Theor Soc (2012) 41:527–556
DOI 10.1007/s11186-012-9181-9

Mutual halo effects in cultural production: the case of modernist architecture

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Published online: 5 October 2012

Abstract Previous research has suggested that in cultural production fields the concatenation of eminence explains success, defined as influence and innovation. We propose that individuals in fields as diverse as philosophy, literature, mathematics, painting, or architecture gain visibility by cumulating the eminence of others connected to them across and within generations. We draw on interaction ritual chain and social movement theories, and use evidence from the field of modernist architecture, to formulate a model of how networks of very strong ties generate motivations and emotional enthusiasm, change reputations, and form collective movements that over time transform the structure of cultural fields. Because major aesthetic innovations break sharply with older styles, they need very strong group solidarity over a long period of time to propagate a new standard of practice. We propose mutual halo effects, i.e., the reciprocal reinforcement of upstream and downstream prestige on a given individual node, as the key factor accounting for success in a cultural production field. We discuss the relevance of these results for building a model of influence and innovation in cultural production fields in which networks—reshaped by shifting technological, political, and economic conditions—trigger new styles.

Keywords Cultural production · Social networks · Interaction rituals · Social movements

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Research on the influence and innovation capacity of scientists, writers, or artists has tended to emphasize the importance of social relationships among individuals in closely-knit social circles. Some studies have documented intergenerational, teacher-pupil or master-apprentice connections among the eminent in science (Zuckerman 1967), classical music (Denora 1995), philosophy (Collins 1998), and architecture (Guillén 2006; Larson 1993). Others have described creative circles as horizontal networks of youthful innovators in various fields: impressionist painters and other art movements (White and White 1965; White 1993), poets and novelists (Farrell 2001; Watson 1991; Cheever 2006), and singers, composers, librettists, and set designers (Johnson 2008). Other research has focused on the volume, preservation, and post-humous celebration of the artist's work, as in the case of painter-etchers (Lang and Lang 1988, 1990). Yet other studies have focused on specific times and locations, and incorporated a broad spectrum of intellectual and cultural activity, as for example in the case of fin-de-siècle Vienna (Janik and Toulmin 1973; Schorske 1981; Timms 1989). In a systematic study of social networks of collaboration in the Broadway musical field between 1945 and 1990, Uzzi and Spiro (2005) found that the financial performance of musicals and favorable critics' reviews increased with connectedness up to the point at which the overall network becomes too saturated and stifling (see also Uzzi 2008). In another study, Burris (2004) found that the prestige of academic departments was shaped by the networks linking departments that produced PhDs to those that employed them.

In spite of this previous research, we still lack an overarching theory specifying the mechanisms that generate different rates of success among individuals active in cultural fields when it comes to influencing cultural production activities and to innovating and spreading new approaches, ideas, paradigms, or styles. In this article, we propose interaction ritual chains as the micro foundation of intellectual efforts to influence and innovate in a given cultural field, specifying the conditions under which social movements emerge with the potential of transforming the entire field of cultural production.

We identify and theorize two types of such network structures, which are often overlapping. The first is a vertical, intergenerational network, from eminent teachers or mentors to eminent students or protégés. The second is a horizontal network of close contacts among individuals of the same generation, typically before they have done their main creative work and acquired their reputations. Because these two kinds of contacts tend to occur repeatedly, successful individuals in cultural production fields concatenate ties among the eminent. Prestigious teachers and pupils, or masters and apprentices, tend to occur repeatedly across generations, and the successful of one period can often trace their lineage to eminent great-grandteachers and even farther back in time, as found in the fields of philosophy (Collins 1998) and architecture(Guillén 2006). Together with the horizontal links within each generation, the amount of surrounding eminence in an individual's network accumulates across several links; the more eminent the individual, the greater the concatenation of eminence in his or her network, and the greater the likelihood that he or she will lay the foundations for a social movement that transforms the field (Collins 1998).

Our initial assumption is that success, defined as influence over the field and innovation, cannot be merely the result of the transmission of information from one individual to another. Pupils who acquire the information that their teachers possess

but do nothing innovative become followers of a school, not eminent figures in their own right. To regurgitate your expert knowledge of Foucault makes you a Foucaultian, not the next Foucault. Most importantly, a social process of creative thinking emphasizes that protégés are not merely learning the content of their mentor's ideas, but are internalizing their methods of making innovations (Collins 2004, pp. 183–196).

The same issue of how innovation arises in intergenerational networks is found in horizontal ties among contemporaries in the process of becoming innovative. A social circle often forms among individuals in a given cultural field at the outset of their careers; they intensely discuss the state of the field—i.e., they redundantly circulate cultural capital that they all share in common. The creativity-spawning work of the group is in transforming older cultural capital in new directions (Collins 1998; Guillén 2006).

We propose that the process by which a social circle does this better than isolated individuals lies in the realm of intense interaction rituals that repeatedly assemble the group, maintain a strong focus of attention on shared topics, pursue upstream and downstream links, and build emotional excitement into Durkheimian collective effervescence (Collins 2004). Persons who take part in successful interaction rituals become intensely committed to group symbols, such as a new scientific paradigm or a novel artistic or architectural style, which for them are Durkheimian sacred objects; and they are filled with emotional energy—confidence and initiative—that enables them to do enthusiastic work and attract new members to the group. A network generates differential success, not merely by the information passed along in it, but by additional micro-interactional mechanisms that generate motivations and emotions, build reputations, form collective movements, and establish linkages both to the upstream and the downstream. When successful, such networks are not merely static but expanding. The result can be to transform pre-existing cultural capital, and the structure of the field. Thus, we argue that micro-interactionist dynamics are the crucial mechanism by which social movements change entire fields of cultural production through network-based mobilization of cultural, symbolic, political, and economic resources (Frickel and Gross 2005; Mische 2008; McAdam et al. 1996; Meyer and Staggenborg 1996; Zald and Useem 1987).

We propose that a particular type of dense, concatenating ties is crucial for generating structural change and individual success in cultural production fields. Major changes in cultural production are brought about by social movements rather than individual careerists, even if ultimately an individual may reap most of the fame stemming from the movement. Hence, success in cultural production may be expected to involve dense clusters. Major cultural innovation tends to be the result of a movement that typically takes a generation or more, over a period of 20 to 40 years.

In the next sections, we use information from the field of modernist architecture to elucidate the role that interaction ritual chains and social movements play in generating influence and innovation in cultural production fields. First, we examine the extent to which strong *upstream* ties of apprenticeship and collaboration influenced individual reputations in the specific case of the field of modernist architecture, thereby propagating prestige across the network. Second, we assess the importance of nurturing a school of followers, i.e., the *downstream*. Third, we discuss the role

that interaction rituals play in articulating social movements with the potential of transforming the field. We conclude by discussing the implications of these results for a multi-layered model of change in cultural production fields.

Research setting: the field of modernist architecture

We formulate our theoretical approach to influence and innovation in cultural production fields based on the historical development of the field of modernist architecture. Our case-oriented approach enables us to use concrete empirical evidence to build theory by understanding patterns of field evolution over time as a function of the interactions among individuals active in the field. We consider a field to be a recognized social arena in which patterns of interaction among its members bring about change, both in the initial predispositions of individuals (*habitus*), and in the hierarchical and external relations of the entire field (DiMaggio 1991; Bourdieu 1977, 1996; Emirbayer and Johnson 2008). We define individual success in a field of cultural production as the extent to which an individual has achieved eminence or prestige as a result of his or her influence or innovativeness.

Our point of departure is the analysis of different types of social connections in the cultural field of philosophy. Collins (1998) provided evidence on the social connections among 2,670 philosophers (and mathematicians) in major civilizations from 800 B.C.E. to 1935 C.E. Among the Greek philosophers (600 B.C.E. - 600 C.E.), the higher the eminence of the philosopher, the more links to other philosophers of all ranks. He divided philosophers into dominant, major, secondary, and minor figures, and calculated network links both backward (to predecessors and associates) and forward in time (to pupils). Calling these the "upstream" and "downstream" sides of the networks, he found that dominant Greek philosophers have nearly twice as many upstream links to previous philosophers on average than major philosophers, three times as many as secondary philosophers, and more than five times as many as minor philosophers. The differences are even larger in the case of downstream links. Similar patterns and orders of magnitude emerged from an analysis of the network of Chinese philosophers from 535 B.C.E. to 1565 C.E.

If we examine the chain extending backwards in time, we see that the more important the philosopher, the more eminent contacts exist within successive links in the chain. Roughly speaking, the average number of contacts doubles, and in some cases nearly trebles within four as opposed to two steps (see Table 1). Over all, evidence from the cultural field of philosophy over several centuries shows that the most eminent individuals have the greatest concatenation of eminence around them, at any given number of links: moderately eminent persons have intermediate concatenation scores; minor figures in the field have relatively low scores.

