematics" (p. 82).

Finally, Armstrong (1985) found that socioeconomic status had "a low but significant correlation with

participation for females but not for males" (p. 82). Studies by Boswell (1985), Brush (1985), Casserly and Rock (1985), and Chipman and Wilson (1985) appear to confirm Armstrong's findings. Brush suggested that these effects (SES on continued mathematics participation) might be associated with social class variation in sex role expectations.

Armstrong (1985) set out in the NAEP survey to identify and assess factors affecting mathematics participation. Results suggested that 13-year-old females begin high school with the same mathematical abilities that males possess. Females at this age have comparable problem-solving skills but are better at computation and spatial visualization than same-age males. By the twelfth grade males have the advantage on problem-solving measures, and females no longer maintain the computation or spatial visualization advantage (in fact no sex differences were found in spatial visualization).

The large sex differences in math course participation found in earlier, smaller studies was not replicated in the NAEP study. Of course, nonstatistically significant differences were found, as males nearly always outnumbered females in advanced courses taken in twelfth grade.

More to the specific focus of the current study, NAEP data subjected to correlation and regression analyses suggested that positive attitudes toward mathematics, perceived need for and usefulness of mathematics, and the

positive influences of parents, teachers, counselors, etc. constituted the three groups of variables having the most positive effect on further course-taking among twelfth graders.

The major predictor variables found in the literature on women in mathematics were classified by Chipman and Wilson (1985) into three groups: cognitive, affective, and social environment. Under the cognitive label they included the variables of previous achievement, spatial ability or skill, and cognitive ability. Commonly, in the literature, these three variables are linked to a student's motivation to continue in mathematics. Affective variables most often treated in the literature are perceived utility of mathematics, liking for mathematics (equivalent to intrinsic value of mathematics), confidence in ability to do mathematics (often negatively framed as "math anxiety"), and stereotyping of mathematics as a male domain. Typically, the social environment variables studied are in terms of the influence of parents, teachers, counselors, peers, social status, and school effects (such as availability of math courses, system of academic tracking, and general science and math curricula). This section will present the research and literature related to attitude variables of confidence in ability to do mathematics, perception of usefulness of mathematics, attitude towards success in mathematics, mathematics as a male domain, anxiety about mathematics, and effectance motivation about mathematics.

Among attitudes which students present about mathematics, Leder (1990) gave primary listing to confidence in one's ability to do mathematics. Citing Meece, Eccles, Futterman, Goff, and Kaczala (1982), who published a model of academic choice in which it was maintained that choices are influenced by perceptions of reality as much as by reality itself, Leder stated that "students capable of continuing with mathematics but who <u>believe</u> that the study of mathematics is inappropriate for them may select themselves out of mathematics or perform at a level they believe others consider appropriate for them" (p. 19). One of the beliefs which has been shown to be consistently related to the continuance of students in mathematics--specifically postcompulsory mathematics courses--is the student's confidence in his/her ability to do mathematics (Eccles, Adler, Futterman, Goff, Kaczala, Meece, & Midgley, 1985; Fennema, Reyes, Perl, Konsin, & Drakenberg, 1980; Fennema & Sherman, 1977, 1978). Leder (1988) conducted a study which included confidence in ability to do mathematics which suggested that, in the case of the students studied, confidence was independent of mathematics performance. Leder (1990) cited a study by Joffe and Foxman (1986) which appeared to contradict Leder's (1988) study: "[They] found that males' and females' differing attitudes toward mathematics were paralleled by differences in the test performance of the two groups [11 and 15 year olds]" (p.

19). The differences were judged to be "minimal except in the top attainment bands" (Leder, 1990, p. 19).

Meyer and Koehler (1990) examined the relationship between internal beliefs and achievement in mathematics. Achievement in mathematics has been positively linked to continued participation of both males and females in mathematics (Meyer, 1986). Reyes (1984) attributed to confidence in mathematics participation in mathematics beyond compulsory levels and to students' aspirations for careers in quantitative fields. In other studies a similar relationship was reported between confidence in ability to do mathematics and mathematics participation (Armstrong & Price, 1982; Sherman, 1982). Eccles (1983) concluded that confidence in mathematics ability showed a stronger positive relationship to continued participation in mathematics than did measures of mathematical ability.

A comprehensive longitudinal study conducted by Fennema (1983) was reviewed by Meyer and Koehler (1990). In this study, Fennema followed the same group of students from Grade 6 to Grade 12 in Madison, Wisconsin. A random sample (n = 108) was selected and added to a sample (n = 63) which was arranged into four nearly equal groups of high-confidence females, low-confidence females, high-confidence males, and low-confidence males, based on the outcome of an instrument using Thematic Apperception Test-like pictures and questions intended to elicit statements reflecting attitudes about confidence in mathematics and about

mathematics as a male domain. Both the random sample and the arranged group sample were tested on the Confidence, Mathematics as a Male Domain, and Teacher subscales of the Fennema-Sherman Mathematics Attitude Scales (Fennema & Sherman, 1976). Sex and confidence were submitted to an analysis of variance. In terms of achievement, Fennema's analysis revealed no significant differences between females and males until confidence was included: [T]here was a significant difference in achievement between the confidence groups in both grades [6th and 8th], with the high-confidence groups having higher achievement scores than the low-confidence groups" (Meyer et al., 1990, p. 79). The mean scores for confidence for females and males were nearly constant from Grade 6 to 8, with females maintaining a position in each group which was "slightly higher" (p. 80). When, however, each students' results were analyzed as to mathematics achievement and confidence from Grades 6 to 8 were considered, high-confidence females had dropped in standing on achievement scores relative to high-confidence males. These findings would seem to suggest that any direction of causation (i.e., achievement causing higher confidence or çonfidence causing higher achievement) was not established.

Mayer et al. (1990) concluded:

> Perhaps the most surprising result of this extensive data collection and analysis is that so little was revealed about males and females with above-average achievement who differ in confidence level. One looks for reasons to explain this and questions the sampling process, the interview technique, the analyses, and

> interpretations. Little explanation is revealed, except some insight concerning the nature of the factors that influence the learning of mathematics for females and males. These factors seem to be much more subtle and complexly interwoven than we have suspected before. (p. 82)

Armstrong (1985), in reporting on the results of a national survey of women in mathematics, conducted in fall 1978, stated that confidence in mathematics correlated significantly ($P < .001$) with participation in mathematics (.280 for 13-year-old males and .194 for 13-year-old females; .466 for Grade 12 males and .423 for Grade 12 females). Participation, defined as course enrollment, is critical to continuing development of mathematics ability and achievement (Fennema, 1981) and to subsequent enrollment in higher level mathematics courses (Chipman & Wilson, 1985). Confidence in the ability to do mathematics is assumed to exert a continuing influence on involvement with mathematics after high school, i.e., during the college experience and beyond.

After describing research programs designed to encourage females to persist in mathematics course-taking and to understand the relationship of mathematical concepts to various jobs, in particular, and to a wide range of career fields, in general, Tobin and Fox (1980) wrote: "[M]athematics is usually valued in relation to its utility . . . . When girls, especially mathematically able ones, become aware that mathematics may be the key to their future, a future which can and should include a responsible

and rewarding job, the number of girls participating in mathematics-related courses may increase" (p. 189).

Sex differences in the perception of usefulness of mathematics by students have been researched (Armstrong, 1985; Fox, 1975; Hilton & Berglund, 1974; Sherman & Fennema, 1977). These studies suggest a relationship between perception of usefulness of mathematics and continuing enrollment in mathematics courses. Such enrollment would seem to be important to future study and future career opportunities.

These perceptions are developmental: Armstrong (1985) reported that for 13 year olds "the variable of usefulness is a better predictor of participation than the variable of mathematics preparation . . . ." (p. 89). By Grade 12, Armstrong stated, "the variable of mathematics preparation required for a job . . . was the better predictor [over usefulness]" (p. 91). Put another way, children and younger adolescents seem to recognize a general usefulness of mathematics; as students mature they become increasingly aware and concerned with factors (including mathematics skills) which are linked to career preparation.

In a report on study of self-perceptions and other variables related to the decision to enroll in mathematics, Eccles, Adler, Futterman, Goff, Kaczala, Meece, and Midgley (1985) stated that "perceiving math as very useful for males [a stereotype among students of both sexes, as established by the authors] does not necessarily have a negative

consequence for girls, perhaps especially when the stereotype reflects an awareness of the high status jobs that are both male-dominated and math-related" (p. 106). Eccles et al. (1985) suggested that the notion of mathematics as a male domain was not related to any other factor; rather, it is the perception of usefulness (along with future expectancies, current expectancies, interest, self-conceptions of ability, and conceptions of the value of math)--often associated with the male domain--which operates as a critical factor in girls' and women's choices about continued enrollment in mathematics and about math-related careers. Studies by Haven (1971), Sherman and Fennema (1977), Armstrong (1979), and Brush (1980) reached similar conclusions about students' perceptions of the usefulness of mathematics and enrollment in noncompulsory mathematics courses, namely, there is a significant positive relationship.

