A Sociological (De)Construction of the Relationship between Status and Quality[1]

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Although many sociologists are strongly wedded to the idea of "social construction," the contextual factors that influence the magnitude of construction are rarely considered. This article explores the decoupling of an actor's status from the actor's underlying quality and examines the factors that influence the magnitude of decoupling. The authors specifically consider the role of quality uncertainty, diffuse status characteristics, and the self-fulfilling prophecy. To analyze the impact of each mechanism on decoupling, they simulate the evolution of thousands of small groups using a dyadic model of status allocation. The authors discuss the results of these simulations and conclude with the implications for future research and the practical management of groups.

INTRODUCTION

At least since the time of Berger and Luckmann's (1966) treatise *The Social Construction of Reality*, the term "social construction" has been

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central to the sociological vernacular. We use the phrase when we wish to challenge assumptions that certain aspects of the social world are natural, objective, and/or inevitable, and we invoke the concept as part of a critique of a reductionist theory of social institutions. Sociologists have produced evidence of social construction for a diverse array of social, political, and economic phenomena, including the construction of racial identity (e.g., Harris and Sim 2002), gender identity (e.g., Ely 1995), memory or "history" (e.g., Fine 1996), status (e.g., Ridgeway and Erickson [2000] on individuals, Ager and Piskorski [2002] on firms), social problems (for a review, see Schneider [1985]), symbolic meaning (e.g., Carruthers and Babb 1996), and market value (e.g., Zajac and Westphal 2004). At the most general level, the term reflects a deep disciplinary conviction that there is a socially derived distinction between what we understand as real and what is actually real.

Despite or perhaps because of the strength of this disciplinary conviction, we rarely consider the contextual factors or mechanisms that influence the magnitude of social construction. Arguing that construction exists is distinct from understanding the conditions that foster or suppress construction in a particular context. Developing a more contingent conception of social construction will give our disciplinary rallying cry more explanatory leverage. This article represents one step in that broad agenda.

In this article we investigate the factors that enable the social construction of status, a central area of inquiry in sociology. The social construction of status refers to the basic sociological notion that an actor's circumstances—the opportunities and rewards to which the actor has access, the social role or position that the actor obtains—do not originate from underlying qualities of that actor. Rather, social processes distort the connection between circumstance and underlying qualities. Our aim in this article is to conceptualize the extent of construction in any given social group and to investigate the mechanisms that potentially decouple an actor's underlying qualities and her circumstances.

We characterize an actor's circumstances by the *status* or *social prominence* that the actor acquires within a group. An actor's *quality* refers to any attribute, performance, or service considered desirable by the group. If each actor's attained status is a strong reflection of his or her quality, then we conclude that there is comparatively little social construction in the group. Conversely, if attained status is a weak reflection of quality, we can conclude the opposite.

The idea that social status is supposed to be highly correlated with and indeed a reward for quality is prominent in social scientific research (e.g., Homans 1961; Becker 1964; Blau 1964). For example, the claim that "recognition and esteem accrue to those who have best fulfilled their roles" (Merton 1973, p. 293) and the premise that prestige is "awarded by the group in exchange for services" (Ridgeway 1984, p. 62) both reflect the underlying belief that those who contribute more deserve more in return. This view corresponds to the popular idea of meritocratic advancement as the just way to distribute rewards (Lipset 1996; McNamee and Miller 2004).

Empirical and experimental research supports the idea that individuals use deference and social attachment to reward high-quality contributions. In a professional setting, for example, Blau (1974) finds that physicists prefer to interact professionally and discuss their own research with those considered to be "research leaders." Likewise, Rees and Segal (1984) find that within an athletic team, teammates tend to like and respect those whose athletic performance is higher than their own. Casciaro and Lobo (2008) find that—across a diverse set of organizations—workers overwhelmingly prefer to work with colleagues who are perceived as being competent in their jobs.[2] Similarly, a central finding from the expectation states tradition is that individuals defer to those who are perceived to be the most competent in task-oriented settings (see Munroe 2007).

Yet there is also considerable evidence that the correlation between status and quality is far from perfect. Studies of groups in a diverse array of settings—from individuals in a lab to firms within a market—point to a loose linkage between actors' within-group status and their quality. Scholars working in the sociology of science, for example, have shown that the prestige accorded to scientists is associated with factors other than scholarly merit, such as the prestige of academic mentors (Reskin 1979) or the prestige of academic affiliations (Hargens and Hagstrom 1982). In a similar vein, there is strong evidence that organizational gatekeepers rely on non-merit-based criteria, such as race, gender, personal ties to employees, and parental status, when evaluating applicants (e.g., Goldin and Rouse 2000; Petersen, Saporta, and Seidal 2000; Correll, Benard, and Paik 2007; Castilla 2008). At the cultural level, Fine (1996) shows how the accepted memory of a political figurehead emerged from several competing versions, each of which was only partially based on real events. In the sociology of markets, Podolny (1993) argues that the linkage between the quality of a producer's product and the producer's status is blurred by the fact that quality is often unobservable and hence uncertain, resulting in the imperfect ability to detect quality levels and changes.

In addition, experimental research has consistently shown that quality and status can easily become decoupled through interaction. Within the

[2] The authors, however, also show that a worker's contribution extends beyond just task-related competency. When competency is held constant, those who are perceived to be likable are much more sought-after work partners than those who are perceived to be unlikable.

tradition of expectation states, for example, researchers show how diffuse status characteristics (such as gender) can affect performance expectations even when these characteristics are uncorrelated with actual resource and performance differences (Berger, Cohen, and Zelditch 1972; Ridgeway 1991; Ridgeway and Erickson 2000). Similarly, one of the central insights from research on animal hierarchies is consistent with the idea that quality or attribute rankings do not directly give way to status hierarchies. Chase and his colleagues (Chase 1974, 1980; Chase et al. 2002) argue that it is unlikely that differences in prior attributes can fully explain the emergent dominance rankings within animal groups and argue that social dynamics (i.e., interaction among group members) not only facilitate the formation of hierarchies but potentially decouple attributes from status.[3] Skvoretz, Faust, and Fararo (1996), in fact, show that certain social mechanisms can create linear status hierarchies even if actors are fundamentally identical with respect to quality.

In summary, there is broad acknowledgment that status frequently correlates with underlying quality, but there is also broad acknowledgment that (1) the correlation is imperfect and (2) emergent hierarchies are not predetermined by quality differences. The literature on status formation, however, lacks well-articulated propositions about the factors that mediate the magnitude of the correlation. The goal of this article thus is to identify and compare the significance of the mechanisms that facilitate the social construction of status.

We begin by building an integrated model of hierarchy formation. We approach hierarchy formation as an issue of deference allocation at the dyadic level: why and to what extent does actor i defer to actor j? While there is a general consensus that status *ought* to be aligned with contributions or quality, research traditions vary in their emphasis as to why proportional returns do not materialize in practice. To date, there has been little effort aimed at reconciling the findings from these various approaches, and the research field, although active, remains fragmented.

Research in the status attainment tradition has consistently shown how ascribed characteristics are correlated with achieved characteristics (e.g., the effect of gender on educational attainment), but the paradigm says little about deference relations per se. The pathway to attaining a prestigious job is distinct from the pathway to becoming a prominent individual among peers. Microlevel research fills in this gap and focuses directly on deference behavior in small groups but says surprisingly little about the role of endogeneity or group dynamics on hierarchy formation

[3] Although we share the same motivation for studying social dynamics, we note that Chase's work on pecking orders is based on acts of aggression/submission, whereas we are explicitly interested in patterns of deference or attachment.

(see, however, Skvoretz et al. [1996]). Even though interaction among group members is considered the vehicle for differentiation, their approach generally assumes that the shape of the hierarchy is driven solely by the observable/exogenous characteristics of its group members.

In this article, we attempt to develop a model of status allocation behavior that accounts for both individual attributes and endogenous group dynamics (e.g., feedback effects, social influence, reputational effects). Our first goal is to integrate insights from several well-known theories of status dynamics, including expectation states theory, network-based theories of attachment formation, organizational studies of uncertainty and status, and research on learning and reactivity.

Having synthesized a model of how individuals allocate status, we then simulate the social hierarchy formation of thousands of small groups. By turning on and off certain aspects of attachment behavior, we can estimate how a given dynamic at the microlevel affects decoupling at the group level. More important, by using one unified behavioral model, we can gauge the *relative* decoupling power of each dynamic.

The article is organized as follows. In the next section, we define strong and weak forms of social construction and briefly review the mechanisms believed to decouple status from quality. Then we formalize each mechanism. Next, we outline the simulation procedure and define outcome measures. Finally, we discuss the findings of our simulations and consider the implications of these findings for research and the practical management of groups. Appendix A provides details of how we drew on Gould's (2002) theory of the origins of status hierarchies to develop our simulation methodology.

THE SOCIAL CONSTRUCTION OF STATUS: THEORIES AND MEASURES

The building blocks of a group's status hierarchy are the prestige- or deference-conferring gestures linking members to one another. An actor occupies a high-status position if members of the group treat her with deference; status cannot be attained or acquired on one's own. As stated earlier, a central belief in the social sciences is that deference is given in exchange for merit or quality, which is consistent with the mainstream belief that status differentiation is justified when rewards are proportional to contribution. What constitutes merit or quality obviously depends on the group context but generally refers to any attribute, performance, or service that is considered highly desirable or valuable to the group (Gould 2002, p. 1153; Ollivier 2004, p. 198). From this perspective, status is not a social construction, but rather a reflection of real quality differences.

Others contend that status is not a straightforward reflection of quality but is, instead, socially constructed. The magnitude or form of construction, however, is often left unspecified. It is important to recognize that there are actually two ways in which status can deviate from quality. First, status can be decoupled from underlying quality to the degree that there is greater dispersion in status than in the underlying quality. Figure 1 provides a visual representation of this for a group of six actors differentiated initially by quality. At time t_0, there is a perfect correspondence between each actor's position on the quality vector and the vector denoting choice status. However, over time, the high-status actors become higher-status and the low-status actors become lower-status. Such an evolutionary path is consistent with Merton's (1968) elaboration of the "Matthew effect."

In addition to the dispersion of status positions being more accentuated than the dispersion of quality, it is also possible that actors' ranks in the status ordering may differ from their ranks in the exogenous quality distribution. Figure 2 represents a second possible type of decoupling in which actors' ranks change over time. The first manifestation of decoupling, represented in figure 1, can be considered a weak form of social construction since there is no real change in the ordering of actors. Underlying quality is therefore still exerting a strong impact on an actor's ultimate position in the status ordering. In contrast, the manifestation of decoupling represented in figure 2 can be considered a strong form of social construction since the initial quality distribution has comparatively little impact on the actors' final status positions.[4] It should be clear that rank reordering is a more significant violation of meritocratic ideals than dispersion or inequality without rank reordering. Whereas greater dispersion alone may violate the norm of equitable returns, it is not fundamentally inconsistent with the notion that greater merit implies greater rewards. Accordingly, in this article, we focus primarily on understanding what causes rank reordering.

With this conceptualization of status construction, the next step involves simulating the evolution of status hierarchies so that we can trace the conditions enabling strong and/or weak construction. Below, we review

[4] Our formulation of strong and weak forms of social construction contrasts with that used in the constructionist literature on social problems, as discussed in Fine (1996, pp. 1166–67). In the social problems debate, the strong view of social construction implies focusing exclusively on discourse and the emergence of meaning, without analyzing the role or impact of "real" events. The weak view suggests that objective events are mediated/interpreted through discourse. Strong and weak thus refer to how much weight is given, a priori, to the explanatory role of discourse/construction. In this article, we use *strong* and *weak* with respect to the level of construction *observed in the outcome*.

