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Author(s): Ian I. Mitroff, Theodore Jacob, Eileen Trauth Moore

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On the Shoulders of the Spouses of Scientists

Ian I. Mitroff,
Theodore Jacob,
and Eileen Trauth Moore

If I have seen farther, it is because I have stood on the shoulders of giants.
(Sir Isaac Newton)

It is by now a commonplace to say that modern science is deeply dependent upon a host of crucial social support mechanisms for its continued functioning, let alone for its very existence.¹ For example, science depends on a wide array of schools and universities which provide the initial education and training of future scientists – and later, once they have become working scientists, subsequent support. Each of these institutions in turn is dependent on the understanding and support of the larger society for their continued existence.² Without these educational institutions, the institution of science would be seriously compromised.

What is not so obvious is that science depends on other factors that have traditionally been hidden from view, if not taken for granted. Indeed, whether it is because they have been taken for granted or because it has been implicitly assumed that they have little direct bearing on science, they have received virtually no mention or study in the literature of the sociology and psychology of science. A notable exception in this regard is the late psychoanalyst Lawrence Kubie.

Authors' addresses (respectively): Graduate School of Business and Department of Sociology; Department of Psychology; and Interdisciplinary Department of Information Science, University of Pittsburgh, Pittsburgh, PA 15260, USA.

While Kubie himself did not conduct any systematic empirical investigations of the particular factor that is the topic of our paper, he clearly recognized its importance:

Certain . . . facts concerning the developing of the personality of the young scientist and the strain of his economic situation have critical effects upon his marriage. There is first of all the initial poverty and the crowded living quarters . . . where space is at a premium; the pressure of anxiety about the future which increases with the passing years as these insecurities slowly come to be appreciated and the consequent tendency to overwork, with the nights burdened by tasks which cannot be completed in the hypothetical working day. There is the inadequate social life; the cramped and hampered sexual life, which may at the same time be a neurotic residue from those early unconscious conflicts which have contributed to shaping the young scientist's life as a whole; the increasing monastic absorption of the man, and the wife's early fading and gradual loss of vitality and of confidence in herself as a woman. These are some of the effects that may occur. Many examples could be given from the lives of prominent scientists and their wives and children which would demonstrate the high price which is paid by these civilian expendables through their sacrifices to that carnivorous god, the scientific career.³

This paper is concerned with the following questions: Since there is strong and repeated evidence from questionnaires and polls that a substantial proportion of high school and college women have negative images of scientists (and for this reason indicate they would not want to marry a scientist),⁴ do the wives of scientists have substantially different images of them? Since there is also substantial evidence that scientists are strongly masculine (in a stereotypical way)⁵ in their orientation,⁶ do the spouses of scientists supply a compensating or balancing effect on the marriage as a whole? Does the fact that one or two of the partners to a marriage is a scientist generate any special kind of stresses on the marriage itself? Does it generate any special kind of benefits? Finally, do women scientists share the same images of scientists as do their non-scientist counterparts? What are their spouses like? In short, if society in general constitutes the broader social support system or environment of science, does the spouse and the family constitute the immediate social support system?

It is all the more surprising that these kinds of questions have not been previously raised, given that the spouse of other occupational groups have been extensively studied. For example, the characteristics of the wives of businessmen, the variety of roles they are expected to play, and the functions they serve, have all been investigated.⁷ Are the spouses of scientists any less important? Given the reflections

of Kubie, one has reason to suspect that the answer is a decisive 'no'.

In order to open the phenomenon up for investigation, two distinct studies were undertaken. The first study consisted of interviews with a select sample of forty-two of the scientists who studied the lunar rocks.⁸ The second study consisted of systematic interviews with fourteen physicists and their spouses. These fourteen couples were purposefully selected for participation according to criteria discussed later. They participated fully by completing all the questionnaire items. In addition, five other couples were interviewed on a less systematic basis. These five were recommended during the course of the interviews with the fourteen. As a result of being contacted on a last minute basis, these persons could not be interviewed as systematically or as fully.

Given the rather modest sample size it should be strongly emphasized that the results and conclusions of this study are meant to be suggestive rather than definitive. However, given the strength and the importance of the results obtained even with a modest sample,⁹ it is hoped that the results will provoke others to inquire into this important and neglected area.

STUDY ONE: THE SPOUSES OF APOLLO

The phenomenon under investigation first came to light as part of a larger study conducted by the senior author into the psychology of the scientists who studied the lunar rocks.¹⁰ Very briefly, the study documented the marked differences in style and temperament between a small number of fundamentally differing 'types' of scientists; it also recorded the deep personal attachment that scientists form in relation to their pet theories and/or hypotheses – and, as a result, the subsequent difficulty they often experience in parting with their ideas. Contrary to popular belief, the study documented the functionality (albeit limited) of this behaviour: that is, while there are obvious dangers in having scientists who are committed to their pet ideas, without such commitment scientists would not have the energy to press forward in the development of those ideas. It seems altogether likely that their ideas would suffer a premature death if they were too easily abandoned.

Repeated interviews conducted over a three-and-a-half year period, plus a wide variety of questionnaires and projective tests, clearly established the deep emotional involvement of the scientists in their

work. All the psychological materials analyzed point toward the same conclusions:

(a) that if their work is a source of great personal satisfaction, in the sense of enjoyment, then it is also a source of great anxiety in the sense of ever-present worries about being scooped, of constant fears of failures, or of not being able to live up to the high standards they and their colleagues have set for themselves;

(b) that in terms of the relative amount of time and energy they devote to concerns having to do with their work, they are more emotionally involved with their colleagues than they are with their families.¹¹

For example, when asked to indicate 'which activity in life gives you the most satisfaction', the overwhelming choice for first place is that of 'my career in science'. While it is also the case that 'family relationships' are the dominant choice for second place, it is clear that 'family relationships' occupy a distinct second position to work.¹² In sum, the study¹³ not only documents the fierce and often bitter competitive struggles for claims of priority so aptly pointed out by Robert K. Merton,¹⁴ but it also bears out the earlier observations by Anne Roe and David McClelland:

Creative scientists are unusually hardworking to the extent of appearing almost obsessed with their work [emphasis in original]. Roe,¹⁵ in reporting on her [study of] eminent scientists, remarks that the *one* characteristic all of them seem to have had without exception is an intense devotion to their work. . . . There was never a question of putting in so many hours a day, a week or a year. Instead they worked nights, weekends, holidays, all the time. In fact, she wondered how they ever found time to be with their wives and families.¹⁶

Of the forty-two scientists interviewed, forty-one were male. The sample was formed through peer recommendation; that is, starting with a few key scientists who were willing to lend their names in support of the study, each scientist who was subsequently interviewed was asked to recommend which scientists (and for which reasons) should be interviewed next.¹⁷ Such a procedure is known as a 'snowball sample',¹⁸ and tends to yield a high proportion of the élite scientists within the system under study.¹⁹ It is therefore especially significant that only one woman scientist was included by

this procedure. In more ways than one, the sample confirmed the following observation by David McClelland:

Men are more likely to be creative scientists than women [emphasis in original]. There are no women among Anne Roe's eminent scientists, and very few in *American Men of Science*. No fact is more obvious than the differential yield for science of the two sexes.²⁰

This is anything but to say that women are constitutionally incapable of becoming scientists and doing outstanding science. It is to acknowledge the sexist bias of science as an institution.

The lunar scientists were asked such questions as: 'How much does your wife understand of your work? How often do you talk to her about it? What do you think your wife's concepts of science and scientists are? What does she think scientists do; how they spend their time?'²¹

Since no reference was made to their wives in the initial explanation of the purpose of the study, and since the major interest was directed toward the scientists themselves, it was decided not to interview their wives. It was felt that interviews with the wives might jeopardize further interviews with the scientists. As a result, in the first study the term 'spouse' not only predominantly refers to 'wife', but the men answered for their wives as well.

The response of the scientists were generally distributed between two poles. At the one end were those wives who had no professional career of their own. Their lives seemed dominated by the careers of their husbands. Although these men contended that they talked to their wives all the time, it became clear as they proceeded in the interviews that they talked little to them of science. The general feeling was that their wives either didn't understand much of science or didn't want to. At the other end were those wives who had a separate professional career of their own, a number of them being scientists. In this case there also seemed little talk about science, the wife's career apparently being independent of her husband's. In both cases (as a general rule), there were definite signs of tension manifested in the interviews. Where the scientists experienced little difficulty in offering the frankest and severest comments on the personal and scientific character of their predominantly male colleagues,²² they displayed noticeable difficulty in talking about their spouses. No other part of the study seemed to raise as much nervous apprehension.

We present some representative responses from the interviews as

a whole. It should be noted that the excerpts are meant as much to convey the general spirit or flavour of the total interviews, as to lend support to each of the propositions in the preceding paragraph. Indeed, like all general propositions, there are exceptions to every one of them: what is important is that each excerpt indicates a degree and kind of tension manifested in the marriage, or towards science.

Scientist A – My wife has technical training. This gives her a certain amount of insight. This helps to relieve some of the normal tensions of every marriage. My wife makes a face whenever I go to the lab at night or on Saturday, but she ‘understands’. [Note: this scientist indicated later by his remarks that there was less than complete ‘understanding’ by his wife; this tactic was frequently adopted by the scientists, of first saying there was no problem in a certain area then of later admitting that there was.] She doesn’t participate in the shop talk when scientist friends come over for dinner. Sometimes, though, she asks questions. She shares my triumphs and sorrows, especially the administrative and political aspects of my work rather than the scientific part of it. She regards scientists with a certain amount of benign scepticism. She thinks they’re good people but like brightly plumaged birds who sometimes have an odd conception of themselves and the world.

Scientist B – My wife doesn’t understand science. I talk to her about my articles and ask if I’ve made myself clear. But I never talk to her about certain technical things. If colleagues come to dinner and talk about science, my wife feels left out. She’s put off by the feeling of intellectual superiority that most scientists have, especially physicists, who she feels are affected, arrogant, and cocky. I try not to be that way because of my wife’s influence. My wife is a professional counsellor. Some of her clients are well known scientists. She sees them as much more frail human beings than they present themselves to the outside world. She goes a little too far in that she doesn’t really have respect for people who in spite of their frailties deserve more respect.

Scientist C – I talk to my wife all the time. I think she has a minimal understanding of my work. Science is my total existence, 365 days of the year, no vacations. If colleagues come to my home, my wife participates in the discussion if it’s broad.

Scientist D – My wife has no real background in science but has a very strong aptitude for understanding people and situations, which makes her an extreme asset to me. I usually talk to her about my work every evening, about daily frustrations, and occasionally, daily accomplishments. My wife might prefer me not to be a scientist; she doesn’t like my spending so much time away from the family. My wife is usually very favourably impressed by scientist guests – as professional people and as personalities. She considers that scientists without good manners – who are not well-rounded human beings – have a serious flaw in their character and have compromised themselves in her eyes. Several guests have not written thank-you notes and so she considers scientists a strange breed. More often than not she thinks they are not tuned

in to simple living in a decent way in a social world. My wife sees people as people and not as scientists.

STUDY TWO: THE SPOUSES OF PHYSICISTS

A second study was undertaken to check on the extent and the validity of the findings from the first study, to secure the views of spouses directly, and to attempt to talk to as many women as male scientists. Given the sensitive nature of the issues to be explored, it was decided, as in the first study, to form a sample through peer nomination. With the close cooperation of a respected woman physicist who was willing to lend her name to the study, an initial sample of six male and six female American East coast scientists, all of whom were known to be married and working in the field of high energy physics, was formed. The original intention was to interview at least twelve married couples, six of whom it was known contained a male scientist and six of whom contained a female scientist. Given the purpose and rationale of the study, initial contact was in all cases to be made through the scientist, the spouse being contacted subsequently if the scientist first agreed to participate.