Similar patterns of change occurred in the emergence of modernist architecture between 1890 and 1940. Architecture and its associated activities—design of interiors, furniture, and household objects—is a complex cultural field at the intersection of the arts and the world of building, and therefore industry. Unlike many other cultural fields such as philosophy, painting, or literature, it carries direct consequences for people's lives at home and at work (Smith 1993, p. 399). As the modernist theorist Siegfried Giedion (1982, p. 705) pointed out, "architecture … works in the boundary

Table 1 Mean number of contacts among Greek and Chinese philosophers within two and four links

	Two links	Four links
Greece: Dominant Philosophers (N=8)		
# of dominant or major philosophers upstream	1.8	3.9
# of secondary philosophers upstream	4.1	8.3
# of both kinds upstream	5.9	12.1
Greece: Major philosophers (N=20)		
# of dominant or major philosophers upstream	0.9	2.2
# of secondary philosophers upstream	1.0	2.7
# of both kinds upstream	1.9	4.9
Greece: Secondary philosophers (N=68)		
# of dominant or major philosophers upstream	0.7	1.6
# of secondary philosophers upstream	1.5	2.9
# of both kinds upstream	2.2	4.5
China: Dominant Philosophers (N=9)		
# of dominant or major philosophers upstream	2.1	3.3
# of secondary philosophers upstream	1.9	3.0
# of both kinds upstream	4.0	6.3
China: Major philosophers (N=16)		
# of dominant or major philosophers upstream	0.8	1.4
# of secondary philosophers upstream	1.6	2.5
# of both kinds upstream	2.4	3.9
China: Secondary philosophers (N=61)		
# of dominant or major philosophers upstream	0.6	1.0
# of secondary philosophers upstream	1.0	1.7
# of both kinds upstream	1.6	2.7

Source: Collins (1998: 66–67).

area halfway between the regions of aesthetic feeling and practical doing." To be sure, architects are supposed to be more than text-producing intellectuals and actually secure clients and resources to build their designs, an aspect that we also analyze below.

A famous definition of modernist architecture highlights three main aspects: "Emphasis upon volume—space enclosed by thin planes or surfaces as opposed to the suggestion of mass and solidity; regularity as opposed to symmetry or other kinds of obvious balance; and, lastly, dependence on the intrinsic elegance of materials, technical perfection, and fine proportions, as opposed to applied ornament" (Barr 1995, p. 29). The modernist architects reacted against the imitation of the classical canons, and departed from the principles of perspective and proportion, the insistence on symmetry, and the pervasive use of ornament. As predicted by resource-mobilization (Frickel and Gross 2005) and professionalization (Abbott 1988) theories, in order to realize their agenda for architectural change, the modernists sought to influence state, industrial, and private projects, organize themselves into both formal and informal associations, reform academic training programs, create their own

schools, and set new standards for the profession (Guillén 2006). The most enterprising modernist architects managed to mobilize resources by establishing networks of various kinds and spurring social movements based on them.

We base our theoretical analysis on 120 eminent architects active between 1890 and 1940, when the modernist movement came of age (Guillén 2006). Ten influential architects were drawn from each of twelve countries or regions: Britain, France, Germany, Italy, the Netherlands, Russia, Spain, and Scandinavia (Denmark, Finland, Sweden) in Europe, and Argentina, Brazil, Mexico, and the United States in the Americas. Taking into account ten architects in each country allows for enough critical mass to assess the interactions among them as well as their connections to those in other countries without biasing the results because some countries have more eminent architects or are simply bigger in size than others.

We consider both weak and strong ties between architects. Much previous research measures strong ties through survey questions about whom one discusses important matters with or obtains resources from; the former are generally equated with casual acquaintanceship (Granovetter 1973). We identify strong ties as those involving collaboration on a building project or one architect serving an apprenticeship under another. We treat training at the same educational institution as a relatively weaker type of tie (Guillén 2006). Collaboration and apprenticeship ties are very strong, involving months or years of very close interaction; they are certainly sturdier than the teacher-pupil ties and acquaintance ties among the philosophers analyzed by Collins (1998). Thus, our data on architects are unique when it comes to distinguishing extremely strong ties from other kinds of ties. This enables us to examine the possibility that very intense ties of working together on common projects are crucial for success.

We also examine if bridge ties linking different clusters in the network were of consequence in shaping reputations. In the world of business and organizations, dense ties are often seen as redundant and as re-circulating information but not adding new information; the crucial ties are those that bridge otherwise unconnected clusters to bring in information uniquely possessed by the bridging individual (Burt 1992). For reasons that we develop below, bridge ties do not appear to be the central feature of creativity in cultural production fields, although they may be important for short-run advantage in utilitarian career pursuits such as finding a job or advancing in a business corporation. The place that bridges ties sometimes play in cultural creativity, supplementing the basic process of building a cultural movement through intense interactions, is discussed near the end of the article.

We measured architects' reputation or prestige (which we equate with success) by the number of key encyclopedias or histories of architecture in which they are given an entry or cited; thus reputations can range from 10 (discussed in all ten sources) down to zero (discussed in none of the sources).[1] Figure 1 displays their prestige score along with their location in the network.[2] The data thus give a ranking across a scale from zero to

[1] For some countries, Guillén (2006) consulted specialized local histories to bring the total number of architects per country up to 10. These received a reputation score of zero. The dataset includes very famous architects, as well as others little known outside their home countries.

[2] Only 92 architects appear in Fig. 1. The other 28 lack strong ties to the network; they are included in calculations of network patterns, but with ties at zero. For the complete list of the architects, see Guillén (2006). The three Dutch architects lacking strong ties, and thus not depicted in Fig. 1, are Gerrit Rietveld, JM Van der Mey, and Robert Van t'Hoff.

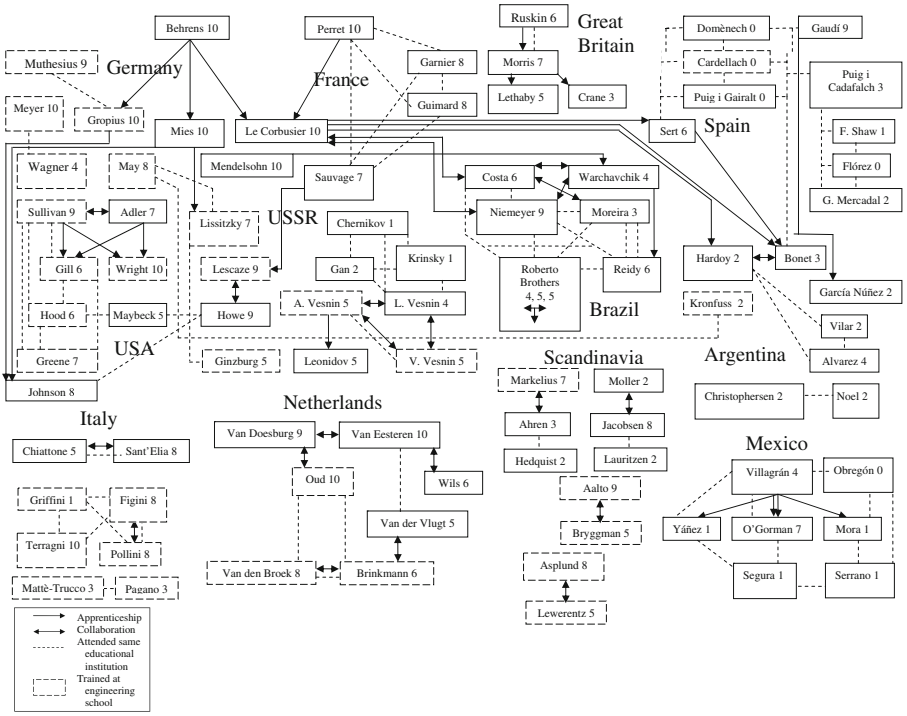

Fig. 1 Networks of apprenticeship, collaboration, and education in the modernist architecture field, 1890–1940. Notes: Number following each name is individual prestige score, derived from number of citations. Cross-national educational links between École des Beaux-Arts graduates not depicted: Argentina (Christophersen, Noel), France (Garnier, Guimard, Perret, Sauvage), the Netherlands (Van Eesteren), Mexico (Pani), and the United States (Hood, Howe, Maybeck, Sullivan). Only 92 architects appear in Fig. 1. The other 28 lack strong ties to the network. For the complete list of the architects, see Guillén (2006). The three Dutch architects lacking strong ties, and thus not depicted in Fig. 1, are Gerrit Rietveld, JM Van der Mey, and Robert Van t'Hoff. Sources: Guillén 2006:134, 149–156; Banham 1980; Benevolo 1977; Curtis 1996; Hitchcock 1971; Weston 1996; Lampugnani 1986; Midant ed. 1996; Muriel ed. 1994; Placzek ed. 1982; Sharp ed. 1981

10. This is similar to Collins's (1998) method—the number of pages devoted to a particular philosopher in books on the history of philosophies in various parts of the world—but with a more fine-grained measurement than Collins's four ranks.

