

## **Appendix B: Bibliometric Analysis**

As part of the Initial Impacts Evaluation, curricula vitae (CVs) were requested from all participating IGERT and non-IGERT faculty members. Ultimately, 350 IGERT and 252 non-IGERT faculty members provided their CVs. Publication information from each CV for the years 1999 through 2003 was extracted, coded, and analyzed by ipIQ, a subcontracting firm hired to conduct the analysis. The purpose of the analysis was to examine the publication and citation patterns of IGERT and non-IGERT faculty members, with a focus on their interdisciplinary publication and citation behavior. The following report summarizes findings from the analysis.



# **IGERT Initial Impacts Study: Bibliometric Analysis**

**FINAL REPORT**

**PREPARED FOR ABT ASSOCIATES, INC.**

**JENNIFER CARNEY, PH.D.**

**DEEPIKA CHAWLA, PH.D, ED.D.**

April 4, 2005  
Prepared by:

Dominic Olivastro  
Kimberly Hamilton  
and  
Peter Kroll

ipIQ  
10 White Horse Pike  
Haddon Heights, NJ 08035  
Tel.: 856.546.0600  
Fax: 856.546.9633  
E-mail: [dolivastro@ipiq.com](mailto:dolivastro@ipiq.com)  
[khamilton@ipiq.com](mailto:khamilton@ipiq.com)  
[pkroll@ipiq.com](mailto:pkroll@ipiq.com)

## TABLE OF CONTENTS

TABLE OF CONTENTS .....	4
<b>Introduction.....</b>	<b>5</b>
<b>Procedure.....</b>	<b>6</b>
OBTAINING DATA .....	6
EXTRACTING PUBLICATIONS.....	6
UNIFYING PUBLICATIONS.....	7
PURCHASING ARTICLE INFORMATION FROM ISI .....	8
FILTERING BASED ON ISI'S DATA .....	9
SUMMARY.....	9
<b>Results .....</b>	<b>10</b>
PRELIMINARIES .....	10
PUBLICATIONS .....	10
THE FREQUENCY OF PUBLICATIONS.....	11
THE FIELDS OF PUBLICATIONS .....	12
CITATIONS .....	15
COMPARISON OF IMPACT .....	16
COMPARISON OF REFERENCES.....	18
CO-AUTHORSHIPS .....	19
<b>Conclusion .....</b>	<b>22</b>

# Introduction

iplQ (formerly CHI Research, Inc) is pleased to present this study to Abt Associates. The study looks at faculty members who participate in the *Integrative Graduate Education Research and Traineeship Program* (IGERT), managed by the National Science Foundation's Directorate for Education and Human Resources, Division of Graduate Education. The IGERT program was specifically designed to educate doctoral students in a multidisciplinary setting.

To analyze the effects of the IGERT program, iplQ compared a set of authors that have participated in the IGERT program (the IGERT authors) with a similar set of authors that have not participated in the program (the Control authors).

The study looked to answer the following questions:

1. Did the IGERT program have an effect on the participants' productivity? iplQ did not find an appreciable difference in the number of publications between the two groups.
2. Are the IGERT authors more likely to publish in an area outside their own discipline than the Control authors? We found mixed results. In certain disciplines—such as Biology, Psychology, Mathematics, and Humanities—the IGERT authors are clearly more likely to cross disciplines; but in others, the opposite is true. In many respects, an interdisciplinary approach is already the norm among American Universities.
3. Have the IGERT authors had a greater impact in their publications? The answer is clearly “yes.” IGERT authors are more highly cited every year, and the trend persists in every discipline except Social Science. The effect is most noticeable among the IGERT authors in Earth and Space, and Biology. Furthermore, the IGERT authors are more highly cited than Control authors regardless of which fields they publish in.
4. Are the IGERT authors more likely to reference material outside of their disciplines? Here again, the results are mixed, but the effect is most noticeable among authors in Biology, Psychology, Mathematics, and Humanities. This may be related to the fact that in these disciplines, more than in others, authors are likely to publish outside their main fields, and thus self-referencing may be a factor.
5. Do the IGERT authors obtain a higher number of authorships on their publications? There is no clear indication of this. A paper published by an IGERT author contains roughly the same number of institutions and departments as a paper published by a Control author.

# Procedure

iplQ (formerly CHI Research, Inc.) compared the publication characteristics of two groups of authors, those that participated in the National Science Foundation's *Integrative Graduate Education Research and Traineeship Program* (the IGERT authors) and those that did not participate (the Control authors).

## OBTAINING DATA

iplQ obtained a set of 602 Curriculum Vitae (CV), 350 from IGERT authors, and 252 from Control authors. Of these, there were 9 CVs that could not be read – 6 from IGERT authors and 3 from Control authors – and they were immediately dropped from the study. This left us with 344 CVs from the IGERT group, and 249 from the Control group.

## EXTRACTING PUBLICATIONS

A machine-readable CV was stripped of all information except the publications of the authors. All publications, both those of the IGERT and Control groups, were tagged with the author's IGERT number and Respondent ID as they appeared on the CV. The Respondent ID was used to determine the author's discipline.

For example, the CV for a typical respondent might have produced the following table of publications (the data are not actual data):

IGERT	RespID	Publications
9870631	11652	The Role of the Spinodal Region in One-Dimensional Models of Phase Transformations (with A. Vainchtein, P. Rosakis & L. Truskinovsky), Physica D 115 (1998) 29-48.
9870631	11652	Stability of Axial Motions of Strings, ZMAP 47 (1996) 809-816.
9870631	11652	Bifurcation and Metastability in a New One-Dimensional Model for Martensitic Phase Transitions (with A. Vainchtein & P. Rosakis), Comput. Meth. Appl. Mech. Engr. 170 (1999) 407-421.
9870631	11652	Global Continuation via Higher-Gradient Regularization and Singular Limits in Forced One-Dimensional Phase Transitions (with H. Kielhöfer) SIAM J. Math. Anal. 31 (2000) 1307-1331.
9870631	11652	Nonlinear Standing and Rotating Waves on the Sphere (with C. Gugg, S. Maier-Paape & H. Kielhöfer), J. Differential Equations 166 (2000) 402-442.
9870631	11652	On 2D Steady Solutions of the Planar Couette Flow Problem (with P. Mehta), manuscript, 2004.

A technical assistant then went through all references and deleted those that did not fit within the years of the study, 1999 to 2003. The table above would have lost the first reference (since it is dated prior to 1999) and the last (since it is dated after 2003). The resulting shorter table looked like this:

IGERT	RespID	Publications
9870631	11652	Stability of Axial Motions of Strings, ZMAP 47 (1996) 809-816
9870631	11652	Bifurcation and Metastability in a New One-Dimensional Model for Martensitic Phase Transitions (with A. Vainchtein & P. Rosakis), Comput. Meth. Appl. Mech. Engr. 170 (1999) 407-421
9870631	11652	Global Continuation via Higher-Gradient Regularization and Singular Limits in Forced One-Dimensional Phase Transitions (with H. Kielhöfer) SIAM J. Math. Anal. 31 (2000) 1307-1331
9870631	11652	Nonlinear Standing and Rotating Waves on the Sphere (with C. Gugg, S. Maier-Paape & H. Kielhöfer) J. Differential Equations 166 (2000) 402-442

Continuing like this, we created a table of 7493 publications between the years 1999 and 2003.

## UNIFYING PUBLICATIONS

The table was sent through iplQ's standard process of unification, in which a technical assistant assigns to each reference the following fields:

- **Type:** "S" if the reference is to a paper appearing in a refereed Scientific journal; "O" otherwise. If the Type is "S", then the following fields were also included:
- **Year:** The year of the article's publication.
- **Journal:** The refereed journal of publication, such as such as *Science*, or *The American Journal of Physiology*
- **Author:** The first 6-characters of the first author of the article.
- **Page:** The first page of the article.
- **Volume:** The volume of the article.

After the unification process the table above looks like this, complete with the added fields.

IGERT	RespID	Publications	Type	Year	Journal	Author	Page	Volume
9870631	11652	Stability of Axial Motions of Strings, ZMAP 47 (1996) 809-816	O					
9870631	11652	Bifurcation and Metastability in a New One-Dimensional Model for Martensitic Phase Transitions (with A. Vainchtein & P. Rosakis), Comput. Meth. Appl. Mech. Engr. 170 (1999) 407-421	S	1999	COMPUT METH	VAINCH	407	170
9870631	11652	Global Continuation via Higher-Gradient Regularization and Singular Limits in Forced One-Dimensional Phase Transitions (with H. Kielhöfer) SIAM J. Math. Anal. 31 (2000) 1307-1331	S	2000	SIAM J MATH	KIELHO	1307	31
9870631	11652	Nonlinear Standing and Rotating Waves on the Sphere (with C. Gugg, S. Maier-Paape & H. Kielhöfer) J. Differential Equations 166 (2000) 402-442	S	2000	J DIFF EQUA	UGG	402	126

There are two important points that should be made about the table above:

1. The first publication was given a type "O", since it does not appear in a standard refereed journal. We have no information on the journal *ZMAP*, and despite the title of the article, we have to assume it is not a scientific paper. In any case, it cannot be used in any further analysis, because we cannot obtain the journal's field.
2. It is not certain that the author listed in the unified fields is, in fact, the first author of the paper. For every publication, it may be that the first author was the author of the CV, and only the co-author was mentioned in the reference. This does not cause a problem, since we can, at a later point, substitute the CV-author for the listed author just by translating the Respondent ID. In the above table, the Respondent ID leads us to assume that the first author, in every publication, may be "HEALY," the author of the CV.