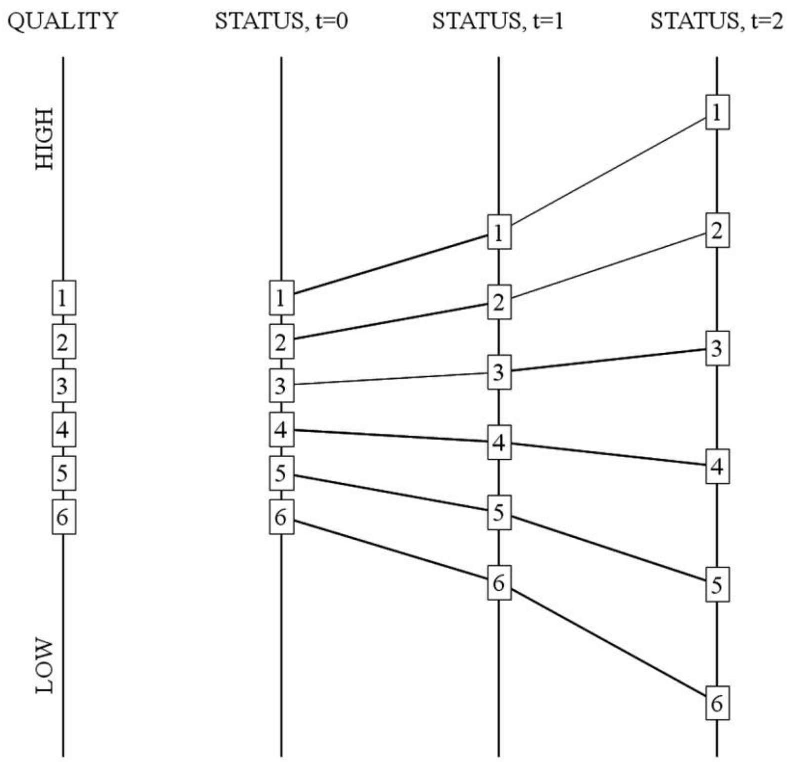

FIG. 1.—Social construction as status dispersion over time

four central explanations for why status can deviate from quality and relate this to their potential impact on the social construction of status. The first is based on the idea that status accrues according to structural advantage: an actor's status in a given social context may be a function of positions that the actor holds in other social contexts and sometimes more so than any of the actor's underlying qualities. The second explanation turns on the observability of quality: uncertainty around quality could produce a disjuncture between acts of deference and true quality. The third explanation involves the norm of reciprocity. The desire to have deference reciprocated can put limits on the degree to which one actor is willing to subordinate himself to another even if the quality differences are sufficient to justify an extreme level of subordination. The last explanation is that of the self-fulfilling prophecy, which posits that decoupling can occur because actors conform to performance expectations set by others, ultimately masking their true ability. We will now consider

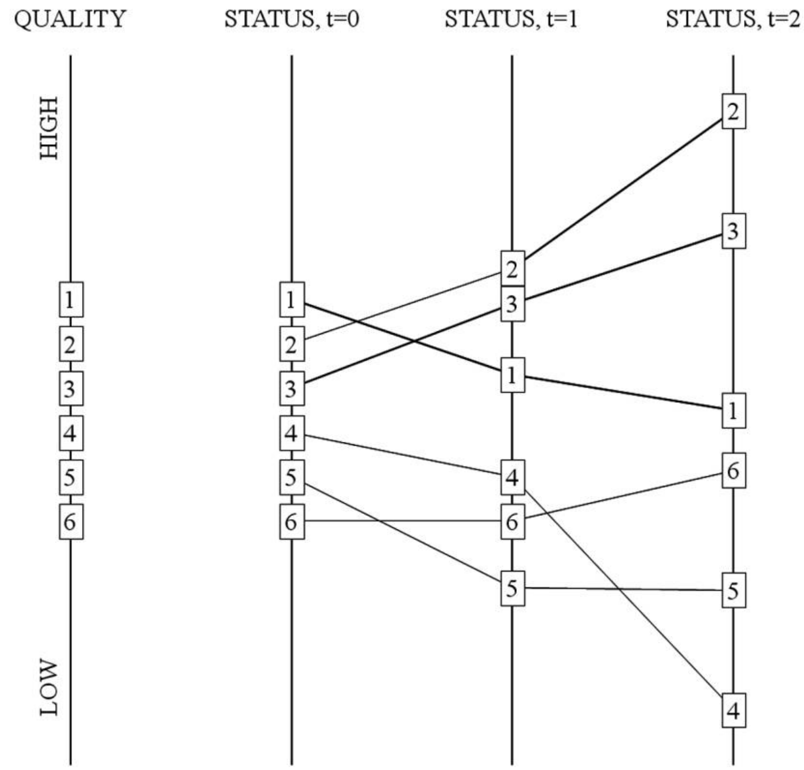

FIG. 2.—Social construction as status dispersion and rank reordering over time

each of these explanations in more detail in order to help to clarify the basic features and variations of our formal model. Though we consider these explanations sequentially, it is important to acknowledge that these mechanisms, while conceptually distinct, often operate in tandem.[5]

Positional Goods

In contrast to the idea that status is given in exchange for quality, a number of sociologists have argued that prestige is awarded on the basis of whether individuals occupy socially advantageous positions rather than on the basis of individual talents and efforts (e.g., White 1970; Bielby and Baron 1986; Sørensen 1996; Tilly 1998). From this "structural" or positional goods perspective, status is awarded to those who have secured an

[5] The extent to which there is uncertainty about quality, e.g., likely affects the extent to which actors rely on diffuse status characteristics as proxies for quality.

advantage over others in terms of valued positions, even if the incumbents of advantageous positions did not necessarily win those positions through superior contributions. This viewpoint is clearly consistent with the belief that status differentiation is socially constructed. There are two conceptualizations of position in the existing literature.

Diffuse status characteristics.—First, position can refer to an actor's status vis-à-vis valued "background" characteristics, such as family background, gender, or race. In contrast to measures of an actor's achievement or her actual contributions to a group, a socially ascribed characteristic contains valued distinctions even though the characteristic itself is intrinsically task irrelevant.

As stated earlier, research from the expectation states and status characteristics paradigm, for example, has carefully shown how a nominal characteristic, such as gender, can become culturally associated with superior and inferior states (e.g., male vs. female) and consequently color perceptions of quality (e.g., Berger et al. 1972; Ridgeway 1991; Skvoretz and Fararo 1996; Ridgeway and Erickson 2000; Ridgeway and Correll 2004; Berger and Fişek 2006). These valued distinctions are referred to as diffuse status characteristics because they trigger assumptions about the general quality of an actor but not her quality with regard to a specific task. For example, in an examination of motherhood as a diffuse status characteristic, Correll et al. (2007) find that men and women not only expect lower-quality work performances from mothers but also hold them to higher standards of excellence.

The fact that a task-irrelevant but socially valued characteristic can affect quality evaluations suggests a strong form of social construction. A key question that remains, however, is the extent to which an actor's socially ascribed position can *permanently* color the way her contributions are viewed. By definition, diffuse status characteristics introduce some disturbance to the status-quality relationship given that general performance expectations are formed prior to any demonstration of quality. But to what extent can diffuse status characteristics decouple status from quality over the long term? A key issue examined below is whether persistent demonstrations of high/low quality can "overcome" expectations based on diffuse status characteristics.

Reputation and social influence.—Another type of positional good is status or prominence within a social system itself. An actor's previous deference position can serve as a signal of quality and thus affect future deference rewards. Merton (1968), for example, observed that when two scientists arrive at the same discovery, the more eminent scientist generally seems to receive the lion's share of recognition, a dynamic he referred to as the "Matthew effect" from the book of Matthew (25:29). The basic notion is that a highly regarded member of a group is likely to attract more favorable attention than a less prominent member for a given demonstration of quality. According to Gould (2002), this dynamic implies that actors pay attention to how others have allocated their affection in the past to inform their own decisions in the present. The extent to which actors "listen" to others is considered the extent to which actors are socially influenced. In the literature on animal hierarchies, this is referred to as the "bystander effect" (Chase et al. 2002, p. 5744).

Recent experimental work on cultural markets strongly supports the idea that endogenous positional cues (i.e., high/low deference positions) can indeed disturb the link between status and quality. With regard to music consumption, Salganik, Dodds, and Watts (2006) show that buyers rely on status rankings to inform their purchasing decisions. The authors created an artificial music market online in which buyers in the treatment group had access to songs' download histories (i.e., their popularity among all previous buyers) whereas buyers in the control group did not. The results showed that, when song rankings were released, there was significantly more inequality in the distribution of purchases than when ranking data were not released, which clearly shows that ranking information affected decision making. In short, buyers were attracted not only to high-quality products but to those that were highly sought after.

The Matthew effect is generally understood to produce a system of cumulative advantage (see DiPrete and Eirich [2006] for a review). If already prominent actors have an easier time attracting deference for a given level of quality, prominent actors will accumulate deference at a faster rate than less prominent actors and thus amplify initial quality differences. As mentioned earlier, the Matthew effect is consistent with a weak form of social construction. Of particular interest in this article, however, are the conditions under which the Matthew effect can actually induce a stronger form of social construction.

The key to this question, we believe, is the extent to which initial status is an accurate reflection of underlying quality. If initial status is a simple reflection of quality, then the fact that status can feed on itself will exaggerate quality differences but not introduce rank reordering (i.e., there should still be a perfect correlation between status and quality). If initial status is not an accurate reflection of quality, however, the compounding of that error over time may induce a more serious disjuncture between status and quality.

Quality Uncertainty

If an actor's quality or performance is understood as the basis for drawing attachments from others, to what extent does uncertainty or ambiguity about quality affect the status allocation process? Uncertainty is a factor that is rarely explored in small-group research on status allocation. Consider, for example, the formation of a status hierarchy among a cohort of employees within an organization. Judgments of a co-worker's quality are likely based on demonstrations of competence (e.g., a presentation at a meeting, a written report) as well as positional cues (e.g., popularity among co-workers, relative size of a worker's office). Depending on how difficult it is to judge true competence on the basis of these factors, a discrepancy between perceived and actual competence may develop over time.

Previous research certainly supports the general idea that status processes are affected by quality uncertainty. Podolny (1993), for example, shows that status becomes a more valuable resource when market uncertainty is high. Hargens and Hagstrom (1982) and Lynn (2009) suggest that quality proxies, such as institutional affiliations, become more important determinants of peer recognition in high- versus low-uncertainty contexts. Others have implied that connections to high-status others are an important means of establishing legitimacy in high-uncertainty contexts (Baum and Oliver 1992; Zuckerman 1999). But despite the recognition that uncertainty is important, the actual dynamics around uncertainty itself are not well specified. Uncertainty is usually hypothesized to have an effect on a given status-related outcome, but the reasons why are often vague; the reader is generally instructed to believe that outcome X is the result of actors coping with uncertainty.

We distinguish two basic ways in which quality ambiguity affects status allocation. First, quality uncertainty can take the form of idiosyncratic judgment errors. Consider how the perception of quality becomes more subjective when task excellence is difficult to quantify and measure. The faculty members of an academic university department, for example, likely have more varied perceptions about each other's administrative skills than productivity level. The latter can be easily gauged by counting publications, whereas there are no simple, nonsubjective measures of administrative capabilities. Overall, observers are more likely to arrive at different conclusions about a given quality demonstration in a high-uncertainty versus low-uncertainty context. Uncertainty in this sense leads to errors that are dyadic and uncorrelated across observers.

