DOCUMENT RESUME

ED 316 445 SE 051 293

AUTHOR	Mulkey, Lynn M.
TITLE	Universalism in Science: An Empirical Investigation of Attitudes toward Women in Science.
SPONS AGENCY	City Univ. of New York, N.Y. Research and Evaluation Unit for Special Programs.
PUB DATE	88
NOTE	41p.; Paper presented at the Annual Meeting of the American Sociological Association (83rd, Atlanta, GA, August 1988).
PUB TYPE	Reports - Research/Technical (143)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Compliance (Psychology); *Early Childhood Education; Elementary Education; Elementary School Science; *Females; Science Careers; Science Education; *Science Tests; *Socialization; Social Theories; *Socioeconomic Influences; Socioeconomic Status; *Student Attitudes; Young Children

ABSTRACT

The norm of "universalism" determines maintenance of science in society by preventing restriction of access to the field on grounds other than competence. Inferences for this theory are made on the basis of a test-case of the proposition that differential socialization predicts entry into the scientific talent pool. The Early Childhood Women in Science Scale (ECWiSS) was employed in a pilot administration to a sample of 791 students from New York City schools. Controlling for ability, significant differences in attitude were associated with various gender, age/grade, and socioeconomic status with gender explaining the greatest proportion (11%) of the total variance (16%). The findings suggest moderate normative compliance and the salience of including early childhood as a critical consideration in models of ascriptive and meritocratic processes affecting recruitment to science. (Author)

UNIVERSALISM IN SCIENCE: AN EMPIRICAL INVESTIGATION OF ATTITUDES TOWARD WOMEN IN SCIENCE*

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*This paper has been prepared for presentation at the 83rd annual meeting of the American Sociological Association, in Atlanta (August, 1988); the study was made possible by funds provided by the Office of Special Programs of the City University of New York, for ongoing research on the Urban Project. The Urban Project, created in 1981 to investigate the factors affecting recruitment of minorities to the sciences, was supported by a Ford Foundation planning grant and is presently under the auspices of the College Discovery and Development Program, a City University of New York and New York City Board of Education consortium.

The author wishes to thank Bernard Barber, Henry Etzkowitz, Susan Cozzens, and O. Roger Anderson, whose comments have benefited this manuscript. Jane Navarre and Perry Halkitis of the NYC Hunter Elementary School for the Gifted, Ann Gibb of the NYC Bilingual Bicultural Mini-School for the Gifted, Theresa Hastings, Wendy Todres, Robert Saggese, and Rosenelle Florencechild, provided extraordinary assistance with data collection and analysis. Appreciation is also extended to Alicia Dodd of the Educational Testing Service, for conducting a computer search of the Test Collection Database, and to Roger Pavelle of John Wiley & Sons, Inc. for help with the technicalities of copyright permission.

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Abstract

The norm of *universalism* determines maintenance of science in society by preventing restriction of access to the field on grounds other than competence. Inferences for this theory are made on the basis of a test-case of the proposition that differential socialization predicts entry into the scientific *talent pool*. The Early Childhood Women in Science Scale (ECWiSS) was employed in a pilot administration to a purposive sample of 791 students from New York City schools. Controlling for ability, significant differences in attitude were associated with variations in gender, age/grade, and socioeconomic status with gender explaining the greatest proportion (11%) of the total variance (16%). The findings suggest moderate normative compliance and the salience of including early childhood as a critical consideration in models of ascriptive and meritocratic processes affecting recruitment to science.

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Abstract

This research provides evidence to support the claim that the norm of *universalism* in science, by preventing restriction of access to the field on grounds other than competence, is a functional prerequisite for the maintenance of science in society. Inferences for theory are made on the basis of a test-case of the proposition that differential socialization predicts entry into the scientific talent pool (high ability students whose positive attitudes toward science are evidenced at or before ninth grade). Given that the pool from which scientists emerge, includes talented youngsters who have positive attitudes toward science, the contribution of ascriptive characteristics to attitudes toward science, once ability is controlled, is investigated. A 27-item instrument, the Early Childhood Women in Science Scale (ECWiSS), containing 4-point Likert-type measures of attitudes toward women scientists, was employed in a pilot administration to a purposive sample of 791 kindergarten through fourth grade students from New York City schools. The null hypothesis that attitudes, holding ability constant, will be the same across all attributes of the independent variables, was tested at three probability levels, using analysis of variance (ANOVA). Regression analyses showed that ascriptive factors explain only 16 percent of the variance in attitudes toward women in science and that gender accounts for approximately 11 percent and greatest proportion of the total variance. Three-dimensions of attitudes were identified by employing a principal-components analysis (*role specific self-concept, home-related sex-role conflict, and work-related sex-role conflict*) and significant differences in this measure were associated with variations in socialization. On the average, girls show more positive attitudes than boys, regardless of race, age, and socioeconomic status. Attitudes toward women in science are also more positive for middle class-versus working-class students, for children from intact households as compared to children living in single-parent homes, and for students attending private schools in contrast to students enrolled in public schools. White boys from low income families are the least likely to agree with the image of the female scientist. The findings indicate the overall approval of *universalism* in American culture, that *deviance is relatively rare*, and that discrimination operates to a small degree to restrict the pool from which scientists are recruited. The results also suggest the value of including early childhood as a critical consideration in models of the ascriptive and/or meritocratic processes affecting recruitment to science. More generally, by specifying the precise conditions under which *universalism* operates, the results extend our knowledge of the normative determinants of the maintenance of science.

UNIVERSALISM IN SCIENCE: AN EMPIRICAL INVESTIGATION OF ATTITUDES TOWARD WOMEN IN SCIENCE*

The debate over the normative structure of science involves those proponents who advocate a Mertonian (structural-functional) model of the ethos of science, and those who advocate a Kuhnian model (phenomenological). Merton (1942), refers to the ethos of science as four institutional imperatives, or norms -- rules of conduct which regulate the behavior and interrelations of scientists. To *universalism*, *organized scepticism*, *disinterestedness*, and *communism*, have been added *individualism*, *faith in rationality* and *emotional neutrality*, and *originality* (Barber, 1952). These are not binding technical prescriptions or proscriptions, but are beliefs about what is right and good, and on which the growth and advancement of science depends. For adherents of the Mertonian school, the main objective of empirical research is to show that the scientific ethos operates as the normative culture of science in which deviance is relatively rare (Storer, 1966). Kuhnian adversaries of this approach seek to prove that the norms posited by Merton are not institutionalized or universally adhered to and that the advancement of scientific knowledge is not contingent upon conformity to the scientific ethos, but is rather the outcome of indeterminate norms. More empirical evidence for assessing the validity of the ethos of science as the standard of scientists' conduct, is required if the Mertonian paradigm, virtually unchallenged for three decades, is to retain recognition as a powerful explanatory model (Toren, 1983).

