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Current Comments®

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Using the *Citation Classic*® Database for Science Studies. Part 2. Helen Astin on How Men and Women Perceive Their High Impact Works

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Introduction: Productivity of Women and Men Scientists

Two weeks ago the first part of a paper by Helen S. Astin, University of California at Los Angeles, on gender differences in author productivity was reprinted in *Current Contents*® (*CC*®).[1,2] Based on a sample of 56 *Citation Classic*® commentaries, 28 authored by women and 28 by men, she examined gender differences in publication year of the high impact work, coauthorship patterns, and types of publications. In summary she found that women tended to produce their classic works in more recent years, probably as a result of affirmative action programs. No differences in coauthorship were found—women collaborated as often as men did. Lastly, a small percentage of the women's classics were book chapters.

Helen S. Astin

Differing Perceptions of Classic Works

In part 2 reprinted here, Astin discusses the results of her content analysis of the *Citation Classic* commentaries. She was interested to see if there were any gender differences in terms of three basic questions: how the research originated; what obstacles were encountered in conducting or publishing the research; and why the authors believed their work was highly cited.

Astin found that women tend to say their *Citation Classic* work was an extension of their dissertation projects or the result of invitations to prepare a review article. In contrast, men say they were driven by the need to solve a problem. She speculated that these responses indicate that women are more "passively" motivated by external circumstances, while men are more "actively" engaged in problem solving.

As regards obstacles or barriers to research, only women mentioned their colleagues' lack of support—or even discouragement—of their research project. Astin notes that this further supports the suggestion that women scientists tend to be more sensitive to external reinforcements than men are. Perhaps the most interesting difference is the way men and women interpret the high citation frequency of their work. The roles here seem to be reversed. That is, men attribute their impact to circumstances rather than the importance of

their work—they say it had high impact simply because of good timing and readability. In comparison, women make rather positive assertions about their work—they tend to claim it was the first of its kind, had wide applicability, and/or facilitated subsequent research in the field. Astin interprets this as being consistent with the suggestion that external reinforcements—in this case, peer recognition by citations—are more important to women scientists.

It is important to stress that these gender differences are largely conditioned by the social structure of science. Astin speculated that women may be more passive and sensitive to external validation because of their past experiences of discrimination in education and the work place. In addition, she cites the well-documented fact that men's and women's research do not receive equal recognition or rewards in terms of salaries, promotions, etc. It will be interesting to see whether these gender differences persist as more women enter science and the career opportunities and professional rewards for both men and women become more equitably distributed. These and other issues relating to women in science were recently reviewed in *The Scientist*®.[3-6]

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Citation Classics: Women's and Men's Perceptions of Their Contributions to Science

HELEN S. ASTIN

ESSAY ANALYSIS

The first question we addressed in the content analysis of the essays was *How was the research conceived?* Five types of responses were coded.

1) *Personal interest or experience.* For example, "I was visiting my grandmother in a nursing home. I was struck by how little control she and other residents were permitted." Personal interest or experience was mentioned as an impetus by 12 women and 12 men.

2) *To solve a problem* was also a popular response to the question (14 men and 10 women listed this as an impetus to the research). "The work was done to answer a difficult clinical question [that] I didn't know...embarrassed by my ignorance [I] decided to try to search for an answer." "Wigglesworth's findings prompted me to

look for a function of the NC (neuro-secretory cells) of the brain of the adult female blow-fly."

3) *Dissertation research* was cited by five scholars (all women). For example, "This review paper was an outgrowth of my doctoral dissertation research," or "Our dissertation investigations...led to an interest in cytotaxonomy and cytogeobotany."

4) *Assisting graduate students* was cited by just one man and one woman. The male participant reflected on the question and responded as follows: "The paper began as a handout to students in a graduate course in causal models." The woman scholar tells us that "when I completed work on the Family Problems Scale...I did not intend to construct another test. However, a graduate student...decided to validate the Family Problems Scale's interpretation in terms of Ego Development, using a sentence completion test.... To complete her project, we needed a tentative scoring manual."

