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RESEARCH NOTE

ABSTRACT Researchers interested in the structure of scientific fields have documented increases in specialization and collaboration. How, if at all, are these two trends related? Is specialization so severe that scholars cannot collaborate unless they share specific research interests? Or, have specializing tendencies promoted research that joins specialty areas and broaches new topics? We answer these important questions for a single discipline, sociology, using both qualitative interviews and latent profile analysis. We empirically identify three collaborative styles that depend on both the areas and extent of specialization in coauthors' research programs. The prominence of the *reinforcing generalist* profile suggests that specialization in science mainly serves to encourage scholars to work with others in their specialty area. However, the existence of two other styles – a more complementary one and one that is characterized by migration into new intellectual terrain – suggests that subfields within sociology are permeable enough to permit boundary-spanning, original research.

keywords coauthorship, collaboration, research teams, social science specialization

Research Specialization and Collaboration Patterns in Sociology

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Most scholars agree that increases in collaboration and specialization represent major shifts in scientific work organization (Blau, 1994; Wenger, 1998), but there is less agreement about the implications of these trends. Collaboration, a cornerstone of academic social activity (Hagstrom, 1965), is generally viewed positively. Despite the additional communication and organizational tasks involved in collaborating with other scholars, evidence suggests that collaboration is beneficial for individual scientists (Presser, 1980) and for scientific progress more generally (Hara et al., 2003). However, reactions to increasing specialization in science have been mixed. Some scholars are concerned that increasing specialization will foster divisions among specialists such that few people will understand or care about work being conducted outside their specialty area (Turner & Turner, 1990; Calhoun, 1992; Blau, 1994; Collins, 1994; Davis, 1994; Stinchcombe, 1994). This is especially true in sociology, the low-consensus discipline we investigate here, which has been referred to as an 'archipelago of poorly connected islands of specialization' (Calhoun, 1992: 25). Others (Kuhn, 1977, ch. 9) are more optimistic,

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viewing specialization as a foundation for cross-fertilization and innovation, even in sociology (Abbott, 2000, 2001).

Investigating the relationship between these two trends may shed some light on this debate. If increasing specialization is making scholars so specialized that they can collaborate only with fellow specialists in their subfields, then perhaps the critics are right: sociology is fragmenting to a deleterious degree. Hyper-specialization may be promoting productivity and depth of knowledge, but it is failing to push subfield boundaries in innovative directions. If increasing specialization is, on the other hand, serving as a springboard for innovative work – perhaps as specialists join their respective subfields in more complementary ways, or as generalists join with others when they investigate new topics – then concerns about fragmentation are unfounded. Rather than pigeonholing sociologists, specialization may expand horizons and move research forward in integrative and original ways (Dogan & Pahre, 1989).

In this paper we assess how scholarly specialization is related to styles of collaboration. This pushes the existing literature on this topic forward in several ways. First, instead of focusing on how specialization affects the *likelihood* of collaboration, as Moody (2004) and others have done, we turn our attention to patterns, or *styles*, of collaboration. Second, we consider not only the specialty area of the paper under study, but also the specialty areas represented in coauthors' research programs, which allows for an assessment of whether authors are moving into new lines of research – either through accretion or migration (Gieryn, 1978). Third, and perhaps most importantly, we present a new dimension of specialization: its extent. We contend that it is not only the areas in which scholars specialize, but also the extent to which they specialize that informs patterns of collaboration. Regardless of subfield, perhaps specialists are more likely to engage in *complementary* styles of collaboration, whereas generalists (given their diverse interests) can easily find prospective coauthors whose interests overlap their own, fostering a *reinforcing* style of collaboration. To inform the debate on the state of sociology, we offer an empirical assessment of how both the areas and extent of specialization shape styles of collaboration.