This investigation is intended as an empirical observation of normative compliance. It focuses its attention on *universalism*. Studies of this type have included those which examine the distribution of rewards (i.e., Cole and Cole, 1973), and those which survey the attitudes of scientists toward the norms of science (i.e., Crane, 1972). This study, however, will utilize the concept of *universalism* in its broader sense — in the sense that Barber (1952) referred to as "a value of science which is connected directly with the larger morality of liberal society (p. 98)." Certain

* The term *science* as used in this paper, refers to those occupations broadly defined by the National Science (1986) — the physical, computer environmental, life, and social sciences, psychology and engineering.

features of liberal and authoritarian societies make them relatively more or less favorable to the continued advance of science. The approval culture places upon *universalism* is directly associated with the maintenance of a high level of scientific activity. The value has a secularized meaning of the Christian ideal of the brotherhood of persons in God so that ideally, all persons are free to find an occupation commensurate with their merits. At the societal level, most Americans accept the inevitability of stratification (the unequal distribution of wealth, power and prestige), but still claim they believe in equality. By this they mean that the rules determining who succeeds and who fails should be fair (Jencks, 1971). Most Americans also believe that education meritocratically encourages social mobility. Access to educational resources reduces the significance of ascriptive criteria for selection into elite occupations such as science (Lantz, West & Elliott, 1976; Bills, 1988). The consequences of ascriptive-based stratification are especially for the development and maintenance of science in society (Barber, 1952; Merton, 1973). That is, the norm of *universalism* is violated when occupational selection into scientific careers is in terms of *particularistic* criteria such as strategies which insure inclusion of persons who are the same race/ethnicity and gender, and less by *universalistic* criteria such as by the actual ability of individuals to meet the skill demands of the work. For example, stratification by gender is manifested by the aggregate underrepresentation of women in science (National Science Foundation, 1986). Women make up only thirteen percent of the science and engineering workforce and are most underrepresented in engineering and the physical sciences (National Science Foundation, 1984), despite the fact that increasingly more women enter law and medicine (Vetter, 1986). A current issue of the *American Psychologist* (American Psychological Association, 1988, p. 221) also illustrates gender stratification. On a list of seventy-seven scientists acknowledged as recipients of awards for distinguished scientific contributions from 1956 to 1987, only five were women, two of which were named as the second of two co-contributors. To explain this phenomenon, we have to believe either in the inherent inability of women to do science or we have to turn to an examination of the social factors, specifically the operation of *universalism* in the broader society and in the scientific community, which restrict their access and contribution to the field. That is, how does compliance at the societal level relate to compliance within the community of scientists? If the norm in the wider cultural context is not adhered to, then compliance within the scientific community seems impossible because the pool from which scientists emerge is already restrictive. We are led to consider whether ascriptive characteristics such as gender, race, age, and socioeconomic status, restrict the science talent pool.

Adherents of the normative approach have typically defined research problems which identify internalized attitudes as dispositions to act in accordance with the rules. Measuring the attitudes of young children should therefore reflect the internalized value of *universalism*.

Literature on the early socialization of scientists has been focused on the adolescent formation of interest and abilities in science and mathematics as determinants of later college major and career choice in scientific fields (Eiduson and Beckman, 1973). Barnett (1974) found that the requirements of a college major or the precollege mathematical preparation of a student is not the crucial factor for women when making a career choice; rather, women avoid majors in science and engineering because they are men's jobs, not because they require mathematics. The more masculine characteristics a female perceives herself to have the more likely she is to choose a nontraditional career such as science (Baker, 1987). Despite these findings, researchers have afforded little energy to studying the childhood origins of attitudes that may influence career choice in science.

The first category of empirical efforts to measure attitudes toward science included scales that were developed for older children. The Image of Science and Scientists Scale (ISS) (Krajkovich and Smith, 1982) was designed to assess high school students' attitudes toward science. They were interested in the ongoing underrepresentation of women in science careers and in the training processes leading to the careers. Numerous programs such as the Career Oriented Modules to Explore Topics in Science (COMETS) (Smith, Molitor, Nelson and Matthews, 1982), developed and implemented to enhance positive attitudes toward women in science, led to the need for scales to measure attitude change after subjects were exposed to programs. Curriculum materials utilized in the programs were usually designed for grades five through nine, and enabled science teachers to provide students with role models of women in science careers, a technique which had been shown to be a successful avenue for encouraging more girls to consider pursuit of science careers. An instrument was developed based on the 957 summaries originally presented by Margaret Mead and Rhoda Metraux (1957), the results of a nationwide survey that investigated the image of science and scientists as held by secondary school students. In the course of the follow-up study, Krajkovich (1978) was able to use the instrument to compare the results of 1957 to those of 1978. Large group testing on an interview or written narrative basis seemed to be an overwhelming task for one researcher; and the need arose for a validated instrument to measure this particular aspect of the affective domain. Krajkovich was influenced by McLure and Piel (1978) and Smith (1976), who in developing tests for high school seniors and older students, demonstrated the importance of three dimensions of attitude toward women in sceince: *characteristics needed for science career pursuit*; *compatibility of spouse, parent, and career roles*; and *equality of opportunity to pursue a career*. Later, in selecting items for the WiSS, these three categories were used by Erb and Smith (1984) to screen and modify the items initially suggested by Mason (1975) for testing sex-role attitudes. The WiSS, constructed to measure attitudes toward women in science, was administered to early adolescents; significant differences in attitudes of females and males toward women in science were found. The work of Erb and Smith, however, did not identify the origins of variation in the acquisition of the role stereotypes that might eventually constitute obstacles to recruitment to science. Early childhood acquisition of attitudes toward and interest in scientists remains an area where virtually nothing has been investigated, perhaps because it is widely believed that few interventions are effective in changing the conditions of the informal socialization that goes on in the home.

A second category of empirical efforts having implications for the measurement of attitudes toward scientists has been associated with cultural transmission theorists who contend that the acquisition of gender identity is the product of gradual learning (Bandura, 1971, 1973; Bussey & Bandura, 1984). These theorists propound that parents, teachers, and other adults shape a child's behavior by reinforcing responses that are deemed appropriate to the child's gender role and by discouraging inappropriate ones. Cognitive-developmental theorists (also called *labeling theorists*) emphasize that children actively seek to acquire gender identities and roles. Children come to label themselves as *boys* or *girls* when they are between 18 months and 3 years of age (Kohlberg, 1966, 1969; Kohlberg and Ullian, 1973) and once they have identified themselves as males or females, they then want to adopt the behaviors consistent with their newly discovered status. This process, termed *self-socialization*, results in children forming a stereotyped conception of maleness and femaleness, an oversimplified, exaggerated, cartoon-like image revolving about such highly visible traits as hair style, dress, stature, and occupation. They then use their stereotyped images to organize their behavior and to cultivate attitudes and actions associated with being a boy or a girl. Both the cultural transmission and labeling theories of gender-role learning have received research support (Macoby and Jacklin, 1974, Bem, 1975); Weitzman (1972) conducted an investigation of how the sex-role socialization of preschool children is accomplished through the vehicle of picture books; Paludi, Geschke, Smith, and Strayer (1984) have studied preschoolers' knowledge of sex-determined role standards; and Aboud (1988) has studied prejudice in children.

Based then on the predictive leads that, 1) science flourishes pending unc lified reception to talent, 2) practicing scientists emerge from a *scientific talent pool* of students who manifest both positive attitudes (interest) and ability by a specific point in their development, and 3) that an individual's perception of the scientist encourages recruitment to science when the self-perception agrees with his/her perception of the scientist's characteristics; the following null hypothesis was generated.

Ho: Controlling for ability, attitudes toward women in science will be the same among young urban school-age children, despite gender, race/ethnicity, age/grade, socioeconom. tatus.

Figure 1 about here

Method

Given that inferences for the maintenance of science can be made from tests of the research hypothesis that socialization affects attitudes toward science, the purpose of this investigation was to design a causal comparative (ex post-facto) study to test the relationship between differential socialization (according to ascriptive characteristics such as gender and race), the independent variable, and attitudes toward women in science, the dependent variable. The research was conducted in several parts; first the instrument, developed to measure attitudes, was written, modified after an initial field testing, and administered anonymously; second, tests of reliability and construct validity were carried out.

