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Socially Influenced Citation Behavior

Diffusing through Disciplines: Insiders, Outsiders, and Socially Influenced Citation Behavior

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A basic premise of diffusion theories is that actors vary in their susceptibility to social influence and yet little is known about the nature and consequences of such heterogeneity in specific market domains. The present study examines variation in social influence with respect to academic research and citation accumulation. Based on theories of uncertainty, signaling, and legitimacy, the main hypothesis is that disciplinary outsiders are more likely than insiders to cite papers that are already highly cited. The empirical analysis, which spans six disciplines and 13 flagship journals, is based on over 800 articles and the 55,000+ citations they accumulate over a 20-year period. Each citation received is classified with respect to both its timing and the discipline from which it was sent. The results show that the effect of prior citation attention is greater for external citation accumulation even after controlling for the fact that externals adopt later on average than internals. Contrary to intuition, however, outsiders do not appear to uniformly exacerbate citation inequality. The broader implications of this study for diffusion and the sociology of science are discussed in the conclusion.

Actors are socially influenced to the extent that they pay attention to the behavior of others when choosing their own course of action. For example, when modeling the diffusion of innovations, an actor's sensitivity to "what everyone else is doing" can be modeled as a threshold: an actor will adopt only after a certain proportion has already adopted (see Young 2009 for a review). In the context of social influence and network formation, researchers view social influence in terms of the weight an actor places on socially derived information versus "objective" information (Gould 2002; Lynn, Podolny, and Tao 2009; Manzo and Baldassarri 2014). Importantly, these formal theories are generally

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built on the assumption that actors can *vary* in their sensitivity to social influence (e.g., Young 2009; Van den Bulte and Joshi 2007).

Empirically, however, we still know very little about the nature and consequences of this type of audience heterogeneity in specific market domains. To date, the main empirical finding associated with adoption thresholds concerns early versus late adopters (Ryan and Gross 1943; see also Tolbert and Zucker 1983; Westphal, Gulati, and Shortell 1997; Rogers 2003). Early adopters are characterized as those who have technical knowledge about an innovation and decide whether to adopt based on this expertise. Later adopters, in contrast, are understood as making decisions based much more on social influence; they wait to pursue options that have been endorsed by earlier adopters and that have already become well-established standards.

There may, however, be other systematic reasons as to why some subsets of actors are more responsive to social influence. The goal of this study is to expand our empirical knowledge of diffusion by investigating the role of internal and external audiences in the spread of academic research. In academia, peer recognition is considered the core reward from which all other rewards are derived (Merton 1977, 48) and citation patterns have been a topic of interest for many decades (e.g., Cole and Cole 1967; Allison, Long, and Krauze 1982; Baldi 1998; Evans 2008). This study broadens the horizon in this area by asking whether the pace of citation accumulation is contingent on where the attention is coming from. Science is a context in which the audience (i.e., the producers and consumers of research) is meaningfully segmented by disciplinary fields and yet ideas can and do diffuse freely across boundaries (see Jacobs and Frickel 2009, 49–51; Weber 2013). An underappreciated implication of this reality is that there could indeed be qualitatively different types of diffusion pathways in science. For example, some articles might take off quickly and become superstars with a following that spans multiple fields. Other articles might be well regarded within the focal field but never spill over to other fields.

In the current study, citations are used to track the diffusion of journal articles through disciplines. Akin to a new corn seed being adopted by farmers or a new drug being adopted by doctors, the focus here is on a focal article (a research product) and its adoption over time by scholars. The central question raised is whether disciplinary "insiders" or internals (i.e., those citing from within the focal field) differ from "outsiders" or externals (those citing from outside the focal field) in their sensitivity to social influence. Various strands of research on uncertainty, signaling, and legitimacy suggest that when researchers cite outside their field, they will be more likely to adopt papers that already have a sizeable following and likewise to neglect papers that have not yet attracted much attention.

The present study is organized around three main tasks. The first is to develop a theoretical argument as to why externals and internals are expected to differ in their sensitivity to social influence. The second is to document the presence of internal and external audiences for a broad sample of published articles from 13 flagship journals across six disciplines. The third and main objective is to test whether the presence of prior adopters has a greater effect on external

citation accumulation than internal accumulation. The empirical test is based on a unique longitudinal data set that consists of over 800 articles and their 20-year citation histories.[1]

Finally, as a follow-up to the test of internals versus externals, the discussion section offers a brief exploration into the effect of external citations on citation inequality. If indeed articles produced within a given discipline are cited by insiders and outsiders, then citation inequality (a group-level property) is shaped by the citation decisions of both insiders and outsiders. The question thus arises as to whether the presence of outsiders systematically affects the distribution of rewards in a given discipline. If outsiders tend to latch on to papers that have already attracted a large internal following, this suggests that the presence of an external group "voting" on internal products will fuel the creation of superstars and thus increase citation inequality within the discipline. On the other hand, external votes may simply create an alternative hierarchy based on their own preferences and interests, thus creating new diffusion channels for research that failed to developed an internal following.

Social Influence and Citation Behavior

Scholars have long recognized the importance of positional cues to reward inequality in science, with most devoting their attention to studying the impact of an author's formal status on reward trajectories (Azouley, Stuart, and Wang 2013; Mazloumian et al. 2011; Merton 1968).[2] An author's formal status cues (as derived from institutional affiliations and awards) are theorized to play a role in citation allocation to the extent that they help readers (1) evaluate the nature and quality of scholarly contributions; (2) focus their attention on promising work; and (3) gauge their potential persuasiveness.[3] For example, to the extent that status leaks through relations (Podolny 2005), readers might interpret an author's institutional prestige as an endorsement of individual quality (e.g., readers infer that work produced by authors from prestigious departments is, in general, of higher quality). A prestigious author might also attract citations because readers feel that citing an eminent author is simply more persuasive and legitimizing than citing a similar claim by an unknown author (Gilbert 1977; Baldi 1998; Wickes and Emmison 2007). But it could also be that articles written by prestigious authors are rewarded per the Matthew effect because readers *search* the literature based explicitly on author prestige (such as tracking the work of a certain group of scientists), which means that the work of prestigious authors would have a higher risk of being cited because of visibility. Merton (1968) himself, for example, associated the Matthew effect with a cognitive load problem, where scientists rely on professional reputation as a way of prioritizing attention: "confronted with the growing task of identifying significant work published in their field, scientists search for cues to what they should attend to" (59).

These same three arguments, however, could also be made for the role of endogenous cues, such as the number of times a focal paper has already been cited. Whereas an author's institutional prestige, for example, can serve as a formal endorsement of a producer's underlying scholarly talent, the extent to which

a paper itself has already attracted a sizeable following could be interpreted as a socially derived proxy for quality that applies to the publication/product specifically and not the producer at large.[4] This rationale would be consistent with the logic of social proof (Cialdini 1993; Kuran 1995): something is proven to be worth choosing if many others (who may or may not be elites) have already chosen it.