The actual sample was formed by first contacting eleven American male scientists. Of these eleven, five were married to scientists themselves. The relatively high percentage of female scientists secured in this way not only helped to fill out the sample with women scientists but it also made it possible to avoid some of the severe scheduling problems that were involved in attempting to interview the female scientists who were originally slated for study. Of the three female scientists through whom initial contact was made, all of the husbands were scientists. All in all, fourteen male scientists were interviewed (hereafter designated as MSs), eight female scientists (FSs) and six female non-scientists (FNSs).

The mean age of the MSs was 41.0 years; all were working as scientists at major universities. The mean age of FSs was 44.0 years; only one of the FSs was currently not working. The mean age of FNSs was 43.2 years. Only two of this group were working. None of the members of the sample had been married before. The average length of marriage for the FSs is 18.2 years; for the FNSs, 12.8 years. There are thus clear differences in age (not to mention such factors as education) between the two groups of women; that there were more significant differences in attitude will become apparent

in a moment.

Each of the partners to a marriage was interviewed separately. All of the interviews were conducted by the senior author. Each was tape-recorded for later in-depth analysis. The average length of an interview was an hour-and-a-half.

The interviews were divided into four standard parts each of which was presented in the form of a written questionnaire with scaled items. The scaled items were given for the purpose of permitting direct quantitative comparisons between the groups. In addition, each respondent was strongly encouraged to talk about whatever came to mind as he or she went through the questionnaires, so that ambiguous issues could be clarified, important issues that were not on the questionnaires could be raised, and a respondent could add important qualifications to his or her responses. In sum, as in the first study, qualitative as well as quantitative data were collected from each respondent.²³

The first part of the interview-questionnaire covered a number of issues having to do with the perceived nature of science, the perceived qualities of scientists and the benefits as well as the costs of being married to a scientist. The second part of the interview involved ratings within a semantic-differential (SD)²⁴ format and was aimed at assessing the respondent's perceptions of various social roles in society, including perceptions of self and spouse. The third part presented a standardized questionnaire²⁵ designed to measure marital adjustment and satisfaction in the marriage. Finally, each partner was presented with a series of statements about the changing status and conception of women's roles in society and the women's liberation movement. Because of both the range of issues explored and their complexity, it is convenient to present the results sequentially in terms of the various parts of the study.

Part 1: Perceptions of Science

Table 1 presents the quantitative scale responses to the major items in the first part of the interviews. Since the responses of the MSs to the items are virtually identical with those of the FSs [i.e. there are no significant statistical differences between the responses of the MSs and FSs (as measured by a t-test analysis)], only the comparison between the FSs and FNSs is shown. Leaving aside for a moment the qualitative responses to the items (which greatly help to shed light on the interpretation of the quantitative responses),

some interesting conclusions can be obtained from the numerical responses themselves.

Since it would take us too far afield to discuss all of the quantitative results, the general sense of the responses can be gained from a discussion of a very few items. While both the scientists (MSs as well as FSs) and the FNSs tend to 'agree strongly' (a Likert scale value of '2') with the statement that 'science is the most objective way of acquiring knowledge that mankind has yet discovered', the FSs are significantly more in agreement with the *lack* of objectivity of scientists than their nonscientist female counterparts. Apparently if distance breeds a perception of objectivity, then close familiarity with science does not. By the same token, the FSs are (according to item 8) much more sensitive to the social and educational barriers of a woman becoming a scientist than are the FNSs. At the same time, the FSs would offer significantly more support to a son or daughter of theirs in either wanting to become a scientist or to marry one.

Here, as in the study of the lunar scientists,²⁶ the qualitative responses are not only revealing in themselves but also important for getting beneath the quantitative responses. In presenting the qualitative responses we have organized them by recurrent themes illustrated by a few representative responses under each theme. The first emergent theme pertains to the reactions of the various groups to the questionnaire itself. As a rule, the MSs were much more critical of the phrasing and the content of the questionnaire than the women (whether FSs or FNSs). The men were much more likely than the women to quibble about and demand that the 'precise meaning' of a word or phrase be supplied and made clear before they could respond to an item. The point is that the exactness and precision perceived by the men as demanded of them in their work seems to have carried over into their life in general. A recurrent theme is that the men seem to want to manage the emotional lives of their families with the same detachment and objectivity as they manage their work.²⁷ What is so interesting is that this theme came up in the context of the sample's reaction to the form of the questionnaire itself. We quote:

MS1 — I don't know what 'science' is, do you? This is another one of those trick questions, right? [Note: none of the items were meant as 'trick questions' but rather as 'probes' which, because of their complex nature, were expected to draw forth varying interpretation]. . . . There are two parts to this question, A and B. They do not logically imply one another. To be precise you should have asked four questions: A and B, A and not B, not A and B, and not A and not B. . . .

Table 1. Quantitative Responses to
Items in Part 1 of Interview:
FSS vs. FNSs

Item #	Item	Mean of FSS N=8	Mean of FNSs N=6	Difference Significant
1. ^a	Science is the most objective way of acquiring knowledge that mankind has yet discovered.	2.00	2.33	No
2. ^a	Science is actually much more subjective than most people are aware of.	3.12	3.33	No
3. ^a	Scientists are not as objective as they would like to think they are.	2.00	4.33	$p < 0.02$
4. ^a	Science makes tremendous demands on the time and energy of scientists.	1.12	1.83	No
5. ^a	Science makes great demands on the family of a scientist.	1.50	2.33	No
6. ^a	It takes a special kind of person to be married to a scientist.	2.62	3.17	No
7. ^{a, b}	My spouse sometimes feels that I am more devoted to science than I am to our family.	2.62	4.17	$p < 0.10$
8. ^a	There are more social and educational barriers to a women becoming a scientist than there are for a man.	1.25	3.50	$p < 0.05$
9. ^a	If I had a son who wanted to become a scientist, I would encourage him to become one.	1.62	2.83	$p < 0.04$
10. ^a	If I had a daughter who wanted to become a scientist, I would encourage her to become one.	1.75	2.83	$p < 0.07$
11. ^a	If I had a son who wanted to marry a scientist, I would encourage him to do so.	1.87	3.00	$p < 0.05$

Table 1 (cont.)