Background

Specialization is a defining characteristic of modern science (Dogan & Pahre, 1989, 1990), and this may be particularly true in social scientific fields that lack a theoretical, methodological, or even substantive core, such as sociology (Abbott, 2000). In the early 1930s, a single sociology journal captured the interest of most American Sociological Association (ASA) members; now hundreds of specialty journals and more than 40 ASA sections exist. Historical analyses of social change within science suggest that rapid growth of scientific fields (Kuhn, 1962) prompted scientists, who are invariably keen on carving out manageable bodies of literature and on fostering their professional visibility (Price, 1963; Ben-David & Collins, 1966), to carve out new professional niches – often in the guise of subdisciplines, or specialty areas.[1] Simply put, working within a specialty area

allows scientists to counteract overcrowding in their field, to stand out more easily, and to avoid being spread too thin (Hackett, 2005). These forces of growth and overcrowding were instrumental in creating the high degree of specialization that characterizes modern science (Wray, 2005).

Increasing specialization in science has directly or indirectly promoted collaboration. Dated (Cole & Zuckerman, 1975) as well as more recent (Moody, 2004) studies have documented a positive relationship between the growth of specialty areas and collaboration rates. This may be attributable to two factors. First, specialty areas are large and highly productive: even small subfields such as 'sociology of sport' have multiple journals; ASA sections such as 'sex and gender' and 'medical sociology' have more than 1000 members; and some areas of research, such as 'comparative and historical sociology', were the focus of almost 400 papers per year in the late 1990s. Thus, it may still be difficult for an individual researcher to digest all the literature in one specialty area, thereby encouraging collaboration with others in that area (Hudson, 1996). Second, some of the most innovative research and the most integrative theories arise from spanning specialty areas (Kuhn, 1977; Dogan & Pahre, 1989; Leahey, 2007). Although Collins (1986: 1355) argues that 'the easiest way to establish links among specialized viewpoints is to incorporate them into oneself', most researchers choose to find a collaborator who possesses the expertise that they lack (Wray, 2005). Collaborating may be the most efficient way for individuals with a fractional paper in them to produce a complete paper (Price, 1963), especially if the paper spans specialty areas, or is particularly complex, given that 'an individual scientist can seldom provide all the expertise and resources necessary to address complex research problems' (Hara et al., 2003: 952).

We delve more deeply into this relationship by considering additional dimensions of collaboration and specialization: we examine *styles* (not only the incidence) of collaboration and the *extent* (not only areas) of specialization. Reflecting field-level trends, scholars may be becoming more specialized by limiting their research agendas to one or a few subfields rather than branching out to cover diverse topics. How, if at all, does this impact the formation of research teams and collaborative relationships? Are teams now likely to be comprised of specialists? When specialists do join together, do they pair with scholars in similar areas that reinforce their own, or in different areas that complement their own? A *complementary* approach would be evident if one author typically studies area A, the other typically studies another specialty area (say, B), and they write a paper together that covers both A and B. A *reinforcing* approach would be evident if both authors have studied similar topics in the past (say, specialty area C), and the paper they proceed to write together is also on topic C. As Hudson (1996: 157) notes, 'the gains from collaborative work might result either from harnessing skill complementarities or from a sort of synergy where multiple contributors develop ideas that none would have developed on his or her own'. It may also be the case that specialists are likely to team up with generalists, who provide the breadth needed to contextualize and theorize specific study results.

The variables we use to identify collaborative styles – particularly the extent of specialization in coauthors' research programs – are new, but our

desire to produce a typology of collaboration strategies is not. Bozeman & Corley (2004) identified one type of collaborator that is particularly relevant to our interests: 'tacticians', who choose collaborators with skills that complement their own. In contrast, we classify papers (rather than scholars) and we assess skill complementarity by comparing coauthors' research interests as manifested in bibliometric sources rather than by self-report. As Crane (1969) documented in her study of rural sociologists, and as Mullins (1983) found in his work on theory groups, collaboration can also take place between mentors and their advisees. Indeed, Bozeman & Corley (2004) found another type of collaborator – the 'mentors' who work closely with junior colleagues and graduate students. This style of collaboration is likely to be crucial, given the increasingly tight academic labor market and concomitant pressure on graduate students and young faculty members to publish (Babchuk et al., 1999).