5) *Invitations* to prepare reviews on a topic were also perceived as the impetus to the preparation and publication of the citation classic. "When invited by the 'Annual Review' to write on this subject in 1978, I leaped at the chance." (One man and three women indicated invitations as a reason in undertaking the work.)

When we look at these responses, we find that women tend to cite dissertation research and invitations somewhat more often, while more men indicate the need to solve a problem as the impetus to undertake the research that led to the citation classic. While only one of these sex differences—dissertation—is statistically significant ($p < .05$ using a one-tail binomial test), it is interesting to speculate on the larger pattern of sex differences. Are women's responses more "passive" and men's more "active"? Do men see themselves as being more actively engaged in problem solving? Do women see their work more as an outcome of circumstances (the need to complete a dissertation or a response to an external invitation)? Such an interpretation would be consistent with some of the research on attribution theory, which indicates a tendency for men to make internal attributions (internal locus of control) and women more likely to exhibit an external locus of control (Simon and Feather 1973).

The essay contributors were also asked to report any obstacles or barriers they had encountered. Only women mentioned a lack of collegial support for their project or topic. Such an obstacle is represented in the comment: "Most of the work for this paper was done at home on nights and weekends in order to minimize certain criticism for failing to be fully engaged in the 'right' kind of research, meaning physiology." Other comments include: "I discussed my idea with a number of senior colleagues. One or two found it intriguing, but in general it was discounted." "The unpopularity of the subject was such that after I completed my thesis...an eminent Oxford professor strongly advised me to change my field of study." It is significant that an earlier study of facilitators and barriers to research productivity also found that women were much more likely than were men to report colleague behavior as a key factor in their scholarly work (Astin and Davis 1985). Again, we have evidence here that women are more likely to make more external attributions, that is, focusing on the endorsement or lack of it by colleagues.

Four men and three women mentioned that their publication was initially turned down by publishers. For example, one author wrote that "we experienced considerable difficulty in getting it accepted for publication." Another one said, "Getting it published was not easy." Out of the seven participants who mentioned difficulties with publishing their work, five were from the social and behavioral sciences. This is not surprising given the high rates of rejection in the social sciences (Zuckerman and Merton 1971). Other obstacles included problems with sample maintenance over time and problems with equipment and facilities. However, the majority of both men and women did not respond to the inquiry about obstacles, and 7 of the 56 participants mentioned only facilitators.

The last question—perhaps the most interesting one—deals with the participants' reasonings about the importance of their work. Participants were asked to indicate why they believed their piece was so frequently cited. Based on their responses, we developed nine categories that could absorb the various explanations that reflected their attributions for their work's high citation count. Table 1 shows the frequency with which each category was mentioned by the participants. The majority of participants believe that the primary reason for the high citation count is that the publication is the first of its kind. "I believe that my paper has been cited so frequently because it is the first demonstration of neuroendocrine function in an adult insect." "This was probably the first scoring manual for any projective test to attempt both logical and empirical justification of ratings." "It is likely that this paper has been cited frequently because it was the first to demonstrate definitively the localization of these important secreted platelet proteins." This attribution "first of its kind" is not unlike the response given by a totally different sample of respondents to a survey in 1982. When a group of highly productive academics was asked to indicate why they chose a certain one of their publications as their most important one, they said that they chose it because they considered it a "ground-breaking" piece of work. In their words the "newness" of research is considered a critical part of its impact on the field (Astin 1983).

TABLE 1. *Attributions for High Citation Counts (in percentages)*

REASONS	WOMEN	MEN
First of its kind	48	15
Scope and applicability	32	15
Integrates knowledge and provides direction for further research	28	7
Raises fundamental questions	16	7
Easy to read; simplicity	12	19
Timing was good for the topic	12	22
Provides theoretical framework	8	15
Journal it appeared in is highly respected and widely read	4	7
Other researchers disagree with the findings and conclusions	4	7

Applicability and scope were also cited often by the participants. One essay author believes that the publication is cited often because "it provides a simple, highly reproducible technique for the determination of microgram amount of phosphate." Another suggests that many experimenters "can probably find a fact or statement within this publication that supports or appeals to them."