Item #	Item	Mean of FSs N=8	Mean of FNSs N=6	Difference Significant
12. ^a	If I had a daughter who wanted to marry a scientist, I would encourage her to do so.	1.87	3.17	p<0.03
13. ^b	In order to be a successful scientist, how much does one have to subordinate all of one's interests to science?	2.62	2.83	No
14. ^{b, g}	How would you describe the degree to which you identify with your profession as a scientist?	1.75	2.33	No
15. ^{c, g}	How good an understanding does your spouse have of your work?	1.87	1.17	No
16. ^{d, g}	How often do you talk to your spouse about your work?	2.75	2.17	No
17. ^{e, g}	How good an understanding does your spouse have of science?	1.25	2.33	p<0.04
18. ^{f, g}	Is your spouse's opinion of scientists more favourable than unfavourable?	1.50	2.33	No

a. Responses based on a 7-point Likert scale from 1=Very Strongly Agree to 7 = Very Strongly Disagree

b. Responses based on a 7-point Likert scale from 1=Very Strongly to 7=Not at All

c. Responses based on a 7-point Likert scale from 1=Very Good to 7=Very Poor

d. Responses based on a 7-point scale from 1=All the Time to 7=Never

e. Responses based on a 7-point Likert scale from 1=Very Good to 7=Very Poor

f. Responses based on a 7-point Likert scale from 1=Extremely Favourable to 7=Extremely Unfavourable

g. Alternate form of question used where appropriate, e.g. in item 7, FNSs responded to 'I sometimes feel my spouse is more devoted to science than to our family.'

FNS2 – Most of the scientists I know would have trouble with your questions because they would not read each sentence for its overall intent but for each word and what it means. For example, when you put ‘always’ in a question, I naturally qualify it to mean ‘most of the time’ and go ahead and respond to it on that basis. But I don’t think my husband could do this. It’s a distinct difference I’ve observed in scientists. Maybe it’s characteristic of an analytical type mind. It certainly is a factor in our everyday life. It inhibits our talking and our life together.

As a corroborating footnote to this theme, it should be noted that five out of the eight FSs interviewed and three out of the six FNSs mentioned of their own accord that the scientist’s way of thinking carried beyond the walls of the laboratory and into the home. None of the MSs mentioned this.

The FSs, as might be expected, were especially sensitive to the fact that ‘women in science experienced unique difficulties, that they often have had to compensate for the fact of being a woman’; some are even bitter about their experience:

FS3 – There is a tendency to recommend people through an old boys’ network and women are generally excluded from this because professors are afraid women won’t reflect as well on them as males. When women achieve, people are surprised.²⁸

FS4 – I applied to the National Research Council of X which is the standard place for graduate students to go for summer employment. My application was returned with the comment ‘we don’t hire women.’ Period! And I happened to be one of the best physics students in my class.

FS5 – There were times when I felt that I wanted to act emotionally and yet I knew that that wasn’t the way to get things done. There have been occasions when I felt that I had to work harder to think of things in quantitative terms than some of my male colleagues.

FS6 – I don’t know of any woman scientist who hasn’t run into prejudice. When I was in graduate school I wasn’t allowed to make observations through the telescope. My thesis advisor was an [astronomical] observer but I wasn’t allowed to observe because I was told that women were too weak to work on the mountain. So when I got out of graduate school I was told, ‘Are you a theoretician?’ ‘No.’ ‘Then you must be an observer.’ ‘No.’ ‘Then you must be a decoration.’

Finally, of all the issues in Part 1 the couples were the most divided (both internally within themselves as well as between one another) with regard to ‘whether science placed more demands on a family than other professions’. (Note that this was an open-ended question

that was asked as part of the overall interview; since it was not scaled, it does not appear in Table 1):

MS7 – My father's a salesman and he's out of town more than I am.

FNS7 – This is the nature of the beast [referring to science]. They're never home. You have to accept it. Last year my spouse [referring to MS7 directly above] was gone for almost six months straight. He came home for one night and took off again.

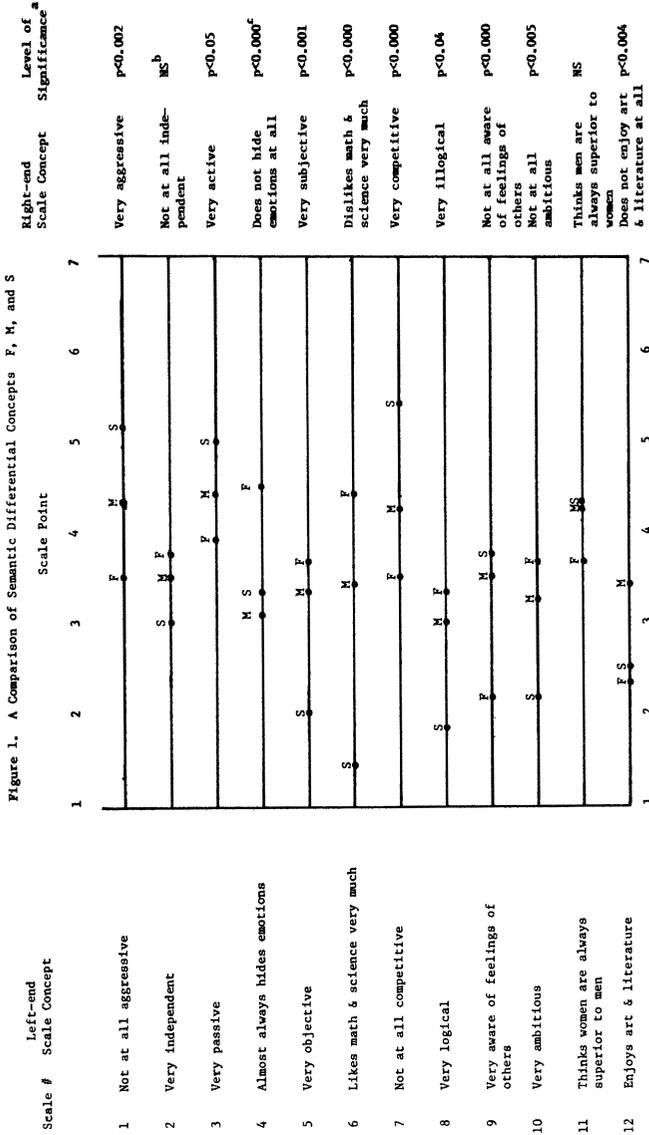
MS8 – Especially in the US if you're going to be successful in physics, it's a competitive business; it pushes people very hard. There's a tendency of Americans to let their career take a big part of their life. Especially evenings and weekends. It doesn't have to be that way. My wife and I don't allow it to happen. The people that I think well of have a better understanding of how to live a good life.