After unification, we found there were 6834 publications that were of type "S" and between the years 1999 and 2003.

#### PURCHASING ARTICLE INFORMATION FROM ISI

Using the unified information from the above table, we created standard keys to ship to the Institute for Scientific Information (ISI), so that further information about the articles could be gotten from their databases. For each publication, we created two keys: One with the first listed author, and a second with the CV-author. In cases in which the first listed author and the CV-author were the same, we created only one

key. It is not possible for both keys to match in the ISI database. In all we created 11,983 keys.

In work of this sort, it is always possible that a valid key will not match. This usually happens because of misinformation in the reference itself. For example, a page may be wrongly cited, or an author's name may be misspelt. Of the 6834 references that were used in the study, a full 5306 (or 78%) were matched to ISI's database, which is a very good match rate based on our experiences.

With ISI's data, we assigned to each publication the following field.

1. The K-code (see Table 1)
2. The Journal Field (see Table 2)
3. The references from the paper.
4. The citations to the paper.
5. The institutional addresses of the authors.

### FILTERING BASED ON ISI'S DATA

The K-code is used to filter out those publications that are not articles, notes, and reviews. Other types of publications (for example, book reviews or editorials), are not considered scientific references and do not have fields assigned to them, and therefore lie outside the scope of this study. Of the 5306 matched papers, 5147 are articles, notes, and reviews and remained in the study.

### SUMMARY

The table below brings together a great deal of information about the procedure of the study.

		IGERT- Authors	Control- Authors	Total
<b>A</b>	No. of CVs	350	252	602
<b>B</b>	No. of Valid CVs	344	249	593
<b>C</b>	No. of Papers in "B" published between 1999 and 2003	4433	3060	7493
<b>D</b>	No. of Papers in "C" of type "S" (Papers published in a scientific journal)	3861	2973	6834
<b>E</b>	No. of Papers in "D" that matched to the ISI database	3021	2285	5306
<b>F</b>	No. of Papers in "E" that were articles, notes, reviews	2926	2221	5147

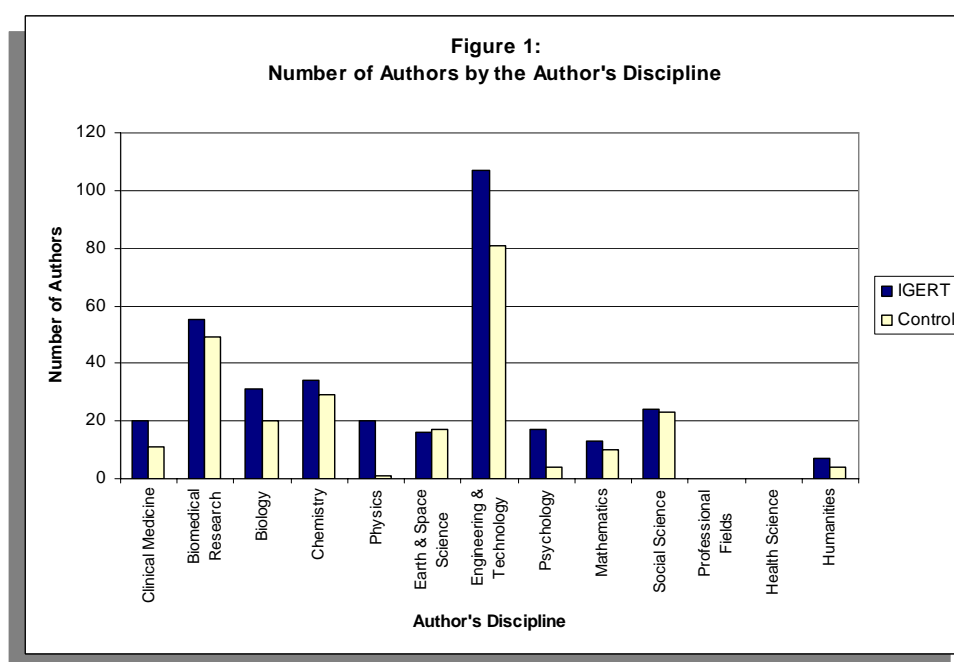


# Results

## PRELIMINARIES

In all there were 344 IGERT authors and 249 Control authors used in the study, or nearly 100 more IGERT than Control authors. The distribution is a little uneven. Although the unevenness is not so great that it can immediately invalidate the study, it is a fact that should be kept in mind as the results unfold.

To get a further handle on the differences, Figure 1 shows the number of authors in each group by the discipline of the author (see also Table 3). The biggest difference is in Physics (20 IGERT vs. only 1 Control author), and in Engineering and Technology (107 IGERT vs. 81 Control authors).



## PUBLICATIONS

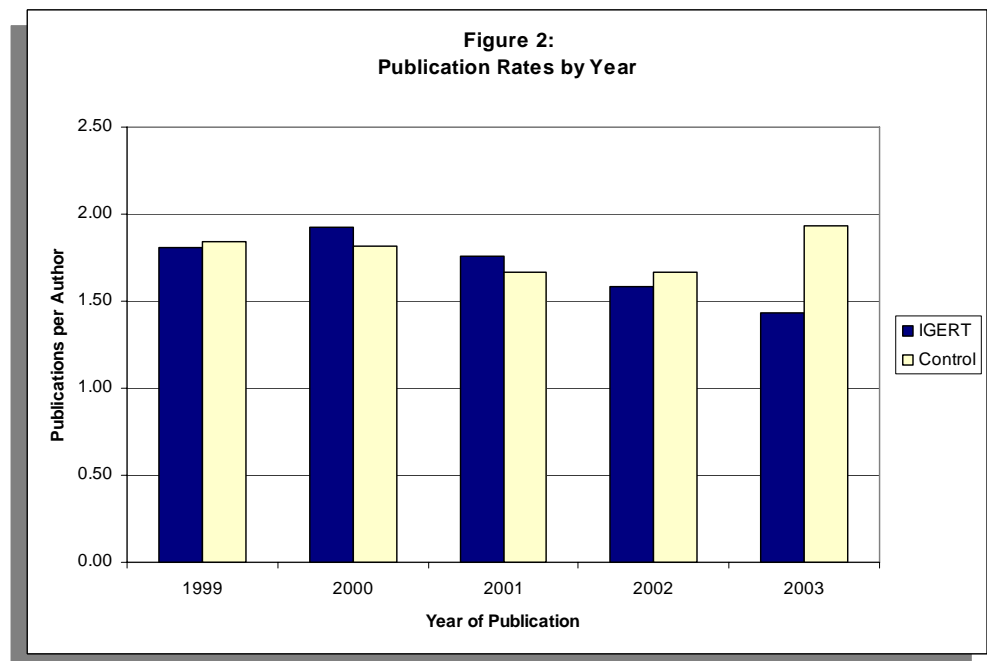
The most obvious use of publication data is to measure an author's productivity. Using this measure, we can ask if the IGERT program has had a positive, negative, or possibly neutral effect on a participant's output.

Another, less obvious, use of publication data is to measure an author's scope of research. In this way, we can see if IGERT authors are more or less likely to move across disciplines in their research. Encouraging an interdisciplinary approach is one of the major purposes of the IGERT program, and this is the first of three ways in which we will try to see if the program has been successful.

## THE FREQUENCY OF PUBLICATIONS

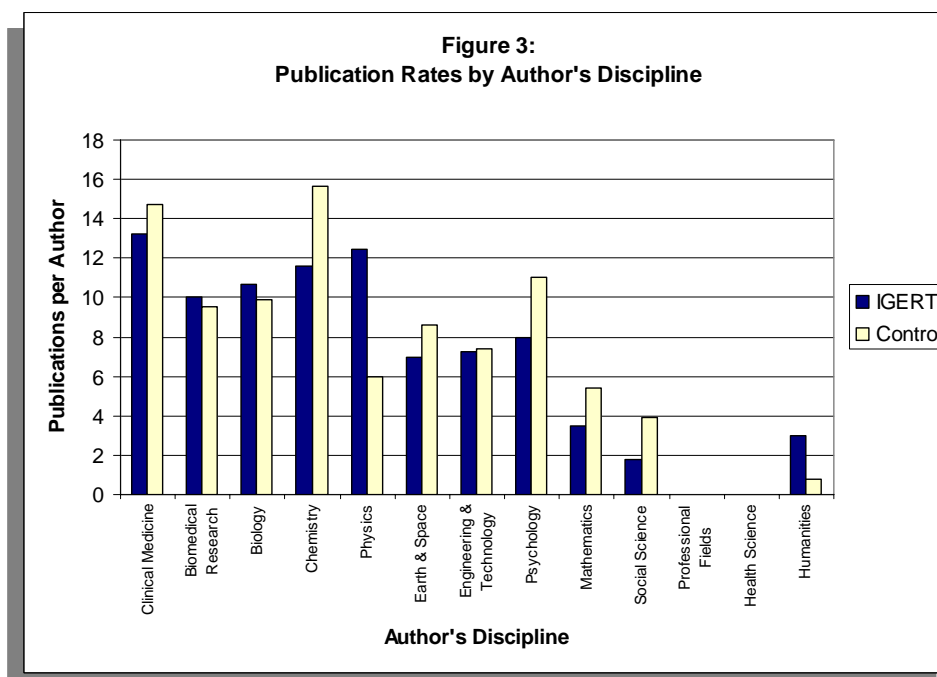
This section will compare the publication rates of the two groups of authors. All data will be presented as publications per author, in order to control for the different sizes of the two groups.