Figure 1 depicts two kinds of network ties: the solid lines with arrow heads indicate either apprenticeship (single arrow) or collaboration on a specific project (double arrows). These are very strong ties. The figure also includes another type of tie: whether the architects attended the same school (dotted lines). These are weaker, indirect ties. The strong-tie network shows concatenation of eminence. The most famous architects are closest in network terms to other most-famous architects. In order to capture this effect, we proceed as follows. For each focal architect we added up the prestige scores of architects within one or two network links. Figure 1 also shows if the architect attended engineering school by drawing the node's box with dotted lines, a factor found to be highly correlated with the rise of the modernist movement (Guillén 2006).

The very highest-ranking architects are distinguished from the next level by their low proportion of isolates from strong ties to this universe of eminent individuals;

only three, or 25%, of rank-10 architects have no strong ties (i.e., Meyer, Rietveld, and Terragni), whereas the proportion of strong-tie isolates among rank-9 architects is 36%, among those with a prestige score between 5 and 8 is 38%, among those with a prestige score of 3 or 4 is 56%, and among the lowest-ranking architects (prestige score of 0 through 2) is 87%.

Let us propose the concept of *mutual halo effect*: the prestige of a particular architect gives prestige to those who are linked to him or her (in fact all 120 architects are men). Prestige flows in both directions, upstream and downstream, converging on each individual node in the network.[3] To be sure, prestige cannot be entirely a matter of the propagation of prestige from elsewhere, since this begs the question of where at least some component of the prestige comes from in the first place. In the case of architects, some perform especially innovative work in style and building technique, or spread their architectural philosophy through publications and public speaking. But the two features, although analytically separable, nevertheless tend to flow together in a circular fashion—not conceptually but in the real empirical world; the innovativeness of style and technique, together with the activity of propagandizing innovations, spreads those styles and techniques and furthers subsequent innovation. Just how this tends to happen will be elaborated below.

Table 2 provides the total prestige ranking in terms of strong ties within one link for each architect in our sample. Among the top 10 are Ludwig Mies van der Rohe, a German architect usually credited with the triumph of the modernist style in the United States, and coiner of the modernist slogan, "less is more"; Walter Gropius, founder and leading figure of the Bauhaus school of art and architecture; Louis Sullivan, the Chicago architect regarded as the creator of the first skyscraper, along with his partner Dankmar Adler and their apprentices, Frank Lloyd Wright and Irving Gill; and Philip Johnson, instrumental in bringing modernism to the United States. At the top of the list in terms of one-link strong-tie halo effect is Le Corbusier, the most flamboyant of the modernist architects as well as the most adept at propagating the movement (for an example of his work, see Fig. 2[d]). In second place is Gregori Warchavchik, a Russian-born architect who migrated to Brazil and helped spur one of the most vigorous and internationally connected movements of modernist architecture, although he himself did not produce many outstanding buildings or designs. Ranking third is Peter Behrens, from the earliest generation of the modernist movement, who received the first large-scale commission, as director of design between 1907 and 1914 for the large German electrical-appliance company AEG (Allgemeine Elektricitäts Gesellschaft), which both built the first famous modernist industrial building (see Fig. 2[a]), and apprenticed a number of later-famous architects (Anderson 2000; Buddensieg 1984).

The last column of Table 2 provides the total prestige score in terms of strong ties within two links. Behrens comes in first, followed by Le Corbusier, and the two leading Brazilian architects, Costa and Niemeyer, both of them collaborators of Le Corbusier, and located at the core of the dense Brazilian network. Argentines Hardoy

[3] Thus, our approach differs from previous analyses of inter-generational networks of artists (e.g., Lang and Lang 1988, 1990). Their argument about a generation having a stake in the reputations of their predecessors because it legitimizes their own practice is congruent with our analysis in part. Like Lang and Lang, we make the point about the upstream, but we also stress that successful architects are those who work actively at building a downstream network of successful followers, which reflects well on them decades down the road.

Table 2 Total prestige of strong ties among 120 famous architects, 1890–1940, ranked in order of prestige within one link and within two links

Rank:		Name	Country	Prestige score (# of citations)	Strong-tie halo effect within:	
One-link	Two-links				One link	Two links
1	2	Le Corbusier	France	10	46	73
2	10	Gregori Warchavchik	Brazil	4	31	44
3	1	Peter Behrens	Germany	10	30	81
4	9	Ludwig Mies van der Rohe	Germany	10	25	45
4	17	Dankmar Adler	USA	7	25	25
6	20	Louis H. Sullivan	USA	9	23	23
7	12	Philip Johnson	USA	8	20	37
7	15	Theo Van Doesburg	Netherlands	9	20	26
9	6	Antonio Bonet	Argentina	3	18	53
9	11	Walter Gropius	Germany	10	18	38
11	2	Lúcio Costa	Brazil	6	17	73
12	15	Irving John Gill	USA	6	16	26
12	21	Frank Lloyd Wright	USA	10	16	22
12	27	William Lescaze	USA	9	16	16
15	17	Cornelius Van Eesteren	Netherlands	10	15	25
16	4	Oscar Niemeyer	Brazil	9	14	67
16	31	William Morris	Great Britain	7	14	14
16	31	Alexandr A. Vesnin	Russia	5	14	14
19	5	Jorge Ferrari Hardoy	Argentina	2	13	54
19	7	Josep Lluís Sert	Spain	6	13	50
19	35	Johannes A. Brinkmann	Netherlands	6	13	13
22	8	Auguste Perret	France	10	10	46
22	14	El Lissitzky	Russia	7	10	28
22	23	Jan Wils	Netherlands	6	10	19
22	39	Marcelo Roberto	Brazil	4	10	10
22	39	Leonid A. Vesnin	Russia	4	10	10
27	23	J.J.P. Oud	Netherlands	10	9	19
27	25	Henri Sauvage	France	7	9	18
27	27	George Howe	USA	9	9	16
27	41	Erik Bryggman	Sweden	5	9	9
27	41	Julián Jaime García Nuñez	Argentina	2	9	9
27	41	Mauricio Roberto	Brazil	5	9	9
27	41	Milton Roberto	Brazil	5	9	9
27	41	Viktor A. Vesnin	Russia	5	9	9
27	41	José Villagrán García	Mexico	4	9	9
36	47	Mario Chiattone	Italy	5	8	8
36	47	Luigi Figini	Italy	8	8	8
36	47	Sigurd Lewerentz	Sweden	5	8	8

Table 2 (continued)

Rank:		Name	Country	Prestige score (# of citations)	Strong-tie halo effect within:	
One-link	Two-links				One link	Two links
36	47	Erik Moller	Denmark	2	8	8
36	47	Gino Pollini	Italy	8	8	8
41	25	Walter Crane	Great Britain	3	7	18
41	27	William Richard Lethaby	Great Britain	5	7	16
41	30	John Ruskin	Great Britain	6	7	15
41	52	Uno Ahren	Sweden	3	7	7
45	22	Jorge Moreira	Brazil	3	6	20
45	31	L.C. Van der Vlugt	Netherlands	5	6	14
45	38	J. H. Van der Broek	Netherlands	8	6	11
48	31	Ivan Leonidov	Russia	5	5	14
48	54	Alvar Aalto	Finland	9	5	5
48	54	Gunnar Asplund	Sweden	8	5	5
48	54	Antonio Sant'Elia	Italy	8	5	5
52	13	Affonso Eduardo Reidy	Brazil	6	4	29
52	17	Erich Mendelsohn	Germany	10	4	25
52	36	Enrique de la Mora y Palomar	Mexico	1	4	12
52	36	Enrique Yánez de la Fuente	Mexico	1	4	12
52	53	Juan O'Gorman	Mexico	7	4	6
57	57	Sven Markelius	Sweden	7	3	3
58	58	Antonio Gaudí	Spain	9	2	2
58	58	Arne Jacobsen	Denmark	8	2	2

There are 59 architects with strong ties of apprenticeship or collaboration, 33 architects with weak education ties but no strong ties, and 28 architects with neither strong nor weak ties, for a total of 120. For the complete list of the architects, see Guillén (2006). The three Dutch architects lacking strong ties are Gerrit Rietveld, JM Van der Mey, and Robert Van t'Hoff. The correlation between our measure of prestige and the two halo measures is +0.40 and +0.35, respectively (significant at the $p<0.05$ level).