Stallings (1985) used questionnaire items and interviews with female high school students to determine factors influencing their decision to continue in mathematics. In comparing women who were enrolled in advanced high school mathematics and who intended to continue to enroll in higher mathematics courses (n = 189) with those who stated they did not intend to enroll (n = 42), Stallings observed from the interviews that perceived usefulness of mathematics was more important to those who intended to continue. Chipman and Wilson, 1985, concluded

from their review of the literature on the utility value of mathematics that "career expectations and career goals also affect the perceived usefulness of mathematics, as may the adequacy of their [students'] information about the mathematical requirements of careers" (p. 294).

In their discussion of the perceived utility of mathematics, Chipman et al. (1985) maintained that the variables of actual and perceived requirements for mathematics relative to careers and educational plans are closely linked to students' perception of the usefulness of mathematics. A distinction was made by Chipman et al. between a general perception about the usefulness of mathematics, as it relates to gender differences, and an individual's perception of how useful mathematics will be for oneself (again, in relation to gender). Various studies were cited which showed mixed results on whether there were any gender differences in the perceived utility of mathematics, which ranged from no differences to differences among samples within the same study to differences favoring males as perceiving more usefulness.

Chipman et al. (1985) summarized their review of five studies which included the variable of perceived usefulness of mathematics: "[T]here is considerable evidence that the perceived usefulness of mathematics, especially the perceived requirement for mathematics in a planned career, is important to [the] decision to enroll in mathematics" (p.

296). Chipman et al. stated that such perceptions may be inaccurate and that students may be inadequately informed about the uses of mathematics in various careers. They also stated, "there is some evidence that girls are or have been less informed than boys" (p. 297).

Lantz (1985) concluded that what she called the "cognitive belief in the perceived usefulness of mathematics" simply indicated that students saw mathematics as necessary and would lead to their continued enrollment. She concluded further that significant others contributed to the development of this belief and that these beliefs are not stable over time. Chipman et al. (1985) observed that students' perception of the usefulness of mathematics declined with age, suggesting a malleability which is both a problem and an opportunity, i.e., students are changeable in this regard in both a positive and negative direction.

Lantz (1985) stated, "Despite a seemingly ubiquitous correlation with intentions, perceived usefulness does not appear to strongly discriminate or predict enrollment in nonrequired mathematics" (p. 334). Lantz opined that this failure to predict course-taking on the basis of mathematics utility "is tied to the uncertain value of the future rewards mathematics is instrumental in obtaining" (p. 334). As an example, Lantz noted: "[O]ne may know that mathematics is a prerequisite for becoming a chemist. But if one is not dedicated to becoming a chemist, the knowledge will have little impact on course taking" (p. 334).

Sex-role congruency is also a factor in mathematics enrollment by women. Sex-role congruency must be distinguished from a related perception usually designated in the literature as the stereotyping of mathematics as a male domain. The latter is the belief that mathematics and mathematics-related activities (scientific studies and science careers) are principally male concerns. A perception of mathematics as a male domain does not preclude females from either aspiring to or succeeding in their participation in that acitivity. For example, boxing, generally acknowledged to be a male activity, can be participated in by females irrespective of the fact that very few females choose to do so.

Sex-role congruency includes the idea of male and female domain stereotyping but goes beyond it to encompass the belief in an attached value, usually in terms of appropriateness or inappropriateness. In other words, the notion of domain is a quantitative construct, while the notion of congruency is a qualitative construct. Also to be considered is the possibility that a sex-role trait may be clearly related to either the female or male domain and desired by the other gender precisely for that reason. For instance, a female might wish to acquire a stereotypical male trait, such as open assertiveness, in order to succeed in a male dominated field.

Meyer and Koehler (1985) wrote the following about the female student: "If she believes mathematics is

inappropriate for females, then her achievement in mathematics could result in a perception that she has not adequately fulfilled her sex role." (p. 63). This belief may include, as Meyer and Koehler said, "a perception that others see her as somewhat less than feminine when she achieves in mathematics" (p. 63). Meyer and Koehler saw the following dilemma: the female student will pay a price to participate and succeed in mathematics at a time when sex-role identity and the judgment of others are very important to the young student. Over time, however, stereotyping by gender regarding mathematics may change. The evidence is conflicting (Armstrong & Price, 1982; Brush, 1980; Sherman, 1979). Whether by Grade 12 or by the first years of college these stereotypes about gender and sex-roles and their relationship to mathematics course taking break down and translate into continued enrollment of females in mathematics courses remains unclear.

Early Recollections

Hall (1899) and Titchener (1900) were perhaps the first to recognize the importance of early childhood memories as a means to discovering current perceptions held by individuals. Adler (1937) regarded early recollections as valuable hints or clues about the direction of an individual's striving and, thus, of an individual's style of life. Early recollections were seen by Adler as related to the current psychological state of the individual: the current meaning of the early recollection being the

important element; the historical-factual validation of the content not being important.

Because thematic differences in early recollections across individuals exist (Berman, 1958), early recollections have been used as a projective technique (Lieberman, 1967; Fakouri & Zucker, 1987; Williams & Manaster, 1990) and for vocational and educational prediction (Attarian, 1978; Hafner & Fakouri, 1984a). Manaster and Perryman (1974) indicated that occupational differences are reflected in early recollections. Thus early recollections may function as a guide for the individual in occupational selection.

Watkins (1992) reviewed Adlerian-oriented early recollections research (also known as early memories research) from 1981 to 1990; thirty studies were reviewed as to sample characteristics, mean age of participants, assessment/analysis methods employed, and results. Samples and sample characteristics included one study of vocational interests of college students (Elliott, Amerikaner, & Swank, 1987), three studies regarding nursing students (Fakouri, Fakouri, & Hafner, 1986; Fakouri & Zucker, 1987; McFarland, 1988), and three studies related to selected college majors (Hafner & Fakouri, 1984a; Hafner & Fakouri, 1984b; Hafner, Fakouri, & Etzler, 1986). These vocationally related studies largely conformed to the overall characteristics of the 30 studies reviewed: subjects were for the most part in their 20s and 30s; nomethetic methodologies were employed to

interpret the data; results showed group differences reflected in early recollection content.

Watkins (1992) summarized those primary conclusions which are related to vocational issues: (a) early recollections reflected current interpersonal behavior and (b) individuals in different college majors or occupations had early recollections which showed differences.

In discussing the significance of early recollection research results for vocational counseling Watkins (1992) quoted his and his associate's conclusions: "[I]f differences in [early recollections] exist in subgroups of a particular occupation . . . then the possible configurations for memory differences within and across occupations could be so large as to defy comprehension" (Watkins & Savickas, 1990, pp. 93-94). Watkins (1992) thus questioned the value of early recollections for use in vocational counseling. Nevertheless, Watkins stated that meaningful, practical implications could be drawn from these types of studies if pilot work were done to help in the development of more focused studies.

One approach towards developing a focused study in a vocational area is to assess the inclination or disinclination towards that particular area. Simply finding two or more groups (i.e., vocational groups, for our purposes here) may not provide adequate focus (Watkins, 1992) to justify a study of this type because presumably a broad range of content saliences may be represented within

any one or several vocational groups. Narrowing the focus so that one overall trait--such as the attitudinal inclination towards mathematics or its relative absence--is correlated with content salience may yield meaningful and practical implications for the counseling psychologist interested in career development and vocational guidance.

Cognitive-Perceptual Theory and Early Recollections

Bruhn and Last (1982) distinguished four theoretical perspectives typically associated with early recollections: (a) Adlerian theory, based on the construct of fictive final goals; (b) psychoanalytic (Freudian) theory, based on drive theory; (c) ego-psychological theory, related to object relations theory; and (d) cognitive-perceptual theory, grounded in memory process. This study utilized the latter theory, cognitive-perceptual theory, as its organizing scheme.