Research suggests that focusing on a single discipline, especially a social-scientific discipline, is advantageous. Becher (1990: 335) argues that the 'study of disciplines, as conventionally defined, yields a misleadingly simplified account of the nature of knowledge fields, and of their associated academic communities'. Mullins (1973, 1983) and Collins (1989, 1998) have shown that studying the intellectual and organizational *components* of disciplines reveals much about the origins, development state, and even future of scientific disciplines. However, much of our knowledge of disciplinary components emerges from observations of fast-moving specialty areas within physics (Crane, 1969), and the social sciences and humanities are still neglected in favor of 'hard' sciences (Guetzkow et al., 2004). Like others (Turner & Turner, 1990; Collins, 1994; Clemens et al., 1995; Babchuk et al., 1999; Abbott, 2000; Guetzkow et al., 2004; Moody, 2004) we help to fill this gap by focusing on the field of sociology. In terms of specialization, sociology is one of the few social scientific disciplines lacking a theoretical, methodological, *and* substantive core (Abbott, 2000); specialization is rife in all its forms. In terms of collaboration, sociology has experienced the fastest growth in collaboration between 1930 and 1980, relative to other social sciences (Babchuk et al., 1999).

Data and Measures

To understand how specialization informs collaborative styles, we employ various kinds of data and methods of analysis. Using data culled from secondary sources, we undertake a quantitative latent profile analysis to identify collaborative 'profiles' or styles. Because we agree with Melin (2000) that there have been few attempts to get empirically close to actual collaborative partnerships, we also interview authors of papers from each profile to better understand the motivations and strategies behind different styles of collaboration. Combining a quantitative, bibliometric analysis with qualitative interviews provides a wider perspective (Martin-Sempere et al., 2002) and helps us understand the 'rational choices individuals make that encourage collaborative research activity' (Babchuk et al., 1999: 18).

We began by selecting papers published in four social science journals during the year 2000.[2] Because the patterns we are exploring may differ across journal types, we sampled one prestigious, general journal (*American Sociological Review* [*ASR*]), two specialty journals (*Social Psychology Quarterly* [*SPQ*] and *Sociology of Education* [*SOE*]), and one interdisciplinary journal (*Social Science Research* [*SSR*]). We took as our sample the 71 coauthored papers that were published in these journals in the year 2000. A total of 148 unique individuals contributed to these 71 'focal' papers. Importantly, we used a conservative measure of collaboration: paper coauthorship (Price & Beaver, 1966; Merton, 1973; Martin-Sempere et al., 2002). This form of output is more tangible than other forms of collaboration (for example, sharing data, exchanging ideas, helping colleagues learn new techniques) and captures the two key elements of collaboration: working together for a common goal and sharing knowledge (Hara et al., 2003).

Although the journal paper serves as the unit of analysis, we needed to collect information about individual contributors in order to construct paper-level measures. We relied on keyword descriptors that Sociological Abstracts assigns to published papers.[3] We collected keyword descriptors for the 71 focal papers we sampled, and also for *all* papers that each of the 148 unique authors had published in the 10 years prior to publication of the focal paper (1990–2000). Based on keywords that describe both the focal paper and each coauthor's recent publication history, we constructed several paper-level measures to tap two dimensions of research specialization: area and extent.

Area(s) of Research Specialization

Topical Overlap among Coauthors

Using the keyword descriptors assigned to the authors' previous publications, we devised a way to measure similarity of coauthors' specialty areas prior to publication of the focal paper. We calculated the number of keywords that are common to *all* coauthors' publication histories (ALLSHARE). For example, if there were three authors, all of whom had the 'sociology of education' and the 'historical sociology' keywords in their publication histories, but no other keywords in common, their value for the variable ALLSHARE would be two. This measure ranges from 0 to 13, with '0' representing coauthors who had not published on the same topic in the past 10 years, and higher values representing those who share more specialty areas.

