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“The sex
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Science and Pseudoscience

By Susan Carol Losh

Science literacy is critical. In 1999 alone, the United States spent 247 billion dollars on scientific and technical research and development. Informed public opinion helps create a climate that supports the “science enterprise,” and it facilitates intelligent discussions of policy.

But science faces constant challenges, in the form of purveyors of “pseudosciences”—astrology, parapsychology, and ‘UFOlogy,’ among others—contending for cultural preeminence. Americans need basic knowledge and the ability to distinguish “real” from ersatz science. After all, not so long ago, so-called “experts” claimed that studying math damaged female fertility, or that Jews were a “mongrel race.”

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Many scholars assert that formal education is the key to creating and maintaining scientific literacy. We expect science knowledge to rise with education, while pseudoscience acceptance falls.

But we need further information about *why* education is important. Is it exposure to science courses? Or education’s facilitation of scientific careers? To what extent do college major or career field mediate how education influences science knowledge or pseudoscience support?

A second variable to consider is gender. Women tend to describe “science culture” as “chilly,” perhaps because the media stress hardships for women scientists. More girls than boys oppose animal research or endorse anti-science statements. Women support Biblical “creationism” and astrology more often than men, although men may more often espouse “modern” pseudoscience, such as time travel. It

is unclear, however, how gender and educational level intersect over time to affect science knowledge or pseudoscience support.

The greatest available concentration of survey items about science and pseudoscience appears in the National Science Foundation Surveys of Public Attitudes Toward Science and Technology, directed by Jon D. Miller of Northwestern University from 1979 to 1999. National public opinion surveys about science are relatively rare, with exact items seldom replicated across time. The few survey questions pertaining to pseudoscience that are asked are often restricted to creationism. The NSF data, therefore, help fill several gaps.

I analyzed six representative telephone surveys of United States adults from the years 1988, 1990, 1992, 1995, 1997 and 1999. Sample sizes ranged from 2,041 in 1988 to 1,882 in 1999.

First, I constructed a science knowledge index by numerically coding and combining the responses to ten survey items measuring basic science knowledge.

Measures of pseudoscience support consisted of items on the acceptance of evolutionary theory, belief in lucky numbers, and an “astrology index”—a standardized composite of how often the respondents read their horoscopes and whether they believe astrology is very, sort of, or not at all scientific. An additional item from the 1988 and 1990 surveys asked about extraterrestrial aliens.

When the science knowledge index was crosstabulated by respondents’ level of education, scores ranged from 5.1 among the poorly educated to 8.2 among the well educated. Poorly educated adults averaged 2.1 “don’t know” responses, compared with 0.7 for the best educated.

Men answered more items correctly than women. For example, 84% of men replied that the earth travels around the sun, compared with 68% of women (see Figure 1). Men averaged 7.4 items correct while women averaged 6.2. Women also volunteered “don’t know” responses on an average 1.7 items compared with only one item for men. Science knowledge scores increased slightly over time for both sexes.

In terms of pseudoscience support,

- Women supported astrology more than men (the mean scores were 0.17 versus -0.21). Respondents who had completed graduate school rejected astrology, while the least educated accepted it (-0.34 versus 0.28). Astrology support dropped slightly over time.
- Women endorsed lucky numbers a smidgeon more than men (2.7 versus 2.6), but support dropped nearly 20% from adults lacking any degree (3.1) to those completing graduate work (2.2).

No change occurred over time.

- About 45% of both sexes disagreed that “some UFOs are alien spacecraft.” The college-educated rejected aliens (47%) very slightly more than the high school-educated (44%) or those without any diploma (45%).
- Fifty-three percent of men and 42% of women supported evolution. So did 68% of the best educated, but only 36% of those lacking any degree. Despite recent, well-publicized litigation over creationism, responses were stable over time.

Thus, women more than men supported “traditional” pseudoscience, rejecting evolution or supporting astrology. However, neither the lucky numbers nor aliens items showed much sex difference, and education did not significantly affect the aliens/UFO item.

While most scholars assume that greater science knowledge produces pseudoscience rejection, this was found to be only partially true. Although belief in evolution rose with science knowledge and endorsement of lucky numbers fell, knowledge was unrelated to the aliens item. Despite controlling science knowledge, significant gender differences in astrology support remained.

The analyses to this point addressed solely educational level. However, women and men enter dissimilar college majors and careers. Bivariate correlations indicated that taking college science courses or holding a science job affects science knowledge. And what of individuals without college degrees who are interested in science? Might interest compensate for formal education?

I used multiple regression equations to assess the *net* effects of gender and educational level, controlling survey year; college degrees in technical sub-

jects, life or physical sciences, humanities, or education; number of college science courses; age; holding a scientific or technical job; science or technology in one’s workplace; and attentiveness to science.

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Despite these controls, sex differences in scientific knowledge stubbornly remained. In fact, men’s science knowledge score advantage over women actually *widened* when these control variables were included, from a 1.2 to a 1.5 item difference. This finding indicates that the sex difference in science knowledge is “real,” rather than an educational or occupational artifact, and it invites further study.