Bruhn (1990) explained cognitive-perceptual theory as a contextual theory that highlights the innate human need to grow and to extend the range of competence. Unlike Freudian theory, which is basically a biological theory, cognitive-perceptual theory is mainly grounded in psychology; cognitive-perceptual theory is related to individual needs rather than biological drives:

> [Cognitive-perceptual theory] holds that autobiographical memory is an excellent tool for understanding the individual's unique way of constructing self, others, and the external world. If we want to understand how an individual perceives his world, the royal road to his internal organization scheme (to coin a phrase) is autobio-

> graphical memory. As we perceive, so also do we remember, and vice versa. (Bruhn, 1990, p. 130)

According to cognitive-perceptual theory, selectivity in perception is based on the individual's frame of reference: "needs, fears, interests, and major beliefs [that] direct and orchestrate first the perceptual process and later the reconstruction of the events which are recalled" (Bruhn, 1990, p. 103). This frame of reference operates in the present but is dependent on existing schema. Schema, a construct related to memory structure, "can be described," according to Bruhn (1990), "as expectations, rules, or axioms derived from past experience that the individual maintains about self, others, and the world. Memory primarily consists of schema about the world, rather than traces or images of the world" (p. 103). Attitudes, rather than mere factual information, are the "stuff" of autobiographical memory. Bruhn called "process of justification" that operation wherein the individual reconstructs past experience by meshing factual details with the initially emerging attitude. The "factual details" may indeed change in order to be consistent with the initially emerging attitude. Thus in the cognitive-perceptual model early recollections may be treated as fantasies about the past which relate to current issues of the individual: "the interpretation [of the early recollection] will be valid even if the memory has been distorted by unconscious forces or entirely fabricated" (Bruhn, 1990, p. 96).

Bruhn (1990) postulated that autobiographical memory is organized according to seven specific organizing principles: attitude, mood or state, content category, time, person, place, and activity. Whether under similar or equivalent nomenclatures, these seven organizing principles can be recognized as among the variables in the Manaster-Perryman Manifest Content Early Recollection Scoring Manual (Manaster & Perryman, 1974).

Early Recollections and Mathematics Attitudes

Although early recollections have been studied across a wide range of populations, to date no early recollection data have been correlated with attitudes towards mathematics. Attitudes towards mathematics have been measured and have been used to differentiate persons as to their positive or negative inclination towards mathematics (Fennema & Sherman, 1976). Women in particular, with respect to mathematics, have been subjects of investigation because of their tendency to be under-represented in advanced mathematics courses and in mathematics-related careers (Fennema, 1981; Levine, 1976; Sherman, 1982; Singer & Stake, 1986; Stallings, 1985)

Variable Selection

Variable selection was based on research literature on cognitive and affective variables as they relate to women's involvement in mathematics. Those variables in the Manaster-Perryman Manifest Content Early Recollection

Scoring Manual (Appendix D) which did not meet the criterion of having been extensively studied in the literature on women in mathematics were excluded from consideration in this present study.

The inclusion of the early recollection content variables of Mother and Father (from the Characters cluster of the Manaster-Perryman Manifest Content Early Recollections Scoring Manual) is related to studies by Eccles, Adler, Futterman, Goff, Kaczala, Meece and Midgley (1985), Raymond and Benbow (1989), and Stallings (1985). These researchers studied parental socializing influences and parental educational encouragement as they relate to enrollment and achievement in mathematics. Eccles et al. (1985), for example, demonstrated that parents' beliefs about the mathematical abilities of and the importance of mathematics for their children were predictive of their children's future mathematics expectancies and future course plans. Gender of parent and gender of child effects were considered also.

The variable Mastery, belonging to the Themes cluster of the Manaster-Perryman Manifest Content Early Recollection Scoring Manual (Manaster & Perryman, 1974), is logically and intuitively associated with confidence. Confidence in doing mathematics has been positively related to attitudes about mathematics and achievement (the latter, however, was not considered in this study). Meyer and Koehler (1990) examined the relationship between attitudes and achievement

in mathematics. Achievement in mathematics has been positively linked to continued participation of both males and females in mathematics (Meyer, 1986). Reyes (1984) attributed participation in mathematics beyond compulsory levels to students' confidence in doing mathematics. He also attributed students' aspirations for careers in quantitative fields to that same confidence. In other studies a similar relationship was reported between confidence in ability to do mathematics and mathematics participation (Armstrong & Price, 1982; Sherman, 1982). Eccles (1983) concluded that confidence in mathematics ability showed a stronger positive relationship to continued participation in mathematics than did measures of mathematical ability.

Participation, defined as course enrollment, is critical to continuing development of mathematics ability and achievement (Fennema, 1981) and to subsequent enrollment in higher level mathematics courses (Chipman & Wilson, 1985).

For the purposes of the present study confidence in the ability to do mathematics is included as an perception variable on the assumption that it continues to influence involvement with mathematics (formally, as in course enrollment, and informally) after high school, i.e., during the college experience (for a limited population) and beyond.

Another Theme cluster variable from the Manaster-Perryman Manifest Content Early Recollection Scoring Manual (Manaster & Perryman, 1974) which was included in this study was New or unfamiliar situation causing excitement. The logic for including this variable was based on the following sequential set of assumptions: (a) excitement has a positive valence, (b) reacting positively--cognitively, affectively, or both--to new or unfamiliar situations is contrary to a dependency state, and, therefore, (c) exhibiting such behavior may be classified as autonomous behavior. With respect to women in mathematics, Fennema and Peterson (1985) presented a model for explaining continued enrollment and success in mathematics which they called the Autonomous Learning Behavior (ALB) model. In this model it was hypothesized that "gender differences on these tasks [complex problem-solving] are caused by differential participation by females and males in autonomous learning behaviors (ALBs). These behaviors act as mediators among the internal belief system, external/societal influences, and the development of high-level cognitive skills" (Fennema & Peterson, 1985, p. 69). Autonomous learning behaviors are characterized by the preference on the part of the learner to work independently and to do so persistently even in the instance of new, unfamiliar, high-order, complex tasks.

The Concern with Detail cluster variable, the Visual variable of the Manaster-Perrymen Manifest Content Early Recollection Scoring Manual (Manaster & Perryman, 1974), can

be related to studies done by Connor and Serbin (1985) and Tartre (1990). The first study suggested that "[t]he skills of 'spatial orientation' and 'visualization' do appear to be contributing meaningfully to predicting mathematics achievement" (Connor et al., 1985, p. 173). Tartre, in addition, concluded that "[s]patial skill level does seem to be more related to mathematics performance for females than for males" (Tartre, 1990, p. 57). That is to say that when spatial skill deficiencies exist in individuals their impact on mathematics performance is greater on females than on males. In any case, the Visual variable in the Manaster-Perryman does not, of course, serve as an indicator of spatial ability; we may, however, assume that the presence of that variable in an early recollection reflects a concern (perhaps a preoccupation) with the visual/spatial and may, therefore, serve to understand the individual's conceptual-perceptual saliences.

The Setting cluster variable, School, is an obvious inclusion. It is expected that memories related to school setting appear in the early recollections of persons who are currently in a school setting, albeit college. Mathematics and school setting have only been studied in relation to setting characters, i.e., teachers, counselors, administrators, and peers (Fennema, 1990; Heller & Parsons, 1981; Leder, 1988; Stallings, 1985). Settings, per se, have not been investigated in relation to women's involvement (either enrollment or achievement) in mathematics.

The Active-Passive variables, a cluster in themselves on the Manaster-Perryman Manifest Content Early Recollection Scoring Manual (Manaster & Perryman, 1974), were treated as one variable--as they are mutually exclusive on the scoring manual instrument. Similarly, the Internal-External variables, which constitute the whole of the Control (as in "Locus of Control") cluster, are either-one-or-the-other variables and are scored accordingly.

Both Active-Passive and Internal-External are variables which are related to independent, autonomous thinking and behavior. As such they are included under the same rationale stated above for the inclusion of the variable New or Unfamiliar Situation Causing Excitement.

The Affect cluster of the Manaster-Perryman Manifest Content Early Recollection Scoring Manual (Manaster & Perryman, 1974) includes the variables Positive, Negative, and Neutral. These refer to the overall feeling tone of the early recollection. Again, these are scored on a presence/absence basis, with only one variable being scored. Affect has been studied in relation to mathematics involvement and achievement by Meyer (1986), Meyer and Koehler (1990), and Reyes (1984). The affect variables of overall positive, negative, or neutral tone have not been studied with relation to women in mathematics; from a cognitive-perceptual model standpoint (Bruhn's model includes the affect component, called mood or state) and from the Manaster-Perryman approach, too, it appears

reasonable to include these variables in order to measure the subject's affective reaction to the content of the early recollection.

Chapter 3

METHODOLOGY AND PROCEDURES

The following section delineates the sample, instrumentation, null hypothesis, data analysis, and limitations of the study.