In addition to dyadic-level or idiosyncratic error, there are many situations in which misperceptions might be correlated across evaluators. When demonstrations of quality take place publicly, for instance, such events establish a common basis for judgment error. On many sports teams, for example, players generally perform in public stage-like settings, where all group members observe a given player's skill level at once. If a player gives an uncharacteristically low performance, it is likely that one observer's mistaken perception will be correlated with the rest of the observers' perceptions. A collective error component can also result from the diffusion of (mis)perceptions among group members. Gossip among teammates, for example, could produce a collective misjudgment about the quality of any given player.

What then is the effect of a lucky or unlucky "break" (collective or dyadic) on decoupling? Intuitively, we expect that decoupling will increase when uncertainty is high because quality perceptions will likely be more error ridden. It is possible, however, that a lucky break in one time period (or with respect to one evaluator) will cancel out unlucky breaks in other time periods (or across evaluators), in which case neither dyadic error nor collective error will induce much decoupling in the aggregate. Alternatively, depending on the amount of error introduced, unlucky or lucky breaks could be enough to drive a more permanent wedge between status and quality. If this is the case, an actor's status within a group would be path dependent or nonergodic, where errors occurring in earlier time periods tend not to be averaged away over time (see, e.g., Arthur 1989).

Concern for Reciprocity

The extent to which one actor is willing to show deference to another is not only based on the characteristics of those being evaluated (target driven) but mediated by the social psychology of the evaluator himself or herself (perceiver driven). Actors reward others with respect and deference, but they also fundamentally desire to be respected by others. The concern for symmetry guides deference relations just as it does exchange relations or friendship ties. Insofar as unrequited love is painful for the admirer but flattering for the beloved, actors benefit from receiving unsolicited deference and conversely "pay" when deference is unreciprocated.

The concept of reciprocity closely corresponds to the concept of power distance in the social psychological literature on national cultures. High-power distance cultures are those in which people are comfortable subordinating themselves to others of superior rank (weak concern for reciprocity); lower-power distance cultures are those in which individuals are not comfortable with such subordination (strong concern for reciprocity; Hofstede 1980). The concern for symmetry is thus expected to create a more egalitarian status hierarchy since large status rewards, unless reciprocated, would be considered uncomfortable.

Whether or not reciprocity enables the decoupling of status from quality, however, is unclear. On the one hand, in settings in which reciprocity is not a concern, we would expect a tighter coupling between status and quality. That is, if actors are generally comfortable with the idea of subordination and willing to accept status inequalities—especially if they are grounded in verifiable performance differences—the resulting status hierarchy ought to be more meritocratic, that is, less socially constructed.

On the other hand, one could easily imagine how a group that is not concerned with reciprocity—that is, a group that tolerates large asymmetrical status rewards—gives rise to a status hierarchy that is only loosely coupled to underlying quality. Gould (2002, p. 1149) suggests that in the absence of symmetry concerns, status inequities are left to grow unchecked, which increases the likelihood that status becomes decoupled from quality. Such a finding would be consistent with Parsons' (1951) observation that cultures unconcerned with reciprocity tend to be the least meritocratic.

Self-Fulfilling Prophecy

Finally, one of the most emphasized mediators of the relationship between underlying quality and status is the social psychological idea of a self-fulfilling prophecy, where expectations actually influence quality. As defined by Merton, the self-fulfilling prophecy is "a *false* definition of a situation evoking a new behavior which makes the originally false conception come *true*" (1948, p. 195). The idea of a self-fulfilling effect has been applied rigorously to research on teacher expectations in the classroom (see Jussim 1986; Jussim and Harber 2005) and manager expectations in the workplace (Eden 1984, 1990), although the phrase has been adopted today to refer broadly to the power of perceptions over reality.

In terms of the construction of status, the prophecy implies that when a group generates expectations about a focal actor and then treats that focal actor according to these expectations, the focal actor may internalize or react to this treatment in a way that conforms to those expectations. Espeland and Sauder (2007) introduce the term *reactivity* to refer more broadly to the idea that actors alter their behavior in response to being evaluated and ranked.

A well-known ethnographic illustration of this mechanism is Whyte's (1943) account of bowling behavior among a group of friends. In *Street Corner Society*, Whyte observes that when low-status individuals perform at a level above their rank, other group members taunt and jeer them until the quality of their bowling falls to a level that is consistent with their rank. Over time, the low-status group members avoid above-average performances since they know that such performances will result in negative attention from the rest of the group. In general, a self-fulfilling mechanism invokes the image of strong decoupling.

MODELING STATUS ALLOCATION BEHAVIOR

Having discussed four theoretical mechanisms by which the relationship between status and quality is thought to be mediated, we now proceed to a formal simulation of these four mechanisms and how they may or may not decouple status from quality. To integrate these mechanisms, we use Gould's (2002) formal model of status allocation behavior as a point of departure. His model provides a suitable framework for operationalizing deference behavior at the dyadic level and measuring decoupling at the group level. Theoretically, his model is useful in that he already offers a way to reconcile how social positions and individual quality simultaneously drive hierarchy formation. But his model also has some serious limitations since it relies on a strong rationality assumption and is static in nature. We utilize a dynamic model instead in which players have only "bounded rationality" and make adaptive adjustments of their behavior based on what they observe in the past.[6] Below we describe the basic concepts and then explain how each mechanism discussed above is operationalized in our model.

First, we consider a group of n actors. These actors might be n individuals in a work group, such as a product development team, or n firms engaged in repeated cooperative activity, such as banks involved in syndication activity. Following Gould's (2002) notation, we allow each actor j to have a "true" quality, which we denote as Q_j. One can think of Q_j as a reflection of actor j's exogenous ability and desire to make contributions to the broader group. In defining Q_j as exogenous, we implicitly specify Q_j as independent of the social dynamics that occur within the group and independent of the group members' perceptions.[7] While the scale of Q is arbitrary, we shall assume throughout that Q is normally distributed with a mean of zero and a standard deviation of one.

We use the term a_{ij} to designate the attachment or orientation of actor i to j. In general, we refer to a_{ij} as the amount of deference given from i to j, although a_{ij} is more accurately understood as the social psychological

[6] A detailed comparison of Gould's equilibrium approach and our dynamic approach is provided in app. A.

[7] Some might argue that the notion of an exogenous quality that can be defined independently of the social context is a fiction. That is, even genetic differences are meaningful only to the extent that they are acknowledged in a social setting as such. Put another way, there is no innate ability (Q_j) that is not a social construction. While we understand that one can hold such a view, this particular understanding of social construction is ultimately nonfalsifiable and therefore not amenable to social scientific inquiry. Since our research agenda is premised on the development of a falsifiable conception of social construction, it is necessary that actors have attributes whose significance can be theoretically defined apart from a social context.

accompaniment to deference behavior.[8] Given this definition of a_{ij}, j's social status or prestige within a group can be defined as

$$\sum_{i \neq j} a_{ij}.$$

That is, j's status is the sum of all the other actors' attachments to j. Given these parameters, our central concern is the relationship between an actor's exogenous quality and her eventual status once the group dynamics have unfolded. What, then, determines the magnitude of a_{ij} and thus $\sum a_{ij}$?

Proportional rewards and reciprocity.—First, individuals (1) prefer to be respected and (2) prefer greater quality in exchange for any deference that is given. In Gould's language (2002, p. 1154), an actor's social welfare or satisfaction is higher to the extent that these two preferences are met. That is, actor i increases her social welfare (u_i) through attachments with resource-rich or "high-quality" alters:

$$u_i = \sum_j a_{ij} Q_j. \tag{1}$$

However, because individuals also desire to be respected by others, unreciprocated attachments weaken i's social welfare. The extent to which actors are "bothered" by unreciprocated attachments is denoted as s, where $s > 0$ (Gould 2002, p. 1153):

$$u_i = \sum_j a_{ij} Q_j - s \sum_j a_{ij}(a_{ij} - a_{ji}). \tag{2}$$

We derive the optimal attachment from i to j, that is, the attachment (a_{ij}) that maximizes i's social welfare with respect to each j, by taking the partial derivative of u_i with respect to a_{ij} for each j, set the derivative to zero, and solve the equation.[9] The best-response function is thus

$$a_{ij} = \frac{Q_j + s a_{ji}}{2s}. \tag{3a}$$

Given our explicit interest in the *formation* of status hierarchies, we add time subscripts to equation (3a) to make a dynamic model. We let players use information from the previous "round of play" to determine their best

[8] In theory, a_{ij} ranges from $-\infty$ to $+\infty$.

[9] Note that our definition of "optimal" differs from Gould's equilibrium definition (see app. A for details).

strategy in the current round. The optimal attachment from i to j in time t can thus be expressed as

$$a_{ijt} = \frac{Q_j + s a_{ji,t-1}}{2s}. \tag{3b}$$

To summarize in words, the size of i's optimal attachment to j depends on j's quality level as well as on j's respect for i (as established previously). Attachments, more generally, also depend on a group-level or cultural concern for reciprocity in relationships (as captured by the parameter s). When the concern for reciprocity is high (i.e., when s is high), actors reduce overall the amount of deference they are willing to "invest" in others.[10]

Reputation and social influence.—In addition to giving deference in exchange for quality or resources, the decision to attach or defer to an individual is likely affected by how that individual is viewed by the rest of the group. Gould (2002, p. 1156) conceives of i's perception of j's quality (q_{ij}) as a function of both j's exogenous or objective contributions (Q_j) and her existing status position. He describes q_{ij} as a weighted average of true quality and group-derived desirability:

$$q_{ij} = (1 - \omega)Q_j + \omega \sum_{k \neq i,j} a_{kj}, \tag{4a}$$

where $\sum_{k \neq i,j} a_{kj}$ is the sum of everyone else's attachment to j and ω is the weight applied to this collective opinion. As ω increases, quality perceptions are more socially influenced.

Applying our evolutionary perspective to Gould's expression, we define i's perception of j's quality at time t:

$$q_{ijt} = (1 - \omega)Q_j + \omega \sum_{k \neq i,j} a_{kj,t-1}. \tag{4b}$$

Quality uncertainty.—As we discussed earlier, uncertainty can manifest at either the dyadic or collective level. First, we consider a scenario in which quality perceptions contain an error component that is unique to each perceiver (i). This is consistent with a situation in which the exposure to quality demonstrations (and/or the interpretation of quality) varies

[10] To clarify, we use the term "reciprocity" to refer to the difference between what is given and what is received ($a_{ij} - a_{ji}$). The amount of suffering caused by unreciprocated attachments, however, is a function of how much i cares for j, i.e., $a_{ij}(a_{ij} - a_{ji})$, and the overall extent to which unreciprocated attachments are deemed intolerable, which is captured by the symmetry parameter s, i.e., $s \times a_{ij}(a_{ij} - a_{ji})$. In other words, i should not find j's lack of reciprocity to be painful if i is only weakly attached to j in the first place. However, i will find the lack of reciprocity from j more painful when i is strongly attached to j. Moreover, i will not be affected by unreciprocated ties at all unless i is bothered by asymmetry ($s > 0$).

across group members. We incorporate this idea by adding an error term (e_{ijt}) to Q_j for each (i, j) dyad at time t:

$$q_{ijt} = (1-\omega)(Q_j + e_{ijt}) + \omega \sum_{k \neq i,j} a_{kj,t-1}. \quad (5)$$

Because there is no substantive interpretation to the scale of q_{ijt} or a_{ijt}, we simply assume that e_{ijt} is uniformly distributed with a mean of zero and a standard deviation of one. In this scenario, the error perceived by one actor is uncorrelated with the error perceived by another actor. In some situations, however, one actor's judgment error may be correlated with that of other group members. We thus formulate a second kind of error term e_{jt} that varies over time but not by observer.

We also consider the fact that quality misperceptions likely decrease over time. Given that quality uncertainty is captured as an error term (e_{ijt} or e_{jt}) in equation (5), one way to model learning is to implement errors that decline over time (i.e., $e_t > e_{t+1}$). This constraint on the magnitude of the error term is consistent with the idea that group members develop a more accurate perception about the quality of others over time. As time progresses and actors have more opportunities to observe each other's quality, it is reasonable to assume that luck and randomness will have less sway over perceptions.