FNS8 – I feel that this family gives up the possibility of having a full-time father [MS8 directly above] a lot of the time, not even a full-time father but a half-time husband. . . . I'm a single parent a fourth or a fifth of the year because my husband is away a lot of the time. . . . I used to think that scientists spent a great deal of time with their work and none with their family but I see now that it's an individual decision. There are lots of scientists who live a nine-to-five life and don't work weekends.

The differences in perception illustrated above are a common feature of the interviews.

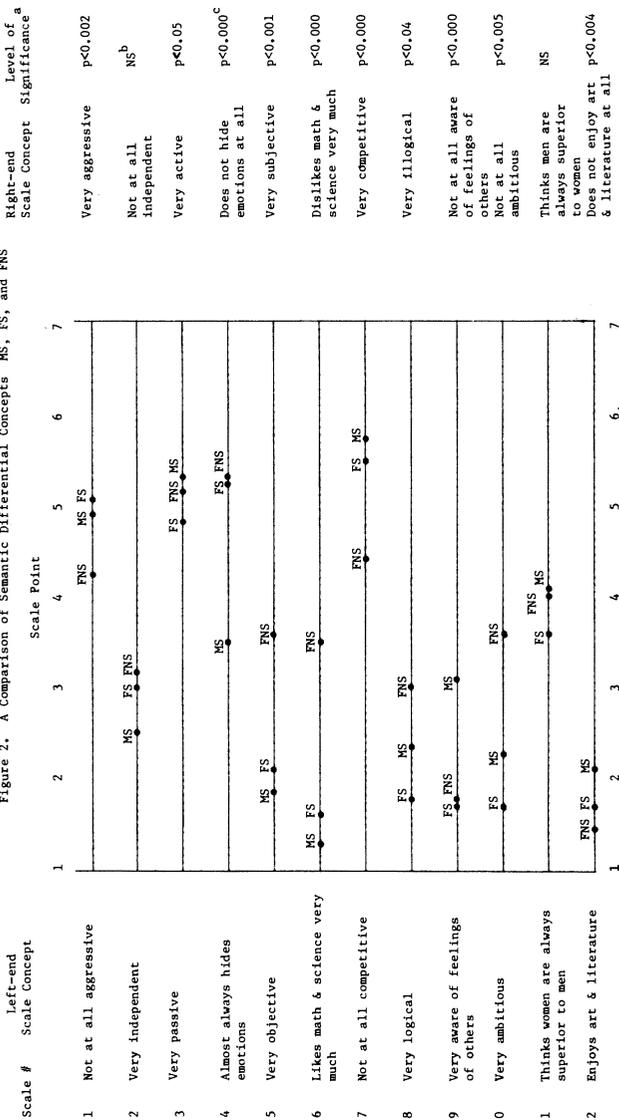
Part 2: Male-Female Stereotypes

Figures 1 and 2 present the quantitative results of Part 2 of the interview. All twenty-four respondents were asked to fill out five semantic differentials (SDs).²⁹ The concepts rated were Adult Man (represented by the symbol M in Figure 1), Adult Woman (symbol F), Scientist (symbol S), Yourself, and Your Spouse. The twelve scales used to rate each of the five SD concepts were chosen from a larger set of forty-one scales devised by Broverman and his colleagues³⁰ to differentiate between male and female stereotypes. That is, the forty-one scales were developed on the basis that they empirically differentiated (at the 0.001 level of statistical significance) between the concepts of An Adult Man and An Adult Woman as held by various groups of men and women.³¹ Twenty-nine of the forty-one scales grouped into a Competency Cluster. The remaining twelve of the forty-one grouped into a Warmth-Expressiveness Cluster. Ten of the twelve scales were chosen from the Competency Cluster; two from the Warmth-Expressiveness Cluster.



a One-way analysis of variance computed between all six concepts of Figures 1 and 2
 b NS = Not statistically significant
 c Level of significance = 0.000 to decision of statistical computations by computer routines (p-test)
 F = Adult Woman; M = Adult Man; S = Scientist

Figure 2. A Comparison of Semantic Differential Concepts MS, FS, and FNS



a One-way analysis of variance computed between all six concepts of Figures 1 and 2
 b NS = Not statistically significant
 c Level of significance = 0.000. Precision of statistical computations by computer routines (F-test)
 MS = Male Scientist; FS = Female Scientist; FNS = Female Nonscientist

Figures 1 and 2 show the location of three data points on each scale. The points F, M, and S in Figure 1 respectively represent the means (\bar{X}) of the respondents' views (N=24) of the concepts Adult Woman, Adult Man, and Scientist. (Since there were no significant differences in perception of the concepts F, M, and S between the FSs, FNSs, and MSs, the responses are not broken down further in Figure 1.) The points FNS, FS, and MS in Figure 2 respectively represent the means of the self-concepts (self-perceptions) of the female nonscientists (N=6), the female scientists (N=8), and the male scientists (N=14). If we take into account the fact that the ends of the scales were randomly aligned in order to avoid biasing the responses as much as possible, then two important patterns can be discerned.

