

Networks and the Diffusion of Cutting-Edge Teaching and Learning Knowledge in Sociology

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INTRODUCTION How are transformational ideas and practices produced and diffused in an academic discipline? Does a new technology lead to more widespread dissemination of cutting-edge teaching and learning materials? Does it lead to changes in the connections and characteristics of sociology faculty members involved in the production and consumption of teaching and learning knowledge? Or, are social interventions necessary to broaden the scope of usage and patterns? This research brief is based on the findings from a National Science Foundation-funded study.

The study compares the characteristics of consumers of the American Sociological Association's (ASA) new interactive, peer-reviewed Teaching Resource and Innovative Library in Sociology (TRAILS) in 2010 with those of a now-defunct paper-based library of paper materials in 2008 (the Teaching Resources Center or TRC). The TRAILS library is designed to host and disseminate cutting-edge scholarship of teaching and learning. We compare TRC users in 2008 with "early adopters," who subscribed to TRAILS during the first six months after its launch in May 2010. We also compare the participation of consumers and producers of teaching and learning knowledge in a teaching and learning network in 2008 and in 2010, before and after TRAILS' launch.

The purpose of TRAILS is three-fold:

1. To expose faculty members to a wide range of cutting-edge ideas and innovative teaching techniques;
2. To disseminate cutting-edge instructional

materials and strategies to a more diverse group of faculty and schools; and

3. To increase the size and scope of a scholarship of teaching and learning network through mobilizing new participants.

The rationale for the study is the rapid growth of digital science libraries on the internet. An important subset aims to make cutting-edge science education materials available. Are materials more likely to be diffused through digital libraries than through paper-based libraries? Existing literature suggests that diffusion of innovative teaching materials may not be a technological process alone.

NETWORKS Network analysis is distinguished by the attention it pays to the links and relations among actors, organizations, and activities within a social system (Rogers 2003; Wasserman and Faust 1994). Links or ties among participants, potential recruits, and the activities in which they participate are necessary for network formation, continuation, and growth. Prior social ties are seen as the basis for recruitment and diffusion that is thought to occur along existing lines of interaction (Diani and McAdam 2003). Those networks with dense ties are viewed as the most successful in bringing about change (Rogers 2003). The density of adherents and the diffusion of knowledge can be examined through the application of network analysis. Existing literature suggests that the mere introduction of technological innovations into new segments of social networks do not guarantee diffusion into these segments (Abrahamson and Rosenkopf 1997).

¹ The study is titled *Innovation in Digital Libraries: An Experimental Examination of the Production, Diffusion, and Use of STEM Teaching Materials*.

We decided to use an affiliation network design to determine if there was a network of teaching and learning scholars in sociology in 2008 that would expand with the formal launch of TRAILS in 2010. An affiliation network captures relationships between individuals who are linked to each other by a set of overlapping group memberships (affiliations). Two individuals are assumed to be connected when they participate in at least one activity together. We examined this network by looking at the characteristics of and linkages among both consumers and producers of teaching and learning knowledge before and after the launching of TRAILS.

DEFINITION OF CONSUMERS AND PRODUCERS

Network membership was made operational by finding if faculty participated in at least 1 out of 13 possible ASA-centered activities either as consumers or producers of teaching and learning knowledge. The 13 activities included 3 consumption and 10 production activities. They are shown in Table 1. The only difference in the 2008 and the 2010 lists is that the purchase of ASA's former paper-based Teaching Resources Center (TRC) materials, as well as the contributions to and editing of TRC materials in 2008, were replaced with subscriptions to TRAILS and the submission to and editing of teaching and learning materials in TRAILS in 2010.

WHY THIS DISTINCTION? Each type of activity entails different modes of network participation. Consumption of teaching and learning materials is a one-way process in which consumers do not generally have much input into the kind of knowledge that is being produced, although they can have some influence through writing letters to the editor of the journal or making comments and asking questions at

TABLE 1. Number of Participants in ASA-Sponsored Teaching and Learning Activities in 2008 and 2010.