Calculated from: Guillén (2006:134, 149–156); Banham 1980; Benevolo 1977; Curtis 1996; Hitchcock 1971; Weston 1996; Lampugnani 1986; Midant ed. 1996; Muriel ed. 1994; Placzek ed. 1982; Sharp ed. 1981.

and Bonet, and Spaniard Sert follow in the ranking, all three disciples of Le Corbusier as well. Mies, Gropius, Philip Johnson, and the American group of Gill, Adler, Sullivan, and Wright, drop a little lower in the rankings when calculating the halo effect in two steps. By contrast, Perret, who was Le Courbusier's master, jumps to 8th from 22nd. Clearly, strong upstream and downstream connections to such a central figure as Le Corbusier increase the halo effect. The correlation between our measure

Fig. 2 Key modernist buildings. **a** Peter Behrens, AEG Turbine Assembly Hall (1908). **b** Josep Puig i Cadafalch, Casa Amatller (1900), and Antoni Gaudí, Casa Batlló (1905–07), Barcelona. **c** Louis H. Sullivan and Dankmar Adler, Auditorium Building, Chicago, 1886–1889. **d** Le Corbusier, Villa Savoye, Poissy-sur-Seine, 1929–31. **e** Lúcio Costa, Oscar Niemeyer et al., Ministry of Education and Health, Rio de Janeiro (1937–43). **f** Ludwig Mies van der Rohe, Seagram Building, New York City (1954–58)

[a] Peter Behrens, AEG Turbine Assembly Hall (1908).

[b] Josep Puig i Cadafalch, Casa Amatller (1900), and Antoni Gaudí, Casa Batlló (1905-07), Barcelona.

[c] Louis H. Sullivan and Dankmar Adler, Auditorium Building, Chicago, 1886-1889.

[d] Le Corbusier, Villa Savoye, Poissy-sur-Seine, 1929-31.

[e] Lúcio Costa, Oscar Niemeyer et al., Ministry of Education and Health, Rio de Janeiro (1937-43).

[f] Ludwig Mies van der Rohe, Seagram Building, New York City (1954-58).

of prestige and the two halo measures is +0.40 and +0.35, respectively (significant at the $p<0.05$ level).

The reputational importance of the downstream

Conventions of folk wisdom attribute creative innovations to genius-heroes, as sociologists have repeatedly noted (DeNora 1991; Merton 1973; Padgett and Ansell 1993; Padgett and McLean 2006; Uzzi and Spiro 2005). Histories of various academic fields tend to do the same, although science has become much more team-based since World War II (Wuchty et al. 2007; Jones et al. 2008). Architectural historians have been especially prone to falling into this trap, as argued by Larson (1993). So does the professional community, at least as it moves downstream and away from the immediate vicinity of where the action originally was. Figures like Corbusier and Mies van der Rohe become emblems for the movement to exalt and defend.

If we were to assume that creativity is strictly a property of the individual, then it would appear that this quality is fixed and cannot be affected by what happens after it appears at a certain point in time. But this way of conceptualizing creativity may be only the result of our conventional image of heroic individuals taken out of the context of their careers. If we examine the historical details of each person's lifetime activity in the context of their unfolding network, there is considerable evidence that judgments about creativity are made as the end result of a network process over a period of time. An individual's reputation takes time to crystallize, and this happens over several stages: the reputation for creative innovation that they achieve during their lifetime is typically different when they are young, in mid-career, and old, as well as the reputation they achieve in the next generation, after they have stopped working, which is a determining factor for their historical standing, as previous research in a variety of cultural fields has documented (Cheever 2006; Denora 1995; Farrell 2001; Johnson 2007; Larson 1993; Watson 1991; White and White 1965; White 1993; Zuckerman 1967).

Collins (1998) argued that, in the case of text-producing intellectuals such as philosophers, the creativity of a particular individual cannot be assessed until several generations after that individual's death. This is the case because the implications of their ideas are not yet worked out, and the reasons for paying greater or lesser attention to that upstream individual have not been fully developed. Numerous philosophers who became giants in the long-term historical record went into eclipse immediately after their death. To mention just a few instances of the pattern: Kant was upstaged by the Idealist movement of the early 1800s but was adulated by the Neo-Kantian movement from the 1870s to 1910; Hegel, who died in 1830, was rejected by the following generation of the 1840s and 1850s but received massive attention from existentialists, Marxists and post-structuralists in the twentieth century; both Plato and Aristotle were downgraded by their immediate successors and the schools they founded shifted to other doctrines, but in following centuries their names became rallying points for long-lasting stances in the intellectual field (Collins 1998). The downstream of a particular cultural producer does not consist simply of blind imitators, but of persons who find new implications in the doctrine, sometimes going off

on extreme tangents; it is this innovativeness downstream that adds prestige to the entire lineage, and reflects backwards upon the historical reputation of the upstream figure. Even negative attention can be reputation-building; the attacks on Hegel by downstream followers such as the existential phenomenologists (e.g., Heidegger, Sartre) are part of the affirmation of Hegel as an eminent figure in the history of philosophy.

The same pattern—the downstream shaping the reputation of the upstream—is also found in the architects' network. Figure 1 includes examples of both high reputations built on the basis of a dynamic downstream, and stellar architects with lower reputations because they failed to nurture a school of followers. Let us first analyze the successful downstream of several central European architects and then contrast them to the lower-prestige Catalan modernists.

A strong downstream leads to prominence

In the modernist architecture universe, two of the biggest personal reputations, Behrens and Perret (both with a prestige score of 10 and both with large network halos) belong to the earliest generation of modernist architects (see Fig. 1). Left to themselves, their work would be labeled as ambiguously modernist, steps in the direction of what later became modern architecture, but at the time, not a decisive break with the past.[4] To see them as giants of the movement, mentioned in all key encyclopedias and historical treatments (which give them a prestige score of 10), there had to be a downstream movement among their professional offspring. Behrens has much more of a network halo than Perret (see Table 2), because the former has three top-rank apprentices (Gropius, Mies, and Corbusier) whereas the latter has only one (Corbusier). We might even say that such founding individuals have an exaggerated reputation, due more to the network halo produced by their eminent followers, in which the identity of modernist architecture crystallized; and as we have argued, this is not simply because of the work of Gropius, Mies, and Corbusier, but because of their influence further downstream, i.e., the enthusiastic movement of modernists they propagated.

For instance, Mies van der Rohe was not considered particularly innovative up through the end of the 1920s, although he was well-connected in the European networks of the interwar period (Guillén 2006, pp. 56–60; Hochman 1989). Similarly, Le Corbusier, although he proselytized aggressively beginning in the early 1920s—more from his writings than his building projects, as yet largely unrealized—achieved his reputation in the 1930s onwards as a movement grew up around him. It was in the 1950s that Corbusier came to outstrip earlier leaders such as Gropius, i.e., after the Bauhaus

[4] Perret was a leader of the French movement of early modernists, known especially for his innovative work in reinforced concrete; this was one of the key new materials of modern architecture, which displaced building with traditional materials of brick and stone. Thus Perret's influence was less in the flamboyant realm of style, visible to the public, and more in the technical realm of skills propagated to the inner group of professional architects, which made possible their striking new designs in new materials. Behrens was an innovative insider for professional architects in more of a social-organizational sense; he pioneered the social practice of long-term, collaborative projects of a quasi-public nature, as head of design for a large electric firm; this foreshadowed the collective practices of the German modernist architects, above all in public housing projects (Larson 1993, pp. 29–49; Guillén 2006, pp. 53–56).

disbanded and Corbusier's followers became famous around the world (Bacon 2001; CGP 1987). Conversely, some of the brightest stars of the German movement during the 1920s—Erich Mendelsohn (prestige score of 10) and Bruno Taut (9), both expressionist architects with closer ties to the movement of modernist painters than to other architects, and Hannes Meyer (10) and Ludwig Hilberseimer (9), leaders of the public housing movement—fell off in their reputations in later decades as they failed to have important followers.

To produce preeminent followers means to have followers who do work distinctive enough to be considered innovative in their own right. One way to achieve this is to find followers in a separate niche—a different branch of architecture, or a different national arena. The key to Le Corbusier's success was his extreme international aggressiveness, seeking out collaborators beyond his primary network in Central-Western Europe, by proselytizing for his style in Spain, Brazil, Argentina, India, Algeria, and elsewhere (Bacon 2001; CGP 1987). But Corbusier did not merely seek out building commissions in far-flung countries; he recruited the most eminent local architects to collaborate with him, thereby developing stars in their own right and building his own downstream.

