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ABSTRACT

This study is a followup to the author's earlier study of the learning differences exhibited by museum exhibit visitors and seeks to discern the effects of the pathological cultural problems identified by other researchers in a science education setting. The setting for this followup study was the New Mexico Museum of Natural History and Science. Field observations at the site focused on gender differences exhibited by visitors in interacting with the exhibits, age differences in patterns of interaction, and what sociological theory of education best fits with those observations. Results have implications for how science is taught to girls. Contains 24 references. (DDR)

On the Ethology of Female Homo sapiens sapiens at the New Mexico Museum of Natural History and Science

by
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On The Ethology of Female *Homo sapiens sapiens* At The New Mexico Museum of Natural History And Science

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The astronomer who hated women generally caused her so much puzzling speculation that she one day asked Mr. Stelling if all astronomers hated women.... But forestalling his answer, she said,-
'I suppose it's all astronomers; because, you know, they live up in high towers, and if the women came there, they might talk and hinder them from looking at the stars.'

George Eliot, *The Mill on the Floss*, Book III, chapter I, Tom's First Half, 1860.

INTRODUCTION

It would have surprised Eliot's Maggie, quoted above, to learn that at the time of her fictional utterance, astronomy was one of the few scientific fields open to women. In the eighteenth century, Caroline Herschel was discovering comets while her brother, William, stared off into space (Kidwell, 1987). Maria Mitchell discovered a comet (1847) and was appointed as Vassar College's first astronomer shortly after (Kohlstedt, 1987). The literature on the aptitude of girls and women for science over he last few decades has indicated that most females lack ability or interest in scientific subjects (Delamont, 1996). Many authors have suggested that there are sociological rather than physiological reasons for the seeming lack of interest by females in things scientific (selections and references in Gornick, 1983; Kahle and Butler, 1985; Abir-Am and Outram, 1987; Riddell, 1992; Sadker and Sadker, 1994; and Delamont, 1996). This study will seek to determine if nature or nurture is responsible for the seeming lack of interest in science of today's women.

RESEARCH QUESTIONS ADDRESSED

This study is a follow-up to a study conducted by the author on learning differences exhibited by visitors the Explora Science Center in Albuquerque, New Mexico, in which no gender differences were noted in the amount of time spent interacting with an exhibit. This study will attempt to discern the effects of the pathological cultural problems cited by the authors identified above in an informal

science educational setting, namely, The New Mexico Museum of Natural History and Science (NMMNHS). Additional questions I pose in the field observation portion of the present study are: 1) Are there identifiable gender differences exhibited by visitors towards the exhibits at the NMMNHS'?; 2) Are there identifiable age differences in patterns of interaction exhibited by visitors at the NMMNHS?; and 3) What sociological theory(ies) of education best fits with the observations and study findings?

FINDINGS OF PREVIOUS STUDIES

Science is the thrill of the pursuit of the unknown. It is "the belief that we can 'make sense of it all'" (Gornick, 1983, p.66). Any person regardless of gender, has the potential to become a scientist- as we all enjoy thrills. It is through our training and socialization that we are propelled to a career in science or not. If one has fond memories of a conquest in science, one might once again pursue another scientific conquest. After a few years of schooling most girls' interest in science begins to wane (Matyas, 1985). Where does one develop an interest in science? Matyas (1985) tells us that it is in school. I suspect that the desire to solve problems by observation and experimentation develops prior to entering school. Certainly, my own experience indicates this. I collected rocks, observed animals in the wild and captivity, and mixed magical potions long before I entered school and was encouraged to do so by my parents. Parental involvement and encouragement was responsible for the careers of three of the prominent female scientists presented as case studies in *Uneasy Careers and Intimate Lives* (Harvey, 1989; Pycior, 1989; Abir-Am, 1989). It is possible that all of the women profiled in the book were motivated by their parents or some other mentor from an early age, but all the other case studies do not report on the scientists' early years. There are numerous studies that note the decline in interest for science in school-aged girls when compared to their male peers (cited in Matyas, 1985). Matyas (1985) concludes that the decline is due to a " lack [of] prerequisite positive attitudes and personal confidence." Matyas (1985) explores children's extracurricular activities before and during schooling

and finds that children are guided by parents, peers, and teachers to "engage in sex-appropriate play." Sadker and Sadker (1994) give many specific examples of sex-role stereotyping in schools and Matyas (1985) cites " social pressure" as a significant factor in discouraging females from pursuing scientific careers. Social pressure to conform to the "traditional" female role has historically hindered women in science (Outram, 1987) and women in general (Riddell, 1992).