Type of Activity	Number of Participants	
	2008	2010
Consumption Activities		
Subscribed to Teaching Sociology	1,010	898
Was a member of the Teaching and Learning Section	436	430
Bought TRC materials in 2008 or subscribed to TRAILS in 2010	365	316
Production Activities		
DRG (Department Resource Group) member	36	31
Participated in teaching and learning Task Force groups	35	7
Served on the Teaching and Learning Section's committees ^a	37	46
Served on editorial board for Teaching Sociology	29	34
Reviewed for Teaching Sociology	93	90
Published at least one article in Teaching Sociology	53	51
Presented teaching and learning research at ASA conference	54	19
Led a teaching and learning workshop at ASA conference	40	14
Edited TRC materials in 2008 or Edited for TRAILS in 2010	6	26
Contributed to TRC materials in 2008 or TRAILS in 2010	134	7
Total faculty in the teaching and learning network	1,490	1,260
Total faculty in the study	5,445	5,234

^a Includes Section officers and committee members.

section panels and business meetings. In contrast, those who produce, edit, and review materials are engaged in interaction with other producers.

HYPOTHESES We hypothesized that there would

be diffusion of teaching and learning knowledge as a result of TRAILS. But, without strategic social interventions, such as discounted TRAILS subscriptions for sociology departments, the technological innovation would not produce changes in the characteristics of consumers of teaching and learning materials, nor the size and structure of the teaching and learning network.

SOURCES OF DATA In data collection for this project, we relied on unobtrusive methods and secondary data. The primary source of data is the ASA membership database, which includes information on members' demographic characteristics, including gender and education; institutional characteristics of members' employers; participation in ASA activities; and purchase of materials and other services. In first studying the TRC, we included 5,445 faculty members who in 2008 were ASA regular, associate, or emeritus members; employed by a U.S. higher education institution; and in a full-time or part-time teaching position. Missing information was obtained through web searches by looking up faculty CVs, biographies on departments' web pages, etc. The ASA membership database information was merged with ASA records on faculty participation in the 13 teaching and learning activities in the period from 2006-2008. Employing institutions were categorized according to 2005 Carnegie classification. In October 2010, six months after the launching of TRAILS, we created a new database of 5,234 faculty that included faculty characteristics and information on their participation in 13 teaching and learning activities for 2010. Since TRAILS is an ASA-sponsored library, we have immediate and direct access to information on who produces and consumes teaching and learning materials.

In addition to network analysis, we conducted two types of multivariate regression analyses to enrich the findings from the network analysis. First, we investigated the significant characteristics of those who purchased TRC materials in 2008 and later, the significant characteristics of those who subscribed to TRAILS in 2010. Because both of our dependent

variables are dichotomous, we employed logistic regression as the most appropriate statistical tool for this set of analyses. To analyze the pattern of participation in the teaching and learning network, we also conducted regression analyses to identify characteristics of the faculty who participated in multiple teaching and learning activities in 2008 and 2010. We used negative binomial regression as our statistical tool in this set of analyses.²