Sample

Participants for the study consisted of 60 women enrolled at colleges or universities in the Midwest region, 30 of whom were math majors or math minors and 30 of whom were nonmath majors. This dichotomy yielded two groups of participants for comparison purposes on the Manaster-Perryman Manifest Content Early Recollection Scoring Manual (Manaster & Perryman, 1974).

Instrumentation

Manaster-Perryman Manifest Content Early Recollection Scoring Manual

Examining the content of early recollections, Manaster and Perryman (1974) hypothesized that thematic differences could be found in the manifest content of early recollections of individuals and that such differences would distinguish between individuals in different areas of study or careers and occupations. They developed an instrument

containing 42 variables clustered about seven themes: characters, themes (what the memory is about), concern with detail, setting, active-passive, control (internal vs. external), and affect. The manual is used as an instrument based on the nomothetic approach. The user scores content variables as either present or absent in an elicited early recollection.

Manaster and Perryman (1974) showed significant differences between groups of individuals across various college majors through the use of the Manaster-Perryman Manifest Content Early Recollection Scoring Manual. Similarly, other investigators have employed this instrument and have shown significant differences in the early recollection variables of various groups (Watkins, 1992). Watkins reported that interrater reliability in 30 studies published from 1981-1990, when reported, was high; in 15 of the 30 studies the Manaster-Perryman Manifest content Early Recollection Scoring Manual was employed (the average interrater agreement, as reported in 11 studies, was 92%).

Mosak (1958) established criteria for early recollections which were used in the majority of the studies reviewed by Watkins (1992): (a) recollections are considered "early" only if they are recalled by the subject as having occurred at or before the age of eight; (b) early recollections are of single, specific incidents (otherwise they become "reports" of events or situations that occurred over time and more than once); and (c) early recollections

are clearly visualizable.

An early recollections questionnaire was developed by the investigator. It was structured in accordance with the criteria presented by Mosak (1958).

Procedures

Each participant was asked to read carefully a human subjects consent form (Appendix A) and to complete a demographic questionnaire (Appendix B). Completion of the survey materials constituted participant acknowledgement of informed consent. The purpose of the collection of demographic information was to determine whether the two groups studied were adequately equivalent and comparable. Each participant was given instructions for obtaining the early recollections (Appendix C). Following the procedure outlined by Fakouri, Fakouri and Hafner (1986), the participants were asked to close their eyes and to visualize the earliest incident they could recall from their childhood and to write the incident as they visualized it with all of the details. Participants were then asked to state how old they were when they had the experience. Age eight was used as the cut-off, following Mosak's (1958) criterion that incidents taking place after age eight not be considered early recollections. Three early recollections were obtained from each participant in order to maximize the opportunity for the participant to reveal saliences which were present but which might otherwise be excluded.

Scoring of the contents of the obtained early

recollections was done by trained judges using the consensus method. A pilot study was conducted to test the instrument and to evaluate the ability of the judges to reach consensus. Three trained judges were used to score the obtained early recollections. Eleven math majors and 17 nonmath majors were asked to participate in the pilot study. Some suggestions for improvements in the presentation and format of the questionnaire were made by participants and were followed. In the pilot study three raters obtained an interrater agreement of 84%. This was judged to be sufficient, as individual rating differences were to be resolved by raters arriving at a consensus.

Hypothesis

The following hypothesis was investigated in the study: Manifest content of early recollections distinguishes women math majors/minors from nonmath majors.

Data Analysis

A 2 x 2 chi-square test of independence was run for each of the early recollection variables (Mother, Father, Mastery, New or unfamiliar situation causing excitement, Visual, School, Active/Passive, and Internal/External) for both groups (women math majors/minors and women nonmath majors). A 2 x 3 chi-square test of independence was run for the Affect variables: Positive, Negative, and Neutral. The results are presented in tables.

Yates' correction for continuity was to be used when

any expected frequency was less than five.

Relevant information concerning the research question and the null hypothesis is descriptively presented in the results. Tabular information drawn from the demographic questions is presented in Table 1.

The Alpha was set at .05.

Limitations

The following limitations applied to this study:

1. The application of the conclusions is limited to groups similar to the sample selected.

2. The validity and reliability of the questionnaire must be taken into account before drawing any conclusions.

3. There was no random selection of participants.

Assumptions

The following assumptions were made in the study:

1. Participants in this study responded candidly to the items of the questionnaire.

2. The Manaster-Perryman Manifest Content Early Recollection Scoring Manual provided a valid measurement of salient interpersonal, familial, and contextual variables.

Null Hypotheses

The hypothesis stated earlier, namely that the content of early recollections distinguishes women math majors/minors from women nonmath majors, was tested through the following hypotheses:

Null hypothesis 1. There is no significant difference

between women in mathematics and those not in mathematics with respect to early recollections containing the Mother manifest content variable.

Null hypothesis 2. There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the Father manifest content variable.

Null hypothesis 3. There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the Mastery manifest content variable.

Null hypothesis 4. There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the New or unfamiliar situation causing excitement manifest content variable.

Null hypothesis 5. There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the Visual manifest content variable.

Null hypothesis 6. There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the School manifest content variable.

Null hypothesis 7. There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the Active

manifest content variable.

Null hypothesis 8. There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the Passive manifest content variable.

Null hypothesis 9. There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the Internal manifest content variable.

Null hypothesis 10. There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the External manifest content variable.

Null hypothesis 11. There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the Positive manifest content variable.

Null hypothesis 12. There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the Negative manifest content variable.

Null hypothesis 13. There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the Neutral manifest content variable.

Chapter 4

RESULTS

This chapter presents the findings of this investigation of the early recollections of women in mathematics. The hypothesis investigated was that there were no significant differences between women math majors/minors and women nonmath majors with respect to their early recollections. Variables were selected from those measured by the Manaster-Perryman Manifest Content Early Recollection Scoring Manual (Manaster & Perryman, 1979). The basis for selection was that each variable had to meet the criterion of having been previously extensively studied in the literature on women in mathematics. The variables from the Manaster-Perryman Manifest Content Early Recollection Scoring Manual which met this criterion were Mother, Father, Mastery, New or unfamiliar situation causing excitement, Visual, School, Active vs. Passive, Internal vs. External (referring to locus of control), and Positive, Negative, or Neutral.

Differences across the selected variables were examined using the chi-square test of independence statistic. Three raters trained in the Manaster-Perryman Manifest Content

Early Recollection Scoring Manual independently scored the early recollections collected. In a pilot study rating trial, the three raters obtained an interrater agreement of 84%. In the present study, the three raters obtained a 96% interrater agreement before they met and reviewed the scores in order to reach consensus--the method recommended by Watkins (1992). Responses on the variables studied were scored dichotomously, that is, either the presence or absence of a variable was scored.

Demographic information was sought. Information included was: age, highest level of education, highest level of mathematics courses taken or being taken (high school or college), major, number of children in family of origin, and birth order position. The demographic composition of the two groups studied is presented in Table 1. A review of Table 1 indicates that the women-in-math group and the women nonmath group were approximately equivalent as to age range and level of education. The number of children in the participants' families of origin reported by the math group had a mean of 2.7, and the mean for the nonmath group was 3.3. Fourteen of the math group reported being the first (or only child) in birth order among siblings; 15 of the nonmath group reported being first (or only child). Other birth order positions are presented in Table 1. Overall, an examination of the demographic information would suggest that the two groups studied were similar.

Results

The following null hypothesis was investigated in this study: The content of early recollections does not distinguish women math majors/minors from women nonmath majors.

Table 1

Frequency Counts of the Demographic Information for Women Math Majors/Minors and Women Nonmath Majors

Demographics	Frequency	
	Math	Nonmath
Participants	30	30
Age Range	17-39	18-47
Mean Age	20.6	23.2
Education Completed (Years)	15.5	15.7
Degrees		
High School Diploma	27	25
Associate Degree	2	2
Bachelor Degree	0	3
Master Degree	1	0
Number of Children in Family of Origin:		
Mode	2	3
Mean	2.7	3.3
Birth Order Position		
First (or Only Child)	14	15
Second	11	8
Last	4	3
Other	1	4

Table 2 contains the number of early recollections of women math majors/minors and of women nonmath majors which contained mention of a mother. Of the 90 early recollections of women math majors/minors, 60% contained a mother character, while, of the 90 early recollections of

the nonmath majors, 50% contained that variable. Chi-square results revealed no significant difference between participating women in mathematics and those not in mathematics with respect to the Mother variable as measured by the Manaster-Perryman Manifest Content Early Recollections Scoring Manual (Manaster & Perryman, 1974).