Topical Overlap between Coauthors' Areas and the Focal Paper's Areas

Two measures tap the degree of topical overlap between the coauthors' publication histories and the focal paper. Our first measure, FOCALMATCH, indicates the proportion of coauthors who have at least one keyword from their publication history that matches a keyword from their focal paper. This continuous measure ranges from 0 to 1, with 1 reserved for research teams for which *all* authors have previously published on the focal paper topic. Our second measure, FOCALMATCH_D, taps the maximum difference in the

degree to which coauthors' research programs map onto the focal paper topic. For example, if there are three authors on a focal paper, and 10% of the first author's keywords (culled from her previous publications) overlap with the focal papers' keywords, 35% of the second author's overlap, and 75% of the third author's overlap, then FOCALMATCH_D would equal 0.65 (0.75–0.10). If FOCALMATCH is high and FOCALMATCH_D is low, this suggests that all contributing authors to the focal paper have published on that topic previously. When values of both are low, this indicates that the authors collaborated on a topic new to all of them.

Extent of Research Specialization

The Extent of Research Specialization among Coauthors

To understand the average extent of research specialization represented by each research team, we first created an individual-level measure of the extent to which each contributor's research program is specialized. We pooled the keywords used to describe each scholar's publications between 1990 and 2000, creating a categorical distribution of keywords for each contributing author. With each author's distribution, we constructed a measure of research specialization using an available index of heterogeneity (Blau et al., 1982): Σp_i^2, where p_i represents the proportion of all the authors' keywords with keyword *i*. This measure ranges between the unlikely values of '0' (for a researcher whose publications each fall in a different specialty area) and '1' (for a researcher whose entire research program falls within one specialty area). An example of how we constructed this key measure is presented in appendix A. From this individual-level measure, we calculate its mean (EXTENT_M) and variance (EXTENT_V) for each paper's set of authors. Thus, a high mean suggests that the collaborators are specialists, a low mean suggests they are all generalists, and a high variance suggests that there is variation within the research team as to each author's extent of research specialization.

Because our specialization measures are constructed from keyword descriptors for papers in each author's publication history, authors with no previous publications (and the focal papers they contributed to) had to be excluded from some of our analyses. Of the 71 collaborative papers, ten had a coauthor with no previous publications, prohibiting us from creating paper-level measures, such as the mean and variance of research specialization. For this reason, we analyze 61 of the original papers in the sample. Although we analyze the other ten cases separately, we recognize that our multivariate analysis of 61 cases is only generalizeable to collaborations among minimally productive academics with experience publishing in top-tier journals like the ones we sampled.

Methods

To classify the collaborative papers, we use latent profile analysis. Latent profile analysis is a special case of mixture modeling, in which categorical

latent variables that represent subpopulations are derived from the intercorrelations of a user-defined set of continuous variables (Muthén, 2001). It is a more probabilistic form of cluster analysis, like latent class analysis, except that we use continuous rather than categorical variables to define the classes (therefore the classes may also be referred to as 'profiles' or what we call collaborative styles). To classify collaborative papers, we use variables (described above) that might distinguish papers in terms of specialization: ALLSHARE, FOCALMATCH, FOCALMATCH_D, EXTENT_M, and EXTENT_V. We use MPLUS version 3.1 to estimate the model and calculate the probability that each paper falls into each profile.

Because our interest is in collaboration styles, and because quantitative methods are inadequate to capture intention and motivation (Melin, 2000), we turn to qualitative inquiry to better understand authors' rationales for undertaking collaborative partnerships. We took a purposive sample of papers from each of the three collaborative styles identified in the latent profile analysis, with the goal of representing all four journals (*ASR, SPQ, SOE* and *SSR*).[4] Our goal was to obtain qualitative data from at least one of each paper's authors, if not more for triangulation purposes. We contacted 49 authors, and 21 (43%) agreed to participate. Between 2005 and 2006, we asked a series of questions to these authors over the telephone, or when necessary, via email.[5] We focused our questions on the focal paper and the research team involved in that particular collaborative arrangement. In addition to elucidating distinguishing characteristics of each profile, we aimed to verify our quantitative findings by asking respondents whether they agreed with the collaborative style their paper had been assigned to in the latent profile analysis.