FINDINGS

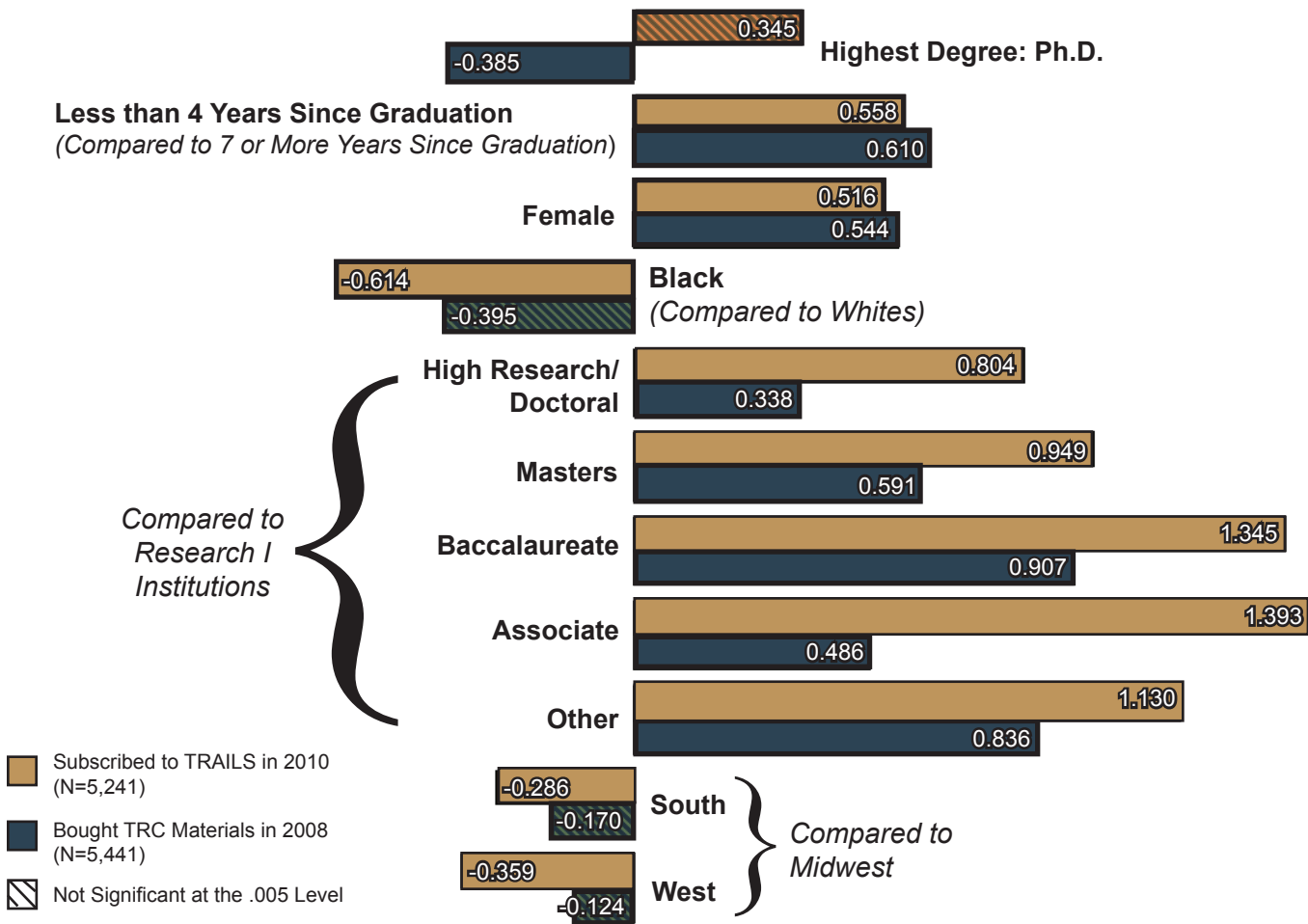
Characteristics of TRAILS Subscribers Compared to TRC Purchasers Did Not Change.

The regression analysis (see Figure 1) shows that women, early career faculty, faculty with Master's degrees, faculty from non-research universities were more likely to buy TRC materials. Men, faculty members at research-extensive institutions, and those with PhDs were less likely to buy TRC materials. We did not find statistically significant differences in TRC purchasing for racial/ethnic minorities, faculty from Historically Black Colleges and Universities (HBCUs) or across regions in 2008. TRAILS subscribers share many of the same characteristics as TRC users.

Just as with TRC users, TRAILS subscribers are significantly more likely to be women, early career faculty, and faculty from non-research universities (compare findings from 2008 with findings from 2010 in Figure 1). Faculty members with PhDs are more likely to subscribe to TRAILS; however, this finding is not statistically significant. We also find that African American faculty and faculty in the South and West of the country were less likely to subscribe to TRAILS than was the case for the purchase of paper-based TRC materials. The regression analysis does suggest some shift in the scope of schools that are materials users. The difference in the likelihood of subscribing to TRAILS between research-extensive (Research I) schools and other types of schools is even greater than it was in the likelihood of purchasing paper-based TRC materials. In other words, the early adopters of this new technology are similar, though not identical,

² We used negative binomial regression because our dependent variables here were counts of activities and because the observations were over-dispersed with respect to Poisson regression (that is, both 2008 and 2010 sample variances exceeded sample means).

FIGURE 1. Characteristics of TRC Buyers and TRAILS Subscribers



Pseudo Log Likelihood
 2010 Model = -1125.6
 2008 Model = -1288.1

^a Variables '4 to 6 Years since Graduation', 'Asian', 'Hispanic', 'Other Race/Ethnicity', 'HBCU,' and 'Northeast Region' do not have statistically significant effects in both models. These variables and controls for missing education and race/ethnicity are included in the models but not shown here.
^b Standard errors are adjusted for clustering on department.

to the prior purchasers of paper-based materials. The new technology does not appear to have increased the scope of users of the cutting-edge teaching and learning materials but instead created a wider gap between the institutional characteristics of users and non-users of the teaching and learning materials.