Adopting the same behavior as others can also enhance the legitimacy of the adopter. DiMaggio and Powell (1983) posited long ago that institutions will mimic a peer when uncertain about a course of action because doing so, in essence, puts the adopter "in good company." In the academic context, when trying to signal membership in a research area, one can cite not only just the "right" scholars, but more specifically, the "right" publications. Citing what everybody else cites would be a way of leveraging the weight of all previous citers ("safety in numbers"), as opposed to, say, the authority of an eminent individual.[5] Finally, being highly cited likely affects the ability to attract future citations simply because of enhanced visibility. Highly cited articles are typically easier to find than unpopular articles (e.g., because they are more likely to be reprinted, because they are often showcased by search engines), which puts them at a higher risk of being cited more in the future.[6]

Internals and Externals

The question arises as to whether segments of the academic audience are more responsive to social influence than others. I argue that an actor's sensitivity to the presence of prior adopters is contingent on whether the innovation in question falls inside or outside a decision maker's perceived realm of expertise. In the production of academic scholarship, expertise is a function of doctoral training and training programs typically are aligned with disciplines. Disciplinary boundaries, however, are by no means impermeable; in fact, scholars and policymakers have increasingly advocated for interdisciplinarity and current levels of interdisciplinary communication are already quite high according to some estimates (Jacobs and Frickel 2009; Porter and Rafols 2009). Recent work examining interdisciplinary citation flows (e.g., Weber 2013; Rosvall and Bergstrom 2008; Boyack, Klavans, and Börnerc 2005; Pudovkin and Garfield 2002) strongly suggests that disciplines do not operate as silos of knowledge but instead form a web of interconnected research areas through which knowledge spreads (Jacobs and Frickel 2009, 49). Therefore, a piece of research produced by an expert in a focal discipline has the potential to be consumed by a broad audience composed of readers who have stronger and weaker memberships in that focal discipline. In short, one could characterize the academic audience as consisting of insiders (members of the focal discipline) and outsiders (members of other disciplines).

Existing research gives us multiple reasons to suspect that insiders and outsiders will differ in their sensitivity to social influence. Specifically, previous work suggests that scholars are more likely to let the opinions/actions of others guide their course of action when consuming knowledge outside their focal discipline. Three lines of reasoning are described below: the role of expertise, search processes, and legitimacy concerns.[7] To be sure, the ensuing discussion focuses on

the preferences and behaviors of actors even though the unit of analysis in the empirical analysis is the citing publication. This is because the adoption of journal articles is typically measured in the form of citations, which are "announced" in publications (see Navis and Glynn 2010). In other words, publications are the vehicle through which authors make citations, but the motivations underlying citation behavior can still be attributed to individual actors.

Expertise and positional cues as quality proxies

To the extent that recognition is expected to accrue to scholarship that makes "genuinely original contributions to the common stock of knowledge" (Merton 1973, 293), the decision to cite rests at least in part on the reader's appraisal of contribution (see Merton 1988, 607). But readers likely vary in their ability to offer an informed appraisal: scholars evaluating research conducted in the discipline in which they are formally trained (i.e., insiders) presumably form their judgments with a level of expertise that is not expected of researchers who are trained in a different scholarly tradition (i.e., outsiders).[8] When internals evaluate the work of other internals, substantive and methodological expertise should allow for a sophisticated evaluation of its relevance and rigor. Readers from outside the discipline, however, may offset their lack of expertise by paying more attention to a paper's positional cues (e.g., published by an already prestigious author, already cited by others, published in a prestigious journal), given that such cues could be interpreted as signals of quality (Podolny 2005). With fewer bases from which to form critical judgments of scholarly quality, outsiders are more likely to be persuaded by options that appear to be endorsed by others (e.g., an organization, another reader, an editor).[9] In sum, because of a lack of expertise in the focal discipline, which results in heightened quality uncertainty, outsiders are more likely than insiders to cite what they interpret to be pre-certified options.[10]

Search costs and limited choice sets

The internal versus external distinction may also have important implications for the way that researchers parse the literature in a focal field. The search for literature requires time and energy, and a lack of substantive expertise in the focal area increases the cost of searching, which thus makes the expected value of a pre-certified paper higher for outsiders. First, scholars are more likely to see an outside body of work as a sea of undifferentiated options—which thus increases their reliance on positional cues as a way of putting some constraints around their options. Moreover, to the extent that scholars have less time to actively search outside their area, outsiders are more likely to limit their choices to publications already brought to their attention (e.g., by seeing what others have cited). Thus, relative to insiders, outsiders are more likely to have choice sets that are limited to, or pre-populated by, well-known and easily accessible papers.

Persuasion, legitimacy, and the intended audience

Attachments to certain papers can signal that the producer is "speaking the right language," which can enhance the legitimacy and persuasiveness of the research

product (Gilbert 1977). The point here is that authors sometimes think in terms of impression management when deciding whether to include or exclude references to previous research. What constitutes a legitimizing choice, however, depends on the *intended* audience: insiders are concerned with convincing other insiders, whereas externals need to persuade members of their own discipline. This implies that externals are less likely to go beyond pre-certified papers in the focal field, since nuance in the focal discipline will not help persuade an audience of outsiders. For example, journal editors and reviewers are not likely to ask for additional citations outside the journal's focal area.

Empirical Predictions

The key empirical prediction that follows from this discussion is straightforward: because readers are expected to rely more on positional cues when they allocate rewards outside their own field, external adopters are expected to be more responsive to the presence of prior adopters relative to internal adopters. With respect to the diffusion of a given article, this implies that prior citations will have a greater effect on external citation accumulation than internal citation accumulation to the focal article (*hypothesis 1*). In addition, the existing literature on adoption timing suggests that the difference between internals and externals will be exaggerated for late adopters. As mentioned at the outset, diffusion scholars characterize early adopters as visionaries who prioritize technological performance over peer opinions (Rogers 2003, 212, 284). Late adopters instead are those who (1) lack up-to-date news about innovations; and (2) explicitly wait for the "weight of the system norms to favor the innovation" (Rogers 2003, 282–99). In the context of academic publications, late adopters likely consist of those who are removed from the research frontier and thus are slower to discover new papers. Moreover, those who want to adopt something only after a critical mass has adopted must wait for citations to accumulate in order for clear popularity signals to emerge. However, early adopters from external fields are more likely to be those who happen to be "in the loop" with respect to the focal discipline. For example, an economist studying the gender wage gap is likely well versed in the relevant work produced within demography and sociology. Thus, the difference between early externals and early internals is expected to be smaller than the difference between late externals and late internals (*hypothesis 2*). Overall, late external adopters are expected to be the most sensitive to social influence.

Methods

Data and Measures

Focal article sample

The following analysis examines the 20-year citation trajectories of a cohort of journal articles published in 1985–1987. Publication and citation records are extracted from the *Web of Science*, which is widely considered a leading database for citation indexing (Bakkalbasi et al. 2006). The articles are sampled from one of 13 flagship journals from six fields: mathematics, cell biology, economics,

political science, sociology, and philosophy.[11,12] Because these disciplines differ markedly on various dimensions—such as the formality of the subject matter (e.g., Whitley 2000 [1984]), citation norms (Glanzel and Schoepflin 1995), and the ratio of externals to internals (see the online supplement)—one could argue that this is a strong test for the generalizability of the difference between insiders and outsiders.

