

## Report on the Smith College Alumnae Survey

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The Smith College Alumnae survey was offered online to 1252 graduates of the college<sup>1</sup>. Representing graduation years 1974 to 2007, 786 alumnae (62.7% of invitees) responded (see Table 1).

The survey recruited demographic information such as academic major, graduation year, post-graduate education, current vocation, and ethnicity; asked whether respondents had participated in summer research at Smith; and asked what motivations influenced the lives of alumnae at graduation and five and ten years following graduation, as applicable.

The analysis of the data included two methodologies. One author (DL) performed a statistical analysis of the quantitative data, while the other (CT) performed a coding analysis of qualitative data, using samples of 125 former researchers and 125 former non-researchers. The coded responses were then entered into the data for triangulation with the quantitative data.

Table 1. Year of graduation for 786 respondents to the Smith Alumnae Survey.

### In what year did you graduate from Smith?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1974	17	2.2	2.2	2.2
	1975	15	1.9	2.0	4.2
	1976	17	2.2	2.2	6.4
	1977	11	1.4	1.4	7.8
	1978	24	3.1	3.1	10.9
	1979	20	2.5	2.6	13.5
	1980	19	2.4	2.5	16.0
	1981	18	2.3	2.3	18.4
	1982	9	1.1	1.2	19.5
	1983	19	2.4	2.5	22.0
	1984	19	2.4	2.5	24.5
	1985	16	2.0	2.1	26.6
	1986	19	2.4	2.5	29.0
	1987	8	1.0	1.0	30.1
	1988	13	1.7	1.7	31.8
	1989	12	1.5	1.6	33.3
	1990	14	1.8	1.8	35.2
1991	17	2.2	2.2	37.4	
1992	13	1.7	1.7	39.1	

<sup>1</sup> The survey opened in April 2008 and closed in June.

1993	19	2.4	2.5	41.5
1994	29	3.7	3.8	45.3
1995	31	3.9	4.0	49.3
1996	18	2.3	2.3	51.7
1997	33	4.2	4.3	56.0
1998	31	3.9	4.0	60.0
1999	33	4.2	4.3	64.3
2000	32	4.1	4.2	68.5
2001	33	4.2	4.3	72.8
2002	39	5.0	5.1	77.9
2003	41	5.2	5.3	83.2
2004	31	3.9	4.0	87.2
2005	37	4.7	4.8	92.1
2006	35	4.5	4.6	96.6
2007	26	3.3	3.4	100.0
Total	768	97.7	100.0	
Missing	18	2.3		
Total	786	100.0		

### Features of the respondents

The majority of the survey sample was identified as White/Caucasian (57%). About 7.1% was identified as Asian, 2.9% as African, and 1.9% as Hispanic. A large group (29.5%) was racially unidentified. Four hundred and thirteen respondents were identified as having experienced summer research at Smith, while 354 were identified as having not experienced summer research at Smith. These numbers do not precisely match the respondents' recollections (416 recalling an experience, 349 recalling no experience, and 2 not remembering). However, the differences between the records of summer research and the recollection of summer research make no appreciable difference in other findings, i.e., the data represented in this report are the same whether the analyst uses the grouping of summer researchers based on institutional records or based on respondent recollection. The distribution of majors is shown in Table 2, where the total count of majors is 850. (Respondents who double majored were counted once in each of their respective majors.) The most frequently represented majors are the Biological Sciences (26.9%<sup>2</sup>), Psychology (18.3%), Mathematics (8.5%), Chemistry (8.5%), and Geology (7.9%).

Table 2. Distribution of majors for the survey respondents, including possible double majors.

<b>Major</b>	<b>Count</b>	<b>Major</b>	<b>Count</b>
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<sup>2</sup> Based on the number of majors reported, i.e., 850.

Afro-American Studies	2	Government	5
American Studies	1	Greek	0
Anthropology	0	History	1
Architecture	0	Italian Lang and Lit	0
Art History	0	Italian Studies	0
Studio Art	4	Jewish Studies	1
Astronomy	9	Latin	0
		Latin Am and Lat	
Biochemistry	64	Studies	1
Biological Sciences	229	Mathematics	72
Chemistry	72	Medieval Studies	0
Classical Studies	0	Music	3
Classics	1	Neuroscience	30
Comparative Literature	0	Philosophy	5
Computer Science	39	Port-Brazilian Studies	0
Dance	2	Physics	36
East Asian Lang and		Psychology	156
Culture	0	Religion	1
East Asian Studies	0	Russian Civ	0
Economics	9	Russian Lit	0
Ed and Child Study	3	Sociology	0
Engineering	18	Spanish	3
Eng Lang and Lit	4	Theatre	3
Film Studies	1	Women and Gen	
		Studies	2
French Studies	4	Other	2
Geology	67		
German Studies	0	<b>Total</b>	<b>850</b>

### Current vocation

In addition, respondents were asked to indicate if any one or more of 12 fields of work were involved in their current vocation (see Table 3). As respondents were asked to mark *all* the fields that applied, the number of responses (1646) exceeds the number of respondents (thus a science teacher might mark both science and teaching/education). When these 12 fields are categorized by summer researchers *vs.* the comparison group (see Figure 1), five significant differences emerge. Former summer researchers report greater involvement with research, science, and environmental study/preservation. The comparison group reports greater involvement with business and social service<sup>3</sup>.

Table 3. The frequency of responses to the question, “Does your current vocation involve any fields of work listed below?” Multiple answers are permitted.

<sup>3</sup> Based on Chi Square statistics at the  $\alpha = .05$  level of significance.

Category	Count
Teaching/education	306
Business	128
Research	242
Law	47
Science	320
Religion	11
Healthcare/medicine	233
Caring for family	92
Public service/government	104
Fine arts	26
Environmental study/preservation	75
Social service	62
<b>Total Responses</b>	<b>1646</b>

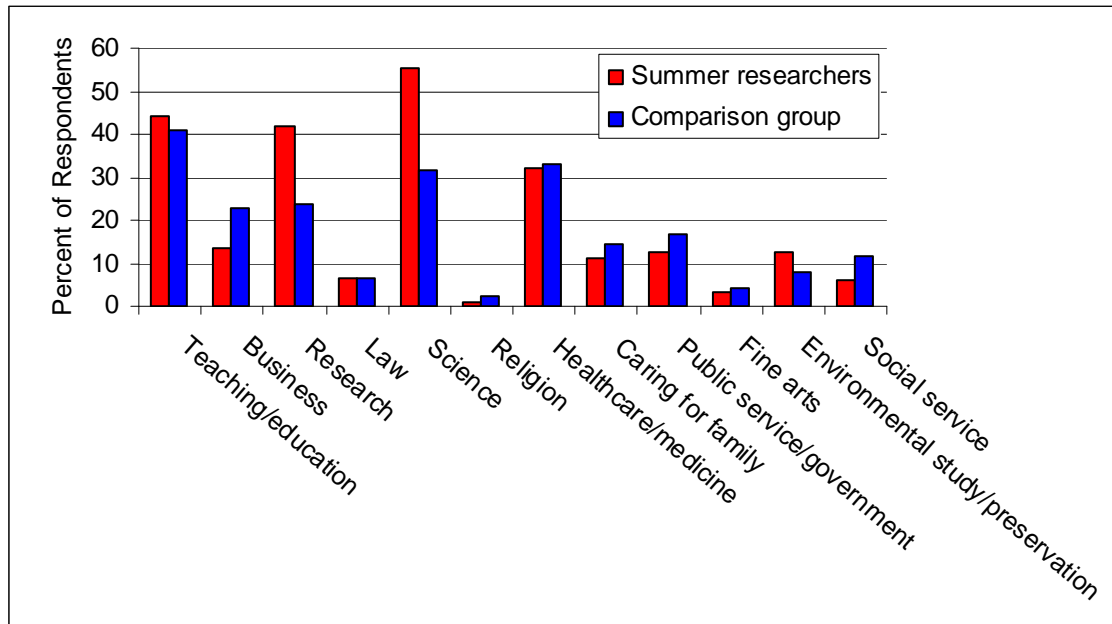


Figure 1. Percent of the respondents in two groups (former summer researchers vs. a comparison group) that indicated the field of work on the X axis was involved in their vocation. The sum is more than 100% because of multiple responses.