The first pattern is that with the sole exception of scales four and twelve, the concepts S, M, and F are not only aligned in the strict order of S to M to F, but in order of increasing masculinity. The concept of the Scientist is perceived as more masculine than the concept of the Adult Man which in turn is perceived as more masculine than the Adult Woman. That is, in terms of the Broverman scales, the concept Scientist is perceived as even more masculine than that of the Adult Man. This may only be a surface reflection of a deeper phenomenon, that science in fact and in perception is a supremely masculine form of inquiry or way of looking at the world.³²

No fact is more obvious than the differential yield for science of the two sexes, though it is saved from being trivial only by the further fact that women have not flocked to experimental physical science in increasing numbers as opportunities for higher education for women have been more nearly equalized. In other words, it may not be a social factor – lack of opportunity for women in science – but rather a personality factor – lack of interest in physical science among women – which accounts for the small number of female physical scientists.³³

The question that deserves to be confronted by future research is whether the *perception* of the scientist as being more masculine follows from the *perceived* versus the *actual* personalities of men and women; that is, whether the perception follows from actual fact or from a perceived stereotype.

The second pattern is that (with the sole exception of scales two and twelve) the scales further break down into two highly regular sub-patterns. Inspection of scales 1, 2, 5, 6, 7, 8, and 10 reveals that the six concepts being rated break into two distinct clusters, scientists versus nonscientists. (For ease of presentation, the six concepts have

been split into two figures of three concepts each. However, since we are interested in comparing all six concepts with one another, twelve separate [one for each scale] one-way analyses of variance were performed. For this reason, Figures 1 and 2 show the same level of statistical significance). That is, the scientists as a group (MS, S, FS) cluster together toward one end of the scale and the nonscientists (M, F, FNS) toward the other. Inspection of scales 4, 9, and 11 on the other hand shows that the clustering here is based on male versus female. That is, the three female concepts (FS, FNS, F) cluster toward one end and the three male concepts (M, MS, S) cluster toward the other. It is interesting that two of the scales, four and nine, which separate men from women have to do with the awareness and expression of feelings, one of the prime dimensions that has served to characterize women and, in our culture at least, to distinguish them from men.³⁴ In this regard it is interesting to note that the FSs perceive themselves as even more ambitious and logical than their male counterparts. They may indeed be more ambitious than their counterparts; they may have had to be. They may have also had to believe that women are superior to men (scale 11) in order to achieve their position.

Part 3: Marital Satisfaction

A questionnaire adapted from the Marriage Role Questionnaire (MRQ) of Crago and Tharp³⁵ was used to assess the degree of marital role disturbance in each of the twelve marriages under study. The MRQ has been previously used to differentiate between disturbed versus normal marriages, where 'disturbed' was defined as the condition where one or both of the partners were seeking psychiatric help or marital counselling. By comparing the responses of the 'disturbed' versus the 'normal' marriages, norms or numerical scores have not only been established for both groups but the scores have proved statistically significant so as to be able to differentiate between them.

The MRQ consists of two parts, an 'expectation' part and an 'enactment' part. In the expectation part, the subject is asked to indicate on a 6-point scale (from -3 to +3) the degree to which something was desirable in his or her marriage. For example, 'How important is it to your marriage that your home be clean and in order at all times?' and 'How important is it that you have sexual relations every time you desire it?' In the second part of the MRQ every expectation item was reworded as an enactment item; for example, a

subject was now asked, 'Is your home clean and in order at all times?' and 'Do you have sexual relations every time you desire it?' A subject's score on the MRQ was the mean of the sum of his or her discrepancy scores between each expectation item and corresponding enactment item. In the Crago-Tharp and Quick and Jacob³⁶ studies, a high discrepancy score was indicative of a disturbed marriage. The total score of the MRQ includes 78 item pairs for males and 71 for females. The total scale score is computed from five subscale scores: Internal Instrumentality, Division of Responsibility, Solidarity, External Social Relations, and Sexuality.

Table 2. Discrepancy Scores for MSs, FSs, and FNSs Compared with Norms for Disturbed and Normals

Males	Disturbed 0.98	MSs 0.89	Normal 0.67	Significant Difs. None
Females	FSs 1.15	Disturbed 1.12	Females As A Whole 1.08	FNSs 0.77	Normal 0.70	Significant Difs. None

Table 2 reports the discrepancy scores for the various groups. While there are no statistically significant differences between the groups (e.g. the FSs and the FNSs) because of the wide scatter in the scores, there are nevertheless some interesting trends. If anything the trends, rather than providing definitive answers, lead one to ask some important questions for future research.

From Table 2 it is clear that the FSs are on the 'more disturbed' side of the norm for females in disturbed marriages. The question however is: Does this necessarily mean that they are 'disturbed' per se? In taking the MRQ many of the women commented on the anachronistic nature of the items, claiming that they were outdated. In short, are FSs 'disturbed' because they are indeed disturbed or because they have rejected (or have had to reject) the role expectations of a conventional marriage? By the same token are the FNSs 'normal' because they have accepted (or perhaps been forced to accept) a conventional role? We can only hope that future research will address itself to these important questions.

Finally, although there was a tendency for high discrepancy scores in one partner to be associated with high scores in the other, the

Pearson product moment correlation was only of the order of 0.25 and not significant. It should be remarked however that the two highest individual scores were found in the same marriage, both partners being scientists.

Part 4: Attitudes toward Feminism

The final part of the interview consisted of the ten items shown in Table 3. The first seven items were taken from a questionnaire designed by Gump to elicit 'Sex Role Attitudes and Psychological Well-Being'.³⁷ The last three items were designed by the senior author to elicit attitudes toward the women's liberation movement.

The responses in this part only confirm those of earlier parts of the interview. The attitudes of the FSs are not only more 'liberal'³⁸ in general than those of the MSs and their nonscientist female counterparts, but with regard to the specific issue of the women's liberation movement, they are significantly more liberal. In the language of women's lib, the FSs are significantly more 'liberated', both in attitude and in the actual fact of having joined the women's lib movement, than the FNSs.