Subjects

Subjects in the study were 791 children from New York City schools. The sample was selected using a non-probability, purposive technique (Kish, 1965). Teachers from 25 schools in the metropolitan area and who were concurrently enrolled in graduate education courses, elected as a way of earning optional extra credit toward their final course grade, to participate by administering the Early Childhood Women in Science in Scale (ECWiSS) to their students and by providing background information on students in their classes. Of the sample, 362 students (46.1%) were reported to be boys and 424 (53.9%) girls; 69 (8.7%) were reported to be in kindergarten, 112 (14.2%) in first grade, 177 (22.4%) in second grade, 223 (28.2%) in third grade, and 210 (26.5%) in fourth grade. Teacher reports also indicated that 256 (32.7%) of the respondents were black, 200 (25.5%) white, 285 (36.4%) Hispanic, 32 (4.1%) Asian, and 11 (1.4%) were unclassified. Of the 791 subjects, 245 (41.7%) were reported as low ability students, 172 (29.3%) as average ability students, and 170 (29.0%) as high ability students. Data on three dimensions of the socioeconomic status of students was indicated; 498 (72.1%) were eligible for *free lunch*, 193 (27.9%) did not qualify for *free lunch*. Information of the family structure was obtained; 368 (58.0%) children lived with both parents, 267 (42.0%) children lived with either the mother only, or father only, or the mother and other relatives, or the father and other relatives, or just relatives, or some other person. School sector data showed 135 (17.1%) of the students were enrolled in private schools and 654 (82.9%) in public schools.

Measuring the Dependent Variable (Attitude Toward Women in Science)

Using the WiSS as a conceptual template, a list of 27 items was initially constructed to reflect sentiments toward females in scientific roles. Teachers who volunteered to participate in the study were informed that the questionnaires were developed to investigate children's attitudes toward women scientists. They were asked to supply confidential information on the background of children (for whom parental consent was obtained) to assist in determining whether children's attitudes vary by gender, age/grade, race/ethnicity, ability, and socioeconomic status (free-lunch eligibility, family structure, and school sector). Teachers were also given instructions for administration of the non-verbal Likert-type scale, for pre-literate and other early elementary school children. Each of the 27 items was presented orally; response choices were presented pictorially in the form of four line-drawn, neuter and non-racial faces with expressions ranging from a pronounced smile to a pronounced frown (Beere, 1970; Johnson, 1976; Ayers, 1977; Rim, 1977). The *faces* corresponded to the response categories; (1) *strongly disagree*, (2) *disagree*, (3) *mildly disagree*, (4) *mildly agree*, (5) *agree*, and (6) *strongly agree*, as shown in Figure 2.

Figure 2 about here

Students were told to color in the face that expresses how s/he feels about what was stated by the teacher. The neutral choice found in most Likert-scales was omitted to force a judgment. The 27-item instrument was administered to five second graders to test for clarity. To enhance reliability, cartoon characters appearing next to the numbered items were included as markers to help children to identify the statement being read by the administrator. Teachers were further instructed to administer the instrument either under standardized test conditions or in small groups. It was explained that this procedure would lessen threats to *internal validity* by discouraging children from copying their peer's responses. Teachers were asked to have a paraprofessional or other assistant administer the questionnaire, whenever possible so that children would not be inclined to respond in a manner consistent with their teacher's facial expression or demeanor. Teachers were also asked not to explain the definition of the word, *scientist* because the questionnaire was designed to measure the image of the scientist presently held by children. To further foster the reliability of the instrument, respondents who did not understand the meaning of an item were instructed not to enter a response for that item. Students were told there was no penalty for leaving questions unanswered and that there were no *right* or *wrong* answers. Data on the test administration was collected and the items that were causing the most trouble for the students were reworded.

As a result of this administration of the instrument, fifteen of the items were reworded, the scale was changed to a four-point Likert scale (see Figure 2), and eight items constituting a separate career preference scale were added. These eight items, derived from a scale constructed by the developers of COMETS (Smith, Molitor, Nelson and Matthews, 1982) staff was based on the classification of occupations developed by Roe (1976). Roe's scale consists of 49 items and is comprised of science, service, and business subscales. It was developed using the same process as the WiSS. Each item on the scale is a career possibility in some classification (e.g., physician or physical scientist in science; social worker or school counselor in service; and insurance salesperson or buyer in business). Subjects are asked what jobs they would like to try for a day. They can respond on a four-point scale from *no interest* to *high interest*, or they can answer *don't know*. The internal consistency alpha and test-retest reliability r of these subscales are moderate and strong, respectively ($a = .76$ and $r = .58$ for the science career subscale, $a = .59$ and $r = .65$ for service careers, and $a = .59$ and $r = .54$ for business careers). A significant positive correlation between students' scores on the WiSS and their scores on the science careers subscales exists, and on the other hand, little or no correlation between students' attitudes concerning women in science and their preference for careers in business or service occurs. The predicted pattern of correlations between the WiSS and five selected scales was observed for both sexes (Erb and Smith, 1984). The eight items, derived from Roe's measures, were appended as a mechanism for intertest correlation. The revised 35-item instrument was then administered. Scores from negatively valued items were reversed and then all items were summed to produce a total scale score. Internal consistency and item-total correlation strategies were employed to cull items from the 27-item domain to represent the general construct of attitude toward women in science. For each item the means, sigma, choice distribution, and correlation with the total scale score were inspected. Those items shown to have a low or negative correlation with the total score ($r \leq .35$) were eliminated from the final form of the ECWiSS. The item scores from one-half of the sample was correlated with the second half. Because these preliminary analyses produced a 27-item measure of attitude toward women in science with high internal consistency, the instrument was further tested for construct validity and aimed at exploring the hypothesized relationship between attitudes toward women in science and the exogenous variables.

The concept, *attitudes toward women in science*, evolved, on face validity, as a descriptor or rubric to describe a syndrome of diverse, yet interdependent behaviors; an instrument that purports to measure attitudes toward women in science. Attitudes should therefore reflect the multidimensionality inherent in the construct originally defined by Mason (1975). Because relying exclusively on an internal consistency strategy tends to ignore the important subcomponents of the construct in favor of aggregating those components into an undifferentiated general construct reflected by a total score, a procedure was proposed that would allow for the examination of the construct as it was best construed.

To examine the internal structure and multidimensionality of the ECWiSS, the protocols of 791 subjects were analyzed using a principal-components analysis in attempt to produce evidence for a general component of attitudes toward women in science as well as evidence for roughly the three interrelated components first introduced by Mason (1975) and later reintroduced by McLure and Piel (1978), Smith (1976) and Erb and Smith (1984). Using the general expression (equation) for the estimate of the jth factor F_j (the W_i's are factor score coefficients, and p is the number of variables)(Norusis, 1985)

$$F_j = \sum_{i=1}^{p} W_{ji}X_i = W_{j1}X_1 + W_{j2}X_2 + \ldots + W_{jp}X_p$$

evidence for a general component of attitudes toward women in science was satisfied by meeting the following methodological criteria: (a) the interitem correlation matrix exhibits no significant negative correlations; (b) the first unrotated component has an eigenvalue that is substantially greater than the eigenvalue of the next largest component; (c) all of the items show positive nontrivial loadings on the first unrotated principal component; (d) the rotated component pattern shows no substantial negative loadings; (e) the intercomponent correlation matrix exhibits no significant negative correlations, and each component is positively correlated with two or more of the other components; and, (f) a principal-components analysis of the first-order component intercorrelation matrix produces a higher order first unrotated component that accounts for a substantial proportion of the intercomponent variance, and all of the components show non-trivial positive loadings on the higher order first unrotated component.

Measuring the Independent Variables (Gender, Age/Grade, Race/Ethnicity, Ability, Socioeconomic Status) and their Effects

The second phase of this research employed a causal comparative design, to measure the construct validity of the general measure of attitude toward women in science and to test the hypothesis generated. The logic of an *ex post facto* (Smith and Glass, 1987) strategy is the researcher starts with the effect and works backward — in this case, attitudes already exist. Analysis of variance (ANOVA) was performed to test for significant differences in attitudes according to gender, race/ethnicity, age/grade, and socioeconomic status (with ability controlled).