Activity at graduation, five years out, and ten years out

Respondents were asked up to three times, depending on the time since graduation, to describe their activity in that period of their lives. Samples of respondents were drawn for an analysis of their qualitatively reported current activity. These activities were coded into 7 groups including graduate/professional schools (all fields), science jobs, other technical jobs (including computer programming and quantitative

analysis), teaching science, seeking what to do (including looking for a job, applying to school, or planning what to do next in one's life), and taking time for family or just time off. The percentages of each group – former summer researchers and the comparison students – who engaged in these activities for each time sample are given in Figures 2, 3 and 4. At graduation and after 5 years, former researchers tend toward graduate education more than comparison students do. At 10 years, the pattern moves to science jobs, a natural progression after graduate school.

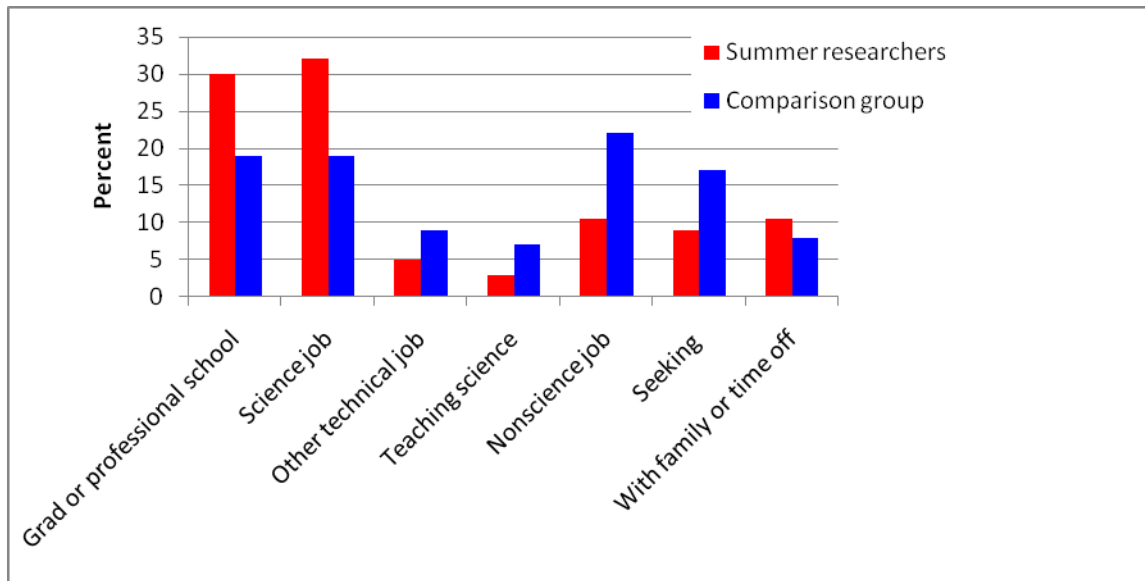


Figure 2. Percent of the samples of researcher and comparison groups identifying their activity at the time of graduation.

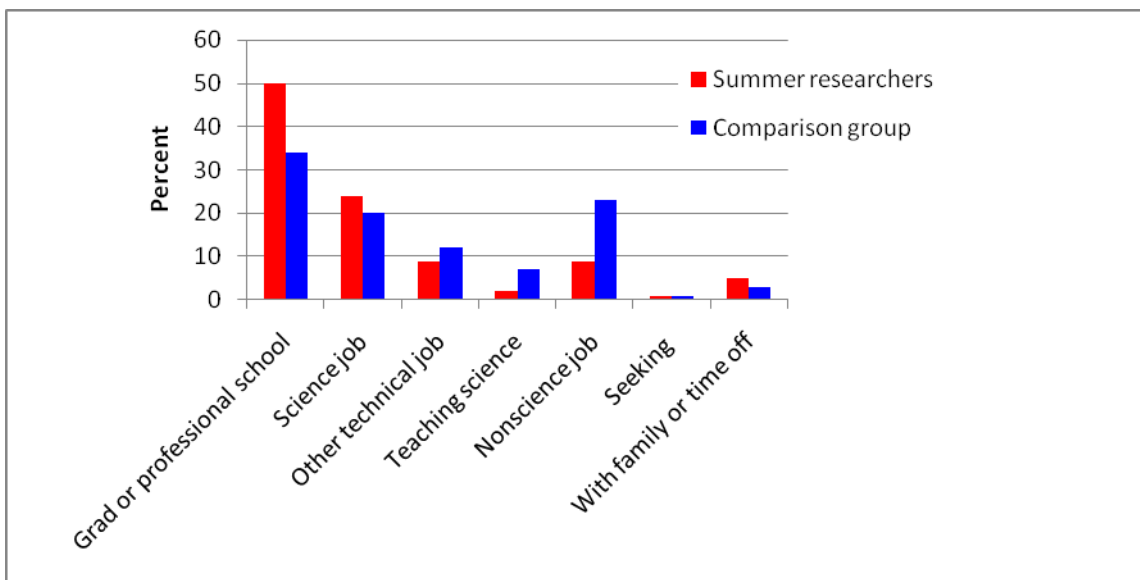


Figure 3. The percentage of the samples of researcher and comparison groups identifying their activity 5 years after graduation.

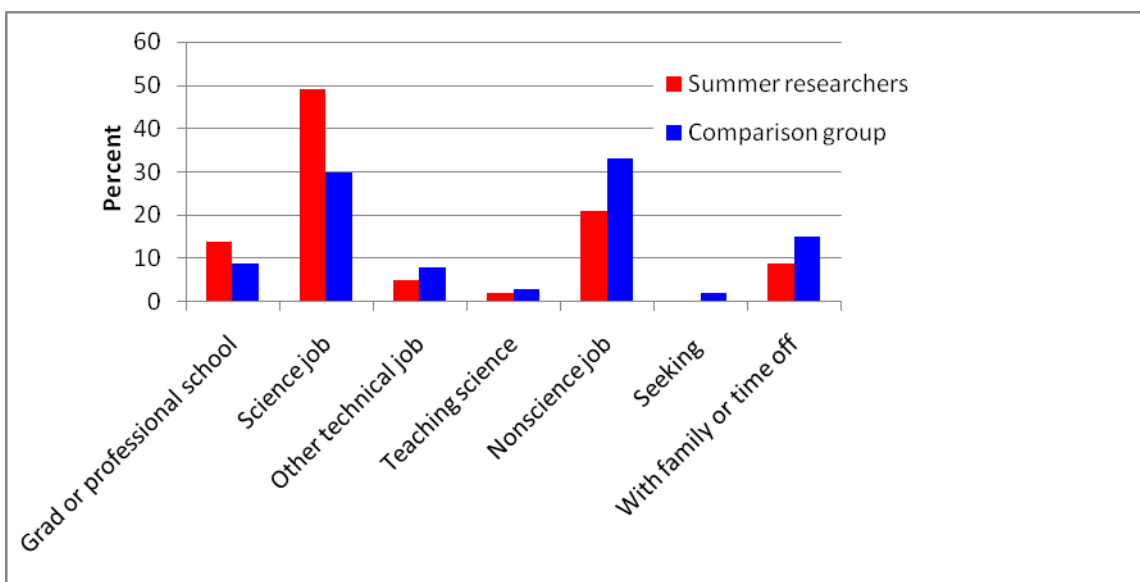


Figure 4. The percentage of the samples of researcher and comparison groups identifying their activity 10 years after graduation.