Overall, looking at the complete database of 5 years (1999 to 2003) and all disciplines, the IGERT group has published about 8.5 papers per author while the Control group has published about 8.9 papers per author. We can break down the data further. Figure 2 compares the publication rates across the publication years, for all disciplines combined (see also Table 4):



The figure does not show any tendency for one group to publish more than another.

In order to see if there is an effect within a specific discipline that is being hidden in the yearly data, Figure 3 makes a similar comparison for each discipline across all publication years combined (see also Table 5):



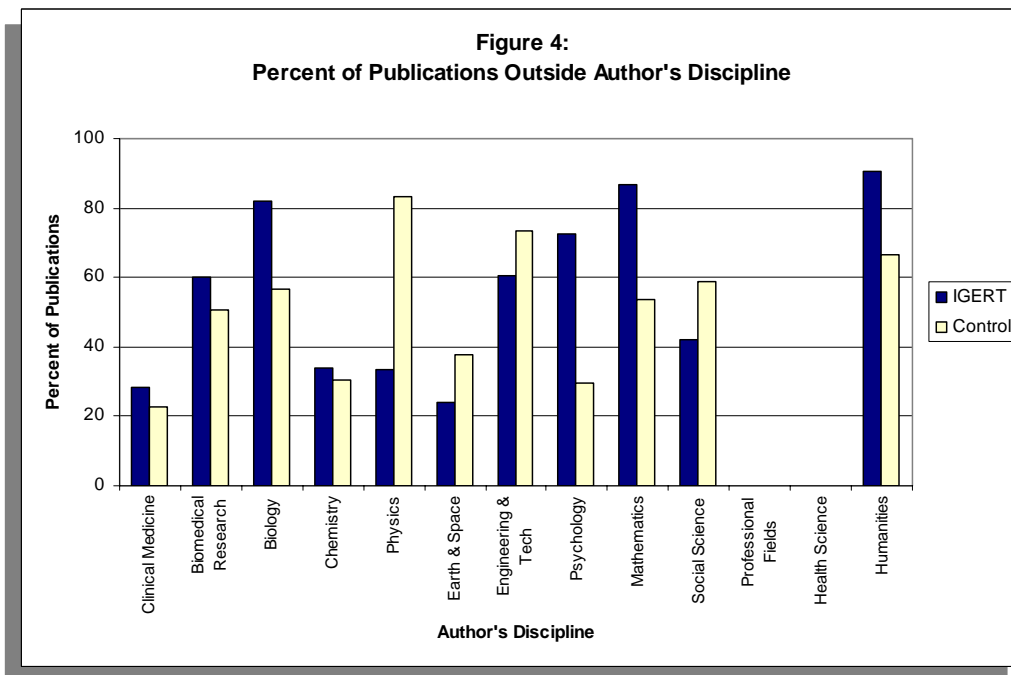
Again, neither figure shows a strong trend of one group being more prolific than the other.

### THE FIELDS OF PUBLICATIONS

This section will compare the contents of the publications of the two groups of authors; in particular, we are interested in seeing if the authors of the IGERT group are more likely to publish outside their chosen discipline than are the authors of the Control group. This will give us a sense of the multi-disciplinarity of the two groups. To make this comparison, we use the percent of each group's publications that appear in a scientific field outside the author's discipline. Overall, 53.6% of all IGERT publications were published outside the author's discipline, compared with 50.5% of all Control publications.

We can break down the data by the author's discipline. For example, consider first the IGERT group. We know that there are 20 authors in this group that are working in the discipline of Clinical Medicine. These authors have published a total of 264 papers. Of these, 75 (or 28.4%) have appeared in fields outside of Clinical Medicine. In the Control group, there are 11 authors in Clinical Medicine, who have published 162 papers, and 37 (or 22.8%) appear outside of Clinical Medicine. The two groups are essentially equal in this case.

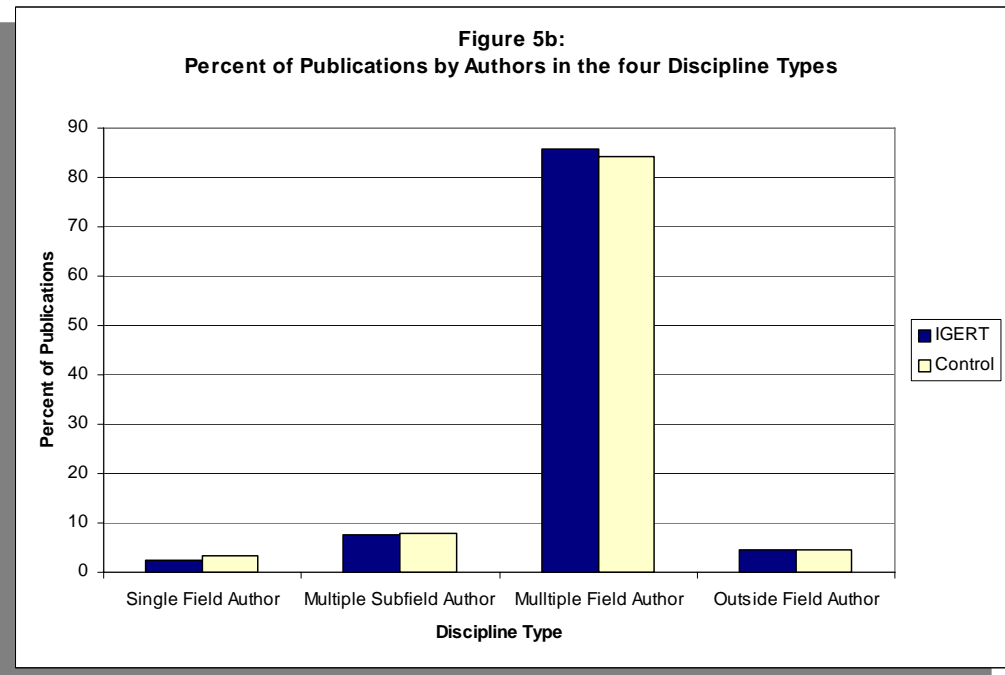
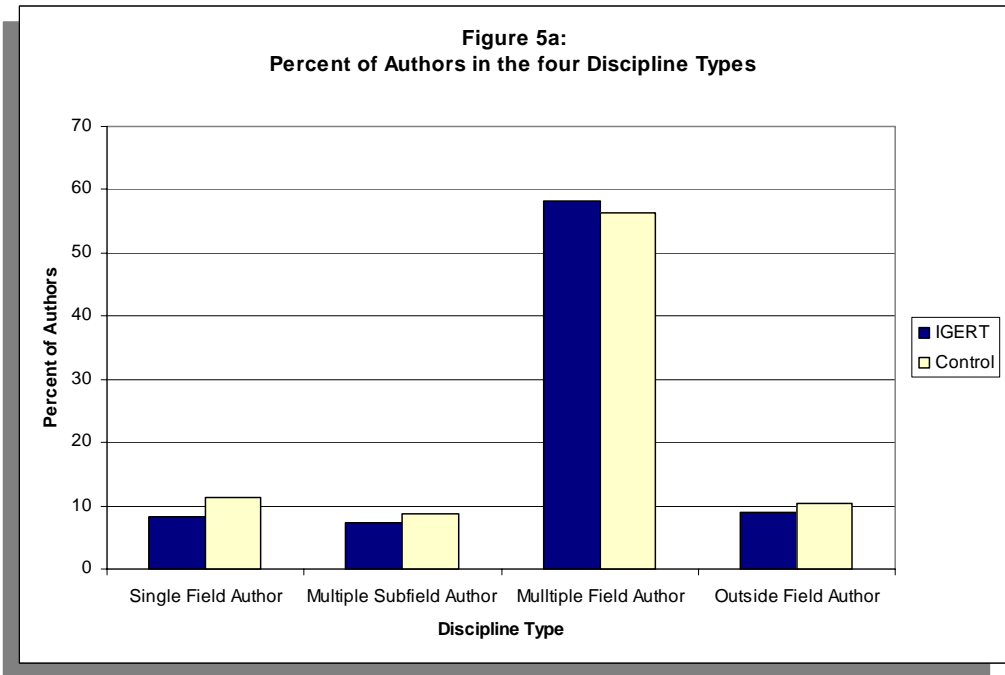
Full information may be found in Figure 4 (see also Table 6). The picture is mixed. In certain disciplines (such as Biology, Psychology, and Mathematics and Humanities), the IGERT authors show a greater tendency to publish outside their disciplines than do the Control authors. In other disciplines (most notably Physics), the reverse is true.