Results

We begin by describing the sample of 61 collaborative papers. We then present results from the latent profile analysis and describe each collaborative profile. Throughout, we integrate the qualitative interview data to illustrate distinguishing characteristics of the collaborative styles.

Sample Description

As might be expected, papers from the four journals we sampled are rather diverse with respect to the areas of specialization that coauthors share (with each other and with the focal paper) and the extent to which their research is specialized (see Table 1). On average, coauthors had almost two keywords in common before publication of the focal paper (ALLSHARE mean = 1.8), though some had as many as 13. Most of the papers (64%) were written by scholars who had published on the focal paper topic previously (FOCALMATCH mean = 0.64). Moreover, most research teams were composed of scholars whose research programs are diverse (EXTENT_M mean = 0.17), though a few were clearly comprised of specialists (EXTENT_M

TABLE 1
Descriptive statistics for 61 collaborative papers: variables used to construct collaboration profiles

	Mean	SD	Min	Max
Area of research specialization				
ALLSHARE No. of descriptors common to all coauthors' publications	1.8	2.2	0	13
FOCALMATCH Proportion of coauthors with 1+ descriptor matching the focal paper	0.64	0.39	0	1
FOCALMATCH_D Max difference in proportions of each coauthor's paper that share a descriptor with focal article	0.31	0.32	0	1
Extent of research specialization				
EXTENT_M Mean of all coauthors' extent of specialization scores	0.17	0.16	0.01	0.75
EXTENT_V Variance of all coauthors' extent of specialization scores	0.06	0.11	0	0.48

maximum = 0.75). The average of EXTENT_V is low (0.06), suggesting that generalists typically collaborate with generalists, and specialists with specialists.

Collaboration Styles

Results from the latent profile analyses suggest that there are three main styles of collaboration. Papers fitting a particular profile were similar on all five factors (ALLSHARE, FOCALMATCH, FOCALMATCH_D, EXTENT_M, and EXTENT_V), but the three profiles differed in the mean level of each factor. Results are presented in Table 2, where the most pronounced differences across profiles are highlighted. We begin by describing the least common profile.

Complementary Specialists

Only 11% (seven) of the 61 collaborative papers can be described as a complementary joining of specialists. Authors whose papers fit this profile have narrow research programs; that is, they tend to publish on the same topic repeatedly. This is evident in Table 2 from a comparison of the mean scores for EXTENT_M, which is highest (0.517) for this profile. In addition, the coauthors had few subfields in common before joining together to write the focal paper (ALLSHARE is low [0.855] compared with other profiles), but some members of the team had already published on the focal paper topic (the FOCALMATCH mean takes on a middle value relative to

TABLE 2
Mean levels on the five measures of research specialization, by collaboration profile

	Complementary specialists		Generalists broaching a new topic		Reinforcing generalists	
	Mean	SD	Mean	SD	Mean	SD
Area of research specialization						
ALLSHARE	0.855	0.138	0.846	0.341	2.266	0.378
FOCALMATCH	0.436	0.136	0.066	0.051	0.825	0.035
FOCALMATCH_D	0.182	0.065	0.030	0.023	0.388	0.047
Extent of research specialization						
EXTENT_M	0.517	0.058	0.174	0.029	0.109	0.014
EXTENT_V	0.318	0.053	0.028	0.010	0.023	0.006
Papers Fitting this Profile	7		11		43	

the other two profiles). The complementary nature of this kind of collaboration extended to the division of labor: all authors agreed that each author had his or her own distinct contribution to make to the final paper, but that the diverse tasks were well coordinated. As one author revealed, 'we work well together – it's like Simon and Garfunkel – we have different skills and bring different things to the table'. Another noted that his coauthor had 'no interest in this [the paper] substantively, but was methodologically disposed to the problem'.