Girls and young women who attend single-sex schools exhibit a greater propensity to participate in science (Matyas, 1985; Sadker and Sadker, 1994; Delamont, 1996). Sadker and Sadker (1994, . 236-237) attribute the success of all-female schools in producing scientists to a climate free from male aggression that allows females to take risks that they would not otherwise take. Sadker and Sadker feel males are distracting or intimidating to their female peers. Subtle or not so subtle sex discrimination is present in coed schools perpetrated by teachers and guidance counselors (Matyas, 1985; Riddell, 1992; Sadker and Sadker, 1994). In an attempt to pin down the characteristics of formal science education that lead to positive feelings about science in female students Kahle (1985) found that well equipped laboratories, non-sexist teaching materials, equitable treatment by teachers, hands-on lessons, well-educated teachers, and parental support were the key factors in increasing female participation in science. Matyas (1985) concluded that hands-on science activities, encouragement from teachers, parents, and counselors, and better preparation of elementary science teachers would result in enhanced female achievement and interest in science. Sadker and Sadker (1994) identified parental support and non-sexist, non-discriminatory classroom environments as the way to correct the inequities they found in our nation's schools. Delamont (1996) interprets the decrease in female participation in science to a change in teaching strategies which have moved away from practical, heuristic methods to a more theoretical, lecture-oriented approach. Young (1972) calls these two methods the "good practice" approach and the "academic expertise" approach, respectively. He attributes

the adoption of either approach to political and economic concerns. In the academic expertise approach, experts decide what should be taught and how it should be taught; whereas the good practice approach incorporates what works. Are "ivory tower" experts and bean counters driving females out of science study?

There is a commonality of solutions to the apparent problem of interesting females in science. All of the authors cited above recommend parental encouragement, a resource-rich environment, and decreased societal pressures as ways to engage females in science. A museum offers opportunities for parents and children to explore science in an atmosphere designed to develop interest and learning. Hugh Mehan (1973) found that children scored higher on informal tests than on formal tests. The museum setting is an informal alternative to a school science classroom and should provide a better guide to science interest than a classroom-based study, based on Mehan's (1973) findings.

Various authors have conducted research into gender differences exhibited by museum visitors. Two papers found gender-related behavior differences but concluded that more study was needed to completely clarify what appeared to be enigmatic observations (Dierking and Falk, 1994; McManus, 1994). Another pair of studies (Korn, 1990; Patterson and Bitgood, 1988) found that the types of objects that males are attracted to are different than those that interest women. Klein (1990) found that male museum attendance increases with increasing age and that young woman outnumber young men at art museums. As noted above, in an observational study on the amount of time spent interacting with exhibits at the Explora Science Center there was no noticeable effect of gender on participation. There was, however, a positive correspondence of time spent at an exhibit and decreasing age which peaked at the teenage years. Additionally, it was discovered that ethnicity had a statistically significant effect on the amount of time spent in exhibit interaction. Native Americans spent less time at exhibits than all other races. Hispanics interacted less than Negroes. Sample size was not large enough to make conclusions about Caucasian interaction.

THEORETICAL PERSPECTIVES ON THE SOCIOLOGY OF SCIENCE EDUCATION

In an essay entitled, Science and the Social Order, Robert Merton (1973) described two conditions that lead to the public's hostility towards science. The first is the "...conclusion that the results or methods of science are inimical to the satisfaction of important values" and the second, "...the feeling of incompatibility between the sentiments embodied in the scientific ethos and those found in other institutions." All of the authors above discussed cultural pressures on females in their search for the causes of female disinterest in science. Is it possible that society has imprinted a different value system on females? Is it possible that female values preclude a life of science? Is it possible that other institutions, for example the institutions of marriage and family, are more highly prized by females, than the institution of science? Not only are these things possible but as the studies cited above indicate, they are probable.