To be sure, however, the analysis is constructed in such a way that allows for the different fields to be aggregated into one examination. For one, the analysis is limited to articles published in prestigious general-interest journals in an effort to construct a sample of papers with roughly the same amount of visibility in each field. In every field, the visibility and prestige of the journal in which an article is published plays a large role in determining its citation trajectory. Rather than statistically controlling for journal visibility within and across disciplines, the analysis is limited to flagship journals, since they have the highest visibility in each discipline. Moreover, the review process that governs selection into each of these core journals provides, for each journal, a corpus of work that insiders perceive to be above a certain quality threshold.

Focal article citation histories

Focal articles published in 1985, 1986, and 1987 were followed respectively until 2005, 2006, and 2007, corresponding to a 20-year observation window for each paper. Table 1 summarizes citation counts at the discipline level, as well as key article characteristics described below.[13] Citation counts in table 1 correspond to the total number of citations received within the observation window after excluding self-citations. Table 2 and figure 1 provide a longitudinal summary of citation accumulation organized by three-year time periods.[14]

Internal and external citations

Internal and external citations are coded respectively as within-field versus between-field citations. Fields are determined using the *Journal Citation Reports* (JCR), which classifies journals based on subject matter. Internal citations are defined as citations sent from journals classified as being either solely in the focal field or cross-listed in the focal field (see the online supplement for a detailed discussion of this measure). Figure 2 displays the percentage of external citations received per year since publication. It is clear that the proportion of external cites generally increases over time. This pattern is consistent with outward diffusion: papers are first circulated among experts and then, over time, get picked up by readers from outside the discipline. It is also possible that this observed diffusion process is due partly to upgrades in electronic search technology beginning in the mid-1990s (see Adams and Clemmons 2011).

In addition to differences in timing, internal and external citation-count distributions also differ substantially in terms of inequality. As summarized in table 3, external citation counts are characterized by a much higher level of inequality (i.e., a more severe right skew) than internal counts. Inequality is measured using Allison's (1978) modified squared coefficient of variation $C = (\sigma^2 - \mu)/\mu^2$, where σ^2 is the variance of the citation-count distribution and μ is the mean number of

Table 1. Descriptive Summary of Focal Articles, by Field

Field	Publication years	Number of citations received[a] (ages 0–20)		Page count		Reference count		Multiple authorship (1 = yes)	Prestige of author's department[b]		*n*
		Mean	*sd*	Mean	*sd*	Mean	*sd*	%	Mean	*sd*	
Cell biology	1985–86	180.3	*230.1*	8.6	*1.9*	45.6	*14.9*	98%	4.3	*0.6*	144
Economics	1985–86	52.8	*96.6*	14.1	*8.0*	20.1	*15.6*	48%	3.8	*1.1*	138
Mathematics	1985–86	15.3	*16.2*	24.7	*17.4*	17.2	*10.9*	45%	3.8	*0.9*	143
Philosophy	1985–87	14.1	*21.6*	17.7	*10.7*	14.9	*11.5*	3%	3.6	*0.9*	101
Political science	1985–86	36.1	*47.6*	19.0	*6.2*	37.8	*19.3*	49%	3.3	*0.8*	142
Sociology	1985–87	70.7	*140.6*	19.3	*9.4*	55.9	*28.6*	54%	3.6	*0.9*	174

[a]Refers to the number of citations received during the observation window and includes both internal and external citations. Self-citations are excluded.
[b]Measured at the time of publication; refers to the highest-ranked author for articles with multiple authors.

citations. *C* is a scale-invariant measure of inequality (i.e., it is not sensitive to absolute differences in the mean of the citation distribution) and thus can be used to compare inequality across journals. What this shows is that internal attention is more evenly distributed across a cohort of focal papers, whereas external attention piles up more unevenly. The fact that there is more "heaping" in the distribution with respect to external audiences is certainly consistent with hypothesis 1, which predicts that externals are more likely to cite already highly cited papers.

Previous citation status

The popularity of a paper is operationalized with respect to the number of times a paper has been cited prior to the citation in question, which is akin to Gould's (2002) measure of choice status, that is, the extent to which actors (or options) have been chosen already by others. This is an indirect way of measuring whether a potential citer has directly observed others citing a given article. In some cases, adopters may be acutely aware of the number of times an article has been cited (e.g., citation counts are easily accessible through major citation databases), but other times adopters may be reacting to seeing an article cited by a small number of others. But since potential citers are more likely to stumble upon a hub than a rarely cited article,

Table 2. Mean Number of Citations (Internal and External) Received per Period

Period	Age	Cell biology		Economics		Mathematics		Philosophy		Political science		Sociology	
		Mean	*sd*	Mean	*sd*	Mean	*sd*	Mean	*sd*	Mean	*sd*	Mean	*sd*
1	0–2	32.7	33.1	3.7	5.2	1.0	1.4	1.3	1.6	2.0	2.2	3.9	4.1
2	3–5	46.8	54.1	8.1	11.2	2.3	2.4	2.1	2.9	5.3	5.7	9.3	10.4
3	6–8	35.0	53.1	8.9	14.5	2.0	2.3	2.2	4.0	6.0	8.6	10.2	18.0
4	9–11	26.2	43.8	8.8	17.8	2.5	3.2	2.1	4.1	5.7	9.6	11.5	28.2
5	12–14	18.1	31.0	7.8	16.8	2.5	3.2	2.0	3.9	5.8	9.7	10.6	18.8
6	15–17	12.1	21.3	7.5	19.1	2.6	3.6	2.0	3.9	5.8	9.5	11.1	24.1
7	18–20	9.4	17.3	8.0	22.6	2.7	4.4	2.3	4.2	5.4	7.8	14.1	45.6

this should induce a positive correlation between the likelihood of directly observing a single citation and the total number of times it has been previously cited.

Specifically, citation status for period p corresponds to whether or not a paper ranks within the top 25th percentile of its journal cohort in terms of the cumulative number of citations (i.e., internal plus external) received through $p - 1$. For example, an article published in *Econometrica* in 1985 has a citation status of 1 (versus 0) in period 4 if by period 3 the article accrued enough citations to put it above the 75th percentile relative to all other *Econometrica* articles published in 1985. Using a 0/1 indicator variable to measure lagged citation status facilitates comparison of the effect of citation status across journals, given that journals vary greatly in the total number of citations received. The percentage gain associated with lagged "top 25th" is comparable across journals regardless of the mean number of citations received, whereas the percentage gain associated with an additional citation is tied to the number of citations a journal receives on average.