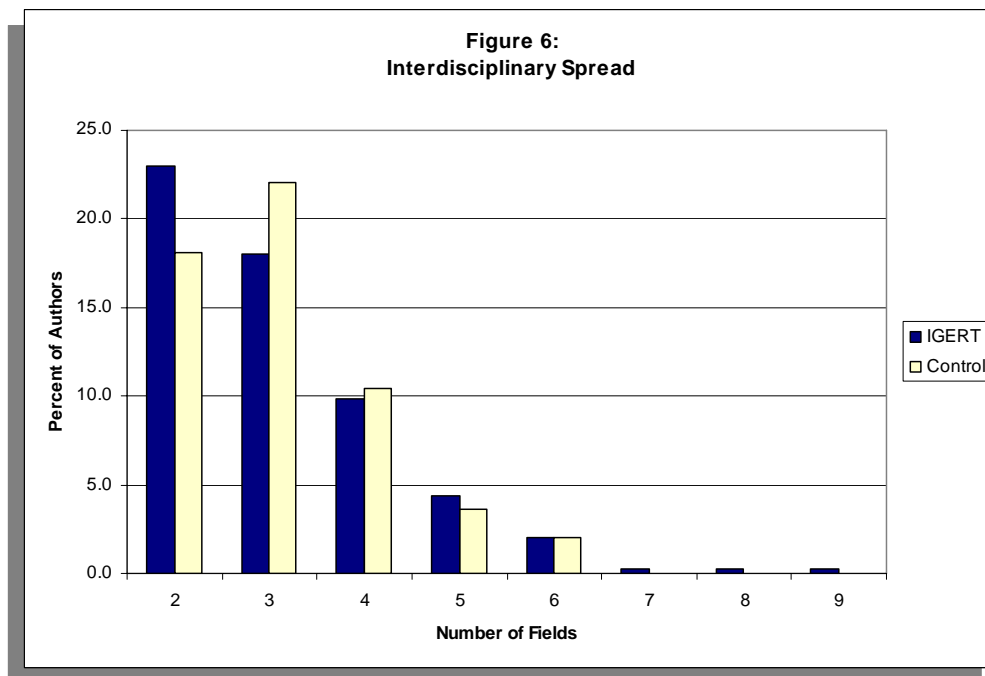
There are many ways to use publications to measure the interdisciplinary approach of authors. Another view is achieved not by counting publications themselves, but the number of authors who have published outside their disciplines. To do this, we have assigned each author to one of four discipline types:

1. **Single Field Authors:** Researchers who publish only within own their own fields, and only within one subfield.
2. **Multiple Subfield Authors:** Researchers who publish only within their own fields, but in multiple subfields.
3. **Multiple Field Authors:** Researchers who publish within their own field and in other fields.
4. **Outside Field Authors:** Researchers who publish only outside their own fields.

Figure 5a plots the percentage of authors who fall in each of these four discipline types, and Figure 5b plots the percentage of publications (see also Table 7). Again, there is no difference between the two groups. In both groups, the preponderance of publications were written by authors in type 3, that is, most authors publish papers (approximately 85% of each group) both in their own discipline and in others. An interdisciplinary approach is already the norm among faculty members, even those outside the IGERT program.



We can also calculate the spread of disciplines between the two groups. Overall, 41.9% of all IGERT authors, and 43.8% of all Control authors, publish in only one field. The percent of authors who publish in two or more fields is shown in Figure 6 (see also Table 8).



## CITATIONS

A citation is a reference from one publication to a previous publication. As such, the citation creates a link between the two publications.

The meaning of the link depends on the direction in which we decide to view it. When viewed by the author who is receiving the reference, the citation is a measure of the author's influence on subsequent research; analyzing these citations will define an author's impact.

When viewed by the author who is referencing a previous work, the citation declares the history on which the author is basing his research; analyzing these references will define the scope of an author's research interests. This will give us a second opportunity to examine the effect of the IGERT program on a participant's interdisciplinary research.

In this study, citations are from all years ending 2004, but the nature of ISI's data is that a few citations from 2005 are also present.

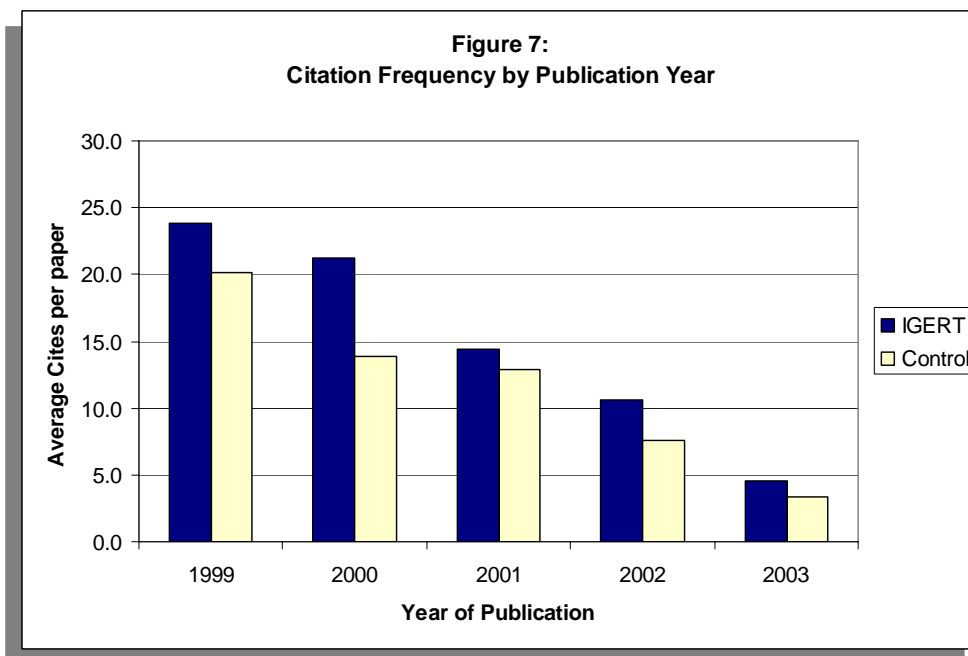
## COMPARISON OF IMPACT

Citations are issued only to publications that are deemed important. In this way the number of citations per publication is a measure of impact. Citation counts, however, must always be normalized in two ways:

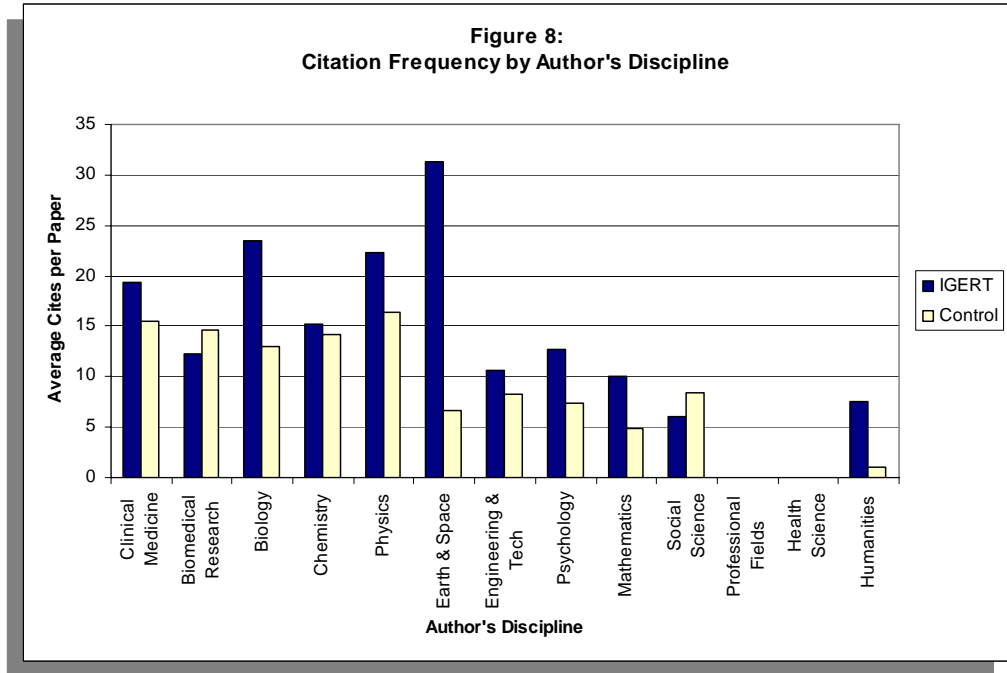
1. By the year of publication, since older papers have more time to be cited.
2. By the field of publication, since some fields, like Biomedical Research, will receive more citations than other fields, like Health Science.

We know that the IGERT authors and the Control authors do not appreciably differ in terms of the number of publications, but this section will show that there is a noticeable and persistent trend for the IGERT authors to receive more citations than the Control authors. Otherwise stated, this means that the IGERT authors generally have a higher scientific impact than others. The nature of the impact is not overly great, but it is certainly persistent.

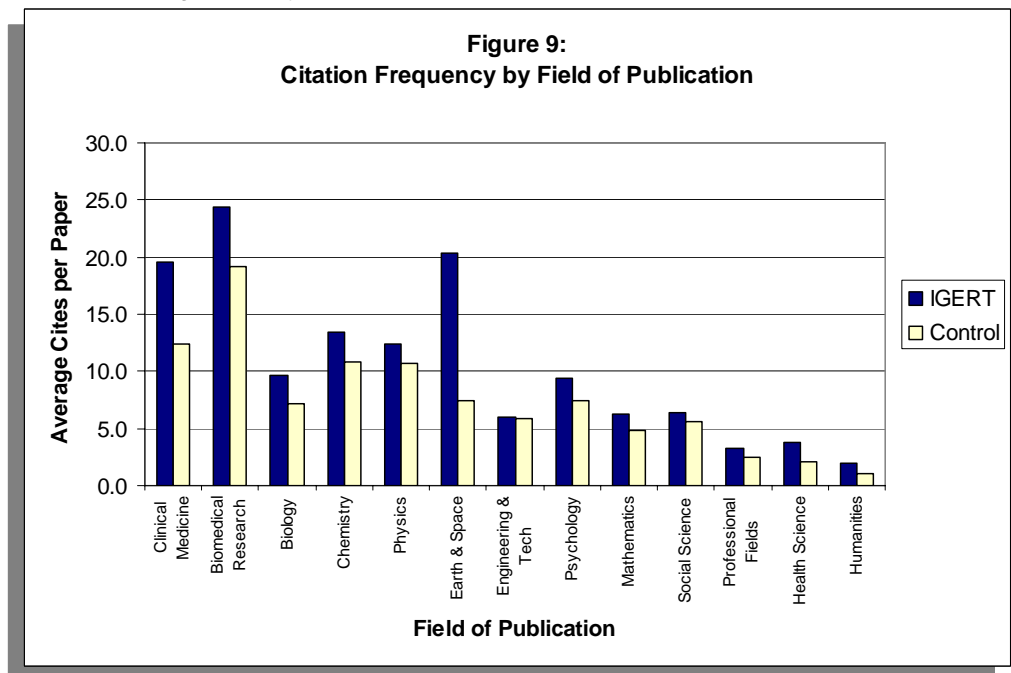
Overall, the IGERT authors receive about 16 citations per paper, while the Control group receives about 12. The trend can be traced over all years of the study, as seen in Figure 7, which illustrates the citation frequency by publication year (see also Table 9). The total number of citations lessens each year only because recent years (2003) do not yet have the time to be cited. But the important point is that in each year, the IGERT authors are more heavily cited. The trend does not appear to be accidental, but points to IGERT's cites per paper being consistently higher than the Control's cites per paper.