Table 2

Frequency Counts, Chi-Square Values, and Level of Significance of Early Recollections of Women Math Majors/Minors and Women Nonmath Majors Containing Character Variables

Variable	Frequency		X^2	DF	p
	Math	Nonmath			
Characters:					
Mother	54	45	1.818	1	>.05
Father	39	35	.367	1	>.05

Table 2 also contains the number of early recollections of women math majors/minors and of women nonmath majors which contained mention of a father. Slightly over 43% of the 90 early recollections of women math majors/minors contained a father character. The percentage of the 90 early recollections of women nonmath majors which mentioned a father was 38.89. Chi-square results revealed no significant difference between participating women in mathematics and those not in mathematics with respect to the

Father variable as measured by the Manaster-Perryman.

Table 3 contains the number of early recollections of women math majors/minors and of women nonmath majors which contained an element of mastery. Of the 90 early recollections of women math majors/minors, 15.56 contained a mastery theme. The percentage of the 90 early recollections of women nonmath majors which reflected mastery was 13.33. Chi-square results revealed no significant difference between participating women in mathematics and those not in mathematics with respect to the Mastery variable as measured by the Manaster-Perryman Manifest Content Early Recollection Scoring Manual (Manaster & Perryman, 1974).

Table 3

Frequency Counts, Chi-Square Values, and Level of Significance of Early Recollections of Women Math Majors/Minors and Women Nonmath Majors Containing Theme Variables

Variable	Frequency		X^2	DF	p
	Math	Nonmath			
Themes:					
Mastery	14	12	.179	1	>.05
New or Unfamiliar Situation	14	21	1.737	1	>.05

Table 3 also contains the number of early recollections of women math majors/minors and of women nonmath majors

which contained mention of a New situation or an unfamiliar situation which caused excitement. The percentage of the 90 early recollections of women math majors/minors who described such an element was 15.56. Of the 90 early recollections of the nonmath majors, 23.33% contained the theme in question. Chi-square results revealed no significant difference between participating women in mathematics and those not in mathematics with respect to the New or Unfamiliar Situation Causing Excitement variable as measured by the Manaster-Perryman.

Table 4 contains the number of early recollections of women math majors/minors and of women nonmath majors which contained some element of concern for detail with respect to the visual sphere. Of the 90 early recollections of the math majors/minors, 47.78% contained a visual element. The

Table 4

Frequency Counts, Chi-Square Values, and Level of Significance of Early Recollections of Women Math Majors/Minors and Women Nonmath Majors Containing a Concern for Detail Variable

Variable	Frequency		X^2	DF	p
	Math	Nonmath			
Concern with Detail:					
Visual	43	40	.2012	1	>.05

percentage of the 90 early recollections of women nonmath

majors which contained a visual element was 44.44. Chi-square results revealed no significant difference between participating women in mathematics and those not in mathematics with respect to the Visual variable as measured by the Manaster-Perryman.

Table 5 contains the number of early recollections of women math majors/minors and of women nonmath majors which contained mention of a school or a school-related setting. The percentage of the 90 early recollections of women math majors/minors who mentioned a school-related setting was 7.78. The percentage of the 90 early recollections of women nonmath majors who mentioned a school-related setting was 10. Chi-square results revealed no significant difference between participating women in mathematics and those not in mathematics with respect to the School variable as measured by the Manaster-Perryman.

Table 5

Frequency Counts, Chi-Square Values, and Level of Significance of Early Recollections of Women Math Majors/Minors and Women Nonmath Majors Containing a Setting Variable

Variable	Frequency		X^2	DF	p
	Math	Nonmath			
Setting:					
School	7	9	.2744	1	>.05

Table 6 contains the number of early recollections of women math majors/minors and of women nonmath majors which were rated as either presenting the recollector as an active or passive participant, i.e., whether the participant initiated or did not initiate what took place in the recollection. The percentage of the 90 recollections of women math majors/minors who were active participants in recollections was 72.22%; the percentage of recollections of the same group who were passive participants was 27.78%.

Table 6

Frequency Counts, Chi-Square Values, and Level of Significance of Early Recollections of Women Math Majors/Minors and Women Nonmath Majors Containing an Active or Passive Variable

Variable	Frequency		X^2	DF	p
	Math	Nonmath			
Active/Passive:					
Active	65	61	.4233	1	>.05
Passive	25	29	.4233	1	>.05

The percentage of the 90 early recollections of women nonmath majors who were active participants in recollections was 67.78%; the percentage of recollections of the same group who were passive participants was 32.22%. Chi-square results revealed no significant difference between participating women in mathematics and those not in

mathematics with respect to the Active/Passive variable as measured by the Manaster-Perryman.

Table 7 contains the number of early recollections of women math majors/minors and of women nonmath majors which either reflected the recollector's internal or external locus of control. Of the 90 early recollections of women math majors/minors, 96.67 contained an element of the recollector's internal locus of control operating; the percentage of the 90 early recollections of the same group which were rated as showing an external locus of control was 1.11. The percentage of the 90 early recollections of women nonmath majors which were rated as showing an internal locus of control was 95.56; of the 90 early recollections of the same group, 2.22% were rated as showing an external locus of control. Summed percentages did not total 100 because raters did not identify a control variable in every early recollection, as some recollections had content which did not lend themselves to reflecting the issue of locus of control one way or another: as it happened, 88 early recollections containing control issues were found in each set of 90 early recollections taken from both groups. Chi-square results revealed no significant difference between participating women in mathematics and those not in mathematics with respect to the Internal/External variable as measured by the Manaster-Perryman.

Table 8 contains the number of early recollections of women math majors/minors and of women nonmath majors which

were rated as to affect, i.e., the "feeling tone" associated with each early recollection. The percentage of the 90 early recollections of women math majors/minors rated as having a positive feeling tone was 60; the percentage of the 90 early recollections of women math majors/minors rated as having a negative feeling tone was 34.44 (the percentage

Table 7

Frequency Counts, Chi-Square Values, and Level of Significance of Early Recollections of Women Math Majors/Minors and Women Nonmath Majors Containing an Internal or External Control Variable

Variable	Frequency		X^2	DF	p
	Math	Nonmath			
Control:					
Internal	87	86	.3430	1	>.05
External	1	2	.3430	1	>.05

balance was rated "neutral"). Of the 90 early recollections of women nonmath majors, 48.89% were rated as having a positive feeling tone. Of the 90 early recollections of women of the same group, 42.22 were rated as having a negative feeling tone (the percentage balance was rated "neutral"). Chi-square results revealed no significant difference between participating women in mathematics and those not in mathematics with respect to Affect as measured by the Manaster-Perryman.

Table 8

Frequency Counts, Chi-Square Values, and Level of Significance of Early Recollections of Women Math Majors/Minors and Women Nonmath Majors Rated as to Affect

Variable	Frequency		X^2	DF	p
	Math	Nonmath			
Affect:					
Positive	54	44			
Negative	31	38			
Neutral	5	8			
			2.423	2	>.05

Post-Hoc Analysis

A Post-hoc analysis of unselected variables from the Manaster-Perryman Manifest Content Early Recollection Scoring Manual (Manaster & Perryman, 1974) was performed to determine whether differences between the two groups studied exist which have not been previously identified or have not been subject to major research. The manual contains a total of 42 variables. Five general variables, which consist of summary frequency counts of the variables which may have appeared in certain clusters and of the "Other" category (i.e., Numbers 8, 21, 22, 34, and 35) were not included in the analysis, as suggested by other researchers (Hafner, Fakouri, & Labrentz, 1982; Hafner, Fakouri, & Chesney, 1988;

Elliott, Fakouri, & Hafner, 1993). The 42 variables are divided among seven clusters thusly: Characters (Mother, Father, Siblings, Other family members, Non-family members, Group, and Animal); Themes (Birth of sibling, Death, Punishment, Misdeeds, Givingness, Mastery, Mutuality, Attention-getting, New or unfamiliar situation causing excitement, Fear or anxiety-provoking or threatening situation, and Open hostility); Concern with detail (Visual, Auditory, and Motor); Setting (School, Inside the home of family or relatives, Outside in subject's neighborhood, Traveling, Inside the home of a non-family member, Outside and away from family home or neighborhood, and Unclear); Active-Passive (Active or Passive); Control (Internal or External); and Affect (Positive, Negative, or Neutral). The early recollection data from the two groups of women studied were analyzed with respect to the content variables not originally selected to be part of the design of this study. Only one variable was significant: the Attention-getting theme variable.

The data in Table 9 indicate differences between women math majors/minors and women nonmath majors with respect to the Attention-getting theme variable. The women math majors/minors mentioned with significantly greater frequency in their early recollections incidents where the focus was on seeking attention ($x^2 = 6.875$, $p < .05$).