Diffuse status characteristics and initial attachments.—In the model that we have laid out thus far, initial attachments are predicated solely on quality perceptions. But what happens when actors enter into a group situation with preconceived notions about one another, triggered perhaps by race or gender? There are two ways to conceptualize how actor i develops an initial attachment to j.

First, we explore the idea that initial orientations can be influenced systematically by diffuse status characteristics or ascribed characteristics, namely, characteristics that trigger assumptions about the *general* quality of an actor but not the actor's quality with regard to a specific task. We implement this by setting initial attachments to correspond to a hypothetical task-irrelevant characteristic. Specifically, actors are evenly and randomly assigned to one of k categories of a nominal characteristic, where each category is assigned a collective value (e.g., positive, neutral, or negative).[11] Depending on j's assignment to a valued category, actor i's initial attachment to actor j is one of k values (e.g., strong, neutral, or weak).

Second, we consider the more general scenario in which i's initial attachment to j is both exogenous to the group and based on particularistic

[11] This logic mirrors that used originally by Berger et al. (1972), where a diffuse characteristic (D) contains x number of states.

criteria. For example, in a cohort of newly hired employees in a firm, initial orientations toward one another are easily influenced by factors such as already-existing relationships and shared characteristics (e.g., preexisting friendships, common region of origin). Petersen et al. (2000), for example, have evidence that racial minorities are at a disadvantage in the hiring process not because of race per se but because they have fewer personal ties to existing employees (i.e., minorities were more likely to be nonreferrals). The simplest way to model exogenous social structure is to randomly draw each actor's set of initial attachments (a_{ij} at t_0) from a hypothetical distribution of attachment scores.[12] We refer to this randomly drawn initial attachment as R_{ij}, where $R_{ij} \sim N(0, 1)$ for each i.

Self-Fulfilling Prophecy

According to the self-fulfilling prophecy, individuals will adjust their own behavior in correspondence with how they are treated by others. The self-fulfilling prophecy mechanism implies an endogenous component to quality. We model this by weighting an actor's exogenous quality (Q_j) with her status from the previous time period:

$$q_{ijt} = (1 - \omega)[(1 - \phi)Q_j + (\phi)z_{j,t-1}] + \omega \sum_{k \neq i,j} a_{kj,t-1}, \qquad (6)$$

where $z_{j,t-1}$ is the standardized value of j's status from time $t - 1$. The standardization ensures that the endogenous and exogenous components of perceived quality are on the same scale, and the value for ϕ determines the relative weight that is assigned to the endogenous and exogenous components of quality.

SIMULATION PROCEDURE AND OUTCOME MEASURES

For each simulation trial, we begin with a small group of 30 actors, each of whom is randomly assigned a level of quality (Q_j).[13] For simplicity, we set Q_j within each group to be normally distributed with a mean of zero and a standard deviation of one. After this initial setup period, the group evolves for 20 time periods, where each time period consists of the three

[12] We provide the details of this procedure in app. table D1.

[13] We chose 30 actors for the group size for several reasons. Overall, we wanted to model a group for which "small-group" and face-to-face dynamics would still apply (i.e., a classroom-sized group), but we also wanted a large enough group such that the rank correlation measure would be meaningful.

basic stages:[14] (1) each actor makes an evaluation about every other actor's quality (q_{ij}), (2) each actor then makes an attachment (a_{ij}) to every other actor on the basis of these quality perceptions, whereby (3) every actor becomes associated with a status position in the group given the sum of attachments directed toward her. Each group "lives" or iterates for 20 time periods following the initial setup period to uncover both the short- and long-term implications of each mechanism.[15] For each trial, we preassign a level of symmetry (s) and a level of social influence (ω).[16]

The main group-level outcome of interest is the magnitude of social construction. Given our operationalization of strong social construction as rank reordering, we use the Spearman rank correlation to measure the correspondence between a group's status ranking and its initial quality ranking. The rank correlation falls between zero and one: a correlation close to one corresponds to an almost perfect match between status and quality, whereas a correlation close to zero indicates that status and quality are basically unrelated. Not only is the Spearman correlation measure a straightforward measure of decoupling, it is not sensitive to arbitrary assumptions about how a unit of quality compares to a unit of status. This outcome measure is consistent with that used by Chase et al. (2002) in their study of fish dominance hierarchies, where they analyzed the number of fish that changed ranks in two virtually independent social opportunities.

Figures 3 and 4 illustrate the simulation procedure for one group ($n = 30$ actors) at a given level of symmetry and social influence ($s = 2$ and $\omega = .25$). These particular figures correspond to a group in which initial attachments were randomized. That is, status at time 0 is based on factors not related to quality. In figure 3, we plot the trajectories of two individuals with similar true quality levels. Note how actor A's initial advantage at time 0 becomes a permanent advantage over time. Actor B, however, does not overcome the initial negative biases that relegated her to a status below her true quality level.

In figure 4, we plot the trajectories of the entire group. The Spearman rank correlation between status at $t = 20$ and initial quality is .72 for this group. These plots, however, suggest that there may be a second outcome of interest: the average length of time it takes for status ranks

[14] See app. tables C1 and D1 for a summary of the simulation procedure for the uncertainty model and the random initial attachments model.

[15] A 20-period window was used on the basis of the observation that hierarchies tended to stabilize well before 20 time periods.

[16] Note that the tolerance for symmetry is modeled here as a group-level property. Since all actors share the same concern for symmetry, one could characterize this as a cultural expectation or a cultural insistence for symmetry.

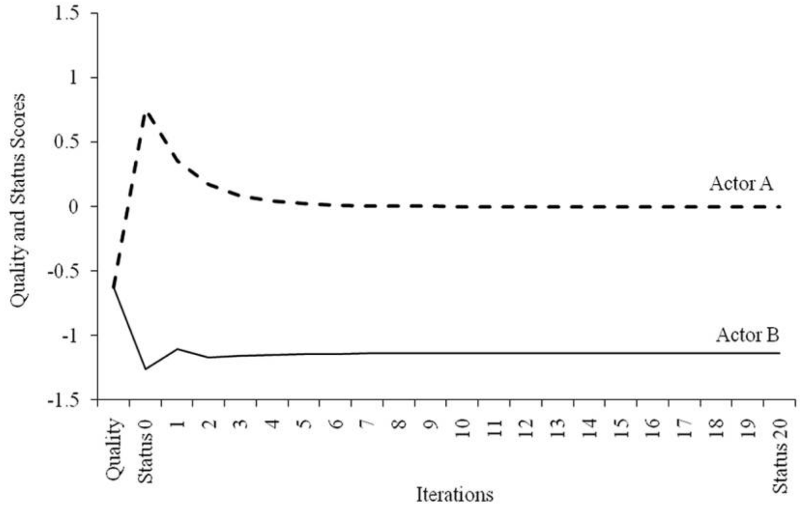

FIG. 3.—Evolution of two actors with initial attachments randomized ($s = 2$, $\omega = .25$)

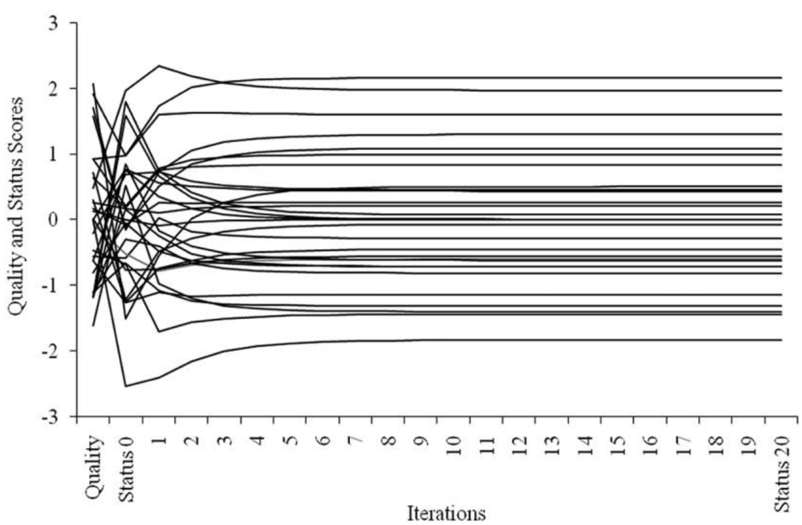

FIG. 4.—Evolution of one group ($n = 30$) with initial attachments randomized ($s = 2$, $\omega = .25$).

to stabilize. For this particular group, status positions appear to stabilize within the first quarter of the group's 20-period life span. Six group members settled into a stable rank position within the first two rounds. That is, their status rank at time 20 was the same as their status rank in rounds 3–19. Twelve members of the group reached a stable position in round 3, and the remaining 12 stabilized during rounds 4–8. The mean number of time periods to equilibrium was 3.9 rounds. At the group level, the rank order correlation between quality and status was .67 at $t = 3$ and .69 at $t = 5$. By the seventh iteration, the correlation stabilized at .72.

RESULTS

Symmetry and social influence.—We first consider the extent to which symmetry and social influence induce rank reordering. To do this, we trace the evolution of small-group hierarchies under three different configurations of symmetry (s) and social influence (ω): low s and low ω, low s and high ω, and high s and low ω. Given that Gould (2002, pp. 1157–58) interpreted 2.5 to be a "moderate level" of symmetry, we considered $s = 1$ and $s = 4$ to represent a low and high concern for symmetry, respectively. Since social influence (ω) falls between zero and one, we used $\omega = .20$ and $\omega = .80$ to correspond to low and high levels of social influence. The larger the weight, the greater the impact of social influence.

Table 1 summarizes the extent to which symmetry and social influence affect the decoupling of status from quality. Overall, the results show that symmetry and influence affect the extent of status dispersion, but the status ordering always remains the same as the quality ordering. As shown in column 1 of table 1, neither symmetry nor social influence induces the rank correlation between quality and status to fall below one. At no point during the group's history does status ever become decoupled from quality (i.e., all group members reached a stable status rank in the first time period; see col. 2).

Symmetry and social influence do, however, rescale the size of status awards (table 1, cols. 3 and 4). Consistent with the Matthew effect hypothesis and the illustration in figure 1, status scores exaggerate quality differences when the weight given to social influence increases. To illustrate this point, we calculated the absolute difference between j's final status score and her underlying quality scores averaged across all actors in the group, that is,

$$\frac{1}{n}\sum_{j}^{n}\left|\sum_{i\neq j}a_{ij}-Q_j\right|.$$

TABLE 1
THE EFFECT OF SYMMETRY AND SOCIAL INFLUENCE ON THE RELATIONSHIP BETWEEN QUALITY AND STATUS

	s	ω	RANK REORDERING: SPEARMAN RANK CORRELATION (1)	CONVERGENCE: AVERAGE TIME PERIOD (2)	SCORE DISPERSION: Mean Absolute Difference (3)	SCORE DISPERSION: Ratio (Model: Baseline) (4)
Baseline	1	.20	1.0	1.0	73.2	. . .
Symmetry effect ...	4	.20	1.0	1.0	17.4	.2
Social influence effect	1	.80	1.0	1.0	259.7	3.5

The mean absolute difference between status and quality scores is roughly 3.5 times as large as when social influence is low ($259.7/73.2 = 3.5$). In effect, social influence augments the returns to status, creating greater dispersion in the distribution of deference rewards.