Analytic Approach

The analysis begins with a series of basic negative binomial regression models. These models show which article characteristics are linked to the total number of citations eventually received. Period-specific models are used in order to allow for potential nonlinearities in the effect of citation status on citations received. For each period, the outcome of interest is the number of citations received (in that period) and the key predictor is previous citation status (0 or 1 for being above the 75th percentile in the previous

Figure 1. Mean number of citations received per period

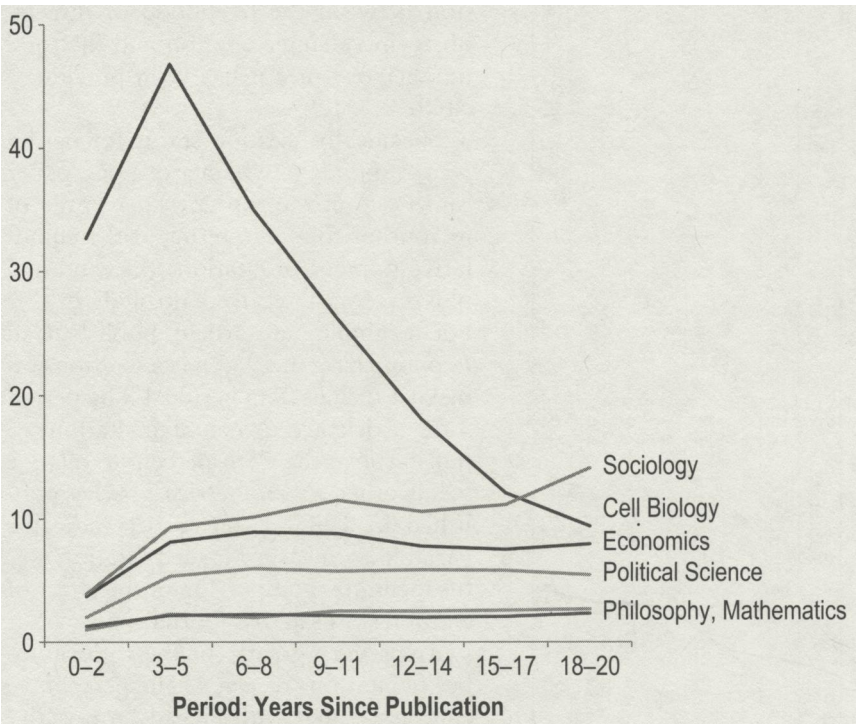


Figure 2. Percentage of citations from external sources per period

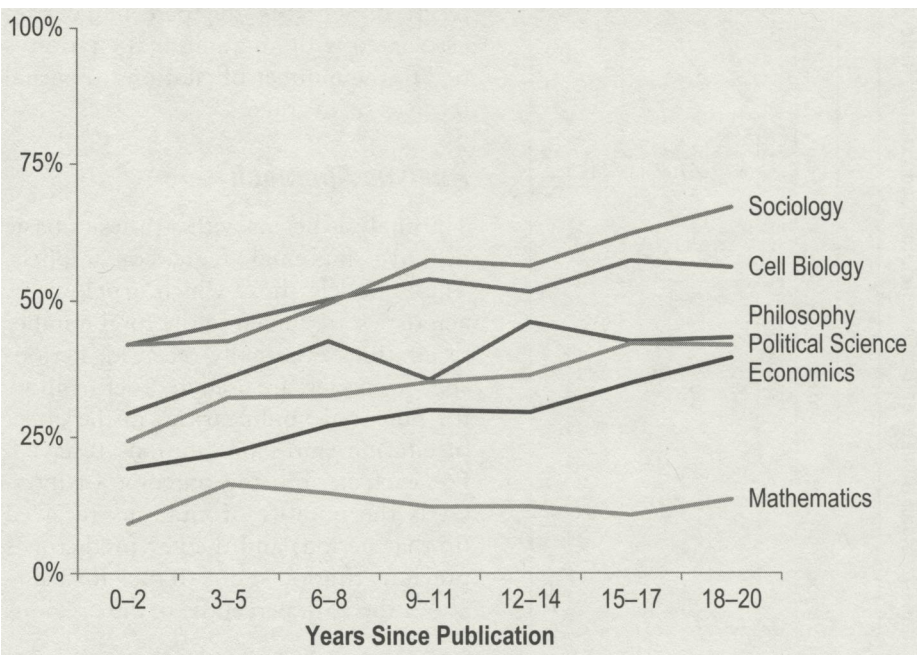


Table 3. Citation Inequality (*C*)

	Citation inequality		
	Internal counts	External counts	% difference
Cell biology	1.59	1.75	+ 10%
Economics	1.73	3.03	+ 75%
Mathematics	1.29	4.09	+ 216%
Political science	1.31	1.83	+ 39%
Philosophy	1.46	2.17	+ 49%
Sociology	1.06	1.47	+ 39%

Note: *C* is equivalent to the estimated dispersion parameter (α) when the observed citation distribution is fit using a negative binomial model with no predictors (see Allison 1978). A high value of *C* corresponds to greater inequality.

period). Journal-specific fixed effects are included in all equations. In addition, four fixed article characteristics that should be relevant across disciplines are included: article length, number of references, prestige of author's institutional affiliation, and the number of authors.

Several scholars have used an article's length as an indicator of the sheer volume of content (which, to be sure, is not synonymous with intellectual content or quality of insight), and have found that page count is a significant predictor of citation accumulation (Baldi 1998; Abt 1993; Stewart 1983). A longer article, for example, might attract a wider audience if the author used the additional space to address multiple topics or to discuss an issue in great detail.

Reference count is also included, given that the number of works cited may create additional diffusion channels, through either co-citation searches or reciprocal attention over time. In addition, articles are coded as either single- or multiple-authored, since published work with more authors has more channels through which it can be disseminated to a community. Wuchty, Jones, and Uzzi (2007) recently showed that team-authored articles tend to draw more citations than solo-authored pieces.

Finally, to account for the prominence of the author(s), organizational affiliations at the time of publication are coded with respect to departmental prestige. For all the journals included in this sample, organizational affiliations are indicated on the first page of the article. Departmental prestige scores (five-point scale) are obtained using the National Research Council's (NRC) study of doctoral programs in 1990 (NRC 1995).[15] For multiple-authored papers, the departmental rank of the highest-ranked author is used. Table 1 provides a summary of the rank distributions in each discipline. Using institutional prestige as an indicator of author status is well suited for this study, given that multiple disciplines are under examination and the NRC provides discipline-specific rankings of departments.

This analysis is then repeated for external and internal citations separately. The unit of analysis is still an article ($n = 842$), but now there are two dependent

variables: the number of external citations received per period and the number of internal citations received per period. Hypothesis 1 predicts that there will be greater returns to positional cues for external citation counts compared with internal citation counts. Hypothesis 2 predicts an interaction effect with adoption timing: the internal/external difference should be greater among late adopters than early adopters. The impact of positional cues on internal versus external citation counts are thus compared within a given time period. A series of cross-model post-estimation tests are used to statistically examine whether the effects of author prestige and previous citation status differ for external versus internal citation counts.[16] To simplify the analysis, time periods 2 and 3, 4 and 5, and 6 and 7 are combined so that only three models for internal citation counts are compared to three models for external counts.

Note that modeling internal and external citation counts separately means that this second set of analyses is detecting how audiences are reacting to the *same* scientific product. For any given article, both internal and external audiences view the same content and the content does not change over time. What does obviously change over time is the way a paper is interpreted and received by specific audiences (e.g., its popularity with certain audiences may change over time). However, by controlling for adoption timing, the analysis identifies how two different audiences respond to the same product at the same point in the product's life course.

It is important to note that the coefficient for previous citation status (in any of the models) should not be interpreted as a raw estimate of the extent to which decision makers are socially influenced. This is because the empirical data do not allow us to tease out the extent to which evaluators are responding to popularity as opposed to the content of the article. Content (e.g., a novel idea, unique data, or controversial findings) could be a common prior cause of both early attention as well as future citations.[17] The main hypothesis, however, is not about how much social influence matters precisely, but rather the fact that some segments of the audience are more likely than others to gravitate toward already popular options. Support for hypothesis 1 is thus tied to whether there is a *difference between internals and externals* with respect to previous citation status.