Advanced degrees

Respondents were invited to report any advanced degrees they earned after Smith. Five boxes were offered for responses. The degrees are difficult to tabulate because the responses were text typed by the respondents. Non-specific responses (“masters”) or unusual abbreviations prevent precise counting of the kinds of advanced degrees. The

numbers expressed as percentages of the researchers and non-researchers are shown in Figure 5. Former summer researchers are more likely to earn a Master’s degree, a medical degree, or a Ph.D, while non-researchers are more likely to earn MBAs or not to earn an advanced degree. Another way to view the data regarding advanced degrees is to look at a category of degree, for example, Ph.D., and note the distribution of the degrees across former summer researchers and the comparison group. This approach yields the results in Table 4.

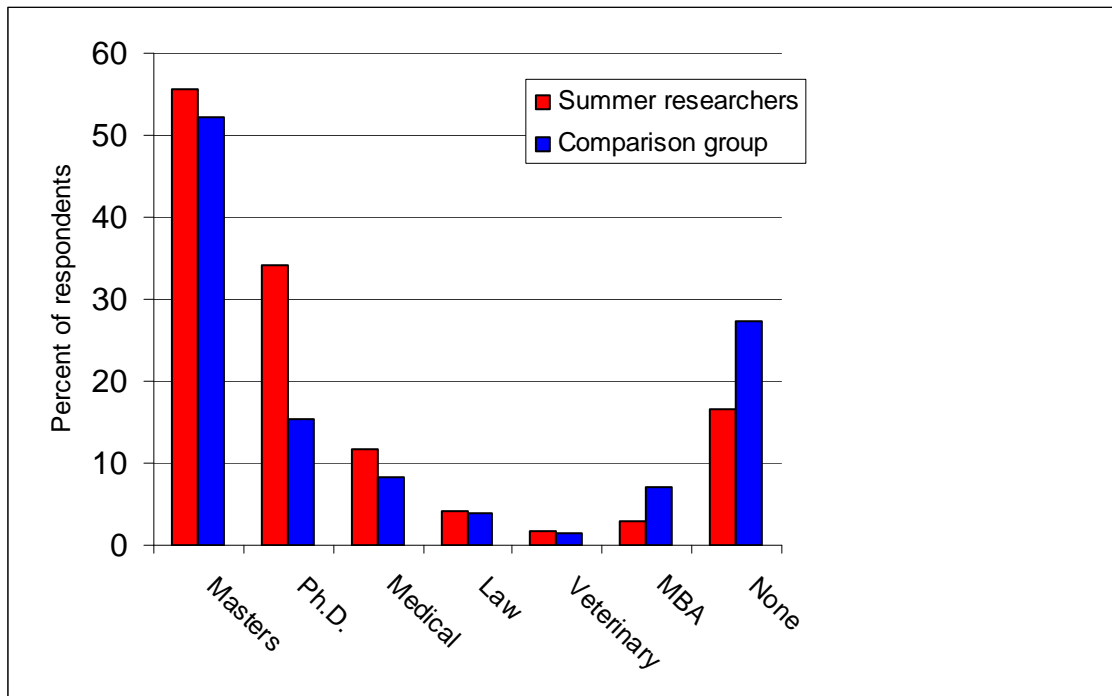


Figure 5. Percent of respondents in two groups that reported advanced degrees.

Table 4. The distribution of advanced degrees across two groups of respondents, former summer researchers and a comparison group.

Advanced Degree	Former summer researchers	Comparison group
PhD (any field)	72%	28%
MD/PhD	89%	11%
MD	62%	38%
Science masters	61%	39%
JD	54%	46%
DVM	(n=4)	(n=8)
Other medical doctorate	(n=11)	(n=8)
EdD	(n=2)	(n=1)
Medical masters	(n=7)	(n=11)

MBA	34%	66%
Other masters	42%	58%
Other degrees	33%	67%
No higher degree	39%	61%

### Motives and intentions

Respondents were asked to evaluate 7 “motives and intentions that influence choices.” The list of 7 motives appeared three times, as the respondent was asked to retrospect for the time of graduation, 5 years after graduation, and 10 years after graduation. The range of responses was “not important”, “small importance”, “important”, and “very important”. On this and the Y axes for Figures 4 through 9, 1 = not important, 2 = small importance, 3 = important, and 4 = very important. Summer researchers evaluated one motive as more important than the comparison group did: at the time of graduation, the importance of continuing their education was rated significantly higher for summer researchers ( $M = 3.38$ ) than for the comparison group ( $M = 3.08$ ). However, the comparison group rated other motives as much higher at the time of graduation than did the summer researchers: The importance of getting work or financial independence ( $M = 3.47$  vs. ( $M = 3.25$ ), and travel ( $M = 2.26$  vs.  $M = 2.09$ ). Evaluation of the 7 motives show changes over time (except for travel). A closer inspection of how motives change from graduation through 5 years out to 10 years out is provided by data from the older alumnae who evaluated motives at all three times. Figures 6 through 12 show the differences between the motives evaluated by former summer researchers and by comparison group members at graduation, at 5 years, and at 10 years. These data are from 177 former summer researchers and 212 comparison group respondents. The results show that two motives, continuing education and being with or starting a family, clearly change over time in an intuitively agreeable way, with a concern about continuing education declining and a concern about family increasing. Although less visually dramatic, the motives of public service, getting work, managing health, and pursuing spiritual values also change significantly over time<sup>4</sup>.

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<sup>4</sup> The analysis of was mixed design ANOVA with 3 levels of time and 2 levels of respondent (summer researcher vs. comparison). The main effects of time are significant at the  $\alpha = .05$  level.

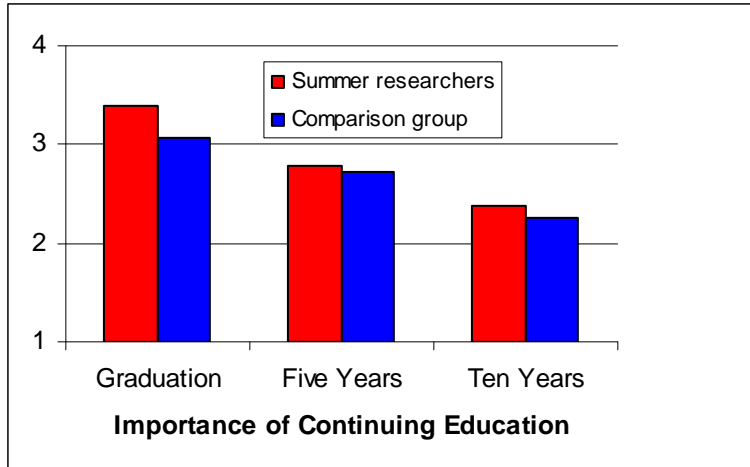


Figure 6. Ratings of importance of continuing education over 3 times since graduation.