As expected, the concern for reciprocity acts as a counterbalance to the runaway effect of social influence. The more individuals are concerned with making attachments to alters who reciprocate the gesture (i.e., the higher the value of s), the less hierarchical the distribution of attachments within the group. In this configuration ($s = 4$, $\omega = .20$), the concern for symmetry is high enough that status scores actually understate differences in quality. The mean absolute difference is only 20% of that in the baseline model. Returning to the interpretation of dispersion as a weak form of social construction and a rank reordering as a strong form of social construction, we can conclude that symmetry and social influence induce the weak form but not the strong form.

Uncertainty.—Recall that we proposed two types of error in assessment due to uncertainty: dyadic error and collective error. In the dyadic variant, each i has some error in perceiving j's quality, but this error is uncorrelated across all i's. In the collective variant, quality is misjudged at the group level: all perceivers of j's quality share the same error. For both types of quality uncertainty, we vary the amount of error observed. The standard assumption in organizational sociology is that measurement error will induce decoupling.

We start with a distribution of measurement error that has the same variance as the variance in exogenous quality scores. We then look at the effect of measurement error when its distribution has one to five times the amount of variation as the exogenous scores. To simplify our description of the results, we refer to the level of error as $1\times$, $2\times$, $3\times$, and so forth. The set of results in part A.1 of table 2 summarize the effect of

TABLE 2
RANK CORRELATION BETWEEN INITIAL QUALITY (Q_j) AND STATUS$_{t=20}$

	Baseline $s = 1$ $\omega = .20$ (1)	Social Influence Effect $s = 1$ $\omega = .80$ (2)	Symmetry Effect $s = 4$ $\omega = .20$ (3)
Baseline model*	1.00	1.00	1.00
A. Uncertainty: error in observing Q_j:			
1. Dyadic level:			
1 ×	.98	.97	.99
3 ×	.91	.85	.98
5 ×	.80	.67	.96
2. Collective level:			
1 ×	.80	.66	.99
3 ×	.36	.32	.99
5 ×	.24	.15	.98
B. Initial attachments:			
1. Randomized	.68	.06	.99
2. Nominal states:			
2 values	.47	.52	.73
3 values	.27	.33	.80
4 values	.19	.19	.81
C. Self-fulfilling prophecy:			
1. Initial attachments based on Q_j only	1.00	1.00	1.00
With feedback	1.00	1.00	1.00
2. Initial attachments randomized	.68	.06	.99
With feedback	.32	.01	.91

NOTE.—Results are based on the average of 30 simulated groups per modification.
* Attachments and status are based initially on Q_j only.

dyadic-level uncertainty on status construction for different configurations of high/low symmetry and social influence.

Overall, dyadic level error does not result in significant decoupling unless social influence is high and the size of the error component is significantly large. In part A.1 of table 2, status remains tightly correlated with quality in almost all configurations; the correlation between status and quality is above 0.85 except when social influence is high and the error variance is five times the quality variance (see col. 2). In addition, when we modify the error term such that it declines over time (a learning mechanism), we find that the rank correlation between status and quality is even closer to one on average. That is, if the magnitude of error decreases over time, as we would expect it would as actors become more familiar with one another, randomness effectively has less and less power to blur the relationship between status and quality.[17]

These findings reflect the fact that negative errors will generally cancel out positive errors at the dyadic level. When social influence is sufficiently high, however, it appears that "noisy" evaluations can solidify into effectively permanent status distinctions, although an egregious amount of error is needed to induce noticeable rank reordering. While some may not regard this finding as surprising, we believe it is noteworthy given that the literature on status in markets is built on a signaling logic that presumes that any kind of response to uncertainty can blur the relationship between status and quality. What becomes plain from our operationalization is that uncertainty is not a major driver of decoupling at the group level if the resulting judgment errors can be averaged out across the group.

The same cannot be said for collective errors in assessment. Collective errors introduce deviation at the score level and lead to a fair amount of rank reordering, even when the error distribution is at the 1× level (i.e., the same variation as the quality distribution). The set of results in part A.2 of table 2 illustrate how different levels of collective uncertainty affect the relationship between initial quality and final status. Collective errors in judgment do lead to a much greater disjuncture between status and underlying quality, implying that contexts in which performances are public will lend themselves to greater social construction than contexts in which performances are observed and adjudicated within dyadic exchanges. The greater the proportion who share a misperception, the easier it becomes for those misperceptions to permanently decouple status from quality.

Although we conceptualized a collective error component with respect to problems in observability, both our operationalization and results are compatible with Fine's (1996) theory of reputational entrepreneurs. Reputational entrepreneurs are actors who shape the memory or image of another actor by way of narrative facility and institutional leverage. Simply put, they decide how they want someone to be labeled and then they get that label to stick. By translating real events into "memory hooks," they can guide the direction in which status becomes decoupled from his actual contributions. Regardless of whether error arises from chance or is manufactured, collectively agreed-on misperceptions are clearly a source of decoupling.

Figure 5 reveals how social influence interacts with uncertainty. The solid lines represent the rank correlation between status and quality when errors in quality assessment are collective. The dashed lines show the effect of a dyadic-level error process. The points used to construct each

[17] Results are not shown but are available on request.

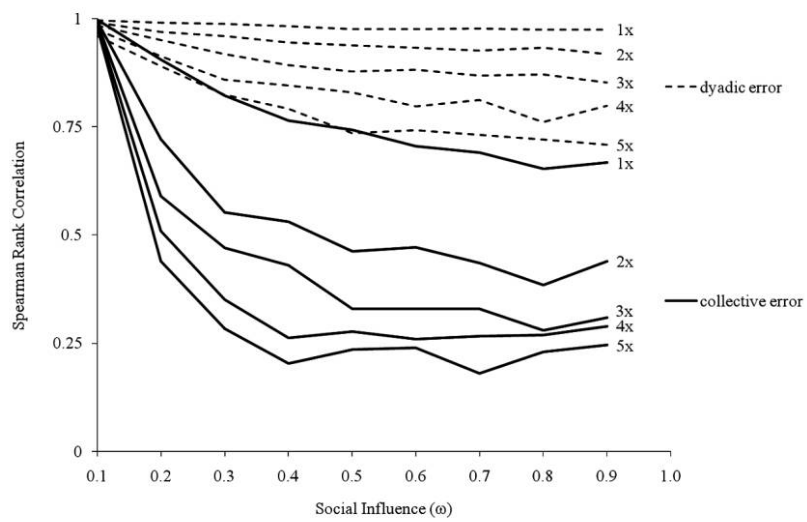

FIG. 5.—Relationship between quality, status, and quality uncertainty ($s = 2$). 1 ×–5 × refer to the magnitude of the error variance; for example, 2 × indicates that the error variance is two times that of the quality variance.

line correspond to the average result of 30 simulated groups at various levels of social influence ($\omega = \{.10, .20, .30, \ldots, .90\}$). When we expand on the results presented in table 2, the correlation between quality and status remains high when uncertainty is formulated at the dyadic level. Even when the error term is drawn from a distribution with five times the variance of the quality distribution, the Spearman rank correlation between a group's initial quality ordering and its final status hierarchy is never lower than .70. In contrast, collective error produces dramatically different results.[18]

What is also clear from figure 5 is that decoupling and social influence are systematically related under either uncertainty variant. Relatively small increments of social influence within a group can have a disproportionately large impact on decoupling status from quality among its members. It appears that a high level of social influence locks in error-ridden quality judgments in the early stages of perception formation.

Compare, for example, the status trajectories of each member of a simulated group when social influence is high (fig. 6) versus when social

[18] As the dyadic- and collective-level errors can occur simultaneously, we model the effects of a mixture of collective- and individual-level error. It appears that the amount of decoupling produced by the hybrid variation is bounded by the amount of decoupling induced by purely individual-level error (i.e., the lower bound) and the amount of decoupling induced by purely collective error (i.e., the upper bound).

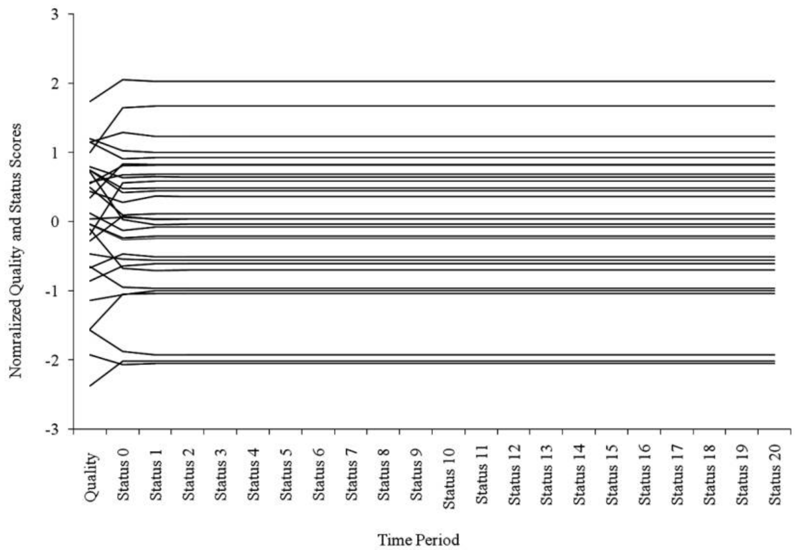

FIG. 6.—Illustration of dyadic uncertainty with high social influence ($s = 2$, $\omega = .10$)

influence is low (fig. 7). When social influence is high, an actor's status quickly locks in. Even though there is still uncertainty affecting the assessment of quality in later rounds, individuals give comparatively little weight to their own assessment and comparatively greater weight to the already revealed pattern of attachments. However, when social influence is low, status trajectories cross over at various points as the error-ridden quality judgments continue to "shape" status over time. This recalibration at each time period ultimately leads to a closer coupling between initial quality and status. In essence, paying a great deal of attention to "how everyone else thinks" forces consensus, and the group appears to settle into a stable status hierarchy within just a few rounds.

Table 3 summarizes the effect of dyadic and collective error on the time it takes a group's status ranking to stabilize. When social influence is high (col. 2), the average time it takes for actors to settle into stable status rankings is shorter than if social influence is low. Interestingly, symmetry lengthens the time it takes for status positions to stabilize. We did not anticiate that the concern for symmetry would guard against the locking-in effect of social influence. It appears that when the concern for reciprocity is high, this concern undercuts actors' willingness to go along with collective judgments.

Initial attachments and diffuse status characteristics.—Next, we examine the evolution of status hierarchies when initial attachments are

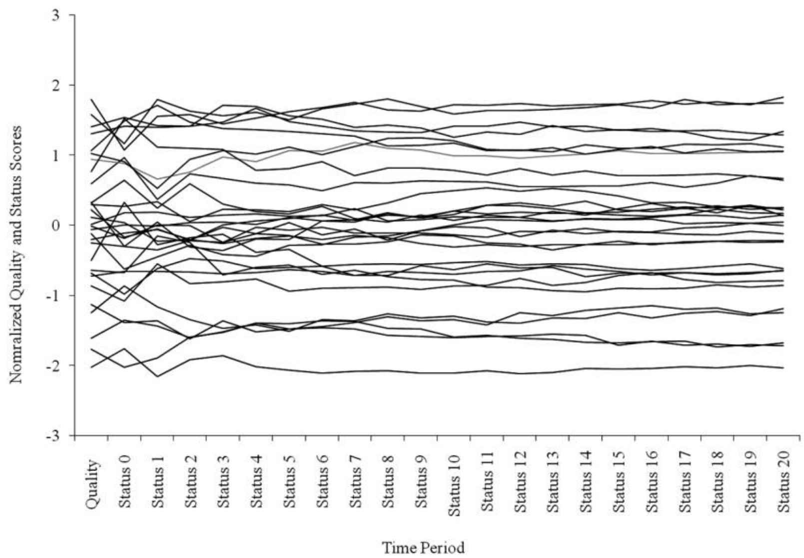

FIG. 7.—Illustration of dyadic uncertainty with low social influence ($s = 2$, $\omega = .90$)

defined exogenously. In the previous simulations, the initial pattern of attachments was based on underlying quality, and we examined how social influence, the need to have attachments reciprocated, and uncertainty affected the extent of decoupling. However, two of our mechanisms, diffuse status characteristics and self-fulfilling prophecy, presume that initial ties are determined exogenously. We now examine two scenarios in which there is decoupling in the first round: one in which initial orientations are entirely randomized and another in which initial orientations are based on nominal characteristics. Both variations are based on the notion that initial orientations fundamentally shape the way future interactions unfold.