Results

Table 4 summarizes a series of negative binomial regression models of total citation counts for six consecutive periods (2–7). These models estimate the extent to which positional cues and article characteristics are associated with the number of citations a paper receives in a given time period, controlling for the journal in which the article is published as well as other article characteristics. As shown in the first row of table 4, the effect of citation status (in period $p - 1$) on the number of internal citations received (in period p) is significantly positive for every time period: articles that rank in the top 25th percentile in $p - 1$ are significantly more likely to attract more citations in period p for all periods 2 through 7. For example, the model estimates that articles with cite counts in

Table 4. Negative Binomial Estimates for Total Citation Counts, by Period

	Total number of citations received per period					
	Period					
	2	3	4	5	6	7
Paper's citation status:						
Top 25th percentile [$p - 1$]	0.97***	1.42***	1.69***	1.76***	1.72***	1.93***
	0.07	*0.08*	*0.08*	*0.08*	*0.09*	*0.09*
Author's departmental prestige	0.11**	0.09	0.11*	0.10*	0.19***	0.16**
	0.04	*0.04*	*0.04*	*0.05*	*0.05*	*0.05*
Logged page count	0.48***	0.36**	0.33**	0.29*	0.28*	0.32*
	0.10	*0.11*	*0.11*	*0.12*	*0.13*	*0.13*
Logged reference count	0.13	0.08	0.11	0.06	0.06	–0.05
	0.07	*0.08*	*0.07*	*0.08*	*0.09*	*0.08*
Multiple authorship (1 = yes)	0.08	0.07	–0.05	–0.11	–0.09	–0.13
	0.08	*0.08*	*0.08*	*0.09*	*0.10*	*0.10*
Journal	[12 dummy variables]					
Constant	–1.76***	–1.06**	–1.47***	–1.12**	–1.52***	–1.54***
	0.36	*0.38*	*0.38*	*0.41*	*0.44*	*0.46*
α	0.70***	0.76***	0.76***	0.88	1.02	1.02
n (papers)	842	842	842	842	842	842
Pseudo R-squared	15%	15%	15%	13%	12%	13%

Note: Robust standard errors are shown in italics below the coefficients.
*** $p < .001$ ** $p < .01$ * $p < .05$

the top 25th percentile for their journal in time period 2 receive roughly 4 times (i.e., $e^{1.42}$) as many citations in time period 3 on average.

With respect to change over time, the results clearly suggest that citation accumulation is path dependent. The returns to being already highly cited appear to increase as articles age, which implies that it becomes harder for unrecognized articles to attract citations over time. More precisely, post-estimation tests for "seemingly unrelated" models (Weesie 1999) show that the "boost" related to citation status in period 3 is about 1.5 times greater than that in period 2 ($p < 0.000$). Likewise, the coefficient for period 4 is about 1.2 times greater than that in period 3 ($p = 0.025$). There are no significant differences, however, among any of the periods 4 through 7. In effect, these results suggest that the likelihood of being discovered significantly decreases with age; the advantage of being already highly cited appears to "lock in" during period 4, which is roughly 10 years after publication.

It is worth noting, by way of comparison, that the impact of author's departmental prestige (a traditional type of status cue) is likewise positive for all time periods, although not statistically significant in each period. While the units are obviously not directly comparable, the magnitude of the institutional prestige coefficients does suggest that author prestige is not as strongly tied to future citation success relative to the effect of being already highly cited.[18] For example, authors affiliated with a department scoring a five on the prestige scale (i.e., highly prestigious) are expected to receive (at most, in period 6) about $e^{.19*4} = 2.1$ times as many citations, which is generally smaller than the boost associated with being in the top 25th percentile of the journal cohort (which ranges from a 2.6 factor increase to a 7.2 factor increase, depending on the time period).

Tables 5A and 5B present the same model, but this time separately for internal and external citation counts. To simplify the comparison, the model is based on three aggregated time periods (2 and 3, 4 and 5, and 6 and 7); there are three models in table 5A for internal citations and three analogous models in 5B predicting external citation counts. The purpose of tables 5A–B is to explore whether positional cues are more strongly tied to external citations compared with internal citation rewards.

As predicted (hypothesis 1), citation status appears to matter more for external citation accumulation than internal citation accumulation. Post-estimation tests suggest that, at least for certain time periods, the coefficients for citation status are significantly larger when predicting external citations versus internal citations (see table 5, part C). Specifically, the effect of citation status is about 1.3 times larger ($p < 0.001$) for external counts in time periods 4 and 5 and 6 and 7. Note that this internal/external comparison takes into account the mean number of citations allocated by internals/externals during each time period, which means that the results are not confounded by differences in the timing of external and internal citations. For example, of the citations awarded by externals in time period 6 and 7, an article that is already highly cited is expected to receive about 7 times ($e^{1.99} = 7.3$) the number of external citations than articles not already highly cited. Of the citations awarded by internals in time period 6 and 7, an article that is already highly cited is expected to receive about $e^{1.53} = 4.6$ times the number of internal citations than articles not already highly cited.

Figure 3 provides a visual comparison of the citation status coefficients with respect to the predicted factor change in citation counts for internals versus externals. These results help highlight how the difference between externals and internals begins to emerge roughly 10 years post publication. Interestingly, the difference between internal and external readers is only minimal (and not statistically significant) among those citing the focal article relatively soon after being published (i.e., early adopters). However, once an article has had time to diffuse, the behavior of internal versus external citers begins to diverge.

These results are thus consistent with hypothesis 2, albeit the interaction is stronger in a sense than originally expected. It is not that the difference is simply greater for late adopters but rather only manifests for later adopters. Put

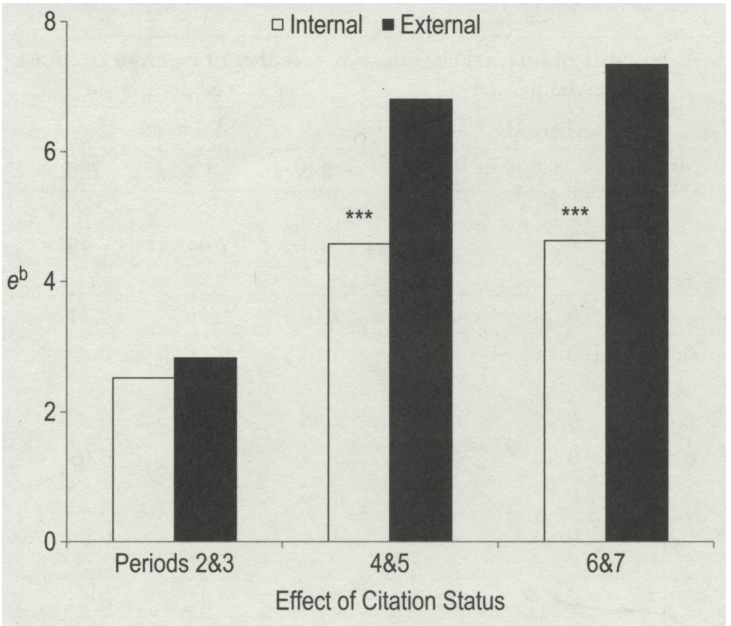
Table 5. Negative Binomial Estimates for Internal versus External Citation Counts, by Aggregated Period