We found that the *complementary specialists* could be differentiated from the other profiles in multiple ways. Most notably, papers with this style of collaboration were more likely to be published in *SPQ* than other journals. Moreover, all of our interviewees representing the *complementary specialists* profile indicated that they had worked with their coauthors previously. In addition, the majority of the interviewees (four out of five) felt that their paper was more multidisciplinary and did not fit easily into a single specialty area. The division of labor was also stark in that each author seemed to make a unique contribution to the final paper.

Generalists Broaching a New Topic

Another 18% (11) of the 61 collaborative papers are almost wholly described by a lack of correspondence between the coauthors' subfields and the focal paper's topic. This is evident from Table 2, where the proportion of coauthors with one or more descriptors matching the focal paper is low (FOCALMATCH = 0.07), as is the difference in proportions of each coauthor's papers that share a descriptor with focal paper (FOCALMATCH_D = 0.03). In other words, the topic of the focal paper was relatively new to all authors involved. As one author put it, 'that was the whole point of the paper – to explore and struggle with this new thing'; and another said he wanted to collaborate on something that would be new

and interesting for all of his coauthors. Coauthors of these papers also tend to have diversified research programs (EXTENT_M is relatively low, and all interviewees considered themselves generalists), spanning a wide variety of research topics. For this reason we refer to them as generalists who joined together to investigate a new topic.

Interviews with authors from this profile suggest distinguishing features. Unlike members of the other profiles, less than one-third of interviewees from this profile had written papers with any of their coauthors previously. In other words, new topics are often paired with new coauthors. This suggests that establishing new working relationships often accompanies and supports the originality and innovation entailed in branching out into new intellectual terrain.[6] We also found that most interviewees from this profile (5/7) believed that their paper was sociological more than multidisciplinary. With respect to the division of labor involved in writing the focal paper, the majority of the 'generalists broaching a new topic' that we interviewed described the process as integrated. This is not surprising, considering the generality of their interests and the cooperation necessary to produce a paper on a new topic.

Reinforcing Generalists

By far the most common profile is one comprised of generalists who share common research interests, and join together to write a paper on one of those overlapping topic areas. This is evident from a comparison of the three profiles' means in Table 2: the reinforcing generalists have the highest mean of ALLSHARE (they have the most in common), the highest value on FOCALMATCH (the coauthors' topic areas correspond with the focal paper's topic), and the lowest values on EXTENT_M and EXTENT_V (suggesting a pooling of generalist authors). For this reason, we refer to papers that fit this profile as constituted by '*reinforcing generalists*'. Seventy per cent (43/61) of the collaborative papers fit this profile.

Interviews with authors representing this profile reveal few defining characteristics and much variability. All of the reinforcing generalists had worked with their coauthors previously and a majority (all but one) viewed their paper as a multidisciplinary contribution, as was the case with the complementary specialists. Unlike the other two groups, however, there was more variation in terms of the division of labor regarding the focal paper. About one-half of the authors interviewed felt that they and their coauthors had each contributed something distinct, whereas the other half believed that the tasks was relatively integrated. Perhaps, as one author suggests, the division of labor could be characterized in both ways, and was simply well coordinated: 'the initial idea on the paper was mine and then the second author helped think through how to do the analysis and the third author did a lot of the computing and data work; I wrote the paper and the other authors worked on drafts and revisions … each contributed something distinct, but it was very well integrated'. When scholars join together to write about a topic they all know fairly well, there is no clear

way to divide up the labor. Who does which task with regard to paper completion may be determined by more idiosyncratic factors, such as availability during different project stages.

Mentoring: Another Collaboration Style?

The ten papers that had to be excluded from the latent profile analysis because one or more coauthor had no previous publications suggest another unique style of collaboration – one in which a more established scholar partners with a scholar-in-training or a non-academic. Six of the ten papers listed students (either MA or PhD candidates) as coauthors, and two had coauthors associated with non-academic institutions. The remaining two had a coauthor listed as an assistant professor at the time of publication, and further analysis reveals that they, too, were students while the study was being conducted. Moreover, we found that more established (full or distinguished) professors are more likely to publish with these young scholars. This was the case for seven of the ten papers. Our interview data suggest that this collaborative style is on the rise due to job market and tenure expectations for productivity. As one interviewee stated, 'we've become more generous as a discipline and we're more willing to give graduate students the opportunity to collaborate'. This corresponds well to the overcrowding that Collins (1986) recognizes, and these master–pupil chains may very well be involved in the creation of new subfields (Ben-David & Collins, 1966; Collins, 1989).