As a caution against misinterpretation of *statistically significant* results, hierarchical linear regression analyses were performed to estimate the size of the actual effect or the *practical significance* of the research. Cohen (1977) refers to the actual effect (estimated by the sample statistic) as the concept of statistical power. For example, the percent of the variance of the dependent variable that is explained by differences in the independent variable can be calculated as a way to judge the outcome of the study (Smith and Glass, 1987). The additional variance in attitude that can be accounted for by one predictor (e.g., age/grade) above and beyond that explained by variables entered previously (e.g., gender) was obtained by computing the change in R_2 when the last variable was entered. The concept, *socialization* (ascription-based), was operationalized as several independent variables: *gender* was coded as (1) *male* and (0) *female*; *age/grade* was coded as (1) *kindergarten*, (2) *first grade*, (3) *second grade*, (4) *third grade*, (5) *fourth grade*; *race/ethnicity* was coded as (1) *black*, (2) *white*, (3) *Hispanic*, (4) *Asian*, and (5) other; *ability* was coded as (1) *low score on latest standardized reading test* (at or below 50th percentile), (2) *average-score on latest standardized reading test* (between 50th to 75th percentile, (3) *high score on standardized reading test* (at or above 75th percentile; (teacher estimated performance for children in kindergarten and first grades since standardized tests are mandated for second grade students); *socioeconomic status* had three dimensions and was coded as (a) *free lunch* (1) *student receives free lunch*, (2) *student does not receive free lunch* (eligibility for free lunch is based on a questionnaire filled out by the parent/guardian of each child, which asks respondents to report their annual income [NYC Board of Education, 1988]).; (b) *household structure* was coded as (1) *in-tact with both parents in home*, (2) *both parents not in home*; (c) *school sector* was coded as (1) *public*, (2) *private*; (*gender of test administrator* was coded as (1) *male*, (0) *female*, but this information was not used in the analysis). Variables with more than two attributes were recoded into dummy variables (having values of 0 and1 for the purpose of the regression analyses [Kerlinger, F. and Pedhazur, E, 1973]).

Results

Reliability

Two reliability models were used in this investigation — the alpha model and the split model. In the first series of analyses, the response characteristics of the 27 ECWiSS items were examined to determine whether each of the items was behaving in a monotonic manner in relation to the full-scale ECWiSS score. The alpha model computed Cronbach's alpha and standardized item alpha

(Cronbach, 1951). The coefficient alpha estimate of reliabiity equaled .90 and the standardized item alpha equaled .90. The split model (Guttman, 1945) partitioned the variables in the scale into two subsets. The sum was computed for each subset and the reliability calculations made use of only the information contained in the two sums for each case. The Guttman split-half reliability coefficient indicated a strong positive correspondence (.87; the alpha for part 1 (first 14 items) was .84, and the alpha for part 2 (13 items) was .81). The 27 items on the ECWiSS along with their positive or negative values and correlations with the total scale score are displayed in Table 1.

Table 1 about here

Validity

The construct validity of the ECWiSS was established using procedures described by Cronbach and Meehl (1967) as known groups and correlates. Second, a principle-components analysis was performed.

Known Groups.

Construct validity and the *universalism* hypothesis were analyzed using the known groups procedure. A factorial design requiring analysis of variance (ANOVA) was employed to test the capacity of the ECWiSS to discriminate differences between groups. The null hypothesis that the mean score on attitude toward women in science would be the same between independent variables and across all attributes (groups) of gender, race/ethnicity, age/grade, socioeconomic status (free lunch eligibility, household structure, and school sector), with ability controlled, was tested. Two-, and three-factor ANOVAs were performed to determine the effects of two or more factors simultaneously as an empirical basis for generalizing the main effects of any factor across all levels of the other.

The results of the analyses of variance appear in Tables 2, 3, and 4. "Talent being equal, how much does attitude vary according to ascriptive characteristics?". Respondents, overall, mildly disapproved of women being scientists (which was reflected by a grand mean score of 2.87 with a standard deviation of .58; the mean scores and standard deviations for low, average, and high ability students, respectively, were 2.71, .63; 2.89, .50; 3.04, .52). The null hypothesis was rejected based on evidence of differences in the scale scores across attributes of the independent variables, with ability as a covariate. A mean difference in attitude was found for gender with males significantly less in agreement with women doing scientific work than females [$F(2,496)=56.01$; $p \leq .001$]. Significant age/grade differences in attitude were also found, with younger children, on the average, reporting more negative feelings about women in science than older children [$F(5,497)=18.74$; $p \leq .001$]. Differences in means were consistently greater between the youngest children and progressively older children, with the largest mean difference between children in kindergarten and children in the fourth grade. The ECWiSS also discriminated significant differences in attitude for children from varying socioeconomic strata with the more well-to-do showing more agreement with women in science than the less well-to-do [$F(2,462)=18.90$; $p \leq .001$]. Main effects were found for household structure and school sector, variables which also reflect aspects of socioeconomic strata. Children living in homes with both parents present had a significantly more positive attitude to women in science than children living in homes that were not intact [$F(2,403)=8.62$; $p \leq .001$] and students attending private school were, in general, significantly more in agreement with women being scientists than students enrolled in public schools [$F(2,497)=30.28$; $p \leq .001$].

Main effects found for gender with each of the other variables were qualified by a number of interactions. Main effects were found for gender with each of the other variables. From the analysis of gender and race/ethnicity (with ability as a covariate), a significant main race/ethnicity effect appeared with the mean score on attitude reliably, but only slightly greater (according to [Scheffé, 1959] post hoc comparisons) for whites than for blacks, Hispanics and Asians, respectively [$F(4,496)=2.05$; $p \leq 1.0$] and when this effect was qualified for gender, no interactive effects were detected. A somewhat modest interactive effect was found between gender and age/grade with males in kindergarten and first grades reporting less agreeable responses to women in science than second and third grade females [$F(4,486)=3.59$; $p \leq .05$]. Females with high ability were reliably, but only slightly more positive in attitude than males with low ability [$F(2,491)=2.83$; $p \leq 1.0$] indicating the relative independence of attitude toward women in science from talent. The average scores on attitude for males and females was essentially the same across all categories of socioeconomic status, but a significant and substantial interactive effect was found between gender and school sector with the differences in mean scores on attitude being more positive for private school than for public school students [$F(1,492)=37.95$; $p \leq .001$] (the mean being highest for private school females).

Tables 2, 3, and 4 about here

Besides these lower level findings, to further qualify the generalization of the effects of ascription on attitudes toward women in science, are the findings from the three-way analyses of variance. Figure 3 depicts the only reliable three-way analysis of variance. For gender, race/ethnicity, and socioeconomic status, the mean difference in attitude toward women in science between males and females was significantly greatest for the white *poor* [$F(4,461)=3.41$; $p \leq .05$] with lower SES white males manifesting the most disagreement with women in scientific fields as contrasted to higher SES white females. For Hispanics, differences in gender effects were the least for high SES students.

Regression Analyses

The results of the stepwise linear regression analyses, used to test the *actual* effects of the independent variables on attitude toward women in science are reported in Table 5.

Table 5 about here

Using the stepwise procedure (SPSSx, 1986), hierarchical regression analyses were used to assess the additional variance in attitude toward women in science that can be accounted for by a predictor above and beyond that explained by variables entered previously. The change in R^2 was computed when the last variable was entered. First, scores on the ECWiSS were regressed on ability; then gender, race/ethnicity, age/grade/, socioeconomic status, household structure, and school sector were entered into the equation. The coefficients are the standardized regression coefficients (ß) that control for the effects of the other variables in the regression equation. Significant ($p \leq .05$) increments appeared in the explained variance with changes in R^2 (.20) found (with ability controlled [.03]), for gender (.11), school sector (.02), and age/grade (.01); gender explained the greatest proportion of the variance in attitudes toward women in science.