	A. Number of internal citations received per period			B. Number of external citations received per period		
	Periods			Periods		
	2 & 3	4 & 5	6 & 7	2 & 3	4 & 5	6 & 7
Citation status:						
Top 25th percentile [$p - 1$]	0.93***	1.52***	1.53***	1.04***	1.92***	1.99***
	0.08	*0.08*	*0.09*	*0.10*	*0.10*	*0.11*
Author's departmental prestige	0.14**	0.13**	0.12*	0.15*	0.18**	0.29***
	0.04	*0.05*	*0.05*	*0.06*	*0.06*	*0.07*
Logged page count	0.62***	0.38***	0.35**	0.21	0.16	0.09
	0.11	*0.11*	*0.13*	*0.15*	*0.15*	*0.17*
Logged reference count	0.06	0.13	0.13	0.26**	0.05	0.03
	0.07	*0.08*	*0.09*	*0.10*	*0.10*	*0.11*
Multiple authorship (1 = yes)	0.06	–0.02	–0.05	0.03	–0.07	–0.22
	0.08	*0.09*	*0.10*	*0.11*	*0.11*	*0.13*
Journal	[12 dummy variables]			[12 dummy variables]		
Constant	–1.39***	–1.20**	–1.16**	–3.01***	–2.28***	–2.58***
	0.37	*0.39*	*0.44*	*0.54*	*0.54*	*0.62*
α	0.85**	0.93	1.13	1.37***	1.20**	1.58***
N (papers)	842	842	842	842	842	842
Pseudo R-squared	11%	11%	8%	14%	16%	14%
C. Test (internal = external)						
Citation status: $\chi^2_{(1df)}$				1.08	13.19***	14.07***

Note: Robust standard errors are shown in italics below the coefficients.
*** $p < .001$ ** $p < .01$ * $p < .05$

another way, in contrast to hypothesis 1, not all externals rely on positional cues to a greater extent than internals. Among later adopters, the power of popularity is greater for outsiders, which is as expected. But for early adopters, outsiders behave similarly to insiders. According to hypothesis 2, this could be because early externals are indeed so much "in the loop" that they behave just like insiders. It could also be the case that the difference is not statistically significant because of sample size issues (i.e., there are few early outsiders). Finally, it could also be that popularity signals are simply not clear enough for early outsiders to rely on them.

Figure 3. Illustration of citation status coefficients from tables 5A–B



Discussion

This study investigated whether an external audience would be more apt to rely on a positional cue—whether or not the focal paper was already highly cited—when allocating citations. In the context of academic research, there are three general reasons why disciplinary outsiders are expected to be more socially influenced. First, to the extent that positional cues are used as informational shortcuts, we expect outsiders to pay more attention to "what everyone else is doing" to cope with the uncertainty brought on by a lack of focal field expertise. Second, because of the cost associated with trying to get the "lay of the land" in unfamiliar research areas, outsiders are likely to restrict their attention to (or not search beyond) papers that are easy to find, which are often already well-known papers. Third, unlike insiders, outsiders do not gain legitimacy from differentiating beyond safe, pre-certified papers (in the focal field), given that such nuance would be lost on their intended audience (i.e., other externals).

Based on the 20-year citation histories of a large sample of articles published in flagship journals, the central finding is that external citation counts are indeed more responsive to the presence of prior adopters, although the difference emerges only among middle and late adopters. These results do not appear to be specific to any discipline, but rather are generally consistent across all 13 journals from all six fields.[19,20] This is important because it suggests that the dynamic is generalizeable to the insider/outsider distinction and is not an artifact of any one discipline.

To understand the implications of this behavior, however, several important issues require further attention. Namely, if outsiders are more socially influenced,

to whom are they "listening"? Given that external citations tend to follow internal citations (figure 2), one might presume that outward diffusion is related to expert verification. That is, papers published in flagship journals are first vetted by internals and are then picked up by an external audience only if already certified by experts. The implication of this type of diffusion process is that the presence of outsiders will fuel the creation of superstars. Outsiders exaggerate reward inequality by heaping their attention on the frontrunners who emerged during the internal certification period.

Such a pattern is illustrated in table 6A with hypothetical data on a cohort of 10 focal papers. In this example, the internal citation count (at, say, 20 years after publication) is given in the "Internal" column, with the highest-cited paper receiving 400 citations. The "External" column shows how 100 percent of the attention from externals is directed to paper A, thus creating an exaggerated gap between papers A and B. This increase in inequality can be captured with Allison's *C* (see table 3), which grows by 25 percent (from 2.10 to 2.63), as well as the Herfindahl index for market concentration, which increases by over 50 percent (from .30 to .47). Again, this pattern would be consistent with the notion that externals are most interested in papers verified first by insiders.

However, another possibility is that outsiders are casting votes based on their own logic, with tastes and interests that are formed independently from insiders. That is, as opposed to the notion that externals wait for internals to establish standards, externals may adopt later simply because it takes scientists longer to become aware of publications outside their research area. In this scenario, audience diversity could actually decrease reward inequality in the focal field. If outsiders' choices are governed by a different understanding of what constitutes useful or "high quality" research than that used by insiders, this suggests that non-members may consume articles that are relatively unpopular with members (see Abbott 1981; Cattani, Ferriani, and Allison 2014). If this is the case, the presence of externals will effectively slow the growth of superstars because they raise the profile of lesser-known articles.

Table 6B describes an extreme version of this scenario, where externals allocate roughly the same amount of attention to each of the 10 focal papers. In this situation, the correlation between internal and external citation counts becomes negligible and both inequality and concentration drop substantially (from 2.10 to 0.55 and .30 to .19, respectively). This is because external attention significantly boosts the standing of papers that are unpopular with the internal audience. Finally, table 6C illustrates the outcome of mixed external attention, which includes concentrated attention to internal superstars as well as random attachments to other papers. Here, total inequality decreases (from 2.10 to 1.24) because of the external attention given to previously unpopular papers but market concentration remains roughly the same (0.30 versus 0.31), given that heaping of external citations to paper A.

Using the 842 papers studied above, preliminary analyses suggest that the distribution of external citations differs quite a bit across journals (and not necessarily by field). Only one cohort of papers (from the *American Journal of Sociology*) appears to have an external audience that significantly exacerbates

Table 6. Hypothetical Internal and External Citation Distributions

	A: Winner-take-all			B: Equal			C: Mixed		
	Internal	External	Total	Internal	External	Total	Internal	External	Total
Paper A	400	400	800	400	40	440	400	220	620
B	120	0	120	120	40	160	120	80	200
C	100	0	100	100	40	140	100	0	100
D	80	0	80	80	40	120	80	20	100
E	50	0	50	50	39	89	50	0	50
F	30	0	30	30	41	71	30	20	50
G	10	0	10	10	40	50	10	0	10
H	6	0	6	6	40	46	6	20	26
I	4	0	4	4	40	44	4	20	24
J	0	0	0	0	40	40	0	20	20
Total	800	400	1,200	800	400	1,200	800	400	1,200
Inequality (C)	2.10		2.63	2.10		0.55	2.10		1.24
Concentration (H)	0.30		0.47	0.30		0.19	0.30		0.31
Correlation (internal & external)	0.93			–0.04			0.93		

citation inequality. Recall the illustration in table 6A: when external attention follows a winner-take-all logic, the total citation distribution exhibits significantly more inequality and concentration relative to the internal distribution, plus the correlation between internal and external counts is high. The internal and external citation count distributions for the *AJS* cohort follow this pattern exactly; the inclusion of external citations exacerbates inequality by 24 percent, and the concentration index increases by 72 percent. Finally, the correlation between internal and external counts is very high ($r = 0.92$). On the other extreme, the cohort of papers from *Advances in Mathematics* has a signature that is very similar to the hypothetical data shown in table 6B (equal attention). For this cohort, including external citations reduces citation inequality by 19 percent and drops the concentration index by 8 percent. Moreover, the correlation between internal and external counts is relatively low ($r = 0.34$). This suggests that external citers of this cohort are latching on to papers that are not popular with mathematicians themselves. The rest of the 11 journals have profiles that suggest mixed attention from externals.