Figure 8 depicts the correlation between underlying quality and status at different levels of social influence for three different levels of symmetry. Recall that a higher value of symmetry implies a greater appreciation for reciprocity. What emerges from figure 8 is relatively clear. First, at moderate and high levels of social influence (i.e., as actors place more weight on others' deference when deciding the actors to whom they should defer), an initial randomized pattern of deference turns out to have a strong decoupling effect on status and quality. The extent to which initial attachments can induce status decoupling clearly interacts with social influence: the more actors are influenced by their peers' choices, the more status can become decoupled from underlying quality.

TABLE 3
Mean Time Period When Status Rankings Stabilize

	Baseline $s = 1$ $\omega = .20$ (1)	Social Influence Effect $s = 1$ $\omega = .80$ (2)	Symmetry Effect $s = 4$ $\omega = .20$ (3)
Baseline model*	1.00	1.00	1.00
A. Uncertainty: error in observing Q_j:			
1. Dyadic level:			
1×	1.30	1.00	11.59
3×	1.66	1.01	16.83
5×	1.79	1.02	17.93
2. Collective level:			
1×	1.61	1.01	8.79
3×	1.48	1.00	12.69
5×	1.30	1.00	14.33
B. Initial attachments:			
1. Randomized	2.53	1.04	11.42
2. Nominal states:			
2 values	1.00	1.00	11.80
3 values	1.00	1.00	15.61
4 values	1.00	1.00	16.40
C. Self-fulfilling prophecy:			
1. Initial attachments based on Q_j only	1.00	1.00	1.00
With feedback	1.00	1.00	1.00
2. Initial attachments randomized	2.53	1.04	11.42
With feedback	2.09	1.03	14.92

Note.—Results are based on the average of 30 simulated groups per modification.
* Attachments and status are based initially on Q_j only.

What is also clear from figure 8—but less intuitive—is that the value placed on reciprocation lowers the extent to which an initial random pattern of attachment can give rise to a significant disjuncture between status and quality. The desire for reciprocity thus acts as a buffer against the potential bias introduced by initial orientations, simliar to how it protects a group from the decoupling effects of uncertainty. The results from table 1 help make sense of the underlying mechanics. An increased insistence on reciprocation reduces the dispersion of status relative to quality. In reducing the dispersion, the insistence on reciprocation also reduces the degree to which a random pattern of choice status can decouple status from underlying quality.

This finding is also summarized in part B.1 of table 2 for three specific configurations of symmetry and social influence. Randomized initial attachments have a clear decoupling effect when social influence is high as

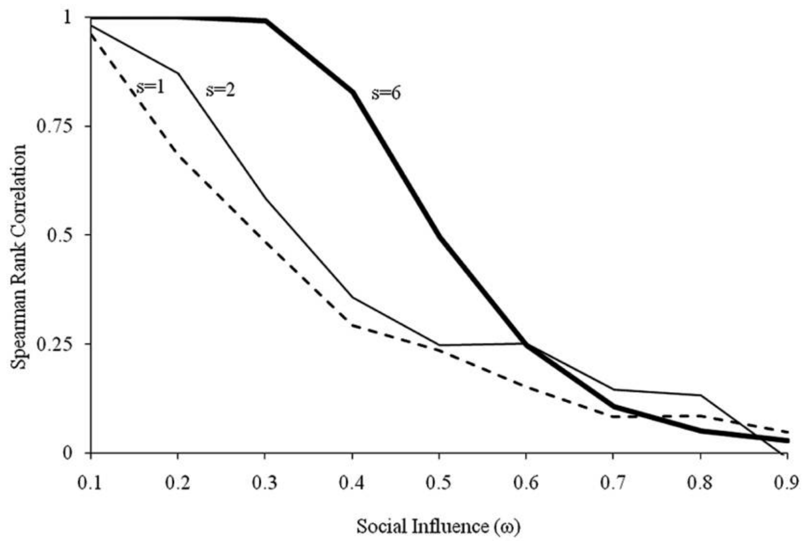

FIG. 8.—Relationship between quality and status with randomized initial attachments

the rank correlation drops from .68 to .06 on average. In contrast, a high level of concern for reciprocity buffers against this problem, raising the correlation to .99. That is, when individuals are uncomfortable giving unreciprocated status rewards, this appears to have the unanticipated effect of promoting equitable returns at the group level. When status awards are scaled back, there is a decreased likelihood that the information introduced through initial attachments will permanently separate status from quality. This finding thus conforms to Parsons' (1951) observation that cultures concerned with reciprocity tend to be more meritocratic.

Figure 9 is also based on the randomized attachment modification, but we superimpose plots of the correlation between status at time t_0 (initial status) and status at time t_{20} (final status) on top of the correlations between quality and final status. The solid lines are the same as in figure 8 for $s = 2$ and $s = 6$. The dashed lines are the correlations of initial status and final status for the same symmetry values.

The intersection of the solid and dashed lines lends itself to a meaningful substantive interpretation: it signifies the level of social influence at which the final status distribution is equally correlated with the initial quality distribution and initial status distribution. For example, when $s = 2$, social influence is only at about .25 when the initial quality distribution and initial status distribution have equal impact on the final status distribution. Since a .25 value of social influence implies that actors give the

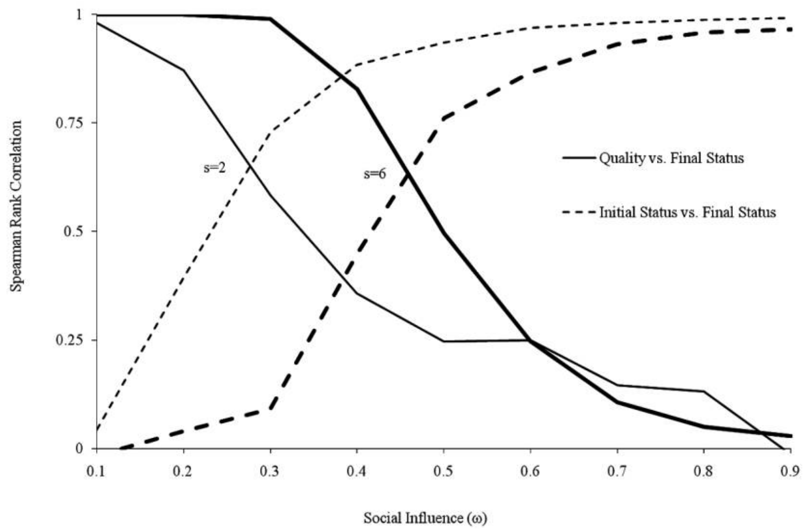

FIG. 9.—The relationship between quality, initial status, and final status with randomized initial attachments.

perception of quality three times the weight of others' orientation in deciding on their own pattern of attachment, we see that the initial status distribution can still have a significant impact even when actors care deeply about true quality. Such a result is analogous to Schelling's (1969) study of segregation in which weak thresholds for being among those like oneself can still result in widespread segregation at the macrolevel. In this instance, individual actors pay considerably more attention to quality than diffuse status characteristics, but those characteristics still exert a significant impact on the final status rankings within the group.

We now explore the idea that initial attachments may be grouped *categorically* according to diffuse characteristics. In this modification, we randomly give each player one of two possible traits, A or B, and then make the assumption that group members are positively oriented toward category A but negatively oriented toward category B. Initial attachments are then set to one of two arbitrary values on the basis of these nominal assignments: every player gives a strong attachment to A-type players ($a_{ij} = 3$) and weak attachments to B-type players ($a_{ij} = -3$). The assignments to categories A and B are thus, by design, uncorrelated with true quality. It should also be noted that even those assigned to group B perceive themselves as having an initial disadvantage, even though trait B is uncorrelated with true quality.[19]

[19] Note that less extreme values of categories A and B (e.g., $-0.5/+0.5$) do not decrease

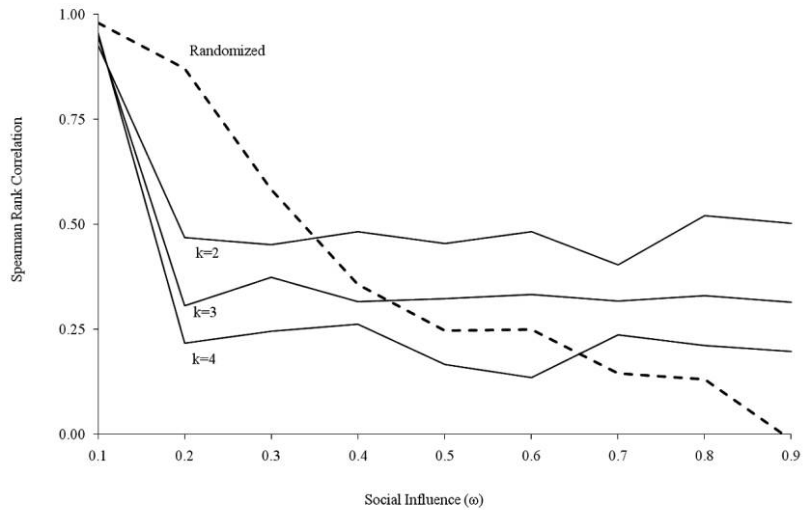

FIG. 10.—Relationship between quality and status with k levels of initial attachments ($s = 2$).

The results (see fig. 10) suggest that even very low levels of social influence cause significant amounts of decoupling between quality and status when initial attachments are categorical. In contrast to the case with randomized attachments, the rank correlation between quality and status dramatically decreases as social influence increases but quickly stabilizes at roughly .50. It is true that if players do not pay attention to how other players give attachments, it is possible for true quality differences to override initial categorization. But when players pay even minimal attention to one another's behavior, then quality rankings and status rankings are correlated for only about 50% of the players. Again, an increased concern for symmetry impedes the decoupling produced by social influence.

Figure 10 also displays the results when the number of categories (k) is equal to three or four. In the three-category modification, initial attachments are set to one of three arbitrary values: strong (+3), neutral (0), or weak (−3). Similarly, when there are four categories, the values for initial a_{ij} are assigned to one of four values, from strong to weak: 3, 1, −1, and −3. It appears that the rank correlation between quality and final status stabilizes at roughly $1/k$ for all values of social influence greater than .15.

the amount of rank reordering, which suggests that it is the presence of the categorical distinctions themselves (and not their distance on a continuum) that induces rank reordering.

Parts B.1 and B.2 of table 2 provide an illustrative comparison of the effects of random and categorical initial attachments. The results suggest that the introduction of nominal states as a basis for attachment has a stronger effect on decoupling status and quality than the initial pattern of randomized attachments. When both symmetry and social influence are low (col. 1), decoupling is markedly higher when initial attachments are categorical. Interestingly, however, the decoupling power of categorical attachments appears to be more robust to symmetry and social influence. Whereas social influence and symmetry interact rather dramatically with randomized initial attachments in terms of decoupling (part B.1 of table 2), this interaction is much less pronounced with nominal attachments (part B.2). Most notably, in contrast to all the other mechanisms, social influence does not appear to exacerbate decoupling with nominal initial attachments.