Corbusier's tactics can be seen by examining the history of the Brazil modernist circle. The initial leader of this network was Gregori Warchavchik, a modernist pioneer, trained in Germany under Mendelsohn (prestige score of 10). Warchavchik emigrated to Brazil and made contact with a local group of architects trained at the architecture school in Rio de Janeiro. He gained some local eminence by designing the first modernist building in Brazil in 1927–28, a private residence (Ferraz 1965; Guillén 2006, p. 99). But he was upstaged when Corbusier first visited in 1929 and began to collaborate with local architects; this raised the eminence of Niemeyer (10) and Costa (6) on the world stage, especially after the fame surrounding the construction of several public buildings in Rio (see Fig. 2[e]), and later of the new capital city at Brasília, the largest modernist urban project (Goodwin 1943). Warchavchik was instrumental in starting the Brazilian cluster on the modernist path; this in turn attracted Corbusier, with his already large international reputation, who outshone Warchavchik with his merely local reputation, and refocused the group into what became known as the Brazilian Corbusier followers.

Another illustrative instance is the link between Mies van der Rohe and Philip Johnson. Initially an academic architect rather than a builder, Johnson was attracted to the modernist movement when it was making a big splash in Germany in the 1920s, and to a lesser degree in France. After visiting Germany and working for Gropius, Johnson organized an exhibition at the Museum of Modern Art (MoMA) in New York, giving architecture the prestige of belonging to the modern movement. Johnson continued to promote modern architecture at the MoMA, and was instrumental in bringing German architects to the United States as refugees during the Nazi period. Through Johnson's influence, Mies got the commissions at Chicago in 1949 for the Lake Shore Drive high-rise apartments, which were among the first triumphs of modernist architecture in the United States and turned him into the archetypal modernist architect ("less is more," he famously pronounced), spurring a movement of followers. Between 1954 and 1958 Johnson helped Mies on the Seagram Building in New York, a glass-walled tower that quickly became the most famous exemplar of the postwar modernist style (Fig. 2[f]). Johnson's downstream creativity extended

even further, as he went on with younger partners to modify the modernist box into the postmodernist style, with the 1974 Pennzoil Place in Houston and the 1979 AT&T building in New York (Jordy 1986; Larson 1993, p. 62; Scully 1974). (We do not count these latter collaborations in our formal analysis, since they fall outside its time limits.) The success of Mies and of Johnson is genuinely synergistic; it cannot be reduced to separate qualities of each, since Mies modified his style under American conditions to the severe lines and emphasis on immense glass walls, while Johnson went from outside promoter to an active participant in architectural development, even beyond that of his senior mentor. The fact that Mies later became the target, along with Corbusier, of postmodernist attacks ("less is a bore!", as Robert Venturi famously put it; see Gartman 2009), did not undermine his historical reputation but solidified it; the important thing is action in the downstream, not necessarily agreement. Mies and Johnson made their reputations in tandem, a successful downstream increasing the prominence of a successful upstream.

A weak downstream diminishes reputation

The importance of the downstream can also be assessed in the case of circles of architects who were themselves creative and productive, but whose ultimate prestige suffered from not nurturing a group of followers. In fact, not all local architectural movements propagated widely, even if they were quite innovative for their time and place. As shown in Fig. 1, the Barcelona architects have very low prestige scores, with the exceptions of Gaudí (9) and Sert (6). When we look at old school ties, we find that the Barcelona group is indeed quite coherent as a cultural cluster, characterized by a fairly dense network of acquaintanceship and participation in socio-political movements, although not the very strong ties of collaboration and apprenticeship (Guillén 2006). These architects built in the same district of the city, a new extension opened up for development after the 1870s; and some of them rivaled each other with extravagantly innovative designs for buildings right next to each other (see Fig. 2[b]). But these kinds of ties were not sufficient to propagate a stylistic movement that spread elsewhere to create an international reputation. It was not for lack of ideological fervor either, for they formed a very self-conscious movement with political as well as artistic ramifications, which was in full swing 10 to 20 years before the modernist movement gathered speed in Germany; it is part of the early generation in which the very notion of what modern architecture would become was still being formulated (Solà-Morales 1984; Guillén 2006, pp. 80–85; Mackay 1989).

All of the various modernist trends shared a breaking away from the dominant architectural trends, above all the neo-classical style and its adaptations in European baroque. The Barcelona *modernisme* was akin to the Art Nouveau movement in Belgian and French decoration, to the Jungendstil or Sezession movement in German painting, and to expressionism in German architecture. All these movements used modern materials—concrete, metal, ceramic, and glass—in opposition to traditional architecture based on stone and brick. But the first attempt at modernism that Barcelona represented did not break with the neo-classical propensity for ornament on the outside of buildings; it eliminated or drastically shifted the classical decorative motifs (urns, balustrades, garlands, wreaths, medallions, caryatids, bas-reliefs, and

the rest) but produced stylized decoration in more abstract forms, typically sinuous lines. In the perspective of what happened 20 to 40 years later with the radical modernists—the minimalist geometrical style that triumphed with Corbusier, Gropius, and Mies—movements like the Barcelona modernists appear almost conservative, lumped with the Arts and Crafts movement around such architect-reformers as Ruskin and Morris in England, who also rejected neo-classicism but held a backward-looking ideology of medieval attention to detail. Partly because of their sociopolitical and aesthetic inclinations, and partly because of their scant efforts at nurturing a following, the Catalan modernists ended up being relegated to the fringes of the overall movement, with the only exception of Sert (prestige score of 6), who worked with Corbusier and migrated to the United States.

Energizing cultural change by intense interaction rituals

The halo effects reported in Table 2 may appear to be excessive in some cases, even anomalous, given that some of the highest-ranked architects were not as creative themselves or did not build that much. But this way of looking at the evidence is not sociologically useful. We propose that outliers with outsized prestige scores became Durkheimian symbols of the larger network and its innovative activity as a collective endeavor. Padgett (1997) proposed that action capacity, skill, or talent resides in the individual, but they are activated by interaction with other actors in the network. In a similar vein, Collins (1998) argued that "the network is the actor on the stage"; it is the activity of the network as a whole across the generations doing the work that becomes summarized in the reputations of a few individual stars. When we analyze these processes as they unfold, we find network halos; and these halos produce some anomalies, figures who seem to have a higher reflected reputation than they are worth through their individual work. The process is not merely one of producing reputations, but more fundamentally producing innovative cultural products; the network of architects not only developed the reputations of its heroes and those in their halos, but built modernist buildings. The expanding network was a movement, developing energy and enthusiasm and confidence, and thereby both producing new designs and producing new reputations. The reputational and substantive parts of creativity cannot ultimately be separated. Both are parts of a network propagating as a social movement (Frickel and Gross 2005; McAdam et al. 1996; Mische 2008), doing its work and building its social prestige as parts of the same process.

A theory of innovation in cultural production based on intense interaction rituals resonates with the work of art historians. They frequently note that major cultural innovations, such as the creation of the modernist architectural style, involved a gestalt switch, a new mode of perception of what is aesthetically important; to become a leading practitioner involved a shift in mentality and in techniques that are both nuanced in detail and pattern-breaking in contrast to cultural tradition (Banham 1980; Benevolo 1977; Weston 1996; Middleton 1982). Thus, dense networks of self-conscious cultural innovators are the engines of major cultural change, particularly in sophisticated high culture.

Thus, the modernist architects organized themselves into myriad working groups, movements, associations, and organizations. They proclaimed manifestos, and launched new educational programs, such as the Bauhaus in Germany and the VKhUTEMAS, the Moscow Higher State Artistic and Technical Workshops (Guillén 2006). The Mexican architect Mario Pani understood the importance of interaction for innovation, when he wrote that "the architect doesn't, cannot, work alone… He [sic] must constantly extend and renew his lines of communication. He has his field commanders, his designers, draftsmen, mathematicians, contractors, suppliers, endless armies of workers, skilled craftsmen" (quoted in Smith 1967, p. 178). Although methodical when it came to organizing for action, the modernists appealed to various abstract ideals and to emotions when making their case. For instance, the Italian futurist F. T. Marinetti's most powerful and famous line went as follows: "We affirm that the world's magnificence has been enriched by a new beauty: the beauty of speed… A roaring car… is more beautiful than the Victory of Samothrace," in a reference to the imposing Greek sculpture at the Louvre Museum in Paris (Marinetti 1973, p. 21).

New ideas (and again, new aesthetics) are made by recombining elements from the existing cultural repertoire; major innovations are made by negating or reversing some of those elements and working out a new combination including these negations. Non-Euclidean geometries were created by negating particular postulates and reworking the rest of the system; innovations in philosophy proceeded in similar ways (Collins 1998, pp. 131–176, 699–700). Modernist architecture negated neoclassical ornamentation and the principle of symmetry, favoring instead simplicity and regularity, and went on to formulate an aesthetic consistent with those premises. A subsequent faction eliminated the wall entirely and replaced it with glass. Innovation by negation and recombination is a form of creativity that occurs by internal processes within an intimate network. Negation goes along with recombination; non-Euclidean geometricians did not throw out all previous geometry but reworked it with additional, radical axioms, thus using previously accumulated cultural capital of their predecessors as a store on which to build a broad new field of activity for mathematics. Negation of some parts of traditional practice allows new reputations to be made; recombination of these innovative parts with existing cultural capital makes this a movement to reconstitute the field, rather than breaking off into an entirely new field. Once the field can be won over, the innovators are guaranteed plenty of opportunities to apply their new approach.