We can see the same trend even if we break the data down by the discipline of the authors, as seen in Figure 8, which presents the citation data by discipline across all years (see also Table 10). Here again, the IGERT authors are more highly cited regardless of their disciplines, except for those authors in Biomedical Research and Social Science, although in both of these cases the citation rates are quite close.



Furthermore, the tendency of IGERT authors to be more highly cited is true regardless of which field they publish in. Figure 9 illustrates this point (see also Table 11). The difference between Figures 8 and 9 should be stressed. In the first figure, the data is grouped by the discipline of the author – that is, it compares the Clinical





Medicine authors in the IGERT group with the Clinical Medicine authors in the control group. In the second figure, the data is grouped by the field of publication, regardless of the author's discipline—that is, it compares the Clinical Medicine papers of all IGERT authors with the Clinical Medicine papers of all control authors.

The difference is most notable in Earth and Space in which the IGERT authors actually receive 20 citations per publication, while the control authors receive only 7. But it is also obvious in Clinical Medicine. The trend becomes less clear-cut in the social sciences, as well as in Engineering and Technology. But the data very clearly points to a real difference between the two groups, and the IGERT authors have a higher impact than others.

### COMPARISON OF REFERENCES

References are indicators of an author's research. Looking at references will enable us to make a third attempt to see if the IGERT program has encouraged interdisciplinarity among its participants. We will do this by seeing if IGERT authors are more likely than Control authors to reference work outside their own disciplines.

As a purely preliminary finding, Figure 10 compares the IGERT and Control authors by the number of references per publication (see also Table 12). This comparison is not pertinent to the point of interdisciplinarity, but it is important to note that in sheer numbers, there are no major differences between the two groups, and more importantly, both groups offer sufficient references to make further comparisons meaningful.

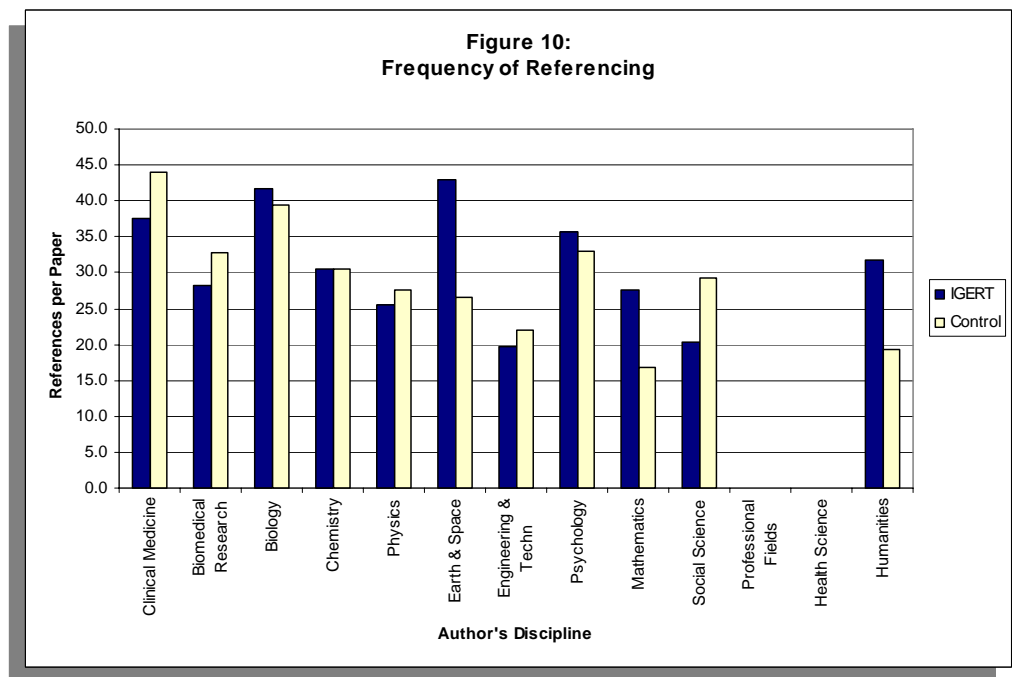
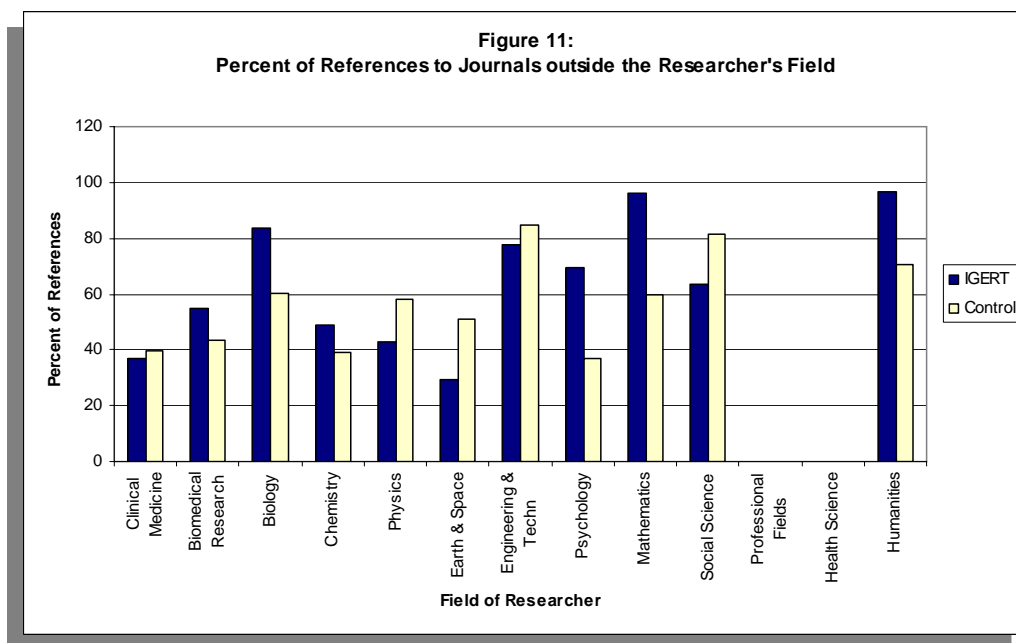


Figure 11 compares the percent of references that are outside the author's discipline (see also Table 13). The results are mixed. Overall 60.2% of all references from IGERT authors, and 54.5% of all references from Control authors, are to fields outside the author's discipline. But in certain fields the IGERT authors are more likely than Control authors to reference papers outside their discipline. This is most striking for the authors in the disciplines of Biology, Psychology, Mathematics, and Humanities, precisely those authors who are most likely to publish outside their fields. But it is true also, although less noteworthy, in Biomedical Research and Chemistry.



## CO-AUTHORSHIPS

Co-authorship is a measure of cooperation among authors. It is a useful measure to see if the IGERT program has fostered a degree of diversity among its participants.

In this section, co-authorship refers specifically to *institutional* co-authorship, i.e. the number of institutional addresses listed on each paper. This differs from the more traditional use of co-authorship in that multiple co-authors working at the same institutional address will list that address only once.

Figure 12 illustrates the average number of institutions on a paper for IGERT and Control groups (see also Table 14). The results are, once again, quite mixed. IGERT authors average 1.96 institutions on their papers, while Control authors average 1.78 institutions. In certain disciplines (Clinical Medicine, Biomedical Research, and Engineering and Technology) the papers published by IGERT authors have more institutions than the Control authors; in other disciplines, the opposite is true. In no case is the difference very great.