Intertest Correlation.

According to Cronbach and Meehl (1967), a second method for testing the construct validity of an instrument is to correlate the new test with measures of similar constructs. If significant positive correlations are observed, those observations are evidence for the construct validity of the new scale; conversely, a nonsignificant or negative correlation with a measure of an unrelated or dissimilar construct also supports constuuct validity. The predicted pattern of correlation coefficients was shown to exist empirically; thus evidence to support the construct validity of the new scale was produced. The scores on the ECWiSS were correlated with two other measure — the *occupational inventory* and an *observational perspective rating*.

Scores on the occupational inventory and ratings of the teacher's estimate of the student's attitude toward women in science (using the same four-point scale appearing in the ECWiSS) were obtained. The prediction that students with high positive attitude toward women in science would display a positive attitude toward scientists or the discipline of science, was supported. Significant positive and moderate correlations between students scores on the ECWiSS and their scores on the occupational inventory were found. For the occupational inventory, the internal consistency alpha was .39 and the Pearson $r = 0.50$ ($p \leq .05$), reflected the association between the two sets of scale scores. The test of the association between the teacher's estimate of the student's image of the scientist and the student's score on the ECWiSS resulted in a positive and moderate correlation ($r=$ .51

Principal-Components Analysis

The results of the principal components analysis provided evidence for a general component of attitudes toward women in science and several interrelated components.

Table 6 about here

A good factor solution was found which was both simple and interpretable; the relationships amongst variables were represented parsimoniously and the factors were meaningful. Having used a principal-components analy· · with an oblique rotation procedure on the ECWiSS protocols of 791 students, five ECWiSS components were identified. Of the various solutions tried, the one that best met our criteria was a five-factor solution that accounted for 49% of the total ECWiSS variance, and the first component accounting for 29% of the total ECWiSS variance. The following are the relevant features: the observed interitem correlation matrix contained no significant negative correlations, with the largest being -.0003. The eigenvalue (lamda) of the first unrotated principal component (lamda = 7.40) was over three times greater than the eigenvalue of the next largest component (lamda = 2.38). All of the ECWiSS items showed positive loadings on the first unrotated principal component, with no loadings shown that were below .34. The rotated component pattern showed few negative loadings with one loading shown at -.14 and a few not greater than -.05. The average calculated item communality for the 27 items was .52. Each of the five components had a minimum of 4 marker items that unequivocally loaded at .51 or greater on that component. The variance component associated with each rotated component exceeded a value of 2.0. Finally, the largest negative correlation in the intercomponent correlation matrix was a trivial -.04 whereas the average intercomponent correlation was .22. Furthermore, each of the five components showed a correlation of .20 and above with at least two other components. On the basis of the marker item (an item which univocally loads on a component at .50 or higher) content (and consistent with the dimensions conceptualized on face validity as used in the work of Erb and Smith (1984), the three ECWiSS components were named *role specific self-concept*, *home-related sex-role conflict, and work-related sex-role conflict.* Table 5 shows the component structure. These items represent the best measure of the general construct of attitudes toward women in science and its components. The scale loadings on the first unrotated principal component were .78, .70, .69, and .58, indicating clearly that a general factor is reflected in the five ECWiSS components.

Discussion

In a *Letter of Transmittal* (Schmitt, 1987), the Chairman of the National Science Board of the National Science Foundation communicated that the actions of Government and industry in recent years demonstrates their recognition of the critical contributions of basic research and advanced technology development to our health welfare, economic competitiveness, and national security. Out of concerns for the maintenance of American science, both conventional and theoretical explanations have been set forth for the failure of various segments of the population to be equally represented in this seemingly valued enterprise. The theoretical posture that science must be open to talent to be ongoing, is known as ***universalism in science***. This investigation, has been intended as an observation of the relationship between socialization and membership in the science talent pool — the effects of gender, race/ethnicity, age/grade, socioeconomic status, and ability on the attitudes of young children toward women in science. Inferences for the theory that competence, not ascription lead to the sustenance of science have been made.

On the average, the attitudes of young children toward women in science are neither positive nor negative, with a small tendency to be negative, and differences in socialization are only slightly associated with variations in attitude. Regardless of talent, children's attitude toward women in science varies according to whether they are boys or girls, relatively younger or older, middle-class- or working-class, or attending public or private school. The main effect of gender remains consistent across all categories of race/ethnicity, age/grade, and socioeconomic factors. This lower order finding is further qualified in that the more able, older females from higher socioeconomic strata, manifest the most agreement with women as scientists, and white males from poor homes show the least approval of women scientists. Clearly, as Freud wrote in a letter to his fiancée, '...human beings consist of men and women and . . . this distinction is the most significant one that exists ' (Wollheim, 1975). We can infer from this special case that *universalism* is a necessary and sufficient cause for the operation of science. Based on the norm of *universalism*, it was expected that ascriptive factors, as opposed to talent, get in the way of the optimal functioning of science, and it was found that differences in attitude toward women in science are, in fact, explained by reasons other than competence. The nature of the evidence that leads to this conclusion is described in more detail below.

In the initial phase of the research, the credibility of the measure, attitude toward women in science, was assessed by the Early Childhood Women in Science Scale (ECWiSS). The ECWiSS is both a reliable and valid measure of the construct — attitude toward women in science — as it occurs among young children. It has been shown to be a reliable instrument whether measured by estimates of internal consistency (alpha = .90) or split-half reliability (r = .89). Its validity has been established first, by showing that the ECWiSS clearly distinguishes between scores of young children according to gender, age/grade, race/ethnicity, socioeconomic status, and ability, on the construct of interest.

The relative contribution of ascriptive characteristics to interest in science is profoundly illustrated by the first and most pervasive finding. The hypothesis that, holding ability constant, the contribution of ascriptive characteristics to attitude toward women in science will be equal between variables and across all attributes, was rejected. It was found that males more than females, regardless of ability, disagree with women being scientists. (These findings replicate those of Smith and Erb, 1986). Retaining the image of the traditional female appears more important for boys than for girls and confirms claims, such as Baker's (1987), that women avoid science and men think women should avoid science, not because it requires skill in math, but because science is a man's work. The primary role of women is to serve as status symbols (Veblen, 1899) for men. For example, men typically groom themselves for work by retaining short hair and short nails, and by wearing slacks and low-heeled shoes, whereas women prepare themselves to be glamorous objects who display colored polish on long nails or who wear uncomfortable high-heeled shoes. This finding is indicative of a *socio-structural* obstacle to the formation of positive attitude toward women in science and has implication for the redefinition of traditional gender roles. Positive attitude toward women in science depends upon equitable standards of behavior that allow men and women to express a broad range of human emotions and role options. This finding also suggests that ongoing research on the compatibility of gender-identity with the image of the scientist include attention to the changing image of science. Recent controversies over the normative structure of science, or over whether an *ethos* or adherence to core values is a prerequisite for production of scientific knowledge (Toren, 1983) affect the image of science. Toren claims, for instance, that the distinction made between academic and industrial science is regarded as an attempt to protect exclusivity and to define away categories of scientists because they do not fit into a preconceived picture of science. Or, she argues that the belief in the rationality and objectivity of science is viewed by some as an ideology which serves the interests of the political-industrial establishment by distorting public perceptions of the causes and consequences of scientific knowledge. Duschl (1988) discusses how views of science as either positivistic or as relativistic, influence children's perceptions of science. Science as *rigid* (objective) in its evaluation of evidence rather than *arbitrary* (intersubjective), and *disinterested* in its definition of problem choice, makes it more compatible with male gender stereotypical behavior

Surprisingly, the hypothesis was not rejected in the case of race/ethnicity, the second ascriptive characteristic examined. Occupational role stereotypes are cross-culturally, located along the lines of gender boundaries rather than race/ethnicity boundaries, so that race/ethnicity, by itself, does not discriminate difference in attitudes toward women in science. When the two factors of gender and race/ethnicity are considered in combination rather than separately, the observable effects are over and above the magnitiude of the effects observed independently, so that while overall, no significant effects were detected for race/ethnicity, a reliable finding between gender and race/ethnicity was found. Amongst black, white, hispanic, and Asian children, the difference in attitude toward women in science was greatest for white girls and boys. Attitudes were also found to vary reliably, according to age/grade. Very young children are more likely, than progressively older children, to disagree with women doing scientific work This finding is interpreted to mean that age could be a barrier to the formation of agreeable attitudes toward women in scientific work.