If Erving Goffman (1959) is right with his "dramaturgical approach" to sociology then society forces women into a performance that prevents them from enjoying science. In the concluding chapter of his book Goffman tells us how "impression management" impinges on the four perspectives of any social establishment; the technical, political, structural, and cultural perspectives. Society has traditionally given women a technical role that requires them to be submissive, keep house, and raise children. The intersection of the political and cultural perspectives with impression management also belie society's beliefs about women and science. It was noted above that discriminatory practices by parents, teachers, and guidance counselors discourage females from participating in science. Goffman tells us that political power is used to direct the activity of others. Do females respond to this power by shying away from scientific activities? Culturally, society's values direct females away from science and into roles that society feels are best suited to women. It is perhaps the perception of females that science is masculine. In fact Kahle's (1985) data on male perceptions of women's roles show a statistically

significant difference in the belief that "women should stick to 'women's jobs'. Twenty-seven and four-tenths % of male respondents felt they should, while only 7.7% of the female participants agreed with the statement. Unfortunately Kahle's sample was drawn from a group of students that had exemplary science teachers and was not representative of the general population. Ninety-six and one half % of the young women surveyed felt that females had as much science ability as men and none disapproved of science as a career for women. If Kahle's sample reflected the beliefs of the general public then this paper would not be necessary. Structurally society considers scientific careers as a status reserved for men only. Women respond to this belief by avoiding science.

One final framework with which to examine the lack of female interest in science with is Freire's banking concept of education versus libertarian education. The principles of libertarian education remind one of Young's (1972) "academic expertise" vs. "good practice" dichotomy noted above. The banking concept is a narrative approach to education in which the teacher talks and the students listen. In libertarian education inquiry and praxis foster imagination, creativity, and true knowledge. It was methods using inquiry and praxis that Delamont (1996), Matyas (1985), and Kahle (1985) found successful in turning young women on to science. Twenty-four % of science teachers nationwide are female. Science teaching is a male-dominated field. The sex-discrimination and bias that Matyas (1985), Riddell (1992), and Sadker and Sadker (1994) uncovered is a form of oppression making Freire's *Pedagogy of the Oppressed* particularly relevant.

It is my hypothesis that in the museum environment women and girls freed from social pressures will be observed enjoying science and actively learning.

RESEARCH METHODS

Data collection in this study was restricted to direct observation, proxemics, and kinesics so that the need for human research participant approval was minimized. Data was collected over two four-hour days at the museum. Data was collected on a

standardized form (Appendix A). Observable visitor demographics- gender, estimated age range, and ethnicity (Asian and Native American were combined because differentiating them was impossible); group size; type of visitor/exhibit and visitor/visitor interactions; length of interactions; whether the interaction was active or passive (did they simply look or did they manipulate and/or encourage others to manipulate the objects exhibited); as well as relevant comments, comprise the data collected.

Data was collected as individuals or groups entered an exhibit area. Data was collected on all members of the observed group, except in one instance when a group of six quickly passed through an exhibit- in this case data was only collected on two members of the group.

Exhibits were primarily chosen for their interactive nature versus exhibits that are simply displays of objects although one display exhibit, the Volcano was observed. Behavior in the Volcano exhibit was fairly consistent with the other observations. Exhibits observed included: the Skullduggery Cart, which offered a variety of animal skulls for visitors to handle; the Fossil Cart, which presented visitors with the opportunity to look at New Mexico fossils thru magnifying glasses; Dinosaur Cart, a collection of plastic dinosaur models and select dinosaur bone and teeth fossils; a microscope at the Naturalist Center, an area in the museum that encourages hands-on explorations; and the Cretaceous Seacoast exhibit's shoreline Touch Tank, where visitors are provided the opportunity to handle living "fossils." The Volcano exhibit allows visitors a glimpse into the innards of a volcano, blasting them with heat and sounds one might encounter inside a volcano.

After data collection began it became obvious that the categories: Directions Read and Explained By, would produce little useful information. I did continue collecting for these two categories but both behaviors were observed only infrequently. I suspect the exhibit designs, personal agendas, or visitor needs impacted these two categories. Further study, including interviews will shed light on this phenomena.

Data was coded and analyzed for gender-related patterns of interaction. Descriptive statistics were performed. The following results were obtained:

RESULTS

During the observation period 48.5 % of the 68 visitors I collected data on were female. The mean estimated age of the visitors was 22 years for females and 23.4 for males. Eighty-two and one half % of the visitors were Caucasian, 14 % were Hispanic, and 3.5% were Asian or Native American. The mean group size was 2.7 people. Data for two of the research questions is presented in chart form below.

On the question of gender effects and exhibit interaction, Figure I clearly shows that female visitors spent more time interacting with five of the six exhibits than male visitors did.