Table 9

Frequency Counts, Chi-Square Values, and Level of Significance of Early Recollections of Women Math Majors/Minors and Women Nonmath Majors Containing Attention-Getting Theme Variable

Variable	Frequency		X^2	DF	p
	Math	Nonmath			
Theme:					
Attention-Getting	29	14	6.875	1	<.05

Discussion

Cognitive-perceptual theory (Bruhn, 1982) provides one framework for understanding the psychological processes which underlie meaningful connections made by an individual in the here and now between early recollections and that individual's current striving and style of life. According to this paradigm, memory is more than the retrieval of stored historical/factual information; rather, memory is understood to involve individual, unique perception and organization. Thus, memory is said to involve a process of construction as well as retrieval. Bruhn (1990) theorized that memory is guided by and primarily consists of individual schema about the world. These schema are at once producers and products of attitudes and beliefs around which individuals reconstruct events. Autobiographical memories

are, therefore, useful means to discovering what a particular individual's attitudes and beliefs are. Early recollections are, in turn, useful reconstructions of events which reflect and reveal those issues which may be currently of importance to the individual.

It was, therefore, expected that certain selected content variables would appear in early recollections of women who are involved in mathematics and that the frequency of their appearance would be significantly different from that of women not involved in mathematics. Of the manifest content variables selected for inclusion in this study of early recollections (based on variables found in the literature on women in mathematics), none of the originally selected variables reached significance when the manifest content of early recollections of women math majors/minors and that of women nonmath majors were analyzed using a chi-square test of independence. The null hypothesis, which assumed there were no differences between the two comparison groups with regard to the selected variables, was retained at $p < .05$. However, based on a post-hoc analysis in which unselected variables from the Manaster-Perryman Manifest Content Early Recollections Scoring Manual (1974) were considered, a significant difference was found between women math majors/minors and women nonmath majors on the theme variable Attention-getting.

With respect to women in mathematics certain saliences have been recognized as variables or factors associated with

predilection for or involvement in mathematics (including elective enrollment in mathematics courses at the high school level). The variable Mother and the variable Father from the Manaster-Perryman Manifest Content Early Recollections Scoring Manual (1979) related to research by Broadbooks, Elmore, Pedersen, and Bleyer (1981), Chipman and Wilson (1985), Eccles, Adler, Futterman, Goff, Kaczala, Meece, and Midgley (1985), Ernest (1976), Raymond and Benbow (1989), Sherman and Fennema (1977), and Stallings (1985) in which parental influence on women's attitudes and beliefs about mathematics was evidenced significantly. In the current study, neither the Mother variable nor the Father variable was found to be significant when the frequency of their mention in early recollections was compared with respect to the two groups studied--women math majors/minors and women nonmath majors. Although surprising, this finding does not necessarily contradict the results of the studies just cited. Those studies generally established through direct questioning, whether by objective instruments or through face-to-face interviewing, the salience of parental influence on students' (typically high school students) attitudes and beliefs relative to mathematics. The results of the current study with respect to these same parental factors may be subject to several interpretations. First, and most apparently, the presence of Mother/Father mentions in these early recollections may correspond to previous studies (e.g., Armstrong, 1985) which showed parental

influence on math course enrollment exists but is neither among the most highly ranked factors nor among the least ranked. Mother/Father variables did appear in the early recollections taken from both groups studied and were higher in number among the mathematics group, but failed to reach significance. Another interpretation could simply be that parental factors cannot be accessed using the Manaster-Perryman Manifest Content Early Recollection Scoring Manual without collecting primed early recollections, i.e., early recollections which have been defined or limited to the subject of mathematics.

Confidence in the ability to do mathematics was shown to be a significant factor in predicting the continued involvement of women in mathematics (Armstrong & Price, 1982; Eccles, 1983; Reyes, 1984; Sherman, 1982). These studies compared males and females as to level of confidence in the ability to do mathematics. Generally, males regardless of their actual measurable proficiency in mathematics, appeared to have more confidence in their ability to do mathematics than females did. For the purpose of this study, the manifest content variable, Mastery, was selected as likely to be as closely representative of the attitude or belief embodied in the phrase "confidence in ability to do mathematics." Results of the current study failed to indicate that the manifest content variable Mastery is a function of mathematics predilection among women. It could be hypothesized that the Mastery variable

is more related to college enrollment in general than specifically to mathematics enrollment among women (all participants were college students) and that the Mastery variable of women's early recollections did not further distinguish between college women. Of course, it is also a tenable position that the Mastery variable, which is defined as reflecting an attempt to control oneself, others, or the environment by physical or psychological acts, does not appear to apply generally to the academic domain or specifically to the domain of mathematics and mathematics enrollment.

Autonomous learning behavior (ALB), postulated by Fennema and Peterson (1985) to be predictive of women's enrollment and success in mathematics, was, for the purposes of this study, assumed to be related to the manifest content variable New or unfamiliar situation causing excitement. Similarly, the Active-Passive variables and the Internal-External variables were seen as related to the independent, autonomous learning behavior, inasmuch as autonomy is likely to be associated with active behavior and internal (self) control attribution. The current study suggests that analysis using the Manaster-Perryman Manifest Content Early Recollection Scoring Manual (1979) does not distinguish between women involved in mathematics with respect to the New or unfamiliar situation causing excitement variable, the Active-Passive variables, or the Internal-External variables. It is opined here that the constructs

represented by the variables of New or unfamiliar situation causing excitement, Active-Passive, and Internal-External are similar enough to the constructs studied under the label of ALB (learner preference to work independently on new, unfamiliar tasks) to expect significant results regarding these varaibles in the current study. However, it may be reasonably postulated that these early recollection manifest content variables are not sufficiently defining of characteristics associated with autonomous learning behaviors in order to distinguish between the two groups of women studied. On the other hand, Fennema et al. (1985) found differences in ALB when they compared males and females: males tended, by junior and senior years in high school, to exhibit more ALB than women and this difference correlated with their respective math course enrollments. Fennema et al. (1985) did not study contrasting groups of women. Perhaps the current study shows evidence that, when women are compared to other women, ALB levels are too homogeneous to distinguish between two groups such as those studied here.

Connor and Serbin (1985) obtained research results which suggested that spatial orientation and visualization contributed significantly to predicting mathematics achievement. Although the current study prescinded from considering mathematics achievement, it was hypothesized that the presence of the Visual variable (from the Concern with Detail cluster of the Manaster-Perryman Manifest

Content Early Recollection Scoring Manual) in early recollections reflects at least a concern with the visual/spatial--if not predictive of visual/spatial ability. The current study produced no evidence that women in mathematics differ from other college women with respect to the Visual variable. Tartre (1990) had concluded that spatial skill was more critical for females than for males with respect to mathematics performance in that, when deficiencies in spatial skill are manifest in individuals, mathematics performance is impacted more greatly in the case of females. Again, a significant factor impeding comparison between these previous studies (Conner et al., 1985 and Tartre, 1950) and the current study may be that only intragender comparisons were made in the latter.

The School variable was included because, in the research literature on women and mathematics, so many variables are school related (teachers, counselors, curricula, peers, etc.). It is assumed that women in mathematics have (according to the cognitive-perceptual framework) constructed memories of past school incidents in greater proportion than other college women. In fact, the school setting and mathematics have been previously studied only in terms of school-related characters: teachers, counselors, administrators, and peers (Fennema, 1990; Heller & Parsons, 1981; Leder, 1988; Rosenberg, 1987; Stallings, 1985). Such studies suggested that women's involvement in mathematics was significantly related to their perception of

the attitudes and beliefs of school-related persons towards women in mathematics. It was hypothesized that the school setting, under the nomenclature of School variable, would appear with significantly greater frequency in the early recollections of women in mathematics than in those of women not in mathematics. Results suggest that there is no significant difference in this regard; analysis through the Manaster-Perryman Manifest Content Early Recollections Scoring Manual (1979) does not distinguish women with a prediction for mathematics from other college women.

It can be argued that school-relatedness is no more likely to appear in the perceptions of women in mathematics than in those of women in other majors. In fact, to have hypothesized such a difference may reflect in itself stereotyping of a sort which may be based on an unjustified notion that mathematics is, due to its perceived difficulty in the popular mind, of a higher academic order than other fields. Perhaps, instead, the results obtained in the current study should have been expected: women in mathematics may be no more concerned with academics and academic settings than are women in other fields of study. Therefore, with regard to women in mathematics and the school setting, their early recollections (which, according to Adler [1937], should relate to the current psychological state of the individual and reflect their style of life, their current perceptions) do not distinguish them from their fellow female students.