Together, these findings suggest that externals have a mixed effect on citation inequality; outsiders do sometimes fuel the rise of superstar papers, but they can also discover papers that have been relatively unpopular with insiders. Clearly, however, future research is needed to develop a more detailed picture of the impact of externals on the internal playing field. In addition to understanding which papers are being picked up by whom, future examinations should also focus on how scholars actually utilize research findings from inside and outside their discipline (e.g., Mizruchi and Fein 1999; Hargens 2000; Wickes and Emmison 2007). For example, it was speculated that externals are less likely to engage in nuanced analyses of research published outside their discipline, since such effort would likely go unappreciated; this implies that in a content analysis of citations, externals should be more likely to engage in ceremonial citations (with respect to a focal article). But in a different vein, it may also be that outsiders, because they are not socialized by the focal discipline and in effect constitute a different "norm audience" (Adut 2009), introduce a new discourse from that used by insiders when writing about the same focal article (see Mizruchi and Fein 1999). Moreover, outsiders may actually feel freer to express criticism of insider research (see Adut 2005, 229). This opportunity (and willingness) to construe an article differently could lead to an innovative type of consumption. The overarching point here is that a closer look at what adopters are actually saying about a work when they cite it—that is, the *form* of adoption (Westphal, Gulati, and Shortell 1997)—can potentially give us much deeper insight regarding the allocation of credit and the diffusion of ideas in academia.

Conclusion: Limitations and New Directions

This study directly enriches our knowledge of diffusion processes by developing an argument for why internal and external positioning could affect sensitivity to social influence. These findings, which show that being highly cited generates a greater boost in external attention than internal attention, imply that outsiders

tend to gravitate more toward products that are already popular. A limitation of the current approach, however, is the inability to pinpoint why; the behavior is consistent with multiple social psychological explanations, and future research is needed to disentangle their relative importance. In addition, because the theory is developed and tested here in the specific context of disciplinary insiders and outsiders, it remains an open question whether the insider/outsider distinction is salient and consequential in other domains.

These findings also have the potential to shape new lines of inquiry in the sociology of science and the study of science policy by raising novel and broad questions about the consumption of research. In particular, tracking the usage of research as it diffuses through communities of scholars provides a window into interdisciplinarity that is distinct from the dominant approach, which focuses on classifying individual authors, authorship teams, and research products themselves (i.e., their time-invariant characteristics) as possessing interdisciplinary attributes (see Wagner et al. 2011). In the mainstream approach, which maps well to conventional wisdom, interdisciplinarity is something achieved through knowledge integration (Porter and Rafols 2009). Not surprisingly, one of the most common approaches to measuring interdisciplinarity is to calculate the extent to which authors draw from various disciplines within the same bibliography (e.g., Porter and Rafols 2009; Rafols and Meyer 2010; Larivière and Gingras 2010).

In contrast, the data here speak to the other side of this phenomenon by tracking how a research product may have an interdisciplinary impact through the audiences it connects. Whereas the two approaches are obviously related, the stories they can tell are distinct. To understand, for example, the evolution of cuisine, we can examine how chefs combine different ingredients to create blended and unique products. However, we can also follow the development of creativity by tracing the history of a given ingredient to understand how various audiences (e.g., professional chefs, lay cooks, food critics, marketers) use it over time. In the case of research, the diffusion approach reveals how a given publication is "accepted" and possibly transformed by the audience that cites it.

Some immediate questions that arise from the diffusion perspective concern the nature and prevalence of certain types of diffusion pathways. For example, how much research produced in a given discipline diffuses to a broad audience? Are specific types of research (e.g., methodological articles) more likely to diffuse across disciplinary boundaries (see Jacobs and Frickel 2009, 51)? Finally, similar to Weber's (2013) work on generations in translation science, how long does it take for research to cross certain disciplinary boundaries?

Another important question for future research is why some disciplines attract a greater external audience than others. Figure 2, for example, shows that the presence of an external audience appears to vary across the six fields. Why does mathematics attract a relatively small external audience, whereas cell biology and sociology attract a disproportionately large external audience? Whitley (2000 [1984], 146–48) argues that audience plurality hinders a field's ability to develop "technical control and competence." Hagstrom (1965), however,

suggests that it is technical sophistication that prevents encroachment from outsiders (226–36). A closer look at the way in which insiders and outsiders actually consume research may provide new insights into what fuels the growth of an external audience.

Notes

1. This approach thus deviates from the standard bibliometric approach, given that the focus is on the citations received by a set of focal articles as opposed to those references *appearing within* a set of focal articles (e.g., Small 1973; Pieters and Baumgartner 2002).
2. This is likely due to Merton's (1968) original formation of the Matthew effect, which drew upon Harriet Zuckerman's (1977) interviews with American Nobel laureates. The key observation was that eminent scientists tended to receive the lion's share of recognition at the expense of lesser-known scholars in the case of multiple independent discoveries or collaborative efforts.
3. Recall the two main (competing) rationales for why scientists cite (see Bornmann and Daniel 2008). In the normative theory of science (Merton 1973, 1977; Kaplan 1965), citations represent the acknowledgment of intellectual debt and constitute a method of protecting the "property rights" of authors with claims to priority (Kaplan 1965, 181). From this point of view, the decision to cite hinges on the reader's appraisal of a scholar's contribution, an evaluation process that may be influenced by positional cues. Readers, for example, could use positional cues to help differentiate the underlying quality of academic work as well as to help delimit what work is even "worth" reading in the first place. Others have argued that citations are mainly rhetorical devices used to build scholarly identities and to persuade intended audiences (e.g., Gilbert 1977; Latour 1987; Wickes and Emmison 2007). For example, authors sometimes use citations to preemptively defend from attack, to signal their membership in a research area, and to "enlist the support" of sources perceived as being authoritative (Baldi 1998, 832).
4. This logic fuels the perspective that citations can be used to measure an article's underlying quality (e.g., Cole and Cole 1967; Cole 1970).
5. This argument does not imply that readers have perfect knowledge regarding what everybody else is citing. It may be that, for some, coming across just one other previous adopter constitutes "what everybody else is doing."
6. The normative implications of this behavior are contingent on assumptions related to the origins of early attention. For those who assume that articles draw early attention because they represent greater scholarly contributions, then, social influence increases the efficiency with which important scientific findings are disseminated, given that late adopters receive guidance as to what to read (see Merton 1968, 59). On the other hand, if one allows for the possibility that early buzz may not be perfectly correlated with quality, a popularity feedback mechanism may in fact serve to decouple citations awards from scholarly contributions (Lynn, Podolny, and Tao 2009). In this scenario, endogenous feedback violates the norms of universalism and can curb scientific advancement (see Merton 1968, 62); excellent research may go largely unnoticed because of social influence (e.g., for whatever reason, a highly useful article fails to pick up early attention and thus fails to ever gain attention), while conversely, social influence can also create superstars out of "average" contributions.
7. The following analysis makes no attempt to rank-order the importance of these three explanations, as the data employed are not well suited to teasing them apart. The

point here is simply that there are multiple reasons for why externals are expected to be more socially influenced.