The third frequently cited reason for the publication's high citation is that the publication integrates knowledge and provides directions for further research. Usually this attribution is made by persons whose highly cited contribution was a review article. Two comments exemplify the nature of this type of attribution: "This frequently quoted review article probably provided [readers] with a convenient summary of the state of the art at a time of rapid expansion." Another one indicates, "Each chapter was an evaluative review of all existing research on that topic...an integration of findings."

When we examine gender differences, we find that women and men differ somewhat on their attributions. Men are somewhat more likely to believe that the high citation count was the result of timing of publication and its readability. For example, "Our paper was published at a time when the popularity of causal modeling via path analysis was at its peak in sociology." "The success of my review can be explained on the basis of being a thorough piece of work, much needed at the time." "It communicated the problem and the solution to researchers in a nontechnical, here's why-and-how-you-do-it style" (41 percent of the men compared to 24 percent of the women make such attributions). These are attributions of circumstance rather than attributions about the significance or importance of the publication. Women are more likely to indicate that the piece was the first of its kind and that it had wide applicability (see earlier quotes). In part the attribution "first of its kind," often given by women, could

be the result of recent changes in the scholarly enterprise, such as the emergence of the "new" scholarship (research on women). Indeed, women's contributions to this emerging area could rightfully be viewed by them as the "first of its kind."

Men have a propensity to attribute theoretical significance to their work; and they often tend to provide circumstantial rather than substantive reasons for the piece's high citation count. Women, on the other hand, interpret the high citations as the result of their having produced work that facilitates others' efforts, by integrating knowledge, and providing further direction, by being widely applicable to the work of many other scholars.

What have we learned from these causal attributions by women and men scholars? When we examine their perceptions about what led them to undertake the highly cited research in the first place, women appear to be responding to others rather than being driven by their own quest. That is, they are less likely to undertake the work because they are interested in solving a problem, but rather that the work was the outcome of the dissertation or they were invited to prepare the piece. Furthermore, when it comes to explaining why their work is so frequently cited, the women appear to be more interested in how their work can be useful to others (their research can help and the findings can be applied by others). They also make more positive attributions about the importance of their work than do the men. They see their research as integrating knowledge and providing direction for further work: "a useful procedure for calculating the affinity of the drugs for the receptor"; "the hope that this approach might lead to a new type of cancer immunotherapy."

It is interesting and somewhat surprising that women in this study make more positive attributions about the importance of their work than do the men—a finding that runs counter to scientists' characteristic "norm of humility," their insistence that their work builds on the work of others. How are we to interpret this observation? Do women—because they receive less recognition and validation—congratulate themselves more for their achievements? Is it that they are not as thoroughly socialized into the norms of science? One should not forget however that many of their remarks also point out that their research has wide applicability, integrates knowledge, and provides direction for further research. In other words, it can be of assistance and help to other scholars and researchers.

The findings summarized thus far underscore the importance of external reinforcement in women's participation in research and publication, as suggested earlier by Cole and Zuckerman (1984). The women in this study do not appear to take the frequent citation of their work for granted. On the contrary, they are more sensitive than men are to the environmental cues that suggest colleagues' acceptance and validation of their achievements. We might speculate here that women's past experiences of gender discrimination and differential treatment in education and the work place may sensitize them to external validation, which in turn can affect their motivation to engage in further research and publication efforts. However, the extent to which external validation or lack of it affects directly women's research productivity ought to be examined further by the use of longitudinal samples.

GENDER AND FIELD DIFFERENCES

As indicated earlier, 56 percent of the essays written by the participants in this study's sample were in the natural sciences (physical and biological), and 44 percent were in the behavioral and social sciences.

Is the scholarly field which a woman chooses as important as her gender when it comes to determining impetus for research, perceived obstacles, and attributions for the high citation count of their publication?