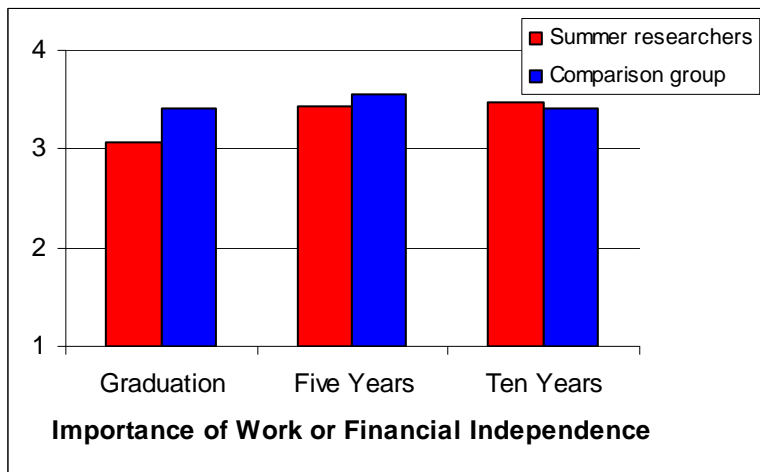


Figure 7. Ratings of importance of getting work or financial independence.

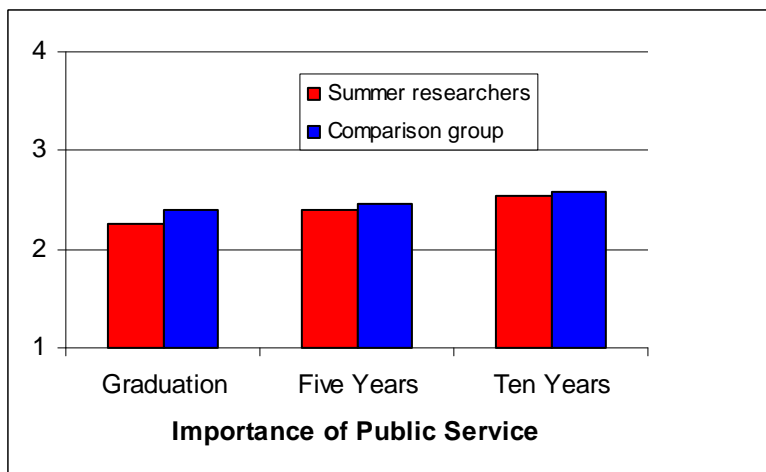


Figure 8. Ratings of importance of performing public service.

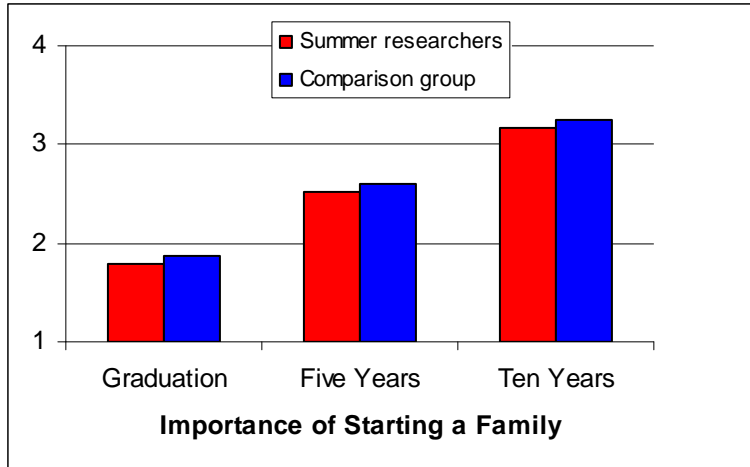


Figure 9. Ratings of importance of being with or starting a family.

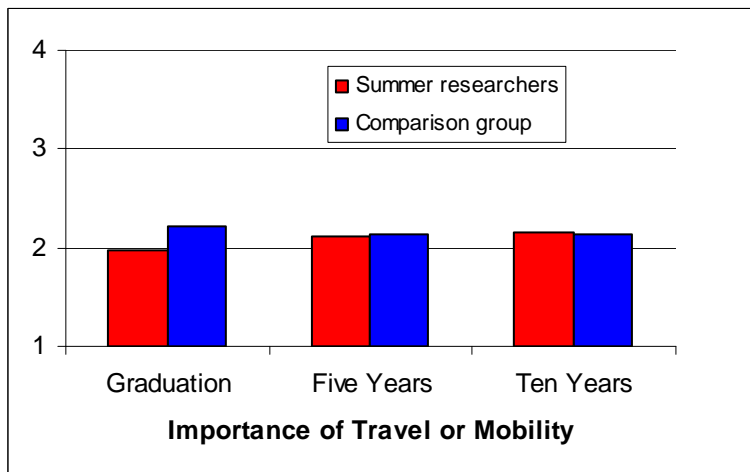


Figure 10. Ratings of importance of travel or mobility.

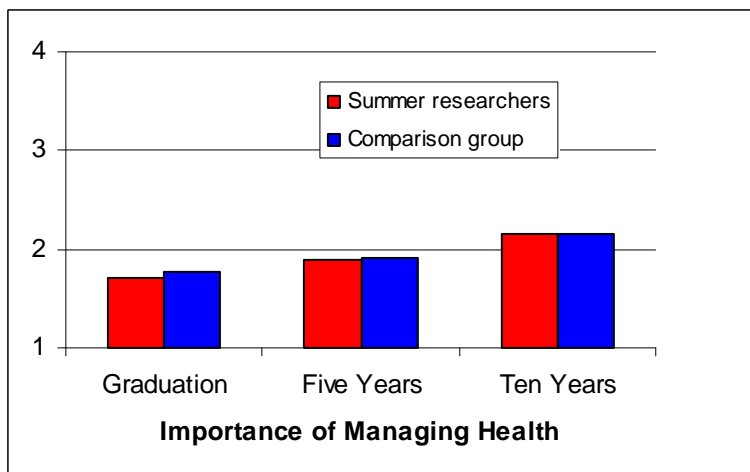


Figure 11. Ratings of importance of managing health.

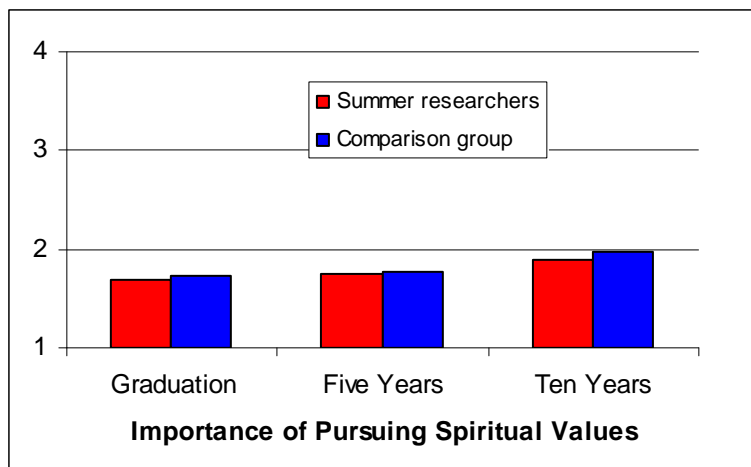


Figure 12. Ratings of importance of pursuing spiritual values.