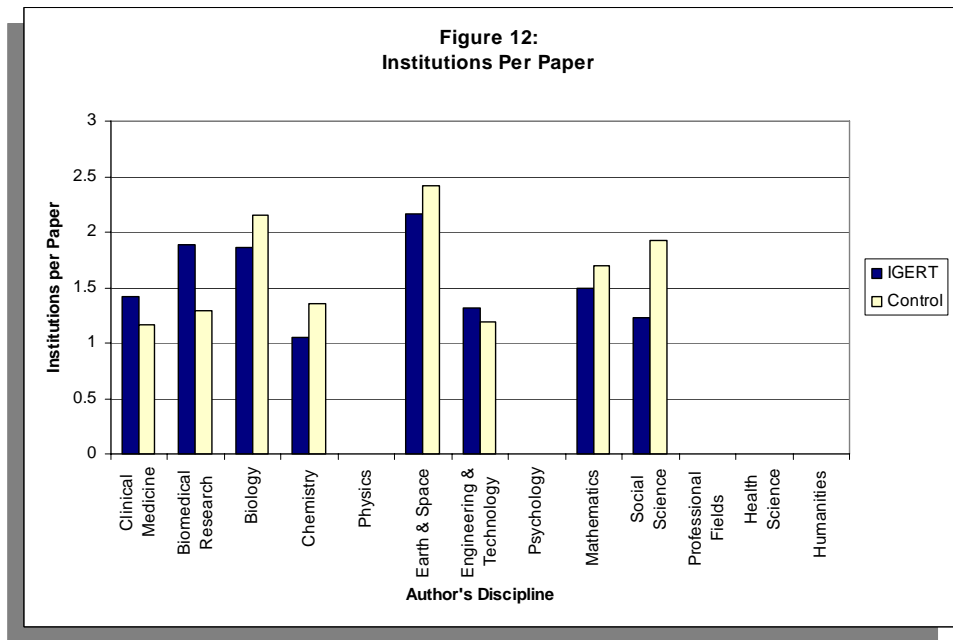
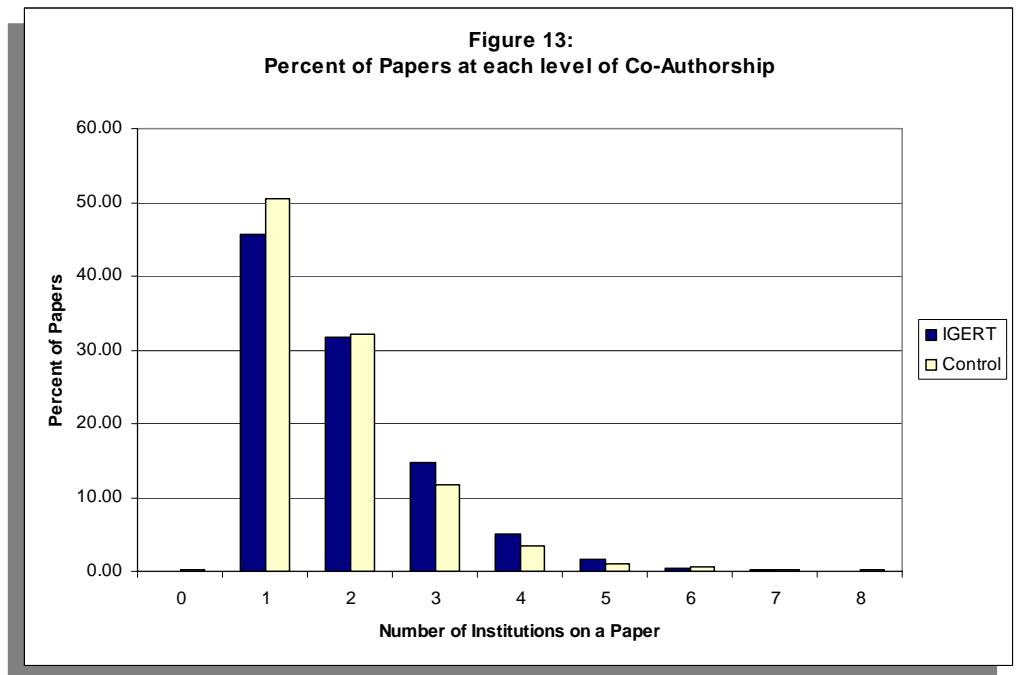
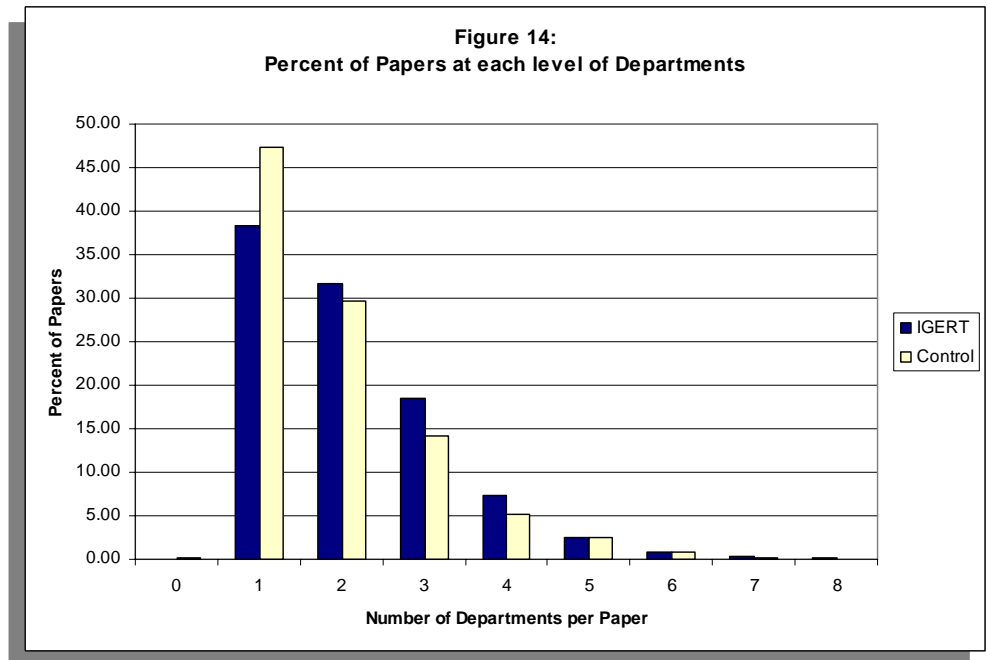


Figure 13 is a slightly different view of the same measure, plotting the percent of papers that have a given number of institutions (see also Table 15). Aside from a very slight tendency for IGERT authors to concentrate at the high levels of co-authorship (for example, papers having 3 or more co-authors), the data does not present a striking difference between the two groups. (A note on Figure 13: there are one IGERT paper, and four Control papers, that have zero institutions. This simply means that an institutional address was not included in the author's paper).



If we move to the department level instead of the Institutional level, we find much the same evidence. Overall, the IGERT authors have 2.1 departments on a paper, while the Control authors have 1.78. Figure 14 plots data that is similar to Figure 13, but counts the number of departments on a paper instead of Institutions (see also Table 16). Once again, there is a slight tendency for the IGERT authors to have a high percentage of it papers with multiple departments, but the trend is not at all striking. (Once again, there are a few papers with no departments).



## Conclusion

We have found that *the Integrative Graduate Education Research and Traineeship Program* has had a mixed result. Participants of this program are not notably more prolific (as measured by their publication rate), but they have a higher impact (as measured by the number of citations from subsequent publications) than non-participants. The results point to a mixed picture about the effects of interdisciplinarity among its participants.

Copyright © 2005 iplQ  
 ABT/IGERT project

### Table 1

Listing of K-Codes  
 as supplied by the  
 Institute of Scientific Information

<u>K-Code</u>	<u>Meaning</u>
5	News Item
A (or blank)	Article
B	Book Review
E	Editorial
I	Item about an Individual
L	Letter
M	Meeting Abstract
N	Note
R	Review

Copyright © 2005 iplQ  
 ABT/IGERT project

### Table 2

Listing of  
 Publication Fields  
 and Author Disciplines

<u>Field</u>	<u>Title</u>
1	Clinical Medicine
2	Biomedical Research
3	Biology
4	Chemistry
5	Physics
6	Earth and Space
7	Engineering and Technology
8	Psychology
9	Mathematics
10	Social Science
11	Professional Fields
12	Health Science
13	Humanities

Copyright © 2005 iplQ  
ABT/IGERT project

**Table 3**  
Number of Authors in each Discipline

<b><u>Author's Discipline</u></b>	<b><u>IGERT</u></b>	<b><u>Control</u></b>
Clinical Medicine	20	11
Biomedical Research	55	49
Biology	31	20
Chemistry	34	29
Physics	20	1
Earth & Space Science	16	17
Engineering & Technology	107	81
Psychology	17	4
Mathematics	13	10
Social Science	24	23
Professional Fields	0	0
Health Science	0	0
Humanities	7	4
All Disciplines Combined	344	249

Copyright © 2005 iplQ  
ABT/IGERT project

**Table 4**  
Number of Publications by Publication Year  
(Across all Disciplines)

	<b>Publication Year</b>					
	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>1999-2003</b>
<b>IGERT</b>	621	661	605	545	494	2926
<b>Control</b>	458	452	415	414	482	2221

Copyright © 2005 iplQ  
 ABT/IGERT project

**Table 5**  
 Number of Publications by Author's Discipline  
 (Papers per Author is found by dividing the number of papers by No. of Authors)

Data for IGERT Authors		No. of	No. with	Publication Years				
Author's Discipline	Authors	Pubs	1999	2000	2001	2002	2003	1999-2003
Clinical Medicine	20	19	56	54	45	54	55	264
Biomedical Research	55	49	109	111	113	116	104	553
Biology	31	29	69	77	65	66	53	330
Chemistry	34	29	86	85	85	75	64	395
Physics	20	19	59	43	55	50	42	249
Earth & Space	16	12	21	36	27	10	18	112
Engineering & Tech	107	84	182	193	164	122	118	779
Psychology	17	15	18	35	27	31	24	135
Mathematics	13	9	9	13	12	6	5	45
Social Science	24	14	10	9	9	7	8	43
Professional Fields	0	0	0	0	0	0	0	0
Health Science	0	0	0	0	0	0	0	0
Humanities	7	5	2	5	3	8	3	21
<b>All Fields Combined</b>	<b>344</b>	<b>284</b>	<b>621</b>	<b>661</b>	<b>605</b>	<b>545</b>	<b>494</b>	<b>2926</b>