Little Change in the Network Since the Launch of TRAILS. After the implementation of TRAILS the density of the teaching and learning network in sociology remained the same. The network diagrams (in Figures 2 and 3) show that there was little change

between 2008 and 2010. However, as Figure 3 shows, faculty participating in the ASA Teaching and Learning Task Forces became disconnected from the rest of the network in 2010 as some of the Task Forces completed their work. The proportion of faculty involved in the teaching and learning activities remains practically the same at about 25 percent, even though there have been some changes in the number of faculty involved in some of the activities (see Table 1). The network's density remains exactly the same (an average of 1.6 activities per person out of a possible 13). The density of a network is important because it facilitates the

Key

■ Activities

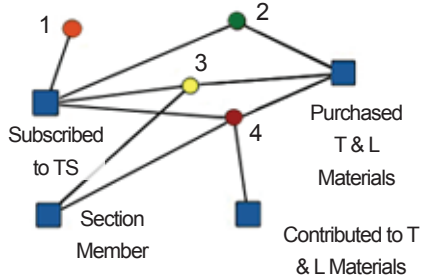
Faculty by Type of Institution

- Research I
- High Research and Doctoral
- Masters
- Baccalaureate
- Two-Year
- Special Focus/Tribal/
- Unclassified

T & L Teaching and Learning

TS Teaching Sociology

How to Read the Network Graph



Faculty's Activities

- 1. Subscribed to *Teaching Sociology* only.
- 2. Subscribed to *Teaching Sociology* and purchased Teaching and Learning materials.
- 3. Subscribed to *Teaching Sociology*, purchased Teaching and Learning materials, and joined the Teaching and Learning section.
- 4. Subscribed to *Teaching Sociology*, purchased Teaching and Learning materials, joined the Teaching and Learning Section, and contributed to Teaching and Learning matters.