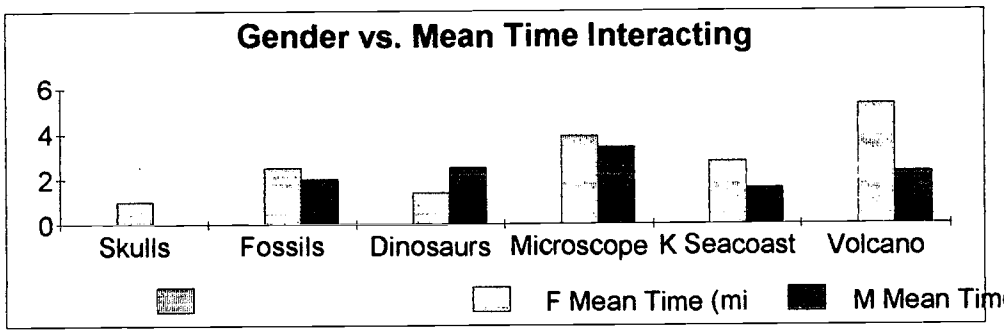

FIGURE I

Active participation with the exhibits versus gender is represented in Figure II. Females were equal to males in percent active participation at one exhibit; females were less active at two exhibits and more frequent participators at three of the exhibits.

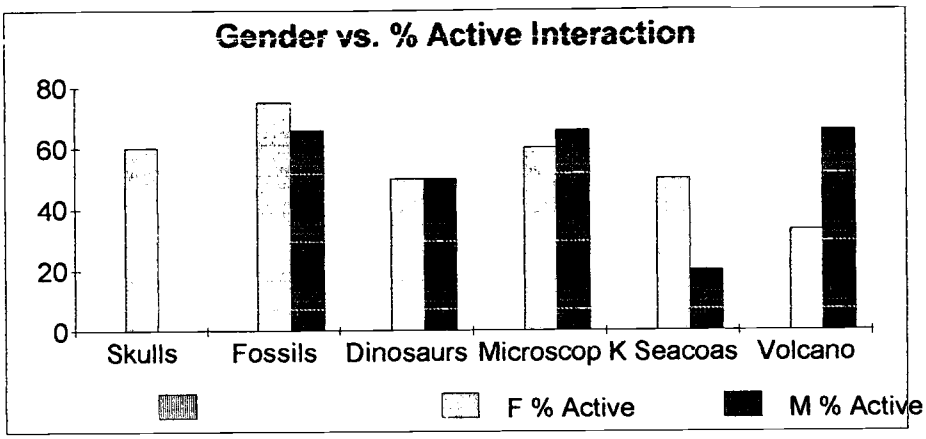

FIGURE II

Overall, females tended to spend more time interacting with exhibits and were the most active participants at more exhibits than males were.

The final chart, Figure III shows the difference age makes in participation with the exhibits. Children were the most frequent active participants at the exhibits observed. The data for the 30 year old age group represents a large proportion of the parents of the children. In all age groups after childhood, except for forty-somethings, passive interaction was the preferred mode of interaction with the exhibits. Age appears to be a significant factor in whether a visitor takes an active or a passive role at the museum.

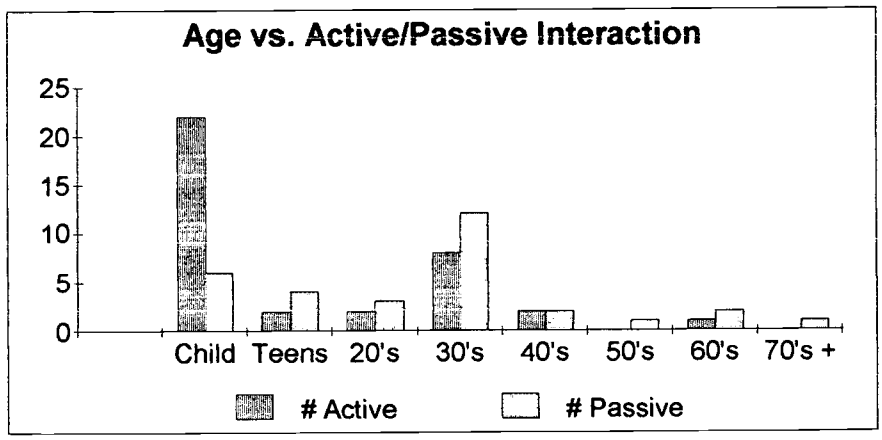

FIGURE III

CONCLUSIONS

Gender and age are significant factors in predicting active participation with exhibits at the New Mexico Museum of Natural History and Science. Women and girls will spend almost one-third more time at a particular exhibit then males. Women and girls also, participate actively with exhibits at a greater frequency then males. Children are substantially more likely to actively interact with exhibits than all other age groups.