Consider, for example, Antonio Sant'Elia, the founder of Italian architectural modernism, writing in his manifesto of 1914: "We must invent and rebuild ex novo our modern city like an immense and tumultuous shipyard, active, mobile, and everywhere dynamic, and the modern building like a gigantic machine… the new architecture is the architecture of cold calculation… boldness and simplicity" (quoted in Curtis 1996, p. 109). The following statement from 1928 by the most accomplished Italian modernist architect, Giuseppe Terragni, adds the idea of negation:

> The house can in a certain way be compared to a machine and must be constructed so that every one of its parts serves a precise purpose. There should be nothing there that is useless or superfluous, because like a machine, this will end up hindering its functioning (quoted in Etlin 1991, p. 265).

In a similar vein, Le Corbusier described one of his most famous designs as follows:

> The house is a box in the air, pierced all around, without interruption, by a long window… From the interior of the vestibule, a gentle ramp leads up, almost without noticing it, to the first floor… [The] different rooms adjoin each other radially from a suspended garden which is there like a distributor of light… It is onto the suspended garden that the sliding walls of glass of the salon and several other rooms are opened in all freedom… Poetry, lyricism, produced by technology (quoted in Benton 1984:ix).

The effect of sacred objects and dense networks

Because negation and recombination are at the center of this kind of innovation, there is an especially strong need for social solidarity in getting the new gestalt accepted. Above all in aesthetic fields, an innovation that turns accepted standards on their head generates visceral aversion among the older practitioners and their clients or consumers. To get through this period while the aesthetic standard is changing, new ideas and styles have to be socially energized if they are to be successful. It is for this reason that the major culture innovators in a field are closely connected to other such major innovators. They are not just transmitting information, but energizing their cultural objects, turning them into Durkheimian "sacred objects" or totems of the group, e.g., the machine in the case of the modernist architects. Thus, the German architect Walter Gropius argued that "the Bauhaus believes the machine to be our modern medium of design," and that "we want an architecture adapted to our world of machines, radios and fast cars…" (quoted in Curtis 1996, pp. 193–194). Mendelsohn agreed: "The machine, till now the pliable tool of lifeless exploitation, has become the constructive element of a new, living organism" (quoted in Curtis 1996, p. 187). And Le Corbusier came up with the most felicitous statement of the metaphor: "A house is a machine for living in.… An armchair is a machine for sitting in, and so on." He longed for a "'House-Machine', the mass-production house, healthy (and morally so too) and beautiful in the same way that the working tools and instruments which accompany our existence are beautiful." As a source of aesthetic inspiration, the machine was a "factor of economy, which makes for selection," thus promoting good taste by overcoming the eclecticism of the traditional architectural styles against which the modernists rebelled (Le Corbusier 1986, p. 1, 4, 19, 95). Thus, the machine became the Durkheimian sacred object that unified the modernist movement in architecture around a relatively small and coherent set of abstract design principles, linked architecture to different higher purposes (utility and efficiency), and unleashed a far-reaching cultural movement by attracting a growing number of architects and clients.

In the neo-Durkheimian terms of interaction ritual chain theory, a highly cohesive group has more potential for generating collective effervescence around its culturally transforming mission. The strong ties of such a network cannot be captured in bland expressions such as "friendship," "apprenticeship," or "collaboration." A very strong tie, when seen from the vantage point of the micro-sociology of everyday

interactions, is intensely meaningful to its participants; the interaction is repeated, frequent, and above all filled with a sense that something important is happening (Collins 2004, pp. 165–167, 190–196; Emirbayer and Goodwin 1994). From a Durkheimian perspective, strong ties are key mechanisms for generating a higher level of emotional solidarity, which facilitates internalizing tacit elements of intellectual practice. Facility at creating new ideas (or new aesthetic patterns) comes from internalizing a sense of the structure of the surrounding social network in one's field. Ideas are supremely important to intellectuals because they are membership symbols that convey connections both of ideas to other ideas and of intellectual factions in relation to other factions. Skilled intellectual practitioners do not have isolated ideas, but an understanding of the chain of arguments and their ongoing history as a field, and simultaneously a sense of which intellectual and social groups are identified with these ideas or against them (Collins 1998, 2004, pp. 183–196).

Cultural innovations, precisely because they are big and bold, need a great deal of social momentum to become successfully launched. Dense social networks are known for providing social support; it is usually assumed that the downside of this support is conservatism and conformity. But "social support" is too pallid a term for the collective effervescence, for the outburst of creative imagination, that energizes the small, dense groups virtually always found at the cutting edge of cultural production in a variety of fields (Cheever 2006; Denora 1995; Farrell 2001; Johnson 2008; Watson 1991; White and White 1965; White 1993). And what they are supporting, in these specialized kinds of networks where past eminence is taken as a trajectory for further creativity, is not conventional conservatism. What the members most intensely socialized in these groups are conforming to is the techniques of how to negate and recombine cultural elements selectively into innovative patterns. Thus, the Russian architect Nikolai Ladovsky thought of modernism as the creation of "a scientific statement of architectural principles on the basis of rationalist aesthetics." He further observed that

> Architectural rationality is founded on the principle of economy just as technical rationality is. The difference lies in the fact that technical rationality is an economy of labor and material in the creation of a suitable and convenient building, but architectural rationality is the economy of psychic energy in the perception of the spatial and functional properties of the building. It is a *synthesis of these two forms of rationality* into one building (quoted in Cooke 1995, p. 98, 178; emphasis added).

Bridge ties, emotional energy, and movement-building strategies

Although we have emphasized the importance of the concatenation of eminence, bridge ties linking otherwise isolated clusters do exist in our data. The most notable such bridge is Le Corbusier, who is trained by the most eminent in both the French and German networks (see Fig. 1). The theory is that a bridge tie promotes innovation by combining previously separated pieces of information (Burt 1992, 2005); as such, it is a combination of separate cultural capitals coming from upstream. Following

recent research on information sharing and transfer in organizations (Reagans and McEvily 2003; Reagans et al. 2004), we propose to view strong ties, and the resulting social cohesion, as providing the motivation for actors to engage and exchange ideas from others located across organizational, institutional, or social boundaries, i.e., across bridge ties.

One key feature of the network of modernist architects is that several important bridge ties are downstream. For instance, Corbusier sought out downstream ties in clusters of architects not yet connected to his originating network, in Spain, Brazil, and Argentina (and in data not included in our analysis, in India; see Prakesh 2002). But these are not brief ties for the sake of acquiring information hitherto unknown in the center; Corbusier established and maintained strong ties of apprenticeship and collaboration, and thereby spread his own message, method, and fame. Corbusier is the purest example of a bridge tie in our data. An alternative explanation of Corbusier's eminence is the success of his strategy of cultivating many successful groups downstream (Bacon 2001; CGP 1987). One might call this the deliberate creation of bridge ties, but not to collect information inwards, but to spread one's movement outwards. Thus, it is conceptually useful to distinguish between *inward* bridges and *outward* bridges, as different strategies contributing to innovation in cultural production fields.[5]

The most innovative downstream link is between Mies van der Rohe and Philip Johnson; it should be called a multiple bridge, however, as Johnson did not uniquely depend on Mies to connect him to the European pioneers of modernism, since Johnson also worked for Gropius. The transatlantic tie is mutually beneficial. Mies fully came into his own when he moved to the United States, building in his distinctively pure style of radically simplified skyscrapers that depended for their aesthetic effect upon their graceful lines and proportions; and the most famous of these buildings were done in collaboration with Johnson. A new combination of architects, using different perspectives, or putting a slightly older paradigm to work in a new setting, can produce distinctive innovations. But the mechanism is not simply the comparative advantage of bridge ties over dense and redundant ties.