FIGURE 2. Sociology Teaching and Learning Network in 2008

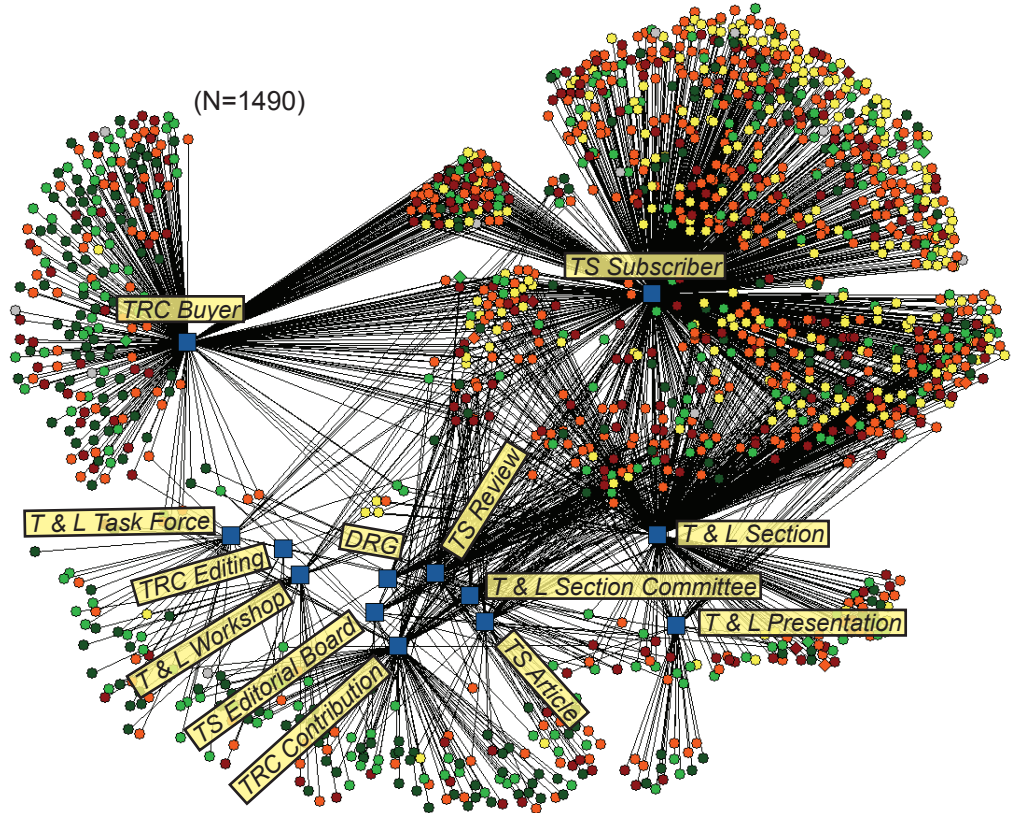


FIGURE 3. Sociology Teaching and Learning Network in 2010

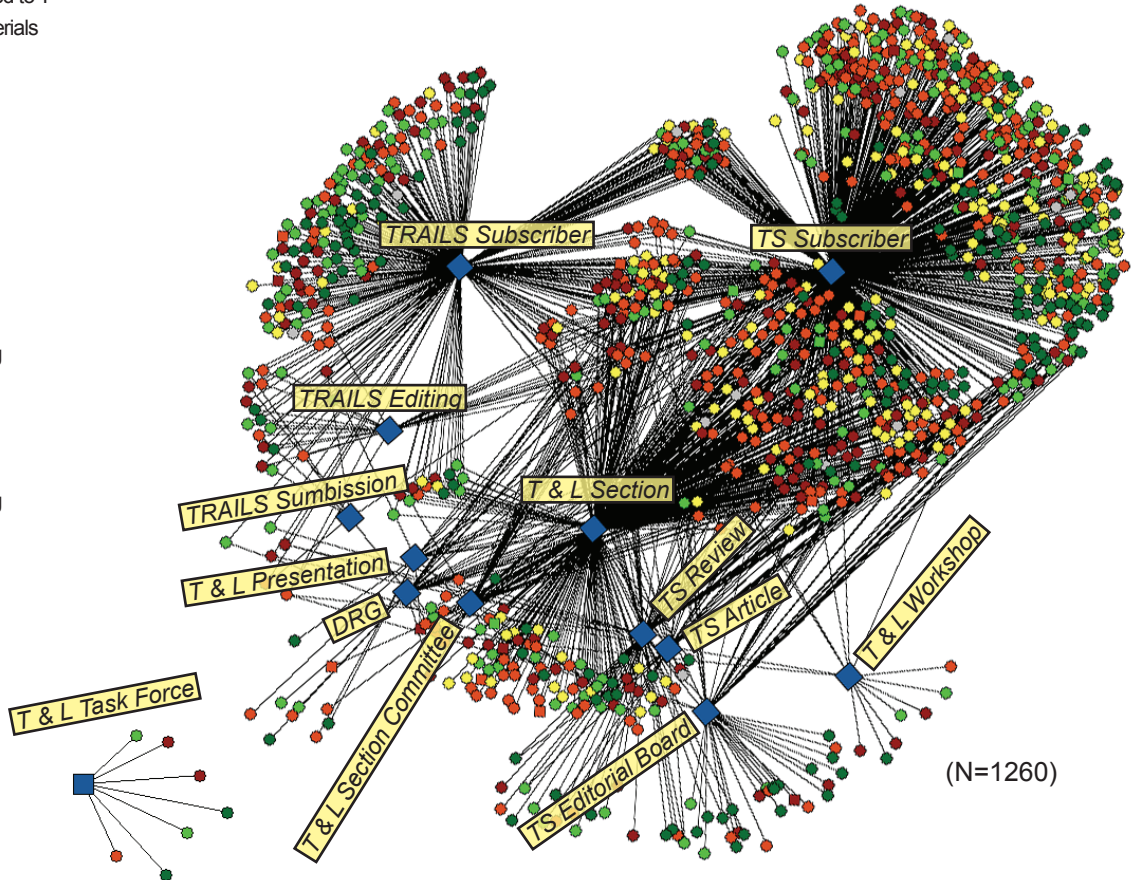
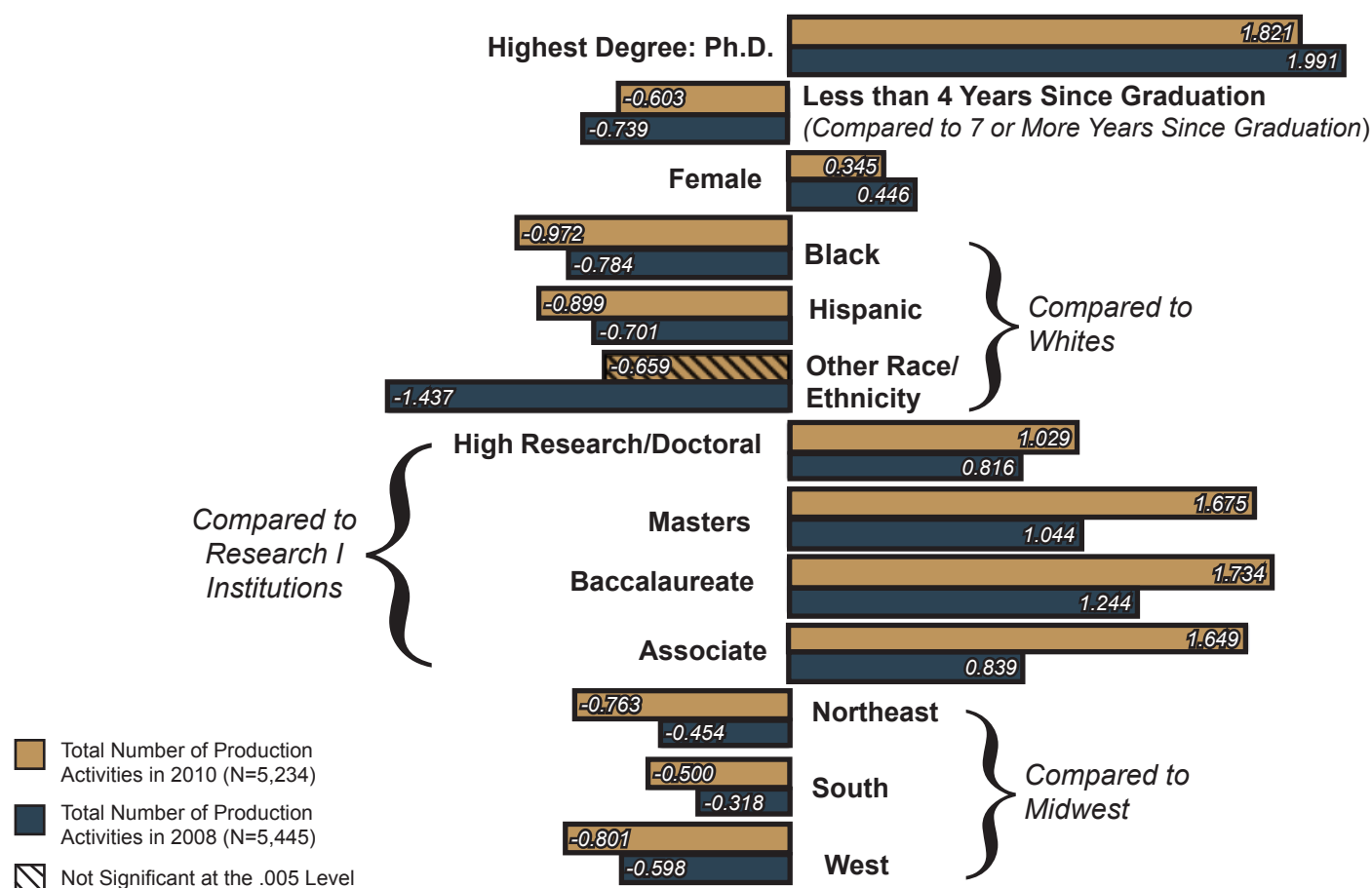


FIGURE 4. Production Teaching and Learning Activities in 2008 vs 2010

Pseudo Log Likelihood

2010 Model = 5097.79

2008 Model = 5585.55

^a Variables '4 to 6 Years since Graduation', 'Asian', 'Hispanic', 'Other Race/Ethnicity', 'HBCU,' and 'Other Institutions' do not have statistically significant effects in both models. These variables and controls for missing education and race/ethnicity are included in the models but not shown here.

^b Standard errors are adjusted for clustering on department.

speed with which ideas and information travel through the network and with which resources can be mobilized if action is necessary.