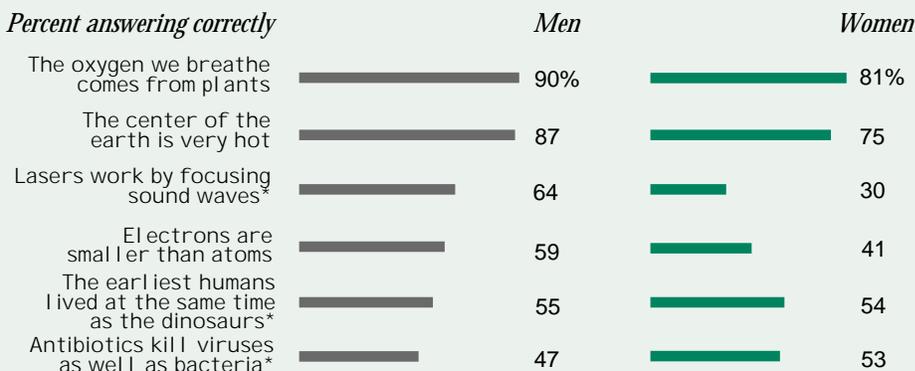
Level of education also remained important in these equations for all respondents. Well-educated adults knew more, rejected astrology or lucky numbers more, and endorsed evolution more often. Compared with those who never completed college, almost *any* college degree (including one in the humanities) boosted basic science knowledge.

However, educational level raised science knowledge scores more for women than men. And when I added science knowledge as a control variable to the multiple regressions, the sex difference in lucky numbers reversed (men’s support was now higher), sex differences on evolution acceptance dropped from 14 to 9% (men greater), and sex differences on astrology lessened, although women’s support for astrology was still much higher than men’s.

Figure 1

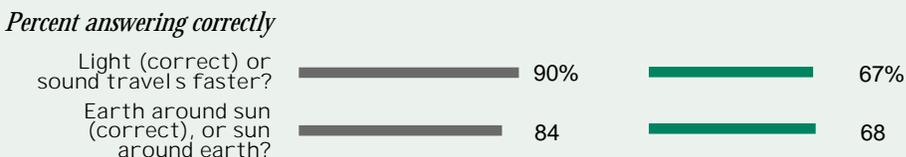
Science Knowledge Differs by Gender

Question: ...For each statement that I read, please tell me if it is true or false...?



*Correct answer is "false."

Questions: ...Which travels faster, light or sound?... Does the earth go around the sun or does the sun go around the earth?...



Source: Survey by the National Opinion Research Center for the National Science Foundation, 1999.

I began my analysis with the general hypothesis that gender-stereotyped education or job experiences foster sex differences in basic science knowledge or pseudoscience support. However, despite educational level, college major, exposure to college science, age, occupation, or work place experience, individuals' basic science knowledge, as well as support for astrology, were affected most by whether they were male or female.

There were also indications that the propensity to accept incredible information varies by sex and depends on the specific ersatz science. Women appeared more superstitious on evolution or astrology, but, after statistical controls, men endorsed lucky numbers more. Gender did not relate to the aliens item.

These are sobering findings at the end of a century characterized by tremendous changes in science, technology—

and gender roles. The differences place women at a disadvantage in understanding or influencing policy, or in implementing life enhancements from technology. Moreover, women still disproportionately influence youth as teachers, counselors, or parents, and typically bear the major responsibility for family health care—roles too crucial to rest on a foundation of faulty or deficient knowledge.

Why these persistent sex differences? The finding that women's basic science knowledge increases more than men's with education, no matter what kind, is a clear indication that education is only a part of the story underlying the female deficit.

The results are, however, consistent with other research on gender and society. Men, for example, gamble more, possibly giving "lucky numbers" special meaning for them. Women, on

the other hand, are socialized to emphasize relationships and more often occupy subordinate positions at home and at work. Thus, even well-educated or knowledgeable women may seek "answers from the stars" about lovers, bosses, or control of the future.

Important factors for future study spotlight culture, particularly religiosity and media exposure. Sex differences in religiosity may partly explain women's greater rejection of evolution—although not their stronger reliance on astrology. And while some knowledge items are so basic that they are ignored by the news media (e.g., the solar system), they appear instead in the science fiction men read or view more frequently than women.

We should also address the topical composition of surveys about science. Few national surveys include a variety of pseudoscience items. When ersatz science topics include only creationism or astrology, surveys contribute to a lopsided view of gender and pseudoscience support.

Further explanations of these sex differences lie in socialization: the emphasis on love relationships for girls; the benign neglect of girls in science or math classes; the media portrayals of female scientists. But one thing is sure. Many American women appear to live in Carl Sagan's "demon haunted world," a dangerous situation indeed for present and future American generations.

Data from the National Science Foundation Science Resources Studies Surveys of Public Understanding of Science and Technology were made available through a site license from the NSF. The author appreciates Melissa Pollak's assistance at NSF.