Table 3 helps illustrate why this occurs. Note how status positions stabilize immediately when initial attachments are broken down into nominal states. When individuals are simplified into crude quality categories (e.g., high/low), this introduces a kind of disjuncture between status and quality that cannot be averaged away over the course of time, even when social influence is low. All members of the simulated nominal states groups converge to a stable ranking in time period 1 (table 3, pt. B2). In other words, nominal distinctions cannot be overcome even with 19 time periods of perfectly transparent quality demonstrations.

Self-fulfilling prophecy.—We now consider the extent to which a mechanism based on the self-fulfilling prophecy can accentuate the decoupling of status from underlying quality. As noted above, the impact of self-fulfilling prophecy is premised on some initial disparity between underlying quality and status. Therefore, we rely on the same initial randomization of attachments as in the previous modification, but we now allow the initially random distribution of attachments and resulting statuses to have an effect on an endogenous component of quality, as specified in equation (6). By comparing the correlation that simply follows from the random pattern of attachment to the correlation that follows from the random pattern with a feedback mechanism, we can assess the impact of the self-fulfilling prophecy on the social construction of status.

Figure 11 portrays the results when the endogenous component of quality is weighted by .5 and the taste for symmetry is set to a value of two. The solid line plots the correlation between status and quality when there is no feedback due to the self-fulfilling prophecy. This line is identical to the $s = 2$ line in figures 8 and 9. The dashed line represents the correlation with the feedback, and the difference is therefore a measure of the impact of self-fulfilling prophecy on reducing the correlation between status and quality.

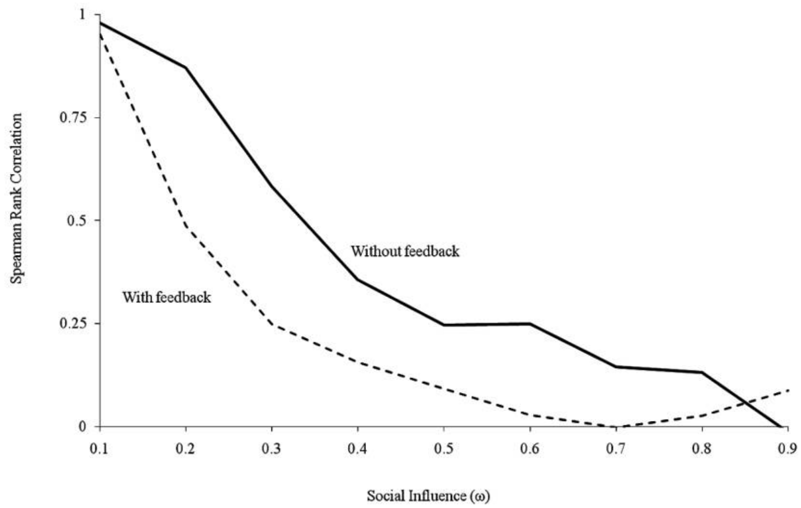

FIG. 11.—Relationship between quality and status with self-fulfilling mechanism ($s = 2$ and $\phi = .50$).

The data shown in figure 11 suggest that the social psychological mechanism of self-fulfilling prophecy does have an additional decoupling effect when initial attachments are randomized. Although the results are not shown here, the self-fulfilling mechanism can enhance decoupling whether the source of disjuncture is uncertainty, diffuse status characteristics, or randomized attachment patterns, as modeled here.

The summarized results in part C of table 2, however, suggest that the self-fulfilling prophecy comes into play only when there is some initial level of inaccuracy with respect to true quality. In table 2, we see that there is no rank reordering when initial attachments are based on true quality (i.e., rank correlation is one). It is worth pointing out that our results conform to Merton's original point that a self-fulfilling feedback mechanism can be "activated" only in situations in which there is some initial disjuncture between expectations and underlying quality. In other words, as some social psychologists have tried to point out (Jussim 1986), initial orientations have to be significantly inaccurate before the self-fulfilling mechanism can be considered as a possible explanation for decoupling. Jussim and Harber (2005), for example, suggest that the self-fulfilling prophecy shows only a small effect in the classroom because teachers' expectations are generally accurate (p. 138). That said, when initial perceptions are inaccurate, actors do augment the social construction of status by conforming to these inaccuracies.

DISCUSSION

The examination of multiple mechanisms underlying the social construction of status has resulted in a number of important insights and propositions for future research. First, dyadic-level uncertainty is generally unimportant; uncorrelated dyadic errors cancel each other out such that an actor's eventual status position generally reflects her original position in the quality ranking. While this result may not seem surprising, it is significant in light of the fact that sociologists have previously assumed that any type of uncertainty about quality would be sufficient to decouple status from quality.

In contrast to dyadic errors, group-level errors in judgment weaken the relationship between status and quality even without much social influence guiding the formation of attachments. The same is true when initial attachments are based on random assignments or nominal characteristics. An actor's initial orientation toward another actor (i.e., an actor's orientation toward another *prior to the demonstration of quality*) can have serious and long-lasting consequences vis-à-vis status allocation. Note that initial judgments were insurmountable despite the fact that our simulated actors cared deeply about meritocracy. In our simulation routine, quality was the only variable used to allocate status after the initial attachment was set. Nineteen time periods of "quality only" rewards still did not rid the resulting status hierarchy of initial biases.

What these three dynamics have in common is that each can generate a collectively agreed-on impression about an actor that can, in turn, eclipse the "truth" about that actor. Social influence, symmetry, and the self-fulfilling prophecy alone cannot induce rank reordering because they affect the *scale* of rewards, not the *basis* for rewards. In contrast, diffuse status characteristics, randomized initial attachments, and uncertainty infuse "new," socially valued information into a system. In some situations, false information will be averaged away over time (e.g., dyadic-level error), and status will eventually reflect underlying quality. In other situations, especially when social influence is high, false information becomes embedded in a way that essentially overwhelms underlying quality, and a new, self-reinforcing reality takes over—a reality in which an individual would be hard-pressed to convince others that his status is not commensurate with his underlying quality.

We are not surprised that increasing levels of social influence exacerbate the decoupling of status and quality. We know from Gould (2002) that increasing levels of social influence result in greater status dispersion; so if the initial judgments are wrong, greater dispersion only augments the disjuncture between quality and status. As depicted in figures 6 and 7, social influence essentially affects the rate at which actors become locked in to a stable position.

We are intrigued, however, by the effect of symmetry on decoupling. We know from Gould (2002) that when individuals care more about symmetry, the amount of deference that actors are willing to give decreases (see eqq. [2] and [3a]). What was not anticipated is how symmetry (i.e., the extent to which unreciprocated attachments are considered intolerable) can actually decrease the magnitude of rank reordering. As the concern of reciprocity increases, discrepancies between status and quality positions (regardless of the initial source of disjuncture) decrease in magnitude (see, e.g., fig. 8). That is, the more individuals are bothered by unreciprocated attachments, the less likely they are to erroneously confer status.

Finally, we are surprised that the self-fulfilling mechanism depends so strongly on the initial disjuncture of status and quality even though the finding should have been anticipated. The self-fulfilling prophecy is often offered as a sufficient mechanism for judgments of quality (and therefore status) to be misaligned with true quality despite Merton's original premise that such a mechanism is valid only when there is an initial disjuncture between quality and expectations. It is clear from the model, however, that the self-fulfilling mechanism augments but does not by itself engender a disjuncture between status and quality.

In general, through this exercise, we were able to gain some leverage on the social construction of status using a bird's-eye perspective. One issue that has impeded our knowledge of status construction is that true quality is generally unobservable, which makes the empirical study of construction often intractable. Any simulation approach, however, is limited by the quality of the model used to generate the data. While few would dispute that this model incorporates some important theoretical insights from sociology and social psychology, the question remains whether we omitted critical dynamics and/or misspecified or poorly specified the dynamics that were incorporated. Although our approach was to translate each mechanism from a theoretical idea to a formal concept in the simplest and most intuitive manner, future research is clearly needed to gauge how sensitive the results are to various specifications. Ultimately, whether a model is realistic or not depends on whether its implications are borne out in empirical studies, as well as our convictions about its underlying theoretical assumptions.

CONCLUSION

As we noted at the outset, the term "social construction" is typically invoked as a disciplinary rallying cry rather than as an analytical construct that is subject to rigorous analysis. At the broadest level, we have tried to bring some added specificity to the term. By operationalizing social construction in terms of the distinction between an objective reality and perceptions of that reality and distinguishing strong and weak forms of social construction, we have tried to open up a new line of questioning for sociological research: What are the contextual factors that lead to more (or less) social construction? While there are a number of social phenomena that could provide a specific context for this general question, we turned our attention to status differentiation, a phenomenon that is of broad sociological interest and, because of recent work by Roger Gould (2002), lends itself nicely to rigorous formal analysis. Given this particular focus, social construction is thus measured as a disjuncture between the allocation of attention and true qualities that are deserving of attention. In part because of the breadth of the topic in sociology, scholars have posited numerous mechanisms for the disjuncture, and we have shown how Gould's model can be drawn on to model the effects of those alternative mechanisms.

This modeling effort has had important implications for research in diverse sociological traditions. Namely, the theoretical synthesis and simulation exercise gave rise to several new hypotheses regarding the evolution of status hierarchies, many of which lend themselves to empirical testing. For example, the comparative impact of dyadic and collective errors in perception should be an important caution for sociological research on status in market contexts: this research must pay closer attention to whether the posited uncertainty about quality results in assessments that are correlated or uncorrelated across dyads. If it is the latter, then we should not expect there to be much decoupling of status and quality in a given market context.

One of the most striking results from our simulation is that, with just a low level of social influence, exogenous biases (e.g., biases based on nominal traits) can decouple status from quality even when those preconceptions are countered with repeated and unambiguous demonstrations of quality. Previous studies on the tension between discrimination and quality uncertainty, however, have generally argued that this sort of bias can be overcome with quality transparency. Dovidio and Gaertner (2000), for example, show that discrimination against black candidates (in simulated hiring processes) manifests only when their qualifications are ambiguous, which they claim is evidence of aversive racism. When black candidates are clearly qualified (or, similarly, clearly unqualified), they do not seem to fare worse than their white counterparts.

Note, however, that a simulated hiring context is, by design, one in which social influence does not exist. Dovidio and Gaertner's results thus correspond to—and indeed are consistent with—our findings in figure 10 when social influence is zero. That is, when social influence is negligible, bias can be overcome with quality transparency. What figure 10 also shows, however, is that the effect of the bias on decoupling interacts with social influence; in settings in which actors take into account others' decisions in forming their own, it is significantly harder for an actor to "recover" from the bias introduced from nominal traits—as evidenced by the dramatic drop in the rank correlation. Further research on the connection between quality ambiguity, discrimination, and social influence is clearly needed. But at a broad level, the results here reinforce the findings of the expectation states tradition that particularistic criteria can have a strong impact on initial quality judgments, and to the degree that they do, these same criteria can lead to a strong, persistent disjuncture between quality and status.

Importantly, the simulations also yield some important implications for those who wish to manage groups such that prestige rewards are closely matched with contributions. At a basic level, the simulations show that even if group members place disproportionate weight on the quality of contributions when deciding on the individuals to whom they should give deference, it is still possible for status to become strongly decoupled from quality. Put simply, caring about quality is not enough. The results surrounding figure 9 demonstrate this fact clearly.

Second, a manager may be able to prevent decoupling by regulating the extent to which demonstrations of quality are open to the public. While many managers will want to build solidarity and trust in a team by ensuring that all contributions are publicly observed, this desire for solidarity needs to be balanced against the fact that public observation can generate correlated errors, which can undermine the relationship between quality and status. Similarly, when building a team, a manager might wish to minimize the degree to which individuals can observe others' acts of deference. Others' acts of deference can undermine the degree to which each individual relies on his or her own judgment of quality in forming attachments.