Consumption activities remain the most frequent activities in the network and production activities remain the least frequent. In fact, in 2010 we observe a drop in some production activities. Submission of materials to TRAILS, the number of presentations and teaching and learning workshops, and the number of Task Force members all decreased in number, and only the number of TRAILS editors has grown significantly in 2010 compared to 2008 TRC editors. Participation

in consumption activities, on the other hand, has not changed much. TRAILS subscribers make up the same proportion of the network in 2010 as did users of TRC materials in 2008 (about 25 percent), but they are slightly more embedded within the network; 53 percent of TRAILS subscribers are involved in some other teaching and learning activities compared to 47 percent for TRC users.

The Network Has a Core. Another important finding is that centralization of this network has not yet changed. Both 2008 and 2010 teaching and learning networks are highly centralized (degree centralization

indexes are 67 and 70 percent for 2008 and 2010 respectively). A high degree of centralization in an affiliation network means that only a small group of network members participate in overlapping activities. In both years, the majority of faculty members in the teaching and learning network were involved in only one activity (64 percent for both 2008 and 2010). In both years we can find a tight and small group of faculty who tend to participate in multiple activities, especially in multiple production activities.

Only six percent of faculty in 2008 and five percent of faculty in 2010 participated in two or more production activities. We call these faculty members the core or center of the teaching and learning network. Faculty at the core of the network may coordinate its activities not only through participation in activities together but also through their rotation between leadership positions. We find that the center of the network remains stable over time. A majority (73 percent) of faculty in the center of 2008 network participated in at least two production activities in years 2006 and/or 2007, and they made up the majority (63 percent) of the central faculty in 2010.

The core faculty in both 2008 and 2010 were involved in production activities such as membership in the Department Resources Group, review activities for publication in *Teaching Sociology*, and officership in the Teaching and Learning Section. What is even more interesting is that if we analyze the pattern of overlapping memberships in the activities, these are among the most central activities in the network. Consumption activities, despite their having many more participants, are not the most central activities.

The three most central activities in the 2008 network were all production activities: membership in the Department Resources Group, reviewing for *Teaching Sociology*, and service as a Teaching and Learning Section officer.³ However, centrality of the activities in the teaching and learning network have slightly shifted after the launch of TRAILS in 2010; the top two

activities remain the same, but Teaching and Learning Section's officership has given way to the "editing" of TRAILS materials. This suggests that the recruitment of TRAILS editors has targeted the most influential faculty from the teaching and learning network, and these faculty members will now have a chance to decide on the most influential approaches to teaching and learning issues in sociology through TRAILS.

Non-Research Intensive Institutions Dominate.

Faculty members from non-research institutions of higher education continue to dominate the network and especially, its productive core. About the same low percent of network participants from research-extensive (Research I) schools participated in the 2010 network as in 2008 network (16 percent and 17 percent, respectively).⁴ Just as in 2008, women get involved in more teaching and learning activities, as do faculty from non-research universities, and faculty from the Midwest. And just as in 2008, racial/ethnic minorities, early career faculty, and faculty members with a degree less than a PhD are involved in fewer teaching and learning activities. Figure 4, based on the regression models, shows these findings.

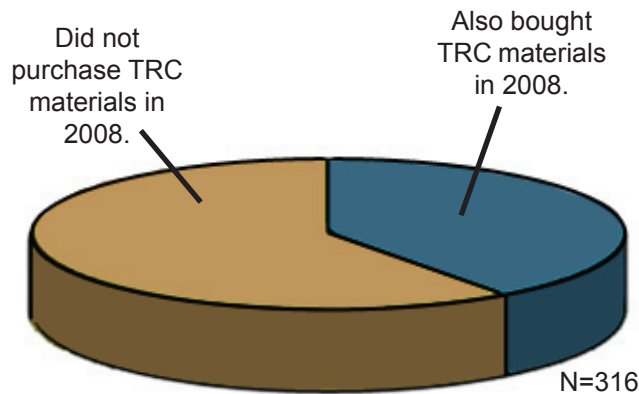
Networks Play a Role in Early TRAILS Adoption.