A view of the interaction of motives and activities at each of the three time samples is provided by the sampling of 125 former summer researchers and 125 comparison respondents at graduation and 5 years out, and the sampling of 100 from each group at 10 years out. Tables 5, 6, and 7 provide the details for respondents who either reported that the motive was very important or that the motive was of no or small importance (the middle 'important' response is excluded).

Table 5. Details of the motives and activities for two samples of respondents (N = 125 for each) immediately after graduation.

Rating of motive/motive	Very Important	No or Small Importance
<u>Former summer researchers</u>		
Continue my education	67 said very important; 49% of those are in graduate school	21 said no or small importance; 38% are working science jobs, 0% are in graduate school
Get work or financial independence	(n=50) 42% are working in science jobs, 12% are in graduate school	(n=22) 55% are in graduate school
Perform public service, work for social change	(n=18) 44% are working in science jobs	(n=67) 37% are in graduate school, 28% are working in science jobs
Be with or start a family	(n=15) 33% are working in science jobs	(n=92) 33% are in graduate school, 33% are working in science jobs
Travel or mobility	(n=9) 44% are in graduate school, 33% have science jobs	(n=80) 34% have science jobs, 31% are in graduate school
Manage my health	(n=15) 47% have science jobs	(n=92) 34% have science jobs, 30% are in graduate

		school
Pursue spiritual values	(n=9) 44% are in graduate school, 44% have science jobs	(n=103) 32% are in graduate school, 31% have science jobs
<u>Comparison group</u>		
Continue my education	(n=60) 37% in graduate school	(n=35) 34% in non-science jobs
Get work or financial independence	(n=77) 25% in non-science jobs, 22% in science jobs	(n=15) 40% in graduate school
Perform public service, work for social change	(n=20) no pattern	(n=62) no pattern
Be with or start a family	(n=17) 29% in non-science jobs, 24% with family	(n=86) no pattern
Travel or mobility	(n=13) 30% either seeking work or figuring out what to do next	(n=70) 24% in graduate school, 21% in non-science jobs
Manage my health	(n=11) 36% in non-science jobs, 27% seeking	(n=88) 23% in non-science jobs, 22% in science jobs
Pursue spiritual values	(n=11) no pattern	(n=97) no pattern

Table 6. Details of the motives and activities for two samples of respondents (N = 125 for each) five years after graduation.

<b>Rating of motive/motive</b>	<b>Very Important</b>	<b>No or Small Importance</b>
<u>Former summer researchers</u>		
Continue my education	(n=54) 76% are in graduate school	(n=36) 42% have science jobs, 17% are in graduate school
Get work or financial independence	(n=72) 42% are in graduate school, 28% have science jobs	(n=14) 57% are in graduate school
Perform public service, work for social change	(n=16) 50% are in graduate school	(n=59) 51% are in graduate school
Be with or start a family	(n=35) 40% are in graduate school, 31% have science jobs	(n=64) 56% are in graduate school
Travel or mobility	(n=11) 36% have science jobs, 36% have non-science jobs	(n=80) 57% are in graduate school
Manage my health	(n=16) 56% are in graduate school	(n=86) 55% are in graduate school
Pursue spiritual values	(n=6) no pattern	(n=108) 54% are in graduate school
<u>Comparison group</u>		

Continue my education	(n=48) 56% in graduate school	(n=51) 35% in non-science jobs, 24% in science jobs
Get work or financial independence	(n=81) 30% in non-science jobs, 27% in graduate school	(n=6) 67% in graduate school
Perform public service, work for social change	(n=23) 39% in graduate school, 30% in non-science jobs	(n=58) 31% in graduate school
Be with or start a family	(n=42) 38% in graduate school, 31% in non-science jobs	(n=42) 33% in graduate school, 29% in non-science jobs
Travel or mobility	(n=14) 43% in non-science jobs	(n=65) 32% in graduate school
Manage my health	(n=16) 50% in graduate school	(n=82) 33% in graduate school
Pursue spiritual values	(n=11) 46% in graduate school	(n=94) 32% in graduate school

Table 7. Details of the motives and activities for two samples of respondents (N = 100 for each) ten years after graduation.

<b>Rating of motive/motive</b>	<b>Very Important</b>	<b>No or Small Importance</b>
<u>Former summer researchers</u>		
Continue my education	(n=20) 45% in graduate school, 45% have science jobs	(n=59) 56% have science jobs
Get work or financial independence	(n=59) 54% have science jobs, 29% have non-science jobs	(n=11) 64% are doing family things
Perform public service, work for social change	(n=17) 53% have science jobs, 29% have non-science jobs	(n=17) 47% have science jobs
Be with or start a family	(n=56) 41% have science jobs, 25% have non-science jobs	(n=27) 63% have science jobs
Travel or mobility	(n=14) 50% have non-science jobs	(n=61) 54% have science jobs
Manage my health	(n=10) no pattern	(n=60) 57% have science jobs
Pursue spiritual values	(n=10) 50% have non-science jobs	(n=72) 56% have science jobs
<u>Comparison group</u>		
Continue my education	(n=20) 35% in graduate	(n=64) 42% in non-science

	school, 25% in science jobs	jobs
Get work or financial independence	(n=66) 39% in non-science jobs, 33% in science jobs	(n=8) 100% with family
Perform public service, work for social change	(n=20) 45% in science jobs	(n=46) 43% in non-science jobs
Be with or start a family	(n=54) 35% in science jobs, 28% in non-science jobs, 24% with family	(n=16) 44% in non-science jobs
Travel or mobility	(n=14) 71% in non-science jobs	(n=54) 30% in science jobs, 26% in non-science jobs, 24% with family
Manage my health	(n=15) no pattern	(n=57) 37% in non-science jobs, 33% in science jobs
Pursue spiritual values	(n=19) 42% with family	(n=65) 37% in non-science jobs, 29% in science jobs

Respondents were also asked how their science education at Smith influenced their decisions at the time of graduation, five years out, and ten years out. The quotations below were selected at random from a pool of all respondents, both those who did summer research and those who did not, excluding only those saying that their science education had *no influence* on their decisions at those particular times. Though more of the research students entered into scientific careers, so did many non-research students. The influence of the science education on decisions seems more closely linked to the career of the respondent than to whether or not she did summer research. Members of all groups—those who did summer research and those who did not, those who majored in science and those who did not—saw benefits in summer research, even if they had not entered into a scientific career.