The developmental constraints which determine how children internalize roles (Kohlberg and Ullian, 1973) are not necessarily detrimental to the formation of positive attitudes to females in non-traditional occupations such as science, but if the *rigid* images of role models, characteristic of young children (Fagot, Leinbach, and Hagan, 1976), are gender stereotypical then age/grade becomes an ascriptive deterrent to the formation of positive attitudes.

Besides gender and race/ethnicity, and age/grade, attitude toward females in scientific roles varies according to socioeconomic status as it concerns household income, number of parents in the home and public or private schooling. Higher household income and private schooling are more frequently associated with positive attitude toward women in science than lower household income and public schooling. The well-to-do white females from private schools show the most agreement to women in scientific roles. This empirical observation might be explained by the view that the middle-class experience enough leisure to be liberal (Veblen, 1899), or by Melvin Kohn's (1959) insights that working-class parents are more concerned about their children conforming to the expectations of others while middle-class parents emphasize that their children be self-expressive.

The higher order analyses conducted to further qualify the generalization of gender effects on attitude toward women in science revealed that while ascription has the most pervasive effect for gender, this generalization requires the following qualification: in terms of attitudes toward women in science, race only matters when one is male and poor. The low-income white male relies most heavily on gender stereotypical behavior. Traditional females are extremely important for this group relative to any other group, perhaps because of fewer options afforded for shaping male identity; reliance on females for nurturance and affirmation is inevitably an outcome. It is easier for poor women than for poor men to marry *up* (Chodorow, 1974), and wishing greater status attainment for women is, for the poor white male, a mechanism for limiting the choice of a mate. For black males, the Veblen depiction is less important; black male identity has typically been formed in light of black females assuming non-traditional roles as single heads of households. Hispanic children have also found it less difficult to negotiate their view of female roles.

The present study examined the extent to which ascriptive-based socialization according to gender, race/ethnicity, age/grade, socioeconomic status, predicts attitude toward women in science as measured by the multi-dimensional ECWiSS. Acriptive variables explained about 16 percent of the variance in attitudes beyond that explained by ability (with gender explaining the greatest amount of the variance). The salience of this finding is for the identification of more gender-related predictors of attitude toward women in science.

The results of the principal-components analysis conducted to test the validity of the dimensions defined in the ECWiSS, constitute a measure of the stability of the three-dimensional characteristics of the original WiSS, and find explanation in the research of Baker (1987) on the influence of role-specific self-concept and sex role identity on career choices in science. *Role-specific self concept* is the perception individuals have of their competency when engaged in a particular task. *Sex roles conflict* is the feeling individuals have when they are engaged in activities they believe to be inappropriate for their sex. The first factor in the principal-components analysis explained 29% of the variance in attitudes, which means the attitude of very young children toward women in science is greatly affected by how they see themselves in relation to their image of the scientist. Approximately 13 percent of the variance was explained by the second factor, the degree to which children felt the characteristics of the female scientist match what they believe is typical for males and for females. These findings suggest that the child's image of the female scientist is in line with the stereotypes portrayed by Rousseau (1979), who believed that rationalism and egalitarianism would tend to destroy the sexual differences just as they were leveling class and national distinctions; marriage and the family would decay and the sexes be assimilated. He argued that there can be no natural, whole, social man if women are essentially the same as men and that the two sexes are different, each sex requiring the other in order to be a whole being, or together forming a single whole being. A woman therefore naturally cares for her children; "thus a man, loving her exclusively, will also care for the children." To cultivate man's qualities in women and to neglect those which are proper to them was to Rousseau, to work to their detriment. "Little girls love adornment almost from birth." For man, he asserted, the aim is the development of strength;

for woman it is the development of attractiveness; women need enough strength to do everything they do "with grace;" men need enough adroitness to do everything they do with facility. 'In fact, almost all little girls learn to read and write with repugnance. But as for holding a needle, that they always learn gladly." Rousseau believed dependence to be a condition natural to women and thus girls feel themselves made to obey. He also asserted that from habitual constraint comes a docility which women need all their lives, since they never cease to be subjected either to a man or to the judgments of men and they are never permitted to put themselves above these judgments."

For an instrument that better reflects the complexities inherent in the attitude toward women in science construct, modification and extension of the present work is required. The first recommendation is for refinement of the scale by eliminating the items that show weaker factor loadings. Second, the findings indicate that about 50 percent of the variation in attitude is explained by gender role behavior, but the residual 50 percent of the variance remains unexplained. Examination of the construct of attitude in terms of other dimensions of gender-compatible images is required. Previous research on the pre-school child's knowledge of sex-determined role standards identifies *physical aggression*, *competitiveness*, *excellence in motor ability*, and *independence* as male stereotypical behavior (Paludi, Geschke, Smith, and Strayer, 1984). Questions pertaining to the uses of science may tap these aspects of attitude toward female scientists. Carefuly conducted qualitative work, such as field-interviews coupled with open-ended self-report surveys will aid in retooling the conceptualization of the ECWiSS.

In sum, how does this constellation of findings help us to understand, more generally, the normative structure of science as it pertains to recruitment to scientific careers? The *universalism* notion that science operates to the degree it is open to talent is not tenable (statistically) in this case but, it was found that only a small amount of variation in attitudes toward women in science can be attributed to ascriptive factors, with gender accounting for most of the differences. The consequences of this major finding that, regardless of ability, males, more than females, disapprove of women becoming scientists, appear mildly dysfunctional for the maintenance of American science, especially if we assume that early learning sets limits for future socialization patterns. Although the relationship between male and female attitudes toward women in science is not complimentary; in other words, girls do not accept the image of women scientists to the degree that boys reject it, male disagreement with women in science threatens the functioning of science. For example, girls who, at some point in the developmental sequence, are both willing and able to be scientists may be thwarted in realizing their goal if men do not accept females in these roles. As Hewlett (1986) argues, because society sees women as being unable to balance the dual responsibilities of motherhood and work, they are likely to retain their second-class citizenship. Further evidence which shows the facility with which women can reconcile the demands of childbirth and childrearing with those of earning a living will reflect the promise that changes in gender stereotypes hold. The work of Cole and Zuckerman (1987) is exemplary. They found that female scientists who marry and have children are no less productive than single female scientists. The results of this study furthermore suggest that differences in productivity between males and females might be accounted for by some other type of gender discrimination. Future investigations in this vain mitigate against stereotypes which perpetuate sex-role conflict and negative attitude toward females having scientific careers.