Finally, networks have been important for early TRAILS adoption. Early adoption is promoted through the teaching and learning network in sociology and through departments. We find that about 40 percent of the early TRAILS users purchased paper-based teaching and learning materials in the last three years of TRC materials' existence (2006-2008). The rest of the adopters were new users of the teaching and learning materials. The new TRAILS adopters were not, however, totally disconnected from the TRC purchasers: more than 40 percent of them had participated in some other teaching and learning activities during the three years prior to abandonment of paper-based materials. Also 80 percent of new users came from the same departments as 2006-2008 TRC purchasers (See Figures 5, 6, and 7). These findings suggest the importance of networks in the use of a new

³ This finding is based on the eigenvector centrality scores for activity overlap matrix with adjustment for the number of participants in activities (see Bonacich 1972).

⁴ Faculty members from research-extensive (Research I) schools make up 40 percent of the faculty included in 2008 and 2010 samples.

FIGURE 5. 40% of all early adopters of TRAILS also purchased hardcopy TRC materials.



technological innovation that provides access to peer-reviewed teaching and learning materials. In other words, information about TRAILS is in fact spreading through the members of the teaching and learning network in sociology.

CONCLUSIONS AND NEXT STEPS

We found support for the study hypotheses. There was no significant change in consumer characteristics, except that there were fewer consumers from research universities. There were no significant changes in the size and structure of the network. But we also found that the teaching and learning network and departmental networks were important for the early adopters of TRAILS. Our findings are preliminary but robust, and we will have more up-to-date data toward the end of the project.

Further research will investigate not only update patterns in TRAILS adoption, but also social interventions as a strategy to expand the scope of user characteristics and network participation. Therefore, in the next phase of the study, we will answer the following research questions:

1. Do more people from a broader scope of institutional types and departments become involved in action-oriented production activities during the second six months of TRAILS? Does the process of diffusion of this innovation follow an "S-shaped curve?"
2. Do strategic social interventions increase network participation and change the factors that predict adoption of the digital materials? These strategies could, for example, include departmental memberships with discounts to faculty subscribers in those departments and especially at Historically Black Colleges and Universities (HBCUs).
3. Can TRAILS alone affect the actual classroom use of innovative teaching and learning strategies and ideas, or is this use also dependent on the scholarship of teaching and learning network in sociology as well as departmental support of TRAILS?

FIGURE 6. 42% of new TRAILS subscribers participated in teaching and learning activities between 2006 and 2008, also purchased hardcopy TRC materials.

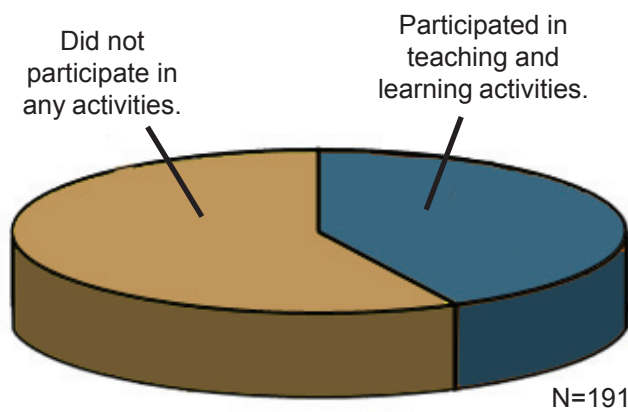
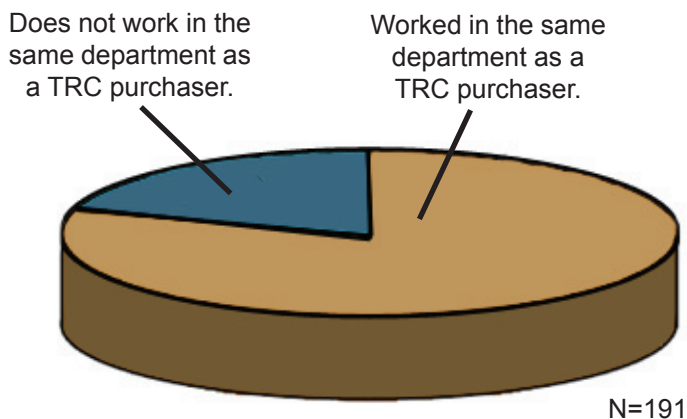


FIGURE 7. 80% of new TRAILS subscribers came from the same departments as TRC purchasers.



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