CONCLUDING REMARKS: ON THE AFFECTIVE LIFE OF SCIENCE

It has long been known that science, both as a characteristic method of obtaining knowledge and as a characteristic body of knowledge, has not only emphasized but glorified disinterested objectivity. Indeed, no other institution emphasizes disinterested or unemotional knowing as much as science does. What has not been so readily appreciated is that, as valuable as this way of knowing is (indeed, precisely because it is so valuable) it has exacted a social cost from its silent partners or behind-the-scenes supporters.

No other fact stands out more clearly from this study than that science is deeply dependent upon women for the care and management of its affective or emotional life. Not only did this repeatedly come out in the interviews but it surfaced from some of the quantitative analyses as well (see scales four and nine in Figure 2). As much as this places a burden on the FNSs, it places a special burden on the FSs. The FSs are especially caught up in a bind or 'role conflict'. On the one hand, the FSs not only affirm but have had to affirm traditionally

Table 3. Quantitative Responses to Items in Part 4:
MSs vs. FSs, FSs vs. FNSs

Item # ^a	Item	Mean of MSs N=14	Mean of FSs N=8	Difference Significant	Mean of FSs N=8	Mean of FNSs N=6	Difference Significant
1.	No matter how successful a woman may be in utilizing her intelligence and creativity, she can never know true happiness unless she marries and has a family.	4.21	5.50	No	5.50	4.83	No
2. ^b	If my wife had to give up her education and get a job so that I would be able to continue my education she would feel envious and resentful that I should be doing things she always wanted to do.	2.71	2.50	No	2.50	4.16	No
3.	A woman should refrain from being too competitive with men and keep her peace rather than show a man he is wrong.	5.21	5.87	No	5.87	5.66	No
4. ^b	I would make more concessions to my wife's wishes than I would expect her to make to mine.	4.50	4.62	No	4.62	5.17	No
5.	A woman who works cannot possibly be as good a mother as the one who stays at home, even though her children may go to school.	5.57	5.00	No	5.00	4.67	No

Table 3. (cont.)

Item # ^a	Item	Mean of MSs N=14	Mean of FSs N=18	Difference Significant	Mean of FSs N=8	Mean of FNSs N=6	Difference Significant
6.	I believe that a wife's opinion should have exactly the same bearing upon important family decisions as the husband's.	3.00	1.12	p<0.004	1.12	1.67	No
7.	Even though women have most of the same privileges as do men, they really aren't as free to pursue their interests and self-development as men are.	2.50	2.00	No	2.00	2.16	No
8.	The women's liberation movement has performed a valuable function in pointing out that women have not been treated fairly in our society.	2.35	1.12	p<0.001	1.12	2.00	p<0.006
9.	I agree with the general aims and aspirations of the women's liberation movement.	2.43	1.12	p<0.000	1.12	2.50	p<0.02
10. ^b	My wife has seriously considered joining the women's liberation movement.	3.29	2.37	No	2.37	4.83	p<0.07

a. All responses based on a 7-point Likert scale from 1=Very Strongly Agree to 7=Very Strongly Disagree.
 b. Questions reworded for appropriate response from women; e.g. item 2 reads for the women 'If I had to give up my education . . . I would feel envious . . .'

male values or virtues just by the fact that they identify strongly with the role of a scientist. On the other hand, the FSs still affirm strongly a traditional female value or virtue, that of displaying emotional concern. Even though they are scientists as well, it still largely falls on the FSs to pick up on and support the emotional life of their families. In other words, they face a twin role or burden that the FNSs do not.

None of this is to say that the same phenomenon does not occur to greater or lesser degree in other professions as well. There is growing evidence that science is not alone in exacting a price from its participants.³⁹ Rather than being completely different from all other professions in this or other respects, the point is that each profession, while bestowing characteristic rewards, also exacts a characteristic kind of price from its members. In the case of science, both the characteristic rewards and costs may well be intimately tied up with one of its prime features, its repeated emphasis on disinterestedness. If this is indeed the case, then what may be ultimately called for is no less than a reappraisal of (1) the role of feelings both within and external to science, and (2) the boundaries between work (or science) and non-work (non-science). As Thomas Cowan and Anne Roe have put it:

This highly specialized art [of the scientist's method] is jealous of the scientist's energy. It entrenches on his personal life. It tempts him to neglect all aspects of his work save those that conform to the scientific ideal. These are conditions of extreme dedication. But this way of life exacts its toll. Collectively, it bears most heavily on the *feeling life of the scientist* [emphasis in original]. I believe that it is here that the scientist must make his greatest sacrifice. For example, he is often told that the power which science creates is impersonal, nonpolitical, amoral. We will not stop to debate [the truth of] this issue. That it can even be [posited] is the significant point. For another example, the scientist's expertise in the art of generalization subjects him to the risk of generalizing ordinary human relations, thus killing off the human sentiment that calls for individuation, the making unique of the relatedness that all human beings seek.⁴⁰

I think many scientists are genuinely unaware of the extent or even of the fact of [their personal] involvement [in their work], and themselves accept the myth of impersonal objectivity. This is really very unfortunate. It is true that only a man who is passionately involved in his work is likely to make important contributions, but the committed man who knows he is committed and can come to terms with this fact has a good chance of getting beyond his commitment and of learning how to disassociate himself from his idea when this is necessary. There is little in the traditional education of scientists to prepare them for this necessity as there are many who are still unaware of it.⁴¹

Finally, the authors are only too well aware of the fact that the potential implications of these results are too important for them to go unchecked by studies with larger and other groups. Given the statistical significance of the results we were able to obtain with an admittedly modestly sized sample, we felt that our results ought to be presented if only for the reason that others would be motivated to pursue such studies.⁴² Indeed, we have initiated further efforts to see whether the same findings also apply to social scientists. Whatever the result of such further inquiries, one thing is clear: science is too important a resource for us not to be aware of both the cognitive and emotional forces which support it from above and propel it from beneath the surface. As human beings, scientists deserve nothing less than the best understanding we can give them of themselves – the pressures acting from within them and from the larger society without.

NOTES

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1. W. Hagstrom, *The Scientific Community* (New York: Basic Books, 1965); J. Ravetz, *Scientific Knowledge and Its Social Problems* (Oxford: Clarendon Press, 1971).