In the case of architectural innovation, the bridge ties became intense collaborations, often long-term and repeated. The collaborators were not just exchanging new ideas, techniques, and information about opportunities as to where to build, but are inspiring each other. They converted one another into a new movement, or intensified their feelings of commitment to extending an existing movement still further, in still more radical directions. In the terminology of the micro-sociology of interaction ritual chains, they are giving each other emotional energy—the confidence, enthusiasm, and initiative to push through in a new direction (Collins 2004). They did not just formulate a new project, but energized themselves in a movement that initially lacks supporters, as suggested by social movement theorists (Frickel and Gross 2005). The group built élan—energy, style, enthusiasm; and this both motivated its members for

[5] Obstfeld (2005) shows, similarly, that successful innovative groups in the engineering division of an automobile manufacturer not only import novel combinations from bridge ties, but actively recruit new members to join them [the "tertius iungens," or third who joins, orientation]; the resulting dense groups with very strong ties are best able to carry through an innovation.

ambitious efforts, and also tended to create an attraction in the attention space that will make the innovation succeed by expanding the network. Philip Johnson was drawn to Gropius's studio because this was "where the action is," to borrow Goffman's (1969) terminology; after working closely with the heroes of this group, Johnson was not only converted but energized, and aggressively publicized the group in a new venue in the United States. Earlier, at the very beginning of the modernist movement, Behrens's workshop at the AEG company acquired a reputation as the place for ambitious, forward-looking architects to work (Anderson 2000; Buddensieg 1984); it was this intensity that was internalized by young and as yet uncreative members of the group such as Gropius, Mies, and Corbusier.

Although there is a bridge tie between Johnson and Mies—and between Corbusier and Perret, on the one hand, and Behrens, on the other—this can be at most only part of their innovativeness (see Fig. 1). Each of these innovators also had very strong and dense ties, often deliberately sought-out and created. At a minimum, bridge ties in cultural production networks need to be added to the dense-intense ties of a deliberately culture-changing movement. Moreover, bridge ties are not necessary for major innovativeness; Gropius and Mies do not bridge upstream, but split off from the same group; and Frank Lloyd Wright, the most explicitly individualistic and idiosyncratic of the modernists, not only has no bridge ties but comes from a very densely connected group at the heart of the movement that invented the skyscraper, the office of Louis Sullivan in Chicago. Wright illustrates another path to innovation, which in cultural production and scientific fields is even more common than bridge ties: innovation by splits and rebellions within a strong cluster of the already eminent (Collins 1998; Frickel and Gross 2005).

We may call this pattern a "revolution within the citadel"; it is part of the tendency for eminence to cluster, both in vertical chains across the generations and in horizontal clusters of contemporaries making their way together. The downstream can become truly eminent only by rebelling against their mentors, striking out in a new direction; yet those at the core are best equipped to do so, rather than those on the periphery, because the younger generation located at the core is best equipped with knowledge of what the cutting edge of the field is at the moment, what will make the biggest splash in the attention space. For those trained at the core, the experience is not just an apprenticeship in cultural transmission, but an apprenticeship in the tacit techniques of being an innovator.

In horizontal groups, cliques of contemporaries, i.e., "Young Turks" who gather together to build up mutual enthusiasm for their culturally transformative mission, tend to go through a double process of rebellious innovation. They rebel against the previous generation of their teachers, against the standards of the past that they are overthrowing; and this negation often shapes the specific content of their innovation. In the case of the modernist architects, there was a rebellion against symmetry and ornament because they were a hallmark of the school that preceded them. But a group that mobilizes to fight for a new cultural style tends to split once it begins to become successful; its members seek out distinctive niches, often by picking quarrels with each other, which have the effect of distinguishing their styles of work within the new framework. Research has documented numerous examples of this pattern (Collins 1998; Farrell 2001; Guillén 2006; Watson 1991). Thus there are two phases of

rebellious innovation: against the past generation, and then to maximize individual success within the new generation.[6] But the latter requires that the standards of the field be changed; the phase of movement solidarity must precede the phase of individual careerism.

These dynamics of cohesion, conflict, and change have been found in other fields. Abbott (2001) refers to "fractal divisions" internal to an academic discipline being brought under control by competition and criticism across disciplines. Similarly, Zablocki (1980) found that communes with stronger ties were more likely to break up, Ansell (2001) reported that "communal closure" produced divisions and the eventual downfall of social movements, and Mannheim (1952, p. 304, 306–307) theorized the concept of conflict among "generation units" within the same chronological group.

The alternative mechanisms of innovation represented by internal rebellions and splits are discussed here chiefly to buttress the main point: concatenation of eminence occurs via dense and intense ties, and this is entirely compatible with innovativeness—at least in the specific case of cultural production fields. Density in the network is not necessarily stultifying and in fact provides the foundations for cultural change. We argue that bridge ties do not play a crucial role in supporting innovation in these fields, although they may sometimes occur; in that case, they add onto the mechanisms of innovation in dense-intense ties, rather than substitute for them. And the most important kinds of bridges appear to be those in which incipient innovators actively seek out a downstream, recruiting dense groups in new niches to the new style. The strategy leading to individual success is to propagate enthusiasm for a new approach to cultural production, thereby spreading one's own fame by means of the fame of one's followers (outward bridges).

The four layers of paradigm shift in cultural innovation

Major cultural movements have causes and consequences on several different levels: material conditions, political and economic shifts, networks, and the cultural products themselves. While previous research has emphasized economic, political, social, and organizational variables (e.g., Larson 1993; Guillén 2006; Gartman 2009), we highlight the role of networks in mobilizing resources and shaping reputations. Collins (1998) argued for a four-stage causal chain, with each level adding something in its own sphere: (a) changes in the surrounding political and economic structure, which bring about (b) changes in the material bases of intellectual life, destroying some culture-producing institutions, and giving opportunities to start new organizations that support intellectual careers; changes in the material and organizational base in

[6] This would be even more apparent in our data if we extended our analysis of leading architects to the second half of the twentieth century. The downstream network flowing from Johnson includes the leaders of the postmodernist movement in architecture. The Yale architecture department, Johnson's organizational base, trained Eero Saarinen, whose firm in turn launched the career of Cesar Pelli (who later became the Dean of architecture at Yale); Pelli in turn was associated with the early career of Frank Gehry (Larson 1993, pp. 289–290). These latter names are among the most eminent of the postmodernist architects—a rebellious movement but nevertheless a "revolution within the citadel" of the preceding network of eminence.

turn bring about (c) reorganization of existing networks from teachers to pupils, and opportunities to start new networks as social movements within the new intellectual space; and finally (d) the creative rearrangement of cultural capital from these networks into new cultural products.

A similar scheme casts light on the several levels of change that brought about the development of modernist architecture. First, modern industry, especially the development of steel and chemicals, made possible steel frame buildings, with walls of reinforced (steel-rod) concrete, and huge expanses of glass, since walls no longer had to bear weight. By the 1890s, electric elevators and machinery for lifts and cranes made very high-rise buildings both technically feasible and socially practical. It became possible to shift away from the traditional reliance on stone, marble, brick, and wood, which used walls as supports (Banham 1980; Giedion 1982; Hitchcock and Johnson 1995). However, the new building materials and techniques per se did not guarantee a new style (Guillén 2006). And in fact, the first skyscrapers were built to look as if they were traditional baroque or neo-classical buildings, steel frame on the inside, but covered in stone as if they were just an extension of earlier models to a greater height off the ground, and decorated with traditional motifs, as Le Corbusier was fond of criticizing.[7] Sullivan's group of innovators in Chicago were technically innovative, but (except for their apprentice Wright) propagated a conservative cultural message; the boom in American skyscraper-building through the 1920s and 1930s, most notably in New York as it caught up with Chicago, remained stylistically conservative (see Fig. 2[c]), until Mies, Gropius and the other modernists arrived from Europe (see Fig. 2[d]).

A second process of change had to do with the political and economic developments that fostered new organizations with which architects could work and that helped them obtain clients (Benevolo 1977; Gartman 2000; Guillén 2006; Jencks 1973). Architects already had a base in some universities and in schools of art, although here the identities were largely conservative. More innovative possibilities came from engineering schools; in the nineteenth and early twentieth centuries, these technical schools were generally of lower prestige than the traditional universities, and had motivation for innovating cultural standards that would raise their prestige. The architectural hybrids who attended engineering schools (in Germany, these were the Technische Hochschulen, upstart institutions looked down upon by the traditional universities) were thus of key importance in the movement of modernist architecture (Guillén 2006; Pfammatter 2000). In Fig. 1, architects trained at engineering schools are denoted by boxes of broken lines, including Gropius, Muthesius, Meyer, Wagner, and May in Germany—those most dedicated to the collective social movements of public architecture—along with Sullivan, Wright, and most of the American movement.