An additional implication of the findings of the present study, is in terms of what Lavin (1976) has referred to as the *cumulative impact of disadvantage. Minority* students are subject, long before graduation from high school, to an unequal appropriation of the resources foundational to the development of interest and ability in science. Differences that appear very early become reinforced (Eiduson and Beckman 1973). While the chronological distance of early childhood to the phases of maturity at which careers are chosen, makes a correlation seem spurious, this limitation should not preclude further examination of very early socialization processes. To strengthen the predictive capability of the ECWiSS, longitudinal (panel) studies of young children through ninth grade would reveal whether change in attitude toward women in science occurs. If little change is evident, then the dysfunctional consequences of early gender-role socialization for the maintenance of science in society are greater than we presently imagine. Ongoing research focusing on influences which mediate the effect of ascription on interest in science will delineate with greater clarity, the role of *universalism* in the maintenance of science in society. Margaret Mead, commenting on the impact of ascription (1935) stated

> ...Among the Mundugumor people of New Guinea children born with the umbilical cord wound around their necks are singled out as of native and indisputable right artists. Here is a culture . . . that has arbitrarily associated . . . two completely unrelated points: manner of birth and an ability to paint intricate designs upon pieces of bark. . .So firmly is this association insisted upon that only those who are so born can paint good pictures, while the man born without a strangulating cord labours humble and unarrogant, and never attains any virtuosity. . . We see the strength that lies in such irrelevant association once they are firmly embedded in the culture.

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Table 1

*Item-Total Correlations for the Full-Scale Early Childhood Women in Science Scale (ECWiSS)**

Item-Total Correlation	Direction of Scale**	Numbered Scale Item
DIMENSION 1: WOMEN POSSESS CHARACTERIISTICS WHICH ENABLE THEM TO BE SUCCESSFUL IN SCIENCE CAREERS.		
.57	+	1. Women can be as good in science careers as men can. *1. Women can be good scientists just as men can be.*
.60	-	2. Men are more qualified to become scientists. *2. Boys have more of what it takes to become a scientist.*
.38	-	3. Careers are good for women as long as they are not the boss. *3. It is good for a woman to have a job as long as she is not the boss.*
.56	-	4. Women scientists are weird. *4. Women scientists are weird.*
.58	+	5. Women can make important scientific discoveries. *5. Girls can do important work in science.*
.46	+	6. Scientific research can be done equally well by men and women. *6. Work in science can be done just as well by men as by women.*
.53	-	7. Women are not reliable enough to hold top positions in scientific and technical fields. *7. Women can't be counted on enough so they shouldn't have the most important jobs in science.*
.58	+	8. Both men and women can be equally good in science and math. *8. Girls can be as good as boys in science and math.*
DIMENSION 2: WOMEN'S ROLES AS MOTHER AND WIFE ARE COMPATIBLE WITH SUCCESSFUL SCIENCE CAREER PURSUITS.		
.52	-	9. A husband's success in his career is more important than a wife's success in her career. *9. For a daddy to do well in his job is more important than for a mommy to do well in her job.*
.37	-	10. A woman's basic responsibility is raising children. *10. The most important job a mommy can have is taking care of her children.*
.43	-	11. A woman with a science career will have an unhappy marriage. *11. A lady scientist will not get along with her husband most of the time.*
.39	+	12. Both men and women can combine careers with family life. *12. Both men and women can go to work and have families too.*
.48	-	13. A wife should spend more effort to help her husband's career than she spends on her own. *13. A mommy should work harder to help a daddy with his job than on her own job.*

* Italicized ECWiSS items are revised WiSS (Erb and Smith, 1984) items.

** To avoid response bias, the scale direction was alternated so that items reflected *positive* /agreeable (+) or *negative* /disagreeable (-) attitudes toward women in science.

Item-Total Correlation	Direction of Scale	Numbered Scale Item
.39	-	14. Getting married is the most important thing in a woman's life. *14. Getting married should be the most important thing in a woman's life.*
.49	+	15. A woman should be considered for a job based on her qualifications regardless of whether she is married and has a family. *15. A woman should be able to get a job even when she is married and has children.*
.34	-	16. For a woman it is more important to be a successful wife and mother than it is to be successful in a career. *16. For a woman it is more important to be a good wife and mommy than to be good at her job.*
.52	+	17. Women can combine successful careers with successful marriages. *17. A woman can be good at her job and be a god wife too.*
DIMENSION 3: WOMEN AND MEN OUGHT TO HAVE EQUAL OPPORTUNITIES TO PREPARE FOR AND PURSUE SCIENCE CAREERS.		
.54	+	18. A woman should have the same job opportunities in science careers as a man. *18. A woman should be able to get the same kind of job as a scientist as a man.*
.51	+	19. Men and women should be paid the same amount of money if they do the same scientific work. *19. Men and women scientists should be paid the same amount of money if they have the same kind of job.*
.30	+	20. Women should not have the same chances for advancement in science careers as men do. *20. Women scientists, like men scientists, should get more money the longer (amount of years) they work on their job.*
.37	+	21. Women should have the same educational opportunities as men. *21. Women should go to school as long as men do.*
.48	-	22. Women have less need to study math and science than men do. *22. Girls do not need to learn as much math and science as boys do.*
.46	+	23. We need more women in science careers. *23. We need more women scientists.*
.53	-	24. Men need more math and science careers than women do. *24. There should be more math and science jobs for men than for women.*
.53	-	25. It is better for a woman to study home economics than chemistry. *25. It is better for a woman to learn how to cook and sew than to learn science.*
.48	-	26. It is wrong for women to seek jobs when there aren't enough jobs for all the men who want them. *26. It is wrong for women to look for jobs when there aren't enough jobs for all the man.*
.53	+	27. A successful career is as important to a woman as it is to a man. *27. Doing well at work is as important for a woman as it is for a man.*

Alpha = .90 **Standardized Item Alpha = .90**

Table 2

Oneway Analyses of Variance (ANOVA) of Early Childhood Women in Science Scale (ECWiSS) Scores for Gender, Race/Ethnicity, Age/Grade, Socioeconomic Status, Household Structure, and School Sector with Ability as a Covariate

Source	ss	df	ms	F
Gender				
Between Groups	30.74	2	15.37	56.01***
Within Groups	135.63	494	.28	
Total	166.37	496	.33	
Race/Ethnicity				
Between Groups	11.22	5	2.24	7.08
Within Groups	155.82	492	.32	
Total	167.04	497	.34	
Age/Grade				
Between Groups	26.72	5	5.34	18.74***
Within Groups	140.32	492	.29	
Total	167.04	497	.33	
Socioeconomic Status				
Between Groups	11.64	2	5.82	18.90***
Within Groups	141.69	460	.31	
Total	153.33	462	.33	
Household Structure				
Between Groups	5.85	2	2.92	8.62***
Within Groups	136.73	403	.34	
Total	142.58	405	.35	
School Sector				
Between Groups	18.21	2	9.11	30.28***
Within Groups	148.83	495	.30	
Total	167.04	497	.34	

****p* $\leq$ *.001*

Table 3

Twoway Analyses of Variance (ANOVA) of Early Childhood Women in Science Scale (ECWiSS) Scores for Gender by Race/Ethnicity, Age/Grade, Socioeconomic Status, Household Structure, and School Sector, with Ability as a Covariate

Source	ss	df	ms	F
Gender	22.16	1	22.16	81.44***
Race/Ethnicity	2.23	4	.56	2.05*
Gender x Race/Ethnicity	1.15	4	.29	1.05
Error	132.23	496	.27	
Gender	22.12	1	22.12	94.92***
Age/Grade	18.99	4	4.75	20.37***
Gender x Age/Grade	3.34	4	.84	3.59**
Error	113.27	486	.23	
Gender	22.71	1	22.71	83.55***
Ability	6.71	2	3.36	12.36***
Gender x Ability	1.54	2	.77	2.83*
Error	133.44	491	.27	
Gender	22.60	1	22.60	86.23***
Socioeconomic Status	2.39	1	2.39	9.12**
Gender x SES	.05	1	.05	.66
Error	119.62	461	.33	
Gender	26.15	1	26.15	95.31***
Household Structure	.18	1	.18	.66
Gender x Household Structure	.33	1	.33	1.18
Error	109.75	400	.27	.33
Gender	22.92	1	22.92	89.57***
School Sector	9.71	1	9.71	37.95***
Gender x School Sector	.01	4	.01	.03
Error	125.89	492	.26	