Journal Differences

The three main collaborative styles were not distributed across the four journals in ways we expected (results not shown). Our surprise that papers in *SPQ*, a specialty journal, are more likely to be authored by generalists was tempered when we remembered that we only measured specialization in substantive topics areas, not theoretical or methodological areas. Perhaps *SPQ* authors, although they rely heavily on experimental design, have published on a variety of substantive topics. Another somewhat surprising finding is that teams of specialists are not more likely to publish in the two specialty journals (*SOE* and *SPQ*). Moreover, the research teams composed of generalists are not more likely to appear in *ASR*, even though a recent editor stated that 'one of the principal functions of a general sociology journal is to enhance the cross-fertilization of otherwise disparate specialties' (Jacobs, 2004). We also find it intriguing that research teams broaching new topics turn to a more interdisciplinary journal (*Social Science Research*) to publish their work.

Validation

Several decades ago, Gieryn (1978) asked whether scientists' own perceptions of their subfields – what he called 'problem choices' – differ from the

patterns suggested by their publications and the keywords associated with them. We can partly address this question and capitalize on an advantage of employing quantitative and qualitative methods by asking interviewees whether they agreed with how their paper was classified according to the Latent Profile Analysis. All but one of the authors we interviewed (20/21) agreed with their classification, though some provided qualifications. For example, an author whose paper fell in the *generalists broaching a new topic* profile agreed that he and his coauthor had not published on the topic before, but pointed out they had not published much at all at that point. Despite such occasional qualifiers, the authors' responses overall indicate a high level of congruence between the qualitative and quantitative data.

Discussion

A primary goal of this paper was to assess how specialization, a defining characteristic of modern science (Dogan & Pahre, 1989, 1990), shapes sociologists' collaboration styles. Results from our latent profile analysis suggest that the areas and extent of specialization pursued by researchers informs collaboration strategies. Most of the papers (70%) in our sample were written by *reinforcing generalists* – scholars with diverse research interests who joined with like-minded others to produce a paper on a familiar topic. This style of collaboration extends the sole-author tradition in a way that may improve efficiency and productivity, but rarely pushes subfield boundaries in new ways. Clearly, a large proportion of sociological research today is focused on depth: scholars join together with others who share their research interests and areas of expertise in order to produce solid work that likely contributes to a single research area. It also suggests that 'sticking with one's own' is a viable and common strategy in this age of what some call hyper-specialization and fractionalization (Collins, 1986; Cole, 2001). The two other styles – *complementary specialists* and *generalists broaching a new topic* – were much less common, representing 11% and 18% of the sampled papers, respectively. However, these profiles may represent the bright side of increasing specialization in science: it encourages a branching out, whether through finding a fellow specialist with different but complementary interests, or by moving forward to a new topic area – via accretion, substitution, or migration (Gieryn, 1978) – with fellow generalists. Both of these styles of collaboration suggest that increased specialization in science, rather than pigeonholing sociologists, actually serves to expand horizons and move research forward in integrative and original ways (Abbott, 2000). It will be interesting to see how the distribution of these profiles changes in years to come.

Our qualitative data help flesh out some of these quantitative findings. For example, even though the scholars we interviewed from the *generalists broaching a new topic* profile were more likely to have published their focal paper in an interdisciplinary journal, they were most likely to work with new

collaborators and to classify their work as purely sociological. Thus, sociologists who are exploring new intellectual terrain – even on topics of interest to a wider cross-disciplinary community – are doing so with new collaborators, but they are staying within disciplinary bounds. In comparison, the *complementary specialists* and the *reinforcing generalists* were more likely to have a history of collaboration with their coauthors, and to produce multidisciplinary work. We also found, intuitively, that specialists working together tended to make distinct contributions to a paper, *generalists broaching a new topic* tended to have a more integrated division of labor, and the *reinforcing generalists* were mixed with respect to their division of labor.