Data for Control Authors		No. of	No. with	Publication Years				
Author's Discipline	Authors	Pubs	1999	2000	2001	2002	2003	1999-2003
Clinical Medicine	11	11	36	33	37	32	24	162
Biomedical Research	49	48	78	91	77	94	128	468
Biology	20	19	52	43	38	31	34	198
Chemistry	29	29	95	95	73	97	93	453
Physics	1	1	2	2	0	0	2	6
Earth & Space	17	15	35	26	28	23	34	146
Engineering & Tech	81	64	129	122	127	104	115	597
Psychology	4	4	3	9	10	7	15	44
Mathematics	10	8	6	14	9	7	18	54
Social Science	23	15	21	17	16	18	18	90
Professional Fields	0	0	0	0	0	0	0	0
Health Science	0	0	0	0	0	0	0	0
Humanities	4	2	1	0	0	1	1	3
<b>All Fields Combined</b>	<b>249</b>	<b>216</b>	<b>458</b>	<b>452</b>	<b>415</b>	<b>414</b>	<b>482</b>	<b>2221</b>



Copyright © 2005 iplQ  
ABT/IGERT project

**Table 6**  
Number of Publications by Author's Discipline and Publication Field

Data for IGERT Authors

Publication Field	Researcher Discipline										
	Clinical Medicine	Biomedical Research	Biology	Chemistry	Physics	Earth & Space Science	Engineering & Technology	Psychology	Mathematics	Social Science	Professional Fields
Clinical Medicine	189	128	120	21	17	0	44	69	7	0	0
Biomedical Research	47	221	96	54	49	19	72	10	10	3	0
Biology	4	13	60	3	0	1	12	0	2	6	0
Chemistry	0	64	0	261	2	2	126	0	0	0	0
Physics	5	54	8	45	166	5	144	4	13	0	0
Earth & Space Science	0	17	14	6	0	85	46	0	0	3	0
Engineering & Technology	5	41	22	5	15	0	307	7	7	1	0
Psychology	14	0	7	0	0	0	1	37	0	0	0
Mathematics	0	1	0	0	0	0	13	1	6	1	0
Social Science	0	0	3	0	0	0	2	0	0	25	0
Professional Fields	0	0	0	0	0	0	11	0	0	0	0
Health Science	0	14	0	0	0	0	0	6	0	3	0
Humanities	0	0	0	0	0	0	1	1	0	1	0
All Disciplines Combined	264	553	330	395	249	112	779	135	45	43	0

Data for Control Authors

Publication Field	Researcher Discipline										
	Clinical Medicine	Biomedical Research	Biology	Chemistry	Physics	Earth & Space Science	Engineering & Technology	Psychology	Mathematics	Social Science	Professional Fields
Clinical Medicine	125	166	11	2	0	1	10	7	0	2	0
Biomedical Research	30	230	87	37	1	5	52	3	1	21	0
Biology	1	7	86	2	0	0	7	0	0	16	0
Chemistry	0	26	0	314	4	2	190	1	0	0	0
Physics	1	12	1	80	1	42	77	1	20	3	0
Earth & Space Science	0	0	5	1	0	91	82	0	0	3	0
Engineering & Technology	1	19	1	15	0	4	158	0	8	0	0
Psychology	4	5	5	0	0	0	1	31	0	3	0
Mathematics	0	0	1	2	0	0	9	0	25	0	0
Social Science	0	0	1	0	0	1	7	0	0	37	0
Professional Fields	0	0	0	0	0	0	4	0	0	1	0
Health Science	0	3	0	0	0	0	0	1	0	4	0
Humanities	0	0	0	0	0	0	0	0	0	0	0
All Disciplines Combined	162	468	198	453	6	146	597	44	54	90	0

Copyright © 2005 iplQ  
ABT/IGERT project

**Table 7**  
Number of Publications by Discipline Type \*

**Data for IGERT Authors**

Discipline Type	Publication Year					1999-2003
	1999	2000	2001	2002	2003	
Single Field Authors	13	14	14	20	9	70
Multiple Subfield Authors	63	48	40	33	34	218
Multiple Field Authors	512	562	534	471	428	2507
Outside Field Authors	33	37	17	21	23	131
<b>Total</b>	<b>621</b>	<b>661</b>	<b>605</b>	<b>545</b>	<b>494</b>	<b>2926</b>

**Data for Control Authors**

Discipline Type	Publication Year					1999-2003
	1999	2000	2001	2002	2003	
Single Field Authors	17	15	16	11	17	76
Multiple Subfield Authors	29	38	28	46	37	178
Multiple Field Authors	383	376	357	342	410	1868
Outside Field Authors	29	23	14	15	18	99
<b>Total</b>	<b>458</b>	<b>452</b>	<b>415</b>	<b>414</b>	<b>482</b>	<b>2221</b>

\* Definition of Discipline Types

Single Field Authors	Researcher publishes only within own field, and only within one subfield
Multiple Subfield Authors	Researcher publishes only within own field, but in multiple subfields
Multiple Field Authors	Researcher publishes within own field AND in other fields
Outside Field Authors	Researcher publishes only outside own field

Copyright © 2005 iplQ  
ABT/IGERT project

**Table 8**  
Number of Researchers by Publication Spread

Data for IGERT Authors		Data for Control Authors	
Number of fields including own	Number of researchers	Number of fields including own	Number of researchers
2	79	2	45
3	62	3	55
4	34	4	26
5	15	5	9
6	7	6	5
7	1	7	0
8	1	8	0
9	1	9	0
2 or more	200	2 or more	140
Ave # flds per researcher	3.105	Ave # flds per researcher	3.1

Copyright © 2005 iplQ  
ABT/IGERT project

**Table 9**  
Number of Citations by Publication Year

Publication Year	IGERT Authors		Control Authors	
	Citations	Publications	Citations	Publications
1999	14823	621	9211	458
2000	14013	661	6265	452
2001	8722	605	5366	415
2002	5786	545	3132	414
2003	2244	494	1642	482
1999-2003	45588	2926	25616	2221

Copyright © 2005 iplQ  
ABT/IGERT project

**Table 10**  
Number of Citations by Author's Discipline  
Citations per Paper is found by dividing the number of Citations by No. of Pubs)

## Data for IGERT Authors

	No. of Authors	No with Pubs	No. of Pubs	Publication Year					1999-2003
				1999	2000	2001	2002	2003	
Clinical Medicine	20	19	264	1712	1758	908	486	233	5097
Biomedical Research	55	49	553	2311	1445	1487	1150	426	6819
Biology	31	29	330	2461	2543	1436	1061	256	7757
Chemistry	34	29	395	1893	1791	1237	847	263	6031
Physics	20	19	249	1780	1873	1129	441	335	5558
Earth & Space	16	12	112	659	1394	573	649	229	3504
Engineering & Tech	107	84	779	2945	2636	1490	801	372	8244
Psychology	17	15	135	696	364	362	181	105	1708
Mathematics	13	9	45	264	62	53	63	11	453
Social Science	24	14	43	79	84	39	49	9	260
Professional Fields	0	0	0	0	0	0	0	0	0
Health Science	0	0	0	0	0	0	0	0	0
Humanities	7	5	21	23	63	8	58	5	157
All Fields Combined	344	284	2926	14823	14013	8722	5786	2244	45588

## Data for Control Authors

	No. of Authors	No with Pubs	No. of Pubs	Publication Year					1999-2003
				1999	2000	2001	2002	2003	
Clinical Medicine	11	11	162	786	578	618	421	104	2507
Biomedical Research	49	48	468	1828	1886	1868	825	435	6842
Biology	20	19	198	1126	615	472	240	112	2565
Chemistry	29	29	453	2630	1329	1072	852	513	6396
Physics	1	1	6	74	22	0	0	2	98
Earth & Space	17	15	146	382	173	247	90	77	969
Engineering & Tech	81	64	597	1864	1339	832	542	318	4895
Psychology	4	4	44	122	71	53	50	30	326
Mathematics	10	8	54	57	109	47	24	27	264
Social Science	23	15	90	342	143	157	87	22	751
Professional Fields	0	0	0	0	0	0	0	0	0
Health Science	0	0	0	0	0	0	0	0	0
Humanities	4	2	3	0	0	0	1	2	3
All Fields Combined	249	216	2221	9211	6265	5366	3132	1642	25616

Copyright © 2005 iplQ  
 ABT/IGERT project

**Table 11**  
 Number of Citations by Publication Field  
 (Citations per Paper is found by dividing the number of Citations by No. of Pubs)

Data for IGERT Authors

	No. of Authors	No with Pubs	No. of Pubs	Publication Year					1999-2003
				1999	2000	2001	2002	2003	
Clinical Medicine	20	19	264	4040	3555	2344	1364	426	11729
Biomedical Research	55	49	553	4664	4399	2505	1824	811	14203
Biology	31	29	330	341	125	284	148	77	975
Chemistry	34	29	395	1885	1725	1390	754	333	6087
Physics	20	19	249	1991	1726	953	647	205	5522
Earth & Space	16	12	112	670	1471	464	678	202	3485
Engineering & Tech	107	84	779	940	629	531	178	162	2440
Psychology	17	15	135	194	268	100	110	14	686
Mathematics	13	9	45	13	14	86	18	7	138
Social Science	24	14	43	71	50	23	46	0	190
Professional Fields	0	0	0	5	2	24	5	0	36
Health Science	0	0	0	7	49	16	8	7	87
Humanities	7	5	21	2	0	2	6	0	10
All Fields Combined	344	284	2926	14823	14013	8722	5786	2244	45588