Social scientists, independent of sex, are much more likely than natural scientists to indicate that the research was driven by a personal interest (15 vs. 9 indicate so). Both women and men natural scientists, on the

other hand, indicate the need to solve a problem as a prime motivation (21 vs. 3 say so). This could reflect something intrinsic to the fields (perhaps "problems" in the natural sciences are more easily and clearly defined), but it could also reflect differences in a person's initial motivation for pursuing "hard" vs. "soft" sciences as a career. While the analysis by field appears to mask the gender differences with respect to obstacles encountered during conception of research, two of the women natural scientists and one social scientist report lack of collegial support compared to none of the men. Problems with publishers tend to be mentioned more often by social scientists, women and men, than by natural scientists of both sexes (five social scientists and two natural scientists mentioned problems with publishers). Again this finding is not surprising considering the fact that there is more room for debate about appropriate methods and about theoretical and interpretive statements in the social sciences than in the physical and biological sciences. Another interpretation is that social scientists are more likely to produce books that are harder to publish than are articles produced by natural scientists. Or, as mentioned earlier, rejection rates are higher in social journals than those in the natural sciences.

The results reported thus far suggest that overall, field may be more of a factor than gender in the experiences reported by scientists who produce highly cited research. It is possible that the norms of science within fields are a stronger determinant of the actual experiences scholars have with respect to the conduct of research and publication process than is gender. However, when we examine the attributions offered by these scientists about the high citation count of their research, gender differences persist. In other words, women more than men believe that their work is significant because it is the "first of its kind" and because it has wide applicability. Likewise males continue to indicate the "timeliness" and "readability" of their publications as crucial factors.

Concluding Comment

If indeed women in the aggregate are less productive than the men are, what accounts for it? Early research on gender differences in achievement indicated that such differences were the result of *differences in needs* for achievement and gratification (McClelland, Clark and Lowell 1953; Maslow 1954; Horner 1972). But recent theories on women's and men's approach to work argue that women and men are motivated by the same work needs (survival, pleasure, and contribution) and that differences in socialization and the structure of opportunity produce different expectations (Astin 1984). Even if both genders are motivated by the same needs, there is evidence that certain needs might be stronger in women than in men. In one study, college men and women were asked to give reasons for their future work interests (Astin 1979). Women were more likely to answer that their future career would enable them to contribute to society, to work with people or ideas, to help others, and to have an opportunity for self-expression. Men, on the other hand, were more interested in occupations that offered high pay, prestige, and rapid advancement. More recently, Cunningham and Cunningham (1986) developed scales to measure the three needs hypothesized by Astin (1984). In their study they were able to demonstrate that while both men and women express these needs in similar ways, women's contribution needs are slightly stronger than men's. Thus evidence from the study reported here showing that women feel their work is cited because it has wide applicability and is useful to others may reflect their greater contribution needs.

How are we to interpret another finding concerning why men and women pursued their research in the first place? While men look at their research efforts as a consciously motivated effort, women view theirs as happenstance: "it just happened," it was simply their dissertation, or they "were asked to do it."

Studies on locus of control and attributions for scholarly success indicate that the male has more of a sense of internal locus of control—a belief that he is responsible for his actions. This tendency has been attributed to differences in opportunities to control the results of one's behavior. If men receive more reinforcement for high quality work than women do, then women may indeed begin to believe that they have less control over the consequences of their behavior. Good work will not necessarily be rewarded.

Women's typical educational and career experiences may serve to reinforce their perception that they have less control over the outcomes. If this is so, it becomes easier to understand why women will be less likely to connect their behavior to its consequences. Our data indicate that, even when they are as successful in their research as men (authoring "classics"), women exhibit less "ownership," that is, they are less likely to connect their behavior with the outcomes. Their work was conceived and undertaken because it was either suggested by the dissertation mentor or because someone invited them to do it. These findings suggest that differences in early socialization and in the structure of opportunity (as reflected in the differential reward structure) have produced differences in expectations about work. These different expectations, in turn, help explain why women and men scientists have different approaches to producing and publishing research.

Even so, more recent evidence suggests that the gap in research production is narrowing. After all, affirmative action and the women's movement have created more opportunities for women to enter scientific careers and to apply for and receive more research funding. While differentials in the reward structure still persist, they have somewhat diminished. Such changes in the structure of opportunity will continue to narrow the gap between women's and men's research productivity.

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