Without interviewing the visitors it is impossible to determine what is responsible for the gender differences exhibited at the various exhibits. There may be gender preferences in exhibit topics or the data may have been affected simply by the gender makeup of the specific groups observed. A greater number of observations averaged over a longer time span would better inform this question.

It appears that females who visit museums are interested participants in science topics and activities. It may be that the informal setting encourages greater participation as Mehan (1973) discovered or it may be that the females who visit museums are simply a motivated subset of all females. A comparison of the study's subjects' performance in a formal science classroom and their observed behavior at the NMMNHS would be useful in determining whether I observed a particularly motivated group or if they were representative of the general population. It would also be interesting to select a group of students who are not performing well in a formal setting and observe their behavior at the NMMNHS.

I observed a number of instances where a child seemed bored or chose not to interact with an exhibit until a parent joined them, thus confirming the benefit of parental involvement. From this preliminary study it is difficult to determine if the resource-rich environment was responsible for the participants' interactions. A study that examined performance in the student's classroom (taking into account the classroom resources) versus their behavior at the NMMNHS could address this question.

I am not sure how to gauge social pressure on a person. I did not observe any aggressive or intimidating behavior in any of the groups observed. Perhaps the formal classroom fosters such conduct or there are other factors involved in museum visitor ethology. If any social pressures were observed they seem to have inhibited the older folks from engaging in active participation or perhaps the older folks "stepped aside" to let the children have greater access to the exhibits.

No visitors exhibited observable overt hostility towards the exhibits at the museum. People who are hostile to science are probably in the minority, if present at all, in a science museum. While I did observe a few parents pulling their children away from exhibits, this behavior probably stemmed from the parents' agenda or the amount of time they allotted to see the museum. It is certain from the results of this study that all females do not have values that are inimical to the study of science or value other institutions more than the institution of science. Only an interview of people who chose not to visit a science museum can help determine if Merton (1973) is correct about public hostility towards science and if that hostility prevents attendance at museums or achievement in the science classroom.

If Goffman's (1959) dramaturgical is responsible for inhibiting girls and young women in the science classroom it seems that a different manifestation of impression management is occurring at the NMMNHS. As was noted above, impression management may be a key factor in the predominance of passive behaviors amongst the older visitors at the museum. A few parents seemed to be embarrassed by their children's behavior which was manifested by obvious impatience or scolding. These few instances were the only obvious examples of impression management I could observe. Again, I must note that the visitors to a museum may not represent the general population.

"Good practice", inquiry, and praxis are key components of all the exhibits observed. Many museums have moved away from simply displaying objects to allowing visitors to manipulate and explore the objects directly or through the use of technology.

Perhaps formal educational settings are intentionally oppressive as Freire's (1972) theory implies. The 'banking concept' of education is prevalent in pedagogical practice. There are efforts to change some of these bankrupt techniques but change occurs slowly in the formal educational bureaucracy. Whether educational oppression is intentional or not it appears to be less evident in the NMMNHS if the women and girls I observed enjoying science are taking advantage of an environment relatively free of social pressures, resource-rich, and conducive to parental interaction with their children. If science education is a problem in the classroom and the females I observed are typical students, then maybe we should teach science in museums or at least drastically modify our science teaching methods.

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DATA SHEET

GENDER F OR M	AGE RANGE	ETHNICITY	GROUP SIZE	EXHIBIT	DIRECTIONS READ	EXPLAINED BY	TIME INTR.	INVOLVEMENT A OR P	NOTES
	teen 20's, 30's,40's 50's,60's 70's	NA, AA, A, HIS, C, U			B--D--A	A-A A-C C-A		A P	
	teen, 20's 30's 40's 50's 60's 70's	NA, AA, A, HIS, C, U			B--D--A	A-A A-C C-A		A P	
	teen 20's 30's 40's 50's 60's 70's	NA, AA, A HIS, C, U			B--D--A	A-A A-C C-A		A P	
	teen 20's 30's 40's 50's 60's 70's	NA, AA, A HIS, C, U			B--D--A	A-A A-C C-A		A P	
	teen 20's 30's 40's 50's 60's 70's	NA, AA, A HIS, C, U			B-D---A	A-A A-C C-A		A P	
TOTAL									
					Before	ADULT Child		Active Passive	

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