Data for Control Authors

	No. of Authors	No with Pubs	No. of Pubs	Publication Year					1999-2003
				1999	2000	2001	2002	2003	
Clinical Medicine	11	11	162	1487	841	893	506	298	4025
Biomedical Research	49	48	468	3079	2222	1976	1222	485	8984
Biology	20	19	198	278	262	216	59	46	861
Chemistry	29	29	453	2124	1260	1242	781	372	5779
Physics	1	1	6	918	739	426	228	245	2556
Earth & Space	17	15	146	582	345	227	118	81	1353
Engineering & Tech	81	64	597	393	382	224	139	77	1215
Psychology	4	4	44	148	71	87	47	18	371
Mathematics	10	8	54	48	73	43	6	8	178
Social Science	23	15	90	143	70	22	18	8	261
Professional Fields	0	0	0	0	0	10	1	4	15
Health Science	0	0	0	11	0	0	6	0	17
Humanities	4	2	3	0	0	0	1	0	1
All Fields Combined	249	216	2221	9211	6265	5366	3132	1642	25616

Copyright © 2005 iplQ  
ABT/IGERT project

**Table 12**  
Number of References by Author's Discipline  
(References per Paper is found by dividing the number of References by No. of Pubs)

Data for IGERT Authors

	No. of Authors	No with Pubs	No. of Pubs	Publication Year					
				1999	2000	2001	2002	2003	1999-2003
Clinical Medicine	20	19	<b>264</b>	1934	2092	2198	1826	1874	9924
Biomedical Research	55	49	<b>553</b>	2929	3126	2993	3195	3364	15607
Biology	31	29	<b>330</b>	2646	3019	3028	2839	2201	13733
Chemistry	34	29	<b>395</b>	2483	2421	2505	2483	2135	12027
Physics	20	19	<b>249</b>	1321	1228	1750	986	1061	6346
Earth & Space	16	12	<b>112</b>	650	1168	873	1111	1003	4805
Engineering & Tech	107	84	<b>779</b>	3246	3771	3273	2780	2280	15350
Psychology	17	15	<b>135</b>	596	1180	981	1124	950	4831
Mathematics	13	9	<b>45</b>	269	195	324	236	214	1238
Social Science	24	14	<b>43</b>	174	138	250	163	150	875
Professional Fields	0	0	<b>0</b>	0	0	0	0	0	0
Health Science	0	0	<b>0</b>	0	0	0	0	0	0
Humanities	7	5	<b>21</b>	60	192	36	274	106	668
All Fields Combined	344	284	<b>2926</b>	16308	18530	18211	17017	15338	85404

Data for Control Authors

	No. of Authors	No with Pubs	No. of Pubs	Publication Year					
				1999	2000	2001	2002	2003	1999-2003
Clinical Medicine	11	11	<b>162</b>	1400	1398	1807	1324	1207	7136
Biomedical Research	49	48	<b>468</b>	2680	2790	2599	2940	4327	15336
Biology	20	19	<b>198</b>	1852	1562	1671	1369	1367	7821
Chemistry	29	29	<b>453</b>	2997	2578	2427	3128	2706	13836
Physics	1	1	<b>6</b>	105	28	0	0	32	165
Earth & Space	17	15	<b>146</b>	745	678	791	730	945	3889
Engineering & Tech	81	64	<b>597</b>	2894	2718	2466	2377	2678	13133
Psychology	4	4	<b>44</b>	82	219	352	201	598	1452
Mathematics	10	8	<b>54</b>	95	174	111	134	389	903
Social Science	23	15	<b>90</b>	632	310	515	684	497	2638
Professional Fields	0	0	<b>0</b>	0	0	0	0	0	0
Health Science	0	0	<b>0</b>	0	0	0	0	0	0
Humanities	4	2	<b>3</b>	5	0	0	23	30	58
All Fields Combined	249	216	<b>2221</b>	13487	12455	12739	12910	14776	66367

Copyright © 2005 iplQ  
ABT/IGERT project

**Table 13**  
Number of References by Author's Discipline and Publication Field

Data for IGERT Authors

	Researcher Discipline										
	Clinical Medicine	Biomedical Research	Biology	Chemistry	Physics	Earth & Space Science	Engineering & Technology	Psychology	Mathematics	Social Science	Professional Fields
Clinical Medicine	6276	4312	4525	657	651	1	1248	2374	383	42	0
Biomedical Research	2662	7041	5989	2433	1519	967	2187	655	460	141	0
Biology	44	277	2242	75	15	88	198	11	42	170	0
Chemistry	26	1609	28	6129	294	74	3131	0	11	0	0
Physics	128	940	183	2311	3625	199	3707	62	191	3	0
Earth & Space	2	571	234	139	22	3409	826	1	0	84	0
Engineering & Tech	25	480	164	216	184	46	3444	61	83	8	0
Psychology	663	142	223	0	4	0	54	1465	11	41	0
Mathematics	12	50	26	26	22	11	232	13	50	25	0
Social Science	0	3	71	2	0	1	67	10	0	319	0
Professional Fields	14	2	2	1	0	0	131	3	0	6	0
Health Science	38	83	7	0	1	0	12	134	0	16	0
Humanities	0	0	2	1	0	0	2	19	0	7	0
Unknown	34	97	37	37	9	9	111	23	7	13	0
All Fields Combined	9924	15607	13733	12027	6346	4805	15350	4831	1238	875	0

Data for Control Authors

	Researcher Discipline										
	Clinical Medicine	Biomedical Research	Biology	Chemistry	Physics	Earth & Space Science	Engineering & Technology	Psychology	Mathematics	Social Science	Professional Fields
Clinical Medicine	4290	4756	402	57	0	23	372	323	6	170	0
Biomedical Research	2384	8648	3734	1744	40	329	1626	80	8	855	0
Biology	45	139	3125	87	0	138	265	29	3	633	0
Chemistry	21	697	41	8406	53	314	3925	1	0	5	0
Physics	133	489	31	3015	69	1038	2569	5	410	73	0
Earth & Space	1	17	204	43	0	1902	1875	0	8	73	0
Engineering & Tech	2	242	15	428	2	101	1979	0	96	29	0
Psychology	216	200	152	1	0	0	11	918	0	117	0
Mathematics	0	18	12	23	1	12	173	3	364	19	0
Social Science	7	4	31	0	0	4	79	44	3	493	0
Professional Fields	1	0	1	1	0	0	137	20	3	48	0
Health Science	10	15	0	0	0	1	5	15	0	97	0
Humanities	1	0	2	0	0	0	0	1	0	7	0
Unknown	25	111	71	31	0	27	117	13	2	19	0
All Fields Combined	7136	15336	7821	13836	165	3889	13133	1452	903	2638	0

Copyright © 2005 iplQ  
 ABT/IGERT project

**Table 14**  
 Number of Institutions on a Publication by Author's Discipline

	<b>IGERT Authors</b>	<b>Control Authors</b>
<b>Clinical Medicine</b>	1.42	1.16
<b>Biomedical Research</b>	1.89	1.29
<b>Biology</b>	1.86	2.15
<b>Chemistry</b>	1.05	1.35
<b>Physics</b>	*	*
<b>Earth &amp; Space</b>	2.16	2.42
<b>Engineering &amp; Tech</b>	1.32	1.19
<b>Psychology</b>	*	*
<b>Mathematics</b>	1.49	1.7
<b>Social Science</b>	1.23	1.92
<b>Professional Fields</b>	*	*
<b>Health Science</b>	*	*
<b>Humanities</b>	*	*

\* Too few researchers to effect a meaningful comparison



Copyright © 2005 iplQ.  
ABT/IGERT project

**Table 15**  
Number of Institutions on a Publication

IGERT Authors		Control Authors	
No. of Departments	Pubs with this No. of Departments	No. of Departments	Pubs with this No. of Departments
0	1	0	4
1	1333	1	1122
2	926	2	714
3	433	3	258
4	150	4	76
5	47	5	23
6	14	6	12
7	4	7	3
8	2	8	5
<b>Total</b>	<b>2910</b>	<b>Total</b>	<b>2217</b>

Copyright © 2005 iplQ  
ABT/IGERT project

**Table 16**  
Number of Departments on a Publication

IGERT Authors		Control Authors	
No. of Departments	Pubs with this No. of Departments	No. of Departments	Pubs with this No. of Departments
0	1	0	4
1	1121	1	1053
2	927	2	658
3	543	3	313
4	215	4	115
5	75	5	55
6	24	6	17
7	11	7	5
8	4	8	0
<b>Total</b>	<b>2926</b>	<b>Total</b>	<b>2221</b>

NATIONAL SCIENCE FOUNDATION  
ARLINGTON, VA 22230

OFFICIAL BUSINESS

RETURN THIS COVER SHEET TO ROOM P35 IF  
YOU DO NOT WISH TO RECEIVE THIS  
MATERIAL . OR IF CHANGE OF ADDRESS IS  
NEEDED . INDICATE CHANGE INCLUDING ZIP  
CODE ON THE LABEL (DO NOT REMOVE LABEL).