*How did your science education influence or motivate your decisions at the time of your graduation? Were there other things going on in your life at that time (activities, interests, how you approached certain major issues) that were influenced by your study of science in college?*

Did research:

- It was the foundation of my future path as a physician, so I guess that's pretty darn influential.
- It taught me how to think clearly and logically, and how to learn in general. My time in the math department at Smith in particular also helped me to feel like part of a community. I had a lot more confidence about life in general. Specifically, I didn't apply what I learned for my degree to anything I was doing though.
- I learned a great deal at Smith, not only about the concepts and content of my major, but about what I can do as a major in that field. The department was incredibly supportive in any decision that I made, but because of the inspiration I obtained from the fantastic professors I had in my department, I knew I wanted to

- devote my life to chemistry and to teaching, so my decision to continue my education when I graduated was a direct product of my education at Smith. I became an athlete my sophomore year at Smith, but because I was studying an intense science and wanted to finish my major by the end of my junior year so I could devote my time as a senior to research, I wasn't able to continue to pursue that interest, despite the fact that it was important to me. The degree of time that's necessary to sacrifice in order to be successful in science did wear and tear on my social life and how much time I was able to spend with my friends and family, and how much time I was able to focus on my personal physical and mental health. Some people are better equipped to deal with these strains than others; I was not very well-equipped, but I have learned a great deal from having to overcome the challenges I have and would not have chosen to do otherwise.
- I wanted to pursue graduate studies in medicinal chemistry but I attended an informational meeting by an economic consulting firm. The compensation and promise of job satisfaction swayed my decision and I pursued a job as an analyst in the consulting firm in New York, delaying my plans to go to graduate school. I had college loans which I had to repay and the promise of a lucrative job after graduation swayed me to take the job as an economic analyst. It was for financial reasons I took a job with the consulting firm at double the salary of what you would earn upon graduation as a chemistry researcher.
  - In a sense it didn't. I had decided before starting college that I wanted to pursue a medical degree. However, the very interesting and challenging courses that I took certainly reinforced my decision to go into a science field.

No research:

- Science work was the work I'd been studying to do – it only seemed natural that I pursue it initially. The scientific approach to life is always with me, so everything I do is influenced by it, to some extent.
- It didn't. I had no plan. I had no plan to use my science education because I studied it for fun. I always thought I wanted to be a doctor. . . so I focused on Biology. I didn't end up there but still wanted the information so I kept studying it.
- My computer science education completely drove my decision to pursue a career involving computers. Pursuing a career in the computer field meant working in a male-dominated industry. The result of this was increased self-confidence.
- My biology degree gave me tangible work skills that I could use to support myself while I continued my education. My Smith education also let me function more like a graduate student than a technician at my first job, writing and publishing and presenting the research from my lab. My experience in science at Smith had also taught me that I actually did NOT want to do basic science research (which I had believed when I started at Smith) but that I did want to use science as a means of helping people – thus the decision to change to pre-med just before I graduated. It also gave me the knowledge needed to succeed when I started medical school. The summer after my graduation, I won a small grant to go back to Paris to work in a lab at the French NIH, where I had worked/studied during my junior year

abroad. It was a great use of my degree to both see the world and to see science from an international perspective.

- It did not; my family influenced my decisions after graduation.

*Five years out, did this pursuit use or benefit from your having studied science at Smith? Please explain. Were there other things going on in your life at that time (activities, interests, how you approached certain major issues) that were influenced by your study of science in college?*

Did research:

- My science education was just an addition to what I already knew. I definitely look at the world (and appreciate it) through a geology lens. I learned that that lens is quite unique.
- After completing my MS degree, I decided that I was tired of working in the sciences and wanted to do something completely different. I decided to move to SF, CA and work for the Hunger Project.
- This was a very difficult period for me. I was at a wonderful PhD program at Yale – with the path of many, many career options ahead. . . but I had been living apart from my husband for years and wanted to be with him and have children. My science education argued for BOTH cases. . . I knew the biological downsides to waiting to have kids, but I also had an appreciation for the stats: if I left, I'd probably never finish my degree.
- My science education motivated me to teach a geology course at the private school where I was working. The other things going on in my life were not influenced by my study of science in college (learning Spanish and playing guitar & drums at the local church service).
- Started to go into an analytical role. I found I like to answer questions – why something works the way it does or why something behaves the way it does. I started applying this to the computer program that I was working with and feeding information directly to the product development group.

No research:

- I chose to return to school to pursue advanced training in veterinary pathology. I'm still pretty narrow-minded about studying veterinary pathology and veterinary medicine.
- I felt strongly that I wanted to make a difference in the community, and help people in a one-on-one basis. My interest in psychology made me very curious to find out what was going on with women at an important crossroad in their lives - unexpected pregnancy.
- Part of my impetus in moving to San Francisco was to be closer to UC Davis, where I hoped to pursue higher education in a botany masters.
- Really enjoyed introducing students to science as a teacher. Other things were love of natural world, gardening.
- I was already into my residency so nothing was different. I still maintain my interest in many subjects outside of medicine: music, literature.

*Ten years out, did this pursuit use or benefit from your having studied science at Smith? Please explain. Were there other things going on in your life at that time (activities, interests, how you approached certain major issues) that were influenced by your study of science in college?*

Did research:

- Science had become my life. I began to face diminishing interests in other aspects of my life. In 1984, I was separated from my husband. In 1981, upon receiving my PhD, I had also received an NSF fellowship to conduct postdoctoral research at the Scripps Institution of Oceanography in La Jolla, CA. That same year, my husband had been promoted to an elevated position in MD State government. We decided to pursue these new opportunities, even though on opposite coasts, but the end result for our relationship was a separation.
- It even helped me with my radiology physics board exam.
- Probably biggest would be influencing my teaching practice. I had excellent science professors and engaging classes at Smith - I try to make my own teaching as rigorous and engaging as what I experienced.
- At this point I think I had come to the realization that I most likely would not get a job related to my field of Study at Smith without getting an advanced degree, but I wasn't sure what I would want to study, and didn't want to start a program and get into debt without being 100% sure. A continued interest in environmental issues and recycling. We also developed the hobby of open-water diving which I think was enhanced by my studies at Smith.
- My education prepared me well for my career, but now my priorities are different. Family is very important, and it is sometimes difficult to manage both family and career. I have relaxed my ambition some to create less stress at work and more time and energy for family. My education allowed me to "climb the ladder" fairly quickly, so I am happy to sit on this "rung" for some time while my children are young.

No research:

- I think Smith could have done a better job at exposing science students to public health, especially for all the pre-med students who think they want to go into medicine because they don't know of any other health careers. Spirituality and faith have become much more important. Family members' deaths influenced this. I value urban neighborhoods, lifestyles, and culture.
- I studied science (biology, marine biology) as part of the volunteer training program, and I actually went beyond the basic requirements, to position myself as a trainer. I interpreted exhibits to the public in the aquarium and on the whale watch, and also taught educators (staff and volunteers). Again, probably my sense that I was capable of doing science and could grasp just about any concept, in a variety of fields. I began writing my first murder mystery at the time, which focused on a fictitious aquarium and a researcher who worked there.

- I pushed hard for a top finance position in my organization, emphasizing my math and MBA background. Little did I know at the time that I was sought after for the higher E.D. role and thus was turned down to even interview for the Finance Dir. position. My science background combined with my women's college education made me more assertive when dealing with the NHS throughout my first pregnancy. I was able to handle personal/family financial matters in multiple currencies with relative ease. This does intimidate many expatriates and their spouses.
- The main science I was looking at by the end of 1988 was keeping my two children healthy and happy. I had a seismic shift in priorities and ended up taking a year off from work as a leave of absence with my second child. Let's just say the biology was winning over the geology. I was becoming more interested in local zoning issues surrounding wetlands and clean water sources. I ended up on the Wetlands Protection committee shortly after my leave of absence began. Science education again directly helped me learn the specifics and analyze information thoroughly as part of our decision processes.
- I was now assuming leadership in my professional organization. I believe these skills were nurtured in my science education and Smith's experience in general.