8. See Mallard, Lamont, and Guetzkow (2009) for qualitative evidence to this point.
9. This argument is derived from the theory of status signaling (Podolny 2005), which posits that decision makers rely on network status cues when forming exchange relations as a way of resolving quality uncertainty. Empirical work in this area shows, for example, that in markets where the underlying quality of potential exchange partners is harder to ascertain, network status cues (e.g., centrality) are more highly correlated with rewards (see Sauder, Lynn, and Podolny 2012 for a review). Of course, if the reliance on status cues is indeed triggered by decision-making uncertainty, then the effect of high/low uncertainty should also manifest at the individual level: decision makers who lack the expertise or tools to differentiate competitors should be the most likely (in any context) to rely on positional cues as a proxy for quality.
10. This is not to say that expertise precludes insiders from engaging in socially influenced behavior. Mizruchi and Fein (1999), for example, suggest that insiders too are subject to bandwagon effects by virtue of being aware of what is fashionable with other insiders.
11. Mainstream, general-interest journals were identified in each field based on (1) bibliometric measures from *Journal Citation Reports*; (2) qualitative data on disciplinary perceptions (Bardhan 2003; Ellison 2002; Burton and Phimister 1995; Korevaar and Moed 1996); and (3) perceptions of practicing scholars obtained via in-person interviews. In most fields, several core journals per field were selected in order to amass a suitable sample size. Given the high volume of articles published annually in cell biology, all articles from this field come from *Cell*.
12. Appendix A summarizes the number of articles originally sampled from these journals; sample sizes range from 159 to 211 articles per field. Articles were sampled chronologically by volume within the cohort window.
13. The final sample shown in table 1 includes only those articles written by authors affiliated with ranked institutions. See appendix A for a summary of the full sample.
14. For the *Cell* articles in this sample, citation counts tend to drop off after period 2. In contrast, the rate of accumulation is relatively constant except for the debut period. This is consistent with library science studies on decay in circulation; obsolescence typically occurs much faster in the natural sciences than in the social sciences and mathematics (see Glanzel and Schoepflin 1995).
15. Rankings are based on perceptions of the "scholarly quality of program faculty," obtained through a national survey of graduate faculty (see http://www.nap.edu/readingroom.php?book=researchdoc&page=summary.html).
16. Tests are computed using the *suest* application in Stata, which allows for cross-model testing via a generalized Hausman test (see Weesie 1999).
17. This is, of course, the heart of the problem with respect to empirically identifying whether actors are responding to positional cues versus some intrinsic characteristic of the product/person: the rationale for why evaluators allocate rewards is a psychological process that is difficult to measure directly. Actors engage in preferential attachment when they allocate rewards on the basis of an actor's position or status, *independent* of her contributions. Empirical studies of the Matthew effect—in science or any other setting—are thus plagued by the difficulty of how to isolate the pure effect of position (see Simcoe and Waguespack 2011, 276–77). Since performance can affect position attained as well as rewards received, most approach the

measurement of the Matthew effect as hinging on a compelling control for quality (see Zuckerman 2011, 125).

18. The relatively modest effect of institutional prestige could be tied to the fact that this analysis focuses only on long-term citation accumulation among articles published in flagship journals. Perhaps among articles published in less visible outlets, institutional prestige holds more sway over evaluators. Similarly, organizational affiliation may be a prominent positional cue with regard to other decision points in the science career, such as a department's decision to hire a candidate, an editor's decision to accept a manuscript, or a review panel's decision to fund a grant. Moreover, institutional rank could play a large role in determining why some articles attract early citation attention and others do not.
19. Field-specific results are available upon request.
20. With respect to the robustness of these findings, further research is needed to test the sensitivity of using a JCR-based definition to define insiders and outsiders (e.g., see Porter and Rafols [2009] for an alternative approach based on subject categories). Additional tests are also needed to explore the sensitivity of a journal-level definition versus an author-level or publication-level definition. While the coarseness of the present indicator should make it harder to find evidence in support of the hypotheses tested here, future studies should try to capture who is citing whom with more specificity.

Supplementary Material

Supplementary material is available at *Social Forces* online, http://sf.oxfordjournals.org/.

Appendix

Appendix A. Descriptive Summary of Focal Articles by Journal

	Total number of citations received[a] (ages 0–20)		Page count		Reference count		Multiple authorship (1 = yes)	Author affiliated with ranked department[b] (1 = yes)	Prestige of author's department[b]		*n*
	Mean	*sd*	Mean	*sd*	Mean	*sd*	%	%	Mean	*sd*	
Cell biology											
Cell	175.5	*213.7*	8.4	*1.9*	43.8	*15.0*	98%	73%	4.3	*0.6*	196
Economics											
American Economic Review	45.4	*84.3*	9.0	*5.6*	18.3	*16.3*	48%	75%	3.6	*1.2*	96
Econometrica	66.0	*100.9*	18.7	*8.2*	21.3	*13.1*	38%	63%	4.2	*0.9*	63
Quarterly Journal of Economics	20.3	*37.4*	21.3	*5.7*	20.3	*10.0*	47%	76%	3.8	*1.1*	34
Mathematics											
Advances in Mathematics	15.9	*20.1*	28.6	*23.6*	16.4	*11.9*	40%	64%	3.9	*0.9*	80
American Journal of Mathematics	10.4	*12.1*	27.2	*15.5*	17.1	*9.8*	38%	75%	3.6	*0.9*	52
Inventiones Mathematicae	17.9	*15.7*	18.8	*13.0*	16.5	*10.2*	49%	90%	3.9	*0.9*	59
Philosophy											
Journal of Philosophy	9.5	*15.7*	13.3	*6.7*	12.6	*11.1*	2%	59%	3.7	*0.8*	117

Philosophical Review	19.5	26.6	25.3	10.9	20.8	12.8	10%	76%	3.3	1.1	42
Political science											
American Journal of Political Science	27.9	43.5	20.7	6.9	34.2	17.3	43%	79%	3.0	0.7	82
American Political Science Review	42.2	49.3	16.7	4.6	40.5	20.0	47%	83%	3.6	0.8	93
Sociology											
American Journal of Sociology	74.7	168.9	27.6	8.3	55.4	28.5	47%	78%	3.7	0.9	90
American Sociological Review	57.7	88.6	13.6	4.1	57.8	29.0	58%	86%	3.5	0.9	121

[a]Includes both internal and external citations. Self-citations are excluded.
[b]Measured at the time of publication; refers to the highest-ranked author for articles with multiple authors.

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