2. *Ibid.*

3. L. Kubie, 'Some Unsolved Problems of the Scientist's Career', in M. Stein, A.J. Vidich and D.M. White (eds), *Identity and Anxiety* (New York: The Free Press, 1960), 241-68.

4. L.E. Tyler, 'Development of Scientist Patterns of Interest in Boys', *Genetic Psychological Monographs*, Vol. 70 (1964), 177-227; M. Mead and R. Métraux, 'Image of the Scientist among High School Students, A Pilot Study', *Science*, Vol. 126 (5 July 1957), 384-90; D.C. Beardslee and D.D. O'Dowd, 'The College-Student Image of the Scientist', *Science*, Vol. 133 (6 January 1961), 997-1001; A.W. Gendig and P.T. Hountras, 'College Student Stereotypes of the Personality Traits of Research Scientists', *Journal of Educational Psychology*, Vol. 49 (1958), 309-14.

5. I.K. Broverman, S.R. Vogel, D.M. Broverman, F.E. Clarkson and P.S. Rosen Krantz, 'Sex-Role Stereotypes: A Current Appraisal', *Journal of Social Issues*, Vol.28 (1972), 59-78.

6. L.E. Tyler, *op.cit.* note 4; M. Mead and R. Métraux, *op.cit.* note 4; A.W. Bendig and P.T. Hountras, *op. cit.* note 4.

7. M.L. Helfrich, *The Social Role of the Executive's Wife* (Columbus, Ohio: Ohio State University Press, 1965).

8. I.I. Mitroff, *The Subjective Side of Science: A Philosophical Inquiry into the Psychology of the Apollo Moon Scientists* (Amsterdam: Elsevier, 1974); I.I. Mitroff, 'Norms and Counter-norms in a Select Sample of the Apollo Moon Scientists', *American Sociological Review*, Vol. 39 (1974), 579-95.

9. It should be noted that the size of a sample necessary for testing important hypotheses is a matter of intense current controversy. While it is true that the larger the sample the smaller the variance of the sample mean, at the same time it is also the case that a larger sample can make it easier to reject the null hypothesis since a smaller deviation is required for rejection. On the other hand, if the smaller the sample size the larger the variance of the sample mean, the larger the deviation from the mean that is required to reject the null hypothesis; i.e. a large deviation will have to be present to reject the null hypothesis with a small sample. This is not to argue for small samples *per se*. Rather it is to say that statistically significant results (particularly highly significant results) produced by small samples are not to be rejected out of hand. For more discussion of these points, see D.E. Morrison and R.E. Henkel (eds), *The Significance Test Controversy* (Chicago: Aldine, 1970).

10. See Mitroff, *op. cit.* note 8.

11. This is reported in a paper dealing with a follow up study of the Apollo Scientists (see note 8): I.I. Mitroff, 'On the Psychology of the Apollo Scientists: A Chapter in the Psychology of Science', *Human Relations*, in press.

12. Mitroff, *ibid.*

13. Mitroff, *op. cit.* note 8.

14. R.K. Merton, 'Resistance to the Systematic Study of Multiple Discoveries in Science', *European Journal of Sociology*, Vol. 4 (1963), 237-82.

15. A. Roe, *The Making of a Scientist* (New York: Dodd, Mead, 1953); A. Roe, 'A Psychological Study of Eminent Physical Scientists', *Genetic Psychology Monographs*, Vol. 43 (1951), 121-35; A. Roe, 'The Psychology of the Scientist', *Science*, Vol. 134 (18 August 1961), 456-59.

16. D.C. McClelland, 'On the Dynamics of Creative Physical Scientists', in L. Hudson (ed.), *The Ecology of Human Intelligence* (Harmondsworth, Middx.: Penguin, 1970), 309-41.

17. Mitroff, *op. cit.* note 8.

18. G. Sjoberg and R. Nett, *A Methodology for Social Research* (New York: Harper and Row, 1968).

19. H. Zuckerman, 'Interviewing an Ultra-elite', *Public Opinion Quarterly*, Vol. 36 (1972), 159-75.

20. McClelland, *op.cit.* note 16.

21. The responses to these questions have not been previously reported in the references referred to in notes 8 and 11.

22. Mitroff, *op. cit.* note 8.

23. *Ibid.*

24. J. Snider and C. Osgood, *Semantic Differential Technique* (Chicago: Aldine, 1969).
25. M. Crago and R.G. Tharp, 'Psychopathology and Marital Role Disturbance: A Test of the Tharp-Otis Descriptive Hypothesis', *Journal of Consulting and Clinical Psychology*, Vol. 32 (1968), 338-41; E. Quick and T. Jacob, 'Marital Role Disturbance in Relation to Role and Relationship Theory', *Journal of Abnormal Psychology*, Vol. 82 (1973), 309-16.
26. Mitroff, *op. cit.* note 8.
27. See also Mitroff, *op. cit.* note 11.
28. See A. Roe, 'Women in Science', *Personnel and Guidance* (April 1966), 784-87, for an earlier study that reports the same feeling.
29. Snider and Osgood, *op. cit.* note 24.
30. See Broverman et al., *op. cit.* note 5.
31. *Ibid.*
32. Roe, *op. cit.* note 15.
33. McClelland, *op. cit.* note 16.
34. Tyler et al., *op. cit.* note 4.
35. Crago et al., *op. cit.* note 25.
36. *Ibid.*
37. J.P. Gump, 'Sex-Role Attitudes and Psychological Well-being', *Journal of Social Issues*, Vol. 28 (1972), 79-92.
38. *Ibid.*
39. A. Roe, *The Psychology of Occupations* (New York: Wiley, 1966); W.O. Weyrauch, *The Personality of Lawyers* (New Haven, Conn.: Yale University Press, 1964).
40. T.A. Cowan, 'Paradoxes of Science of Administration', *Science*, Vol. 177 (15 September 1972), 964-66.
41. Roe, 'The Psychology of the Scientist', *op. cit.* note 15.
42. See note 9.