#### Use of science education in current vocation

Respondents were asked to describe how they used their science education in their current vocation. Those pursuing science or medical degrees or working in science-related jobs reported that they were using their earlier science training. Those not working in the sciences sometimes said they were not using their science education, or gave examples of other types of use, listed below:

- “To evaluate news and reports in the general sector”
- “When I get frustrated with the egos and pettiness I sometimes encounter in science, I remember the way the science faculty at Smith conducted themselves with genuine curiosity about their fields and sincere concern for undergraduate education.”
- “I’m a more critical consumer of news from any media: questioning research results on several levels, putting findings into the proper perspective.”
- “I use my psychology background to better understand my children.”
- “As an art director for a science publication, I use the research methods and problem solving tools I learned in my science courses at Smith to help figure out how to communicate topics in science that are less familiar to me.”
- “It has helped me to research genealogy.”
- “I review grant proposals, and translate scientific information in the proposals so that our non-scientist board members will understand the importance of the project and its objectives.”
- “None. It’s depressing and that is why it’s taken me so long to answer this survey.”
- “Learning scientific writing taught me how to write clear concise legal pleadings and briefs.”

- “Assisting my kids with their homework.”
- “Writing, editing, and indexing textbooks and science-based articles.”
- “I turned out not to be a scientist. However, the lab techniques I learned have made me an excellent documenter of process, helpful in the business world.”
- “I still think like a scientist, even working in the social sciences.”

### Adding to the value of the Smith education

The final question in the survey invited a qualitative response to the question, “In what way did the research experience add to the value of your Smith education?” Of course, non-researchers did not respond to this question. The former summer researchers offered 381 responses to the question. Analysis of these responses yielded 16 types of identifiable benefits, as shown in Table 8. The following extended list of quotations illustrates the nature of these perceived benefits.

Table 8. Sixteen categories of benefits identified from the 381 responses to the question, “In what way did the research experience add to the value of your Smith education?”

<b>Benefit category</b>	<b>Frequency</b>	<b>Percent</b>
Learn about research	103	27%
Gain credentials for one’s resume	89	23%
Chance to apply one’s classroom knowledge	85	22%
Help to decide about future plans	81	21%
Gain skills	63	17%
Work closely with a mentor	57	15%
Gain confidence in one’s abilities	53	14%
Do an honors thesis	48	13%
Learn more about a subject	29	8%
Gain sense of belonging to one’s academic department	28	7%
Publish an article or give a scholarly presentation	24	6%
Chance to focus in depth on a single topic	17	4%
Learn what it’s like to be a scientist	14	4%
Have enriching experiences (other than the research)	10	3%
No benefits	10	3%
Have a better summer job than would have otherwise	8	2%

### Learn about research

- The most valuable aspect of summer research was learning to work in the lab fairly independently. Although it did not give me much of a picture of what it was like to work in a larger academic lab, and what the expectations of a career in research were, it did give me a sense of which skills were needed for doing research full time.
- Through this experience, I learned the importance of actively engaging those other researchers to learn about what they were doing - even those who studied topics very different from my own interests. Since I worked as a team (at times) with these other researchers – I started to see the connections between their work and my own – it has been an important insight as I have pursued my career as a researcher in interdisciplinary sciences. This is an important skill – when working across disciplines – because it is critical to interest your colleagues in the larger project – and learning how to bring the relevance of the project back to their own interests is key to widespread buy-in – especially on complex projects.
- It taught me how difficult it is to conceive a research idea, conduct the study, and then analyze and interpret the data. Especially in a limited amount of time.
- It gave me valuable experience in the field and in a lab setting and taught me how science works, as well as how to work independently and to deal with disappointing results.

### Gain credentials

- It made it much easier to find a job in research when I graduated; companies told me they valued seeing that I had spent a real amount of time in the lab.
- It really didn't. I did [two research projects on other campuses]. It was one of those things you needed to get into med school. It looked good on the applications.
- This experience gave me that necessary "first research job" experience so that I could work other research jobs after that. Additionally, it's a project that I still have on my resume and I'm asked about at interviews.

### Apply classroom knowledge

- Practical application of what you have learned to real-life laboratory situations.
- Research was an outstanding aspect of my education - it opened my eyes to the importance of applying what was learned throughout my education.
- I had an opportunity to apply what I had learned in class to a practical problem.

### Decide future plans

- It gave me the chance to determine if I would like to have a career in science and certainly helped me get into the grad school of my choice.
- The research experience had a tremendous positive effect on my Smith education and led me to decide to concentrate on research rather than being premed.
- I participated in a fellowship, which was my first experience doing research in the 'real world' outside of class experiments/projects and which led me to undertake

- an honors thesis during my senior year. I think it made an enormous impact on my future desire to pursue research.
- If I had not actively participated in research as an undergraduate, I probably would not have gone on to graduate school in social psychology. I was originally a philosophy major who was interested in philosophy of mind and language. Because I wanted to get a better sense of the physiological and psychological aspects of the brain and language production, I started taking courses in psychology and ended up with a double major. It wasn't until I actually started doing research in psychology that I began to consider pursuing psychology in terms of a career.

#### Gain skills

- Working for the summer with a professional scientist and seeing how they approached /solved problems was extremely valuable. We also did weekly stand up meetings where we would rotate presenting an article that we read in a science magazine and that was also helpful. Again, don't remember what I presented, but learned how to read an article with an eye for how I would synthesize the information and explain it to someone else. All valuable experiences.
- Summer and term-time research were invaluable experiences – I had the opportunity to "do" science: to develop advanced laboratory skills; to hone my analytical ability; to work independently; to read and understand scientific literature; and, to communicate my ideas, both orally and in writing, to a scientific audience. All of these skills formed a solid foundation upon which I built a successful graduate school experience and career.
- I learned a lot of methods that I later used in the lab as a basic science researcher.

#### Work with a mentor

- I developed a closer relationship with a faculty advisor which made me feel more connected to Smith and helped me in the future when I was applying for graduate school.
- Being part of a research team for three summers while attending Smith was a very positive experience. In fact, I would say that it was one of the most memorable aspects of my academic time at Smith. It allowed me to develop a relationship with professors in my department on such a deep level. Many of these relationships I still maintain today, having graduated 6 years ago.
- My research experience at Smith gave me an opportunity to work closely with my professor and to thus build a relationship with him that has been professionally and personally rewarding. His 40-something years of experience in the field was an invaluable resource. His enthusiasm was highly contagious, and I value the two summers I spent working with him as two of the best in my life. I continue to benefit from his knowledge, enthusiasm, and contacts. We have remained in contact since my graduation and have traveled to conferences together.
- It was the most important thing I did while at Smith. I went back to school with greater maturity and had a completely different perspective on my classes. My advisor became a real role model for me, and I ended up attending the same

graduate school she had attended. This experience was so life-transforming that I started a summer undergraduate research program in my own department.

#### Gain confidence

- It certainly boosted my sense of competence a great deal. Also gave me experience in designing and running a study from start to finish.
- My research experience, and the resulting honors thesis, challenged me and changed my perception of what I could accomplish academically. My advisor saw more potential in me that I realized in myself and the summer experience gave me experience on a number of levels.
- I learned how to handle myself as a woman in science. I went to my first scientific meetings and met with grant collaborators. This gave me a great feeling of belonging to a lab of like-minded women and practical purpose and application to my studies. I now see the professor treated us as her graduate students, and her engagement with me gave me great experience and confidence in handling myself in a research environment. Her openness about the realities of being a woman in field-based research have helped me deal with the bumps in the road that I've faced in my research career.