The ideology of the expanding engineering profession was not merely to work with new techniques and materials, but to apply the engineering approach to new industrial scientific management. This ideology was extremely useful for institution

[7] Among the most famous Chicago buildings of the 1920s were the Chicago Tribune Tower (built by Raymond Hood) with its Gothic façade; its rival directly across Michigan Avenue, the Wrigley Building, carried graceful white Italian Renaissance motifs on its upper stories. Other skyscrapers put Moorish, Romanesque, or Victorian decorations on the outside of their modern steel-frame construction.

building, since it favored the employment of architects, not merely as one-shot professional services for individual clients, but as continuing, in-house professional experts in large social enterprises in the corporate business world and in civic public projects.[8] Modernist architects came from a movement that was transforming the institutional bases in which architects could work and make a living (Gartman 2000, 2009; Guillén 2006; Pfammatter 2000). The rise of modernist architecture was the result of the increasing intersection and overlapping of different organizational, institutional and social domains, including government agencies, certain political parties, industrial firms, universities, engineering schools, professional associations, and museums, among others (Guillén 2006). In this respect, the process by which the modernists transformed architecture paralleled that found by Padgett and McLean (2006) to lie at the origins of the invention of modern financial capitalism in Renaissance Florence.

In addition, connections to the world of engineering placed architects in contact with industrial firms and government agencies, the two actors that became their key clients. The leading German, Italian, Russian, and some of the French modernists either worked at industrial companies or designed buildings and products for them. They also developed close ties to government agencies seeking to improve living conditions in the city and provide cheap housing for the growing working class.

Close ties to certain clients or the ability to secure commissions, however, does not explain success or prestige in the long run. A few examples help make the point. Behrens is not considered to be today one of the key architects of the modernist movement because he worked for the AEG company (Buddensieg 1984), but because he attracted to his workshop followers that eventually became even more influential than he was (Anderson 2000). Gropius attracted commissions to the Bauhaus because he was already famous; firms such as Junkers benefited from his prestige, and not vice versa (Jablonowski 1983). Corbu's early contacts were with painters and with prominent French industrialists (CGP 1987, p. 400), not with other architects, but one cannot grasp his influence worldwide without the latter. With the only exception of Sert, all of the Catalan architects worked assiduously for wealthy industrial clients, but that did not help them develop a downstream of followers or enhance their international prestige (Bohigas 1973, 1998; Freixa 1986). Similarly, it would be inaccurate to say that the prestige of Mies, Terragni, Sert, or Niemeyer emanated from their commissions with the governments that sponsored some of their most influential work: Stuttgart, Fascist Italy, the Generalitat of Catalonia, or Brazil's Health and Education Ministry. The opportunities and resources provided by the government were crucial for bringing their design to fruition, but dozens of other architects obtained commissions from the same entities, but none of them reached the same fame and recognition over the long run.

[8] Modernist architecture took off when it acquired a new base not just for training but for commercial work: notably the AEG workshop headed by Behrens between 1907 and 1914, and then in the 1920s the German civic projects for public housing, headed by Martin Wagner in Berlin and Ernst May in Frankfurt (Larson 1993, pp. 36–41). The modernist architects also used as bases to propagandize the new style professional associations (such as the Werkbund for the applied arts, dating from 1907), the Bauhaus school, established under Gropius in 1919 (which brought together both painters and architects as teachers), and the CIAM (International Congress for Modern Architecture), founded in 1928 to promote leading members such as Corbusier in international design competitions.

Although painters do not need to mobilize nearly as many resources as architects in order to produce their artwork, changes in sponsorship triggered and supported by underlying social networks. During the late nineteenth and early twentieth centuries, commercial art galleries developed, exhibiting artists as avant-garde, emancipated from state-controlled art academics. As White and White (1965) showed, the impressionist movement and its successors formed an expanding network, based in these new outlets for marketing painting, which also emphasized breaks with the past both in genre and technique. Although we do not pursue that network story here, the existence of these networks of avant-garde painters provided alliances with the modernist architects. We have, however, underlined the most important of these network crossovers, the significance of the MoMA as the initial base for Philip Johnson, from which the modernist architectural movement was imported into the United States.

The third process of change was linked to this complex of organizational bases in which architects could work, draw incomes, and mobilize support (Blau 1984). This made it possible to organize new networks, especially the very-strong-tie networks we have analyzed in this article. The networks are the core of the process of cultural production; the organizational bases, like the new materials and industrial techniques available from the late nineteenth century onwards, only provided a potential that had to be realized by networks. The network as an expanding social movement is what carries out a cultural innovation. Some individuals such as Le Corbusier and Mies van der Rohe occupy especially pivotal places in the networks, but above all because their activity is to expand the network as an enterprise in which many creative projects draw inspiration and energy from each other, thus contributing to a large halo effect for the most creative, entrepreneurial, and organizationally oriented architects, on whom upstream and downstream prestige converged to shape their reputations for decades to come.

Finally, a fourth aspect of change on the outcome level are the actual buildings and artifacts that constitute modernist architecture, together with the designs created and exhibited (often without being built), and the textual statements that propagandized for a new architectural philosophy and aesthetic. Our sociological approach emphasizes the social construction of this outcome; these are cultural products, arising from the aggressive expansion of networks.

Conclusion: toward a model of change in cultural production fields

Our case study of the emergence of modernism as the dominant approach in the cultural field of architecture illustrates the importance of the concatenation of prestige in network dynamics. We focus the attention on the role played by very strong ties of apprenticeship and collaboration. Success in this type of network is explained by the concatenation of prestige vertically and horizontally. Network halo effects in the downstream direction are especially important, as producers of cultural artifacts must nurture a school of followers that both reflects and magnifies their own influence and prestige. We propose this concatenation of eminence as the central component in a theory of influence and innovation in cultural production.

Our analysis of eminence is not free from limitations. First, our empirical measure is based on citations to specific architects in the main histories and encyclopedias. This is an indirect measure of influence or success, filtered as it is through the interpretation of key gatekeepers in the field. Alternative measures could be constructed using data on architectural commissions or on the reaction of the public to the buildings themselves, although they are not available for a large sample of architects across the 12 countries included in this study. Second, while our model can account for the diffusion or circulation of prestige across the network of architects, it cannot explain the ultimate source of the success, whether it is individually or organizationally based. These limitations invite more systematic empirical research.

Our article resonates with recent work regarding the impact on the prestige of academic departments of the networks linking departments that produce PhDs to those employing them (Burris 2004). In addition, we also propose that bridge ties across structural holes are relevant in cultural production fields, but they tend not to be used for competitive advantage from scarce information (inward bridges), but as opportunities to build aggressively a downstream network to propagate one's style and fame by fostering eminent followers in new niches (outward bridges).

The mechanism underpinning the concatenation of eminence is the series of interaction rituals taking place among cultural producers (Collins 2004). Overthrowing an established approach to cultural production in a given field requires more than the activities of one or more individuals. Fields are resistant to change (Emirbayer and Johnson 2008), and it typically takes much more than weak ties to shift them in a different direction. Intense patterns of interaction among individuals enable them to arrive at a shared definition of the problems and the opportunities facing them, and to gain confidence and initiative to launch a different approach, to organize a social movement focused on achieving change (McAdam et al. 1996; Meyer and Staggenborg 1996; Zald and Useem 1987). The transformation of fields of cultural production tends to go through phases during which a relatively small number of individuals interact in intimate and intense ways, develop a new template, undermine the established cultural order, and subsequently split up, as architectural historians have documented (Jencks 1973). The key temporal divide is marked by success at transforming the field, given that the protagonists of such change can no longer have the same relationships with one another they once had when they were a merely movement unified by their opposition to the established norm within the field.

Our model based on interaction rituals incorporates insights from the resource-mobilization approach to social movements. From this perspective, social movements are "conscious strategic efforts by groups of people to fashion shared understandings of the world and of themselves that legitimate and motivate collective action" (McAdam et al. 1996, p. 6). We argue that in cultural fields such shared understandings and collective motivations are developed through strong-tie networks. Change within cultural fields typically occurs as a separate "segment" or "faction" emerges, one with a distinctive sense of mission and an innovative methodological and technical approach (Frickel and Gross 2005; Bucher and Strauss 1961; Rao et al. 2003). The interactions within the rising segment, and between the movement and the mainstream countermovement likely to surface in response to it (Meyer and Staggenborg 1996), contribute to the formation of networks of ties that in turn create

reputations, channel resources (both material and symbolic), and expand them vertically from one generation to another, and horizontally through clusters.

Micro-interactionist and social-movement perspectives coincide in highlighting the importance of shared understandings, emotional enthusiasm, and resource mobilization. We propose that in cultural production fields, the most important resource for a new movement is prestige concatenation. Cultural movements become successful through the mutual halo effect, the mechanism that enables a small, aspiring group of individuals to innovate, that is, to overcome inertia, overthrow inherited ideas and ideals, and advance new aesthetic standards within which to work. For high-culture innovation, at least, the problem is not merely to use existing networks but to expand the network, by propagating its success downstream. We submit that approaching the empirical study of influence and innovation in cultural production fields from the perspective of the concatenation of eminence vertically and horizontally across networks of strong ties offers a promising new avenue for research.

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