Brush (1985), Meyer (1986), Meyer and Koehler (1990), and Reyes (1984) studied affect in relation to mathematics involvement and achievement. These studies concurred in their conclusion that a positive, anxiety-free, and confident attitude was associated with continuing enrollment and success in mathematics by women. Affect in the Manaster-Perryman Manifest Content Early Recollection Scoring Manual (1979) is limited to analyzing the overall feeling tone of the early recollection in terms of a Positive, Negative, or Neutral variable. In Bruhn's (1990) cognitive-perceptual model "mood" or "state" is the general affect component. It was hypothesized that through the Affect cluster of the Manaster-Perryman women math majors/minors would be distinguished from women nonmath majors. Results failed to indicate any significant difference in this respect between the two groups studied.

For a possible explanation of these negative results, it may be sufficient to assume, in retrospect, that the early recollections taken in this study constituted too general a measure of affect to be compared with the affect measured in the previous mathematics studies, which limited their concerns to affect specifically related to mathematics and math course-taking.

In the post-hoc analysis, the theme variable Attention-getting, reached significance ($X^2 = 6.87$, $p < .05$). This variable, however, has not appeared in any previous literature related to women in mathematics.

Summary of Findings

Consistent with the formulation of null hypotheses in order to investigate the hypothesis that the content of early recollections distinguishes women math majors/minors from women nonmath majors, the following findings resulting from this study are presented thusly:

Null hypothesis 1 is retained: There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the Mother manifest content variable.

Null hypothesis 2 is retained: There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the Father manifest content variable.

Null hypothesis 3 is retained: There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the Mastery manifest content variable.

Null hypothesis 4 is retained: There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the New or unfamiliar situation causing excitement manifest content variable.

Null hypothesis 5 is retained: There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the Visual manifest content variable.

Null hypothesis 6 is retained: There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the School manifest content variable.

Null hypothesis 7 is retained: There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the Active manifest content variable.

Null hypothesis 8 is retained: There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the Passive manifest content variable.

Null hypothesis 9 is retained: There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the Internal manifest content variable.

Null hypothesis 10 is retained: There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the External manifest content variable.

Null hypothesis 11 is retained: There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the Positive manifest content variable.

Null hypothesis 12 is retained: There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections

containing the Negative manifest content variable.

Null hypothesis 13 is retained: There is no significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the Neutral manifest content variable.

Post-hoc analysis results showed that there was a significant difference between women in mathematics and those not in mathematics with respect to early recollections containing the Attention-getting manifest content variable.

Chapter 5

SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

This chapter contains the summary, conclusions, implications, and recommendations based on the investigation of early recollections of women in mathematics.

Summary

The purpose of this study was to investigate whether the content of early recollections is consistent with known determinants associated with mathematics predilection in women. To achieve this purpose participants were asked to complete a questionnaire in order to obtain three early recollections. Such early recollections were regarded by Adler (1937) as valuable indications of the direction of an individual's striving and, consequently, of an individual's style of life. Early recollections were seen by Adler as related to the current psychological state of the individual: the current meaning of the early recollection was the important element, not the historical or factual validation of the content. Because thematic differences in early recollections have been found between individuals (Berman, 1958) and groups (Lieberman, 1967; Fakouri & Zucker, 1987; Williams & Manaster, 1990) early recollections

have been used for vocational and educational prediction (Attarian, 1978; Hafner & Fakouri, 1984a). Manaster and Perryman (1974) demonstrated that occupational differences are reflected in early recollections. Early recollections may, therefore, function as a guide for the individual in occupational selection.

Participants in this study were asked to close their eyes and to visualize the earliest incident they could recall from their childhood and to write the incident as they visualized it with all of the details. Participants were then asked to state how old they were when they had the described experience which they recollected. Age eight was used as the cut off--that is, incidents which were recalled as taking place after age eight would not be considered as fulfilling the definition of an early recollection. Three early recollections were obtained from each participant to optimize the opportunity for saliences to be revealed.

Participants in the study consisted of 60 women enrolled at four Midwestern colleges and universities. Thirty of the participants were mathematics majors or minors; 30 were nonmath majors, i.e., majors in areas not typically associated with mathematics. This dichotomy yielded two groups of women participants for comparison purposes. The Manaster-Perryman Manifest Content Early Recollection Scoring Manual (Manaster & Perryman, 1974) was employed to score the early recollections obtained. Three trained raters individually scored the early recollections

and then final score determinations were made by the consensus method recommended by Watkins (1992). Scoring of content variables consisted of rating either the presence or absence of the selected variables: Character variables, Mother and Father; Theme variables, Mastery and New or unfamiliar situation causing excitement; Concern for detail variable, Visual; Setting variable, School; Active/Passive variables, Active and Passive; Control variables, Internal and External; and, Affect variables, Positive, Negative, and Neutral.

The following research question was investigated in this study: Does the content of early recollections distinguish women math majors/minors from women nonmath majors? The null hypothesis investigated was: The content of early recollections does not distinguish women math majors/minors from women nonmath majors. In order to investigate this null hypothesis using the Manaster-Perryman, individual null hypotheses were formulated for each of the specific variables listed in the preceding paragraph.

A 2 x 2 chi-square test of independence was run for the variables Mother, Father, Mastery, New or unfamiliar situation causing excitement, Visual, School, Active, Passive, Internal, External, Positive, Negative, and Neutral. The chi-square test of independence produced no statistically significant differences between women math majors/minors and women nonmath majors at the set level of

significance (.05) with respect to any of the originally selected variables. In a Post-Hoc analysis, wherein chi-square tests of independence were run on the remaining variables from the Manaster-Perryman Manifest Content Early Recollection Scoring Manual (Manaster & Perryman, 1974), the Theme variable, Attention-getting, was unique in producing a significant difference between the two groups investigated. Women math majors/minors were found to have significantly more attention-getting content in their early recollections than was found in the content of early recollections of women nonmath majors. This variable is described in the Manaster-Perryman Manifest Content Early Recollection Scoring Manual as scored when "the participant receives or wants special attention" (Manaster & Perryman, 1974).

Conclusions

On the basis of this study, the following conclusions are warranted:

1. The early recollection manifest content variables of Mother, Father, Mastery, New or unfamiliar situation causing excitement, Visual, School, Active/Passive, Internal/External, and Positive/Negative/Neutral (Affect) appear not to differentiate between women in mathematics and women in other fields of study at the college level.

2. The early recollection manifest content variable Attention-getting may differentiate between women in mathematics and women in other fields of study at the college level.

Implications

The results and conclusions drawn from this study suggest the following implications:

1. The manifest content of early recollections does not appear to yield enough significant information on a nomethetic level to distinguish between women with a predilection for mathematics and other women.

2. Confirmation of the significance of variables previously identified by research on women in mathematics may be attainable only through an idiographic analysis of the content of early recollections.

3. The implications of the significant frequency of the appearance of the theme of Attention-getting in the early recollections of women in mathematics should be addressed in further studies on women in mathematics, as this theme has not been previously noted in the literature.

4. Recent studies (Kwiatkowski, Dammer, Mills, & Jih, 1993; LeFevre, Kulak, & Heymans, 1992; Lips, 1992) comparing college women and men have generally confirmed the significance of attitudinal factors which were found in earlier studies comparing pre-college level students. The results of this study suggest that factors related to women's perceptions about mathematics when compared among women (in intragender studies) may be different from those factors which have been found to be significant when women are compared to men (in intergender studies), or, on the other hand, perceptual factors assessed by the Manaster-

Perryman may not be related to the belief/attitude factors in other studies.

5. Differences between the subject groups may simply be related to factors other than the variables assessed by using the Manaster-Perryman.

Recommendations

The results of this study suggest that the Manaster-Perryman Manifest Content Early Recollection Scoring Manual (Manaster & Perryman, 1974) yields little information towards identifying women with a predilection for mathematics. The researcher must always be cognizant of the particularities of the group of subjects which has been utilized in a given study, especially developmental factors. Thus it was hypothesized in the Discussion section of this study that age characteristics or educational level characteristics or both may have contributed to the overall nonsignificant results found in this study. It is therefore recommended that future researchers of this subject structure their group selection so as to test the age and/or educational level components which may be yielding particular results.

Because nearly all previous studies attempting to find variables differentiating the mathematically inclined from the disinclined among women were conducted at the pre-college level (Haven, 1971), future research using early recollections might yield more significant results if conducted with equivalent pre-college groups. The use of

early recollections may be beneficial with such groups as a vocational assessment tool when combined with other more traditional assessment modalities.