#### Honors thesis

- It added tremendously. I was at Smith the summer between my junior and senior year as well as the summer after my senior year. I was able to begin my thesis project the first summer and do some additional experiments my second summer. Both summers were very useful in preparing me for graduate school both in and out of the lab.
- The research I did over two summers led to me writing a senior honors thesis and provided necessary experience for my career.
- The research I started that summer eventually became the work I did for my senior thesis. It laid the ground work for that as well as allowed me to be a co-author on a published paper in a scientific journal.

#### Learn a subject

- It was an amazing learning experience. Through this experience I learned which aspects of Psychology most interested me and that shaped the duration of my Smith education - it influenced which professors I sought out for classes and for further research experience.
- I was able to interact more with Geology department professors and get hands-on experience in the field of geology. My summer research enhanced my understanding of geology and my engagement in the department.
- It broadened my understanding of psychological concepts and practice.

#### Belong to a department

- The research really helped me to find a sense of community at Smith. I felt I had a family in my mentor, my lab-mates. As an international student, it was very important to my success away from home. As for the work itself, I genuinely loved what I was studying.

- I built a relationship with the Physics department faculty that I have maintained to this day. I believe I have a closer relationship to my professors than most students, and I value this a great deal. Working for the physics department exposed me to general lab techniques and gave me confidence working in the lab which was helpful in graduate school. But, it is the affection that I feel for the faculty at Smith that I value most.
- The summer at Smith is a much quieter period than during the semester, allowing for a lot more concentration on research projects. I also became more connected with the other students who were there, as well as some of the professors.

#### Publication or presentation

- I received multiple publications which have really helped through medical school and now residency.
- I was able to start a project that resulted in a paper being published about the results. I also wrote an honors thesis about this project.
- I was able to make significant progress on research for my senior thesis. This work ultimately led to my giving a talk at a national conference during the spring of my senior year at Smith, which had a significant impact on me.

#### Focus in depth

- Being a student at Smith carries a lot of responsibilities. However, doing summer research allows the time to focus solely on the research without having a lot of other distractions.
- It allowed me to work on one topic in greater depth than I had during the school year.
- The summer was a great time to completely focus on my subject, without carrying other courses at the same time. It was interesting to be on campus when there weren't as many students; it seemed to me a quieter, more "laid back" time of study.

#### Learn to be a scientist

- It was my first time working on an independent research project and taught me much more about actual bench science than a science laboratory class did.
- While the research was not cutting edge (looking back now, I realize the project was not on the turning page of science), it certainly helped me to start thinking like a scientist. Prior to the summer of research, I had only taken lab courses that were structured (and had a known outcome). The summer research at Smith allowed me to start thinking on my own, and learning how to solve problems that are unexpected and unprecedented. The experience added a positive spin to my Smith education in that it challenged me further than the typical class schedule. Considering Smith is an undergrad only, private institution, I am impressed with its ability to fund students in research settings such as this.
- I think most importantly it prepared me for graduate school. I knew what graduate level research in psychology looked like, and I knew how to interact with faculty around research questions.

- In my time at Smith, the challenging coursework and incredible instruction enabled me to gain a knowledge base and a way of thinking about science that left me with a very strong foundation. Even now, when I find myself thinking through a problem or an issue related to my current research, I often end up so grateful for Smith and all that I was given. Summer research provided an opportunity to begin to use that foundation to think freely and creatively about science, to explore an area in depth, to search for what was known and what could be added to the current body of knowledge. It was the practice of science that I experienced through summer research. Not only was the physical lab work valuable, but more importantly, what it allowed was the intellectual challenge that comes from having to think about the outcome of that work, about whether it was what you expected, or more often than not, what you didn't. When I think back on that summer, what I value the most are the hours I spent sitting with my advisor and talking science, thinking through experimental design, thinking through problems, and thinking through possibilities, almost as if we were two philosophers. It's that feeling that keeps me moving forward in my current work in science. While there are many factors that made me ultimately choose to continue my graduate studies in the sciences, it was the summer experience that made me realize what was beyond the foundation of knowledge that we were working so hard to gain.

#### Enriching experiences

- Summer fun. Paid. Coral Research. Bahamas and Belize.
- The research itself was not particularly valuable. It was tedious and the professor spent little time incorporating me into the project. I was more of a lab tech. The experience of living on campus in the summer and enjoying the beauty of Western Massachusetts and what it had to offer including hiking and visits to Tanglewood was tremendous.

#### No benefits

- I believe that these types of positions generally can be quite helpful. . . Mine was not. I worked for a graduate student [not at Smith] and had virtually no substantive responsibilities at all. I basically washed glassware.
- It was pretty good, although I think I did a poor job choosing a quality research project and could probably have used some guidance choosing a project. The professor I worked with seemed to be using the funding we received for his own benefit; it wasn't very "scientific."
- Not a whole lot - my professor was very distracted that summer and we received very little oversight.

#### Good summer job

- It taught me that I didn't want to do computer science research but it was a good experience over all and I appreciated having a job.
- I couldn't have participated in the summer research program if it didn't come with the generous stipend (of \$3600 for 10 weeks), as my financial needs would have

forced me to take a more typical, and far less intellectually beneficial, summer job.

### Conclusion

Surveys suffer from the inability of the surveyors to control respondent compliance. We do not know if there are confounds that render the responses of these survey respondents different from those potential responses of non-responders. Nevertheless, there is reason to believe the information is credible. To summarize, the results indicate:

- Former summer researchers report greater involvement with teaching, research, and science in their current vocation.
- Former summer researchers recall more involvement with post-graduate education and science jobs than the comparison group at the time of graduation and 5 years after graduation.
- Former summer researchers report greater involvement with science jobs than the comparison group 10 years after graduation.
- Former summer researchers report more Ph.D.s than the comparison group.
- Over time, the importance of continuing one's education declines; the importance of starting a family, managing health, and pursuing spiritual values rises. These trends hold for both former researchers and the comparison group.
- Both former summer researchers and comparison group members articulated the benefits of studying science, how research added to the benefits of their education, and the use of their science education in their current vocation. Both the quantitative and qualitative information demonstrate that a summer research experience was not the only path to a career in science or the appreciation of science education.

The present results may be compared to other studies of undergraduate researchers, including Lopatto (2004, 2007), Seymour et al. (2004), and Bauer and Bennett (2003). Of these, Bauer and Bennett studied alumni while the other work was engaged with undergraduate students. The categories of gains reported in the present analysis as "adding to the value of the Smith education" resonate with the findings of these studies. All reports indicate that students who do research make gains in learning about research, gains in research skills, working with a mentor, learning a topic in depth, belonging to a learning community, improvement of writing and speaking skills, learning to think and act like a scientist, and growth in self-confidence. In addition, all studies report that undergraduate researchers clarify or confirm their career goals while improving their credentials for jobs and post-

graduate education. The data support the view that undergraduate research at Smith sets the occasion for the benefits of the research experience in the context of this singular institution.

#### References

- Bauer, K.W., & Bennett, J. S. (2003). Alumni perceptions used to assess undergraduate research experience. The Journal of Higher Education, 74(2), 210-230.
- Lopatto, D. (2004). Survey of Undergraduate Research Experiences (SURE): First Findings. Cell Biology Education, 3, 270-277.
- Lopatto, D. (2007). Undergraduate research experiences support science career decisions and active learning. CBE – Life Sciences Education, 6, 297-306.
- Seymour, E., Hunter, A-B, Laursen, S.L., & Deantoni, T. (2004). Establishing the benefits of research experiences for undergraduates in the sciences: First findings from a three-year study. Science Education, 88 (4), 493-534.