* $p \leq 1.0$
** $p \leq .05$
*** $p \leq .001$

Table 4

Means and Standard Deviations for Full-Scale Early Childhood Women in Science Scale (ECWiSS) by Gender, Race/Ethnicity, Age/Grade, Socioeconomic Status, Ability, Household Structure, and School Sector (N=791)

Variable	M	SD
Gender:		
Male	2.76	.68
Female	3.16	.46
Race/Ethnicity		
Black	2.92	.61
White	3.25	.57
Hispanic	2.82	.55
Asian	2.97	.64
Other	2.90	.59
Age/Grade		
Kindergarten	2.62	.25
First	2.78	.39
Second	2.76	.56
Third	3.02	.68
Fourth	3.28	.57
Socioeconomic Status		
Eligible for *Free Lunch*	2.78	.55
Not Eligible for *Free Lunch*	3.37	.55
Ability		
Reading Below Grade Level	2.69	.63
Reading On Grade Level	2.87	.51
Reading Above Grade Level	3.01	.53
Household Structure		
Child Lives with Both Parents	3.02	.64
Child Does Not Live with Both Parents	2.86	.63
School Sector		
Student Enrolled in Private School	3.26	.46
Student Enrolled in Public School	2.57	.61

Table 5

Standardized Regression Coefficients for Predicting Attitude Toward Women in Science (ECWiSS) from Ability, Gender, Race/Ethnicity, Age/Grade, Socioeconomic Status, Household Structure, and School Sector (N=526)

Independent Variables	Early Childhood Attitude Toward Women in Science β
Ability	.09 **
Gender	-.35 ***
Race/Ethnicity	-.03
Age/Grade	.10 **
Socioeconomic Status	.08 ·
Household Structure	.04
School Sector	-.23 ***
R^2	.20
R^2_{adj}	.19

**$p \leq .05$
***$p \leq .001$

Table 6. *Early Childhood Women in Science Scale (ECWiSS) Items and Principal-Component Loadings**

Items	Loadings 1	2	3	4	5	FUPC
1. Women can be good scientists just as men can be.	.69	.21	.47	.26	-.32	.64
2. Boys have more of what it takes to become a scientist.	.58	.32	.32	.16	-.62	.65
3. It is good for a woman to have a job as long as she is not the boss.	.07	.31	.14	.09	-.65	.41
4. Women scientists are weird.	.41	.15	.26	.39	-.69	.61
5. Girls can do important work in science.	.78	.17	.38	.31	-.36	.65
6. Work in science can be done just as well by men as by women.	.42	.20	.60	.20	-.19	.52
7. Women can't be counted on enough so they shouldn't have the most important jobs in science.	.32	.21	.38	.13	-.36	.58
8. Girls can be as good as boys in science and math.	.70	.13	.48	.41	-.34	.66
9. For a daddy to do well in his job is more important than for a mommy to do well in her job.	.11	.52	.31	.29	-.56	.55
10. The most important job a mommy can have is taking care of her children.	.26	.72	.08	-.05	-.27	.38
11. A lady scientist will not get along with her husband most of the time.	.20	.35	.45	-.05	-.47	.47
12. Both men and women can go to work and have families too.	.39	.13	.75	.18	-.28	.57
13. A mommy should work harder to help a daddy with his job than on her own job.	.09	.52	.47	.08	-.46	.51
14. Getting married should be the most important thing in a woman's life.	-.01	.6[illegible]	.26	.15	-.32	.41
15. A woman should be able to get a job even when she is married and has children.	.30	.57	.63	.48	-.29	.56
16. For a woman it is more important to be a good wife and mommy than to be good at her job.	.15	.76	.07	.06	-.20	.35
17. A woman can be good at her job and be a good wife too.	.37	[illegible]5	.59	.51	-.32	.59
18. A woman should be able to get the same kind of job as a scientist as a man.	.47	.27	.30	.61	-.33	.60
19. Men and women scientists should be paid the same amount of money if they have the same kind of job.	.33	.17	.55	.45	-.32	.58
20. Women scientists, like men scientists, should get more money the longer (amount of years) they work on their job.	.23	-.01	.55	.29	-.06	.37
21. Women should go to school as long as men do.	.28	.07	.26	.77	-.12	.44
22. Girls do not need to learn as much math and science as boys do.	.17	.42	.35	.40	-.40	.52
23. We need more women scientists.	.72	.16	.29	.32	-.19	.53
24. There should be more math and science jobs for men than for women.	.33	.42	.23	.29	-.58	.58
25. It is better for a woman to learn how to cook and sew than to learn science.	.22	.58	.24	.27	-.53	.56
26. It is wrong for women to look for jobs when there aren't enough jobs for all the man.	.16	.44	.51	.06	-.42	.51
27. Doing well at work is as important for a woman as it is for a man.	.43	.10	.41	.60	-.39	.60

* N=671. 1=*Sex Role Identity* (eigenvalue = 7.9, percent of variance explained = 29.3, cumulative percent = 29.3), 2=*Home-Related Sex Role Conflict* (eigenvalue = 2.4, percent of variance explained = 8.8, cumulative percent = 38.1), 3=*Work-Related Sex Role Conflict* (eigenvalue = 1.2, percent of variance explained = 4.3, cumulative percent = 42.4), 4=Unamed (eigenvalue = 1.1, percent of variance explained = 3.9, cumulative percent = 46.4), 5=Unamed (eigenvalue = 1.1, percent of variance explained = 3.9, cumulative percent= 50.2). FUPC=first unrotated principal component. Based on the above loadings, it is recommended that the following 15 items be dropped from the 27-item ECWiSS: Items 3, 4, 6, 7, 11, 13, 15, 17, 18, 21, 22, 23, 24, 25, and 27.

Figure 1

*Analytical Model to Test the Universalism in Science Hypothesis: Partial Relationships between Ascription and Attitutde Toward Women in Science with Merit Held Constant**

	MERIT (Ability)			
	High Ability		Low Ability	
	ASCRIPTION (Sex)		ASCRIPTION (Sex)	
Attitude	Male	Female	Male	Female
Positive Attitude				
Negative Attitude				
Total				

**Ascription* is not related to *attitude* if the same percentage of people of both sexes have positive attitudes. If the percentages change when the cases are divided into high and low ability, the differences in perctanges are attributed to *merit*.

Figure 2

Response Item from Original and Revised Versions of the Early Childhood Women in Science Scale (ECWiSS)

Original 6-point Scale Form

8. Girls can be as good as boys in science and math.

Revised 4-point Scale Form

8. Girls can be as good as boys in science and math.

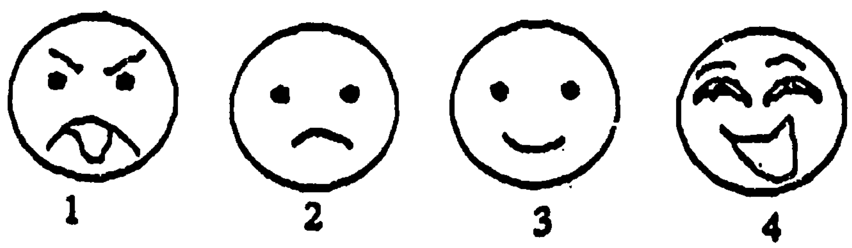

Figure 3. *Mean Ratings of Attitudes by Gender, Race, and SES with Ability Controlled*