Age or educational level may not be the only participant characteristics operating in the results of this study. As pointed out in the Introduction, mathematics has tended in our contemporary society (and, per force, in the American workplace) to act as a filter (Sells, 1980) which, in effect, eliminates many women from taking advantage of vocational opportunities which are, to varying degrees, mathematics dependent (Wise, 1978). Distinguishing characteristics, such as those attempted to be measured by manifest content variables reported in early recollections, may fail to reach salience unless participant selection criteria includes more than a college major declaration or course enrollment. Serious commitment to the study of mathematics, planful career choices involving mathematics, and significant proficiency and achievement in the field of mathematics may be among other measurable group characteristics which would allow early recollection manifest content variables to reach significance in future research.

The two groups compared in this study were college women math majors or minors and college women nonmath majors. Future research comparing the manifest content of early recollections of more narrowly focused nonmath groups with those of women math majors/minors may yield significant

results. An obvious comparative specialization would be women engineers. The engineering fields--mechanical, chemical, electrical, civil, etc.--are highly mathematics dependent and include in their corresponding curricula various and numerous higher mathematics courses. These courses, however, are typically of a more practical, pragmatic orientation than may be seen by mathematics major. Such differences in orientation--pure or theoretical vs. practical or applied--may manifest themselves in the content of early recollections where they did not when less specialized majors were compared to math majors/minors.

Some of the participants in the current study, while not majoring in what would be a field traditionally associated with mathematics, were in fields which included required mathematics courses (e.g., psychology majors typically are required to take at least an introduction to statistics). Future researchers may wish to select their comparison groups on the basis of degree of exposure to or level of sophistication of math classes taken by participants (perhaps factoring in measures of achievement in such classes: grades and/or standardized measures). The purpose of such group selection, in this case, would be to create greater polarity between comparison groups. (In the current study, limiting the women math group to majors only might have had some of the same polarization effect except that in actuality there were only two math minors among the 30 math group participants.) Finding a nonmath comparison

group comprised of participants with no exposure whatsoever to mathematics at the college level (possibly from among certain liberal arts groups) may yield interesting and significant differences which could be used in research and towards practical vocational-choice applications with respect to women and the area of mathematics.

Fennema and Sherman (1976) developed nine Likert-type scales which were purportedly domain specific and which measured attitudes related to the learning of mathematics. Each scale can be used independently or the instrument can be administered as a complete package. Fennema and Sherman (1971) hypothesized the following to be related to the participation and/or learning of mathematics: (1) confidence in learning mathematics (which can reasonably be assumed to correlate with the variable Mastery used in the current study); (2) perception of attitude of father toward his daughter/son as a mathematics learner (which is also likely to correlate well with the Father variable used in the current study); (3) perception of attitude of mother toward her daughter/son as a mathematics learner (similarly likely to correlate with the Mother variable); and (4) perception of attitude of teacher toward a student as a mathematics learner (perhaps less evidently correlating with the School variable). (Other scales measured "effectance motivation" [roughly equivalent to "problem-solving attitude"], attitude towards success in mathematics, perception of mathematics as a male domain, perception of

mathematics as useful, and mathematics anxiety.) Fennema and Sherman (1976) recognized that some of the scales could not be technically described as attitude scales but chose the term as most representative for purposes of communication about the instrument. Future research in the area focused on in the current study could include the use of the Fennema-Sherman Mathematics Attitude Scales to distinguish research groups to whom the early recollection study done here could be applied.

Other recommendations for further study: an idiographic approach may be taken in order to analyze the content of early recollections with respect to women in mathematics. The reliability and content validity of idiographic interpretations of early recollections was studied by Jones (1987). Idiographic interpretations have been referred to a "naturalistic" and likely would involve conducting an interview with the individual participant--something which was not done in the current study. A model for such a study might be the naturalistic study by Sherman (1983).

Primed early recollections (Shulman & Mosak, 1988) could be collected in a future study of women in mathematics. Primed recollections are recollections that are structured and focused by the manner in which the initiating question is asked, e.g., "Recall the earliest incident you can associate with an activity having to do with mathematics."

The future researcher interested in collecting early

recollections of women in mathematics might find significant, interesting, and useful differences by conducting an intergender study. Such a study might include the use of a sex-role perception measurement instrument such as the Bem Sex-Role Inventory (Bem, 1977). Fennema and Sherman (1976), cited evidence that tasks perceived to be gender appropriate are more likely to be performed better than tasks perceived to be gender inappropriate--and success in mathematics (better performance) is directly related to involvement with and enrollment in mathematics and mathematics courses (Leder, 1990).

Finally, as the theme variable Attention-getting achieved salience in this study but has not been previously studied with relation to women in mathematics, it is recommended that other studies be conducted to confirm or disconfirm the significance of this variable in distinguishing women as to mathematics predilection.

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APPENDIXES

APPENDIX A

Informed Consent

Thank you for volunteering to participate in this dissertation study. The purpose of the study is to assess the differences in attitudes, beliefs, and perceptions of women with regard to mathematics.

In order not to take up too much of your valuable time, the data collection involved in this study will only take approximately 20 minutes to complete.

To ensure anonymity and to keep your responses strictly confidential, PLEASE DO NOT WRITE YOUR NAME ON ANY OF THE MATERIALS handed to you. No identifying characteristics will appear in this study.

This study meets the standards of the Human Subjects Committee at Indiana State University and no known risks may arise from participation in this study.

Please note that participation in this study is voluntary and you may withdraw at any time. Your completion of the survey materials for this study will constitute your acknowledgement of informed consent.

If you have any questions or concerns I may be contacted through the Department of Counseling Psychology at Indiana State University.

Thank you for your help with this study.

Michael R. Elmore, Ph.D. Candidate
Counseling Psychology
Indiana State University

APPENDIX B

Personal Background Questionnaire

PLEASE DO NOT GIVE YOUR NAME.

Please complete the following information about yourself.

Age:_____

Years of education completed:_____

Degrees held:_____

Number of children in family you grew up in:_____

What is your birth order (e.g., "first"):_____

Are you or were you ever a mathematics major or minor?
☐ Yes ☐ No
If you answered "No," what is your major?_____

What was the highest level mathematics course you took at any level of your education (please try to use a descriptive course title such as "Algebra I in high school" or, if you cannot recall the course title, describe briefly the course):_____

_____

_____

_____

APPENDIX C

Early Recollection Questionnaire

Close your eyes and visualize the earliest incident you can recall from your childhood? Please write the incident as you visualize it with all of its details on the lines below:

_____

_____

_____

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_____

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_____

How old were you when this happened?_____

What part of the memory stands out most vividly for you?_____

_____

_____

What feelings did you have at the time of this incident?_____

_____

_____

----------> Now please go on to the next page------>

Early Recollection Questionnaire

Please write another early memory on the lines below (follow the same directions explained on page 1):

_____

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_____

How old were you when this happened?_____

What part of the memory stands out most vividly for you?_____

_____

_____

What feelings did you have at the time of this incident?_____

_____

_____

----------> Now please go on to the next page------>

Early Recollection Questionnaire

Please write another early memory on the lines below (follow the same directions explained on page 1):

_____

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How old were you when this happened?_____

What part of the memory stands out most vividly for you?_____

_____

_____

What feelings did you have at the time of this incident?_____

_____

_____

THIS COMPLETES THE QUESTIONNAIRE. THANK YOU FOR YOUR COOPERATION.

APPENDIX D

Manaster-Perryman Manifest Content

Early Recollection Scoring Manual (Excerpted)

The variables for early recollections utilized in this study were the following:

A. Characters (persons mentioned in the early recollection)

1. Mother
2. Father

Score character variables on presence-absence basis.

B. Themes (what the memory is about)

15. Mastery (attempts by subject to gain physical or psychological control of self, others, or environment)
18. New or unfamiliar situation causing excitement

Score theme variables on presence-absence basis.

C. Concern with detail

23. Visual (reference to color, size, shape, etc. of a person or object)

Score concern with detail variable on presence-absence basis.

D. Setting (where the situation or event took place)

26. School

Score setting variable on presence-absence basis.

E. Active-Passive

36. Active (subject initiates action; she acts

rather than is acted upon)

37. Passive (subject initiates little or no action; she is acted upon rather than acts)

Score active-passive variable on presence-absence basis. One or the other, but not both, variables should be scored.

F. Control

38. Internal (subject accepts responsibility for what happens)

39. External (subject dissociates from any responsibility for what happens)

Score control variables on presence-absence basis. One or other, but not both, variables should be scored.

G. Affect

40. Positive (overall feeling tone of the early recollection is pleasant)

41. Negative (overall feeling tone of the early recollection is unpleasant)

42. Neutral (no indication of affect in the early recollection)

Score affect variables on presence-absence basis. Only one of the variables should be scored.

In the Post-Hoc analysis, the following variables were scored:

B. Themes (What the memory is about)

17. Attention-getting (the participant receives or wants special attention)