Our analysis and results will ideally serve as a springboard for additional research. We encourage researchers interested in collaboration and researchers interested in specialization to join forces themselves, and collaborate in order to better understand the links between these two important characteristics of scientific research. In this paper, we have revisited Gieryn's (1978) notion of problem choice and problem change, but we were not able to take a longitudinal perspective on how changes in area(s) and extent of specialization over the course of scholars' careers informs collaboration patterns over time. Our qualitative results suggest that collaboration may also be related to integrative, subfield-spanning work; future studies might examine this more systematically. In addition to paying greater attention to patterns over time and to integrative work, we encourage future researchers to delve into other disciplinary fields. The focus of our research was sociological research, especially prominent sociological research published in top journals. Can the same three profiles adequately capture collaborative styles in other disciplines? Research focusing on fields other than sociology could contribute to a much broader theoretical understanding of collaboration in science and how authors' areas and extents of specialization relate to it.

Notes

1. In this paper we use the terms subfields, sub-disciplines, and specialty areas interchangeably.
2. Like other papers on collaboration in sociology (Clemens et al., 1995), we chose to focus on a single year to make the data collection feasible. Because no special issues of these journals were published in the year 2000, we have no reason to suspect that there are peculiarities, especially ones that might be related to collaboration styles and specialization.
3. There are 127 keyword descriptors, representing subfields such as Social Movements and Stratification (see the entire list at <www.csa.com/factsheets/socioabs-set-c.php>). Sociological Abstracts is ideal because it covers a longer time period and more journals than other comparable databases.
4. Due to ease of obtaining updated contact information, all the interviewees were affiliated with an American institution, compared with only 77% (148) of all authors. However, research on collaboration in other countries (Martin-Sempere et al., 2002; McKelvey et al., 2003; Duque et al., 2005; Pontille, 2006) suggests similarities with American patterns, so we do not expect any bias to result from this difference.
5. Interview schedules are available from the authors upon request.

6. In addition, our finding that all but one of the authors fitting this profile characterized their paper as 'subfield-spanning' suggests the need to examine how collaboration style is intertwined with work that contributes to two or more subfields.

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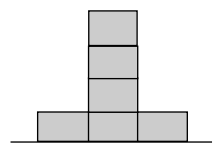
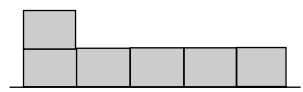
Appendix A
Construction of the 'extent of specialization' measure

	Classification codes*			Extent of specialization $[\Sigma x_i 2 / (\Sigma x_i) 2]^{\dagger}$
	First	Second	Cumulative distribution	
Sociologist no. 1				
Paper 1	0715	-		
Paper 2	0410	-		$\Sigma x_i^2 = 1^2 + 4^2 + 1^2 = 18$
Paper 3	0410	-		$(\Sigma x_i)^2 = (1+4+1)2 = 36$
Paper 4	0410	-		$[\Sigma x_i^2 / (\Sigma x_i)^2] = 18/36 = \mathbf{0}.5$
Paper 5	0621	0410	0715 0410 0621	
Sociologist no. 2				
Paper 1	2045	-		$\Sigma x_i^2 = 2^2+1^2+1^2+1^2+1^2 = 8$
Paper 2	0207	-		$(\Sigma x_i)^2 = (2+1+1+1+1)^2 = 36$
Paper 3	1977	-		$[\Sigma x_i^2 / (\Sigma x_i)^2] = 8/36 = \mathbf{0}.22$
Paper 4	2959	-	2045 0207 1977 2143 2959	
Paper 5	2143	2045		

* For example, 0715 = social change & economic development, 0410 = group interactions & social group identity
$^{\dagger}\Sigma x_i^2/(\Sigma x_i)^2$