Finally, managers might benefit by being sensitive to any determinants of the initial pattern of attachments that are unrelated to quality. Interventions in group processes that deemphasize diffuse status characteristics and accentuate underlying abilities, like that reported in Polzer, Milton, and Swann (2002), will be especially important in ensuring that status is granted on the basis of quality contributions. In terms of providing direction for proactive management, the results tell a manager that she can reduce some of the disjuncture between status and quality if she works to foster a norm of reciprocity in the allocation of attention. That is, if the manager encourages those in her group to give attention to those who have given them attention, then status differences are less likely to crystallize in a way that is significantly decoupled from quality.

In conclusion, by laying a foundation for what might be labeled a contingent perspective on social construction, we have opened up the possibility of offering normative prescriptions for how group dynamics should manage the decoupling of status from underlying quality. Analyses like the simulations in this article provide some guidance for intervening in group dynamics so that the negative consequences of social construction are minimized.

Similar analyses might help to clarify the extent of social construction in other contexts. For example, since Granovetter (1985) introduced the term "embeddedness" into the sociological vernacular, sociologists have been trying to work through multiple mechanisms that spell out how the returns to an actor's effort are helped or hindered by the social context in which the actor is embedded (e.g., Portes and Sensenbrenner 1993; Uzzi 1997). A formalization of such mechanisms could help identify the contingent significance of social context in shaping economic behavior. Similarly, while Latour and Woolgar (1986) made the broad point that the perceived value of a scientific contribution is socially constructed, others suggest that the extent to which rewards in science are socially influenced may be contingent on certain contextual factors, such as the level of disciplinary uncertainty (e.g., Hargens and Hagstrom 1982; Lynn 2009). Again, a more formal consideration of the different mechanisms that potentially enable the social construction of value in a profession would provide a theoretically based road map for future research in this area.

Though sociologists believe strongly in the social construction of the world around us, they also typically believe that the world would be "a better place" if social processes did not decouple an actor's rewards from his underlying talents and effort. Accordingly, regardless of whether the focus is on status processes in general, embeddedness, the perceived value of scientific contributions, or some other social phenomenon, the approach in this article provides a way to assess the extent of decoupling and the relative importance of the various mechanisms underlying it.

APPENDIX A

The foundation of our status allocation model is adapted from Gould's (2002) theory on the origins of status hierarchies. His model is aligned with our conceptualization of status hierarchies insofar as it is based on a group dynamics logic, where a person's status is defined as the sum of all the status-conferring gestures directed toward her. More important, he synthesized into a formal model three simple and noncontroversial principles regarding the status behavior of individuals in small groups and thus provided a point of departure for the more integrative and dynamic model we build in this article. A key difference between our work and Gould's original approach is that Gould was interested in understanding the equilibrium state of a static model, whereas we pursue a dynamic and evolutionary approach to understanding status formation. We summarize this difference below.

Gould's model of status allocation is built on the principle that an actor's social satisfaction or welfare is a function of interpersonal attachments. First, actor i benefits from attachments (a_{ij}) to those with superior qualities (Q_j) and thus prefers to give deference in exchange for quality. However, i also prefers to withhold attachments unless the gesture is reciprocated. That is, actor i's utility (u_i) increases with attachments to high-quality alters but decreases with asymmetrical attachments (p. 1154):

$$u_i = \sum_j a_{ij} Q_j - s \sum_j a_{ij}(a_{ij} - a_{ji}). \tag{A1}$$

In essence, *desirable* alters (e.g., those who possess superior qualities) are distinct from *available* alters (e.g., those who will reciprocate the attachment). Unreciprocated attachments thus weaken i's satisfaction depending on the value of s, the extent to which actors are "bothered" by asymmetrical attachments.

On the basis of this equation, Gould shows that the optimal set of attachments from i to j in the equilibrium state—that is, the set of attachments that maximizes i's social welfare given all other attachments directed toward i within the group—is as follows (p. 1154):

$$a^*_{ij} = \frac{Q_i + 2Q_j}{3s}. \tag{A2}$$

This solution is consistent with the concept of a Nash equilibrium, where "everyone's choice of action is preferable to (or as good as) the alternatives so long as everyone else's choice of action remains constant" (p. 1148).

Gould then builds into this model the idea of social influence, that is, that i's attachment to j may be influenced by how others in the group are attached to j (a_{kj}). The concept is that suitors are attracted not only to high-quality alters but to highly sought-after alters. To formalize this idea, Gould expresses i's perception of j's quality (q_{ij}) as a weighted average of true quality and group-derived desirability (p. 1156):

$$q_{ij} = (1 - \omega)Q_j + \omega \sum_{k \neq i,j} a_{kj}, \tag{A3}$$

where $\sum_{k \neq i,j} a_{kj}$ is the sum of everyone else's attachment to j, and ω is the weight applied to this collective opinion. As ω increases, quality perceptions are more socially influenced. When q_{ij} is substituted for Q_j, the equilibrium attachment can be found to be the following:[20]

$$a_{ij} = \frac{(1-\omega)\left\{Q_i[s^2-(n-3)s\omega] + Q_j[2s^2-2(n-3)s\omega-(n-2)\omega^2] + s\omega\sum_{k\neq i,j} Q_k\right\}}{[s-(n-2)\omega][3s^2-(2n-7)s\omega-(n-2)\omega^2]}. \quad \text{(A4)}$$

In summary, Gould's model, which views status formation as a phenomenon driven by strategic players, is enormously insightful and provides the point of departure for our work. His approach, however, also has two serious limitations.

First, Gould uses a one-shot game approach, which is a static rather than a dynamic approach. It does not explicitly model the adaptive process in which players adjust their strategies on the basis of their observation of how others play. His approach focuses on the equilibrium state, relying on the implicit but strong assumption that players can always reach the equilibrium state instantaneously through highly rational calculation. A player would need to understand not only all of his or her own alternatives and associated payoffs but also all the alternatives and associated payoffs of every other player in the game before he or she can calculate the equilibrium. In other words, for players to reach the equilibrium state, each would have to think like a globally oriented game theorist and be able to "crack the game."

Such a view, as critics usually point out (e.g., Simon 1955), imposes an undue burden on the agents' informational and computational capacity. A more realistic approach would be to assume that agents have only "bounded rationality"; that is, they possess limited information and make "local" adjustment in response to what they observe around them. Such a process, studied by game theorists through "learning" or "evolutionary" models, *may or may not* reach an equilibrium state, even when well-defined equilibria do exist.

Thus, in addition to relying on a more realistic premise of bounded rationality, a dynamic learning model allows for the examination of possible outcomes outside of the equilibrium. This is of key interest to us given that strong decoupling (i.e., rank reordering) *cannot* occur in the equilibrium state of Gould's model, the second serious limitation of his original formulation. Regardless of the parameter values, status rankings will always be perfectly correlated to quality rankings in the equilibrium

[20] Note that this equation differs slightly from Gould's eq. (5) (p. 1157), which we find contains errors.

state of his model.[21] This can be verified by summing j's received deference according to equation (A4). Rearranging the terms, we see that $\sum_{i \neq j}^{n} a_{ij}$ is equal to

$$\frac{(1-\omega) \cdot \left\{(s^2 + s\omega) \cdot \sum_{i=1}^{n} Q_i + [(2n-3)s^2 - (2n^2 - 8n + 7)s\omega - (n^2 - 3n + 2)\omega^2] \cdot Q_j\right\}}{[s - (n-2)\omega][3s^2 - (2n-7)s\omega - (n-2)\omega^2]}. \tag{A5}$$

That is, j's status is a linear function of j's own quality, Q_j, and the sum of qualities of all players in the group, $\sum_{i=1}^{n} Q_i$. Since $\sum_{i=1}^{n} Q_i$ is constant for all members of the group, a person's status ranking is a simple reflection of his or her quality ranking. Given our explicit interest in understanding strong decoupling (rank reordering), the equilibrium approach is thus of very limited use. We need an approach in which stronger forms of social construction are at least a theoretical possibility. Below, we outline the dynamic approach we adopted.

We start with the same utility function, equation (A1), for individual players as in Gould's analysis. Players are assumed to be only boundedly rational. That is, they know only their own utility functions, and they observe only others' *past* behavior. Each player tries to choose the best strategy for the current round, based on the observed strategies of others in the previous round. This type of simple dynamic mechanism, known as the "best-response" dynamics, is widely studied in the game theory literature (Osborne 2004).

At any time t, player i wants to choose her optimal strategy based on her own utility function and the observation of others' strategies at time $t-1$. So we replace a_{ij} with a_{ijt} and a_{ji} with a_{jit-1} in (A1). To find the best-response function of player i, we take the partial derivative of u_i with respect to a_{ijt} for each j, set the derivative to zero, and solve the equation. The best-response function of i is

$$a_{ijt} = \frac{q_{jt} + s a_{jit-1}}{2s}. \tag{A6}$$

We use lowercase q rather than capital Q to indicate that it is the perceived quality rather than the true quality of j that i uses to make the decision. The perceived quality, q_{it}, comes from two sources, as depicted in equation

[21] In most cases, the correspondence is positive; i.e., players with higher quality will have higher status. In rare cases with extreme parameter values, the correspondence is negative; i.e., players with lower quality will have higher status. But in all cases the correspondence is complete and involves no shuffling.

(A3), partly from j's true quality and partly from the respect others paid to j in the previous period:

$$q_{ij} = (1-\omega)Q_j + \omega \sum_{k \neq i,j} a_{kjt-1}. \tag{A7}$$

Substituting (A7) into (A6), under the assumption that s is not zero, we get the full best-response function for i:

$$a_{ijt} = \frac{1-\omega}{2s}Q_j + \frac{\omega}{2s}\sum_{k \neq i,j} a_{kjt-1} + \frac{1}{2}a_{jit-1}. \tag{A8}$$

This equation describes how player i allocates deference to player j at time t. As the game has n players and each player needs to allocate deference to every other player, the whole game is described by a system of equations consisting of $n \times (n-1)$ best-response functions as depicted above. To express the entire system of equations in matrix form, some notational arrangement is necessary. Let $\alpha(t)$ be the column vector that contains all a_{ijt}, $i \neq j$, in the following order:

$$\alpha(t) = (a_{12t}, a_{13t}, \ldots, a_{1nt}, a_{21t}, a_{23t}, \ldots, a_{2nt}, \ldots, a_{n1t}, a_{n2t}, \ldots, a_{n(n-1)t}). \tag{A9}$$

Let ρ be the column vector that contains the corresponding Q_j's, scaled by $(1-\omega)/2s$:

$$\rho = \frac{1-\omega}{2s}(Q_2, Q_3, \ldots, Q_n, Q_1, Q_3, \ldots, Q_n, \ldots, Q_1, Q_2, \ldots, Q_{n-1}). \tag{A10}$$

The system can be written as

$$\alpha(t) = A \cdot \alpha(t-1) + \rho, \tag{A11}$$

where A is an $n \times (n-1)$ by $n \times (n-1)$ symmetric matrix. A concrete example of matrix A when $n = 3$ is the following:

$$A = \begin{pmatrix} 0 & 0 & \frac{1}{2} & 0 & 0 & \frac{\omega}{2s} \\ 0 & 0 & 0 & \frac{\omega}{2s} & \frac{1}{2} & 0 \\ \frac{1}{2} & 0 & 0 & 0 & \frac{\omega}{2s} & 0 \\ 0 & \frac{\omega}{2s} & 0 & 0 & 0 & \frac{1}{2} \\ 0 & \frac{1}{2} & \frac{\omega}{2s} & 0 & 0 & 0 \\ \frac{\omega}{2s} & 0 & 0 & \frac{1}{2} & 0 & 0 \end{pmatrix}. \tag{A12}$$

Investigating the dynamic system above, we obtain several analytical results regarding its equilibrium state and its convergence behavior. First, we find that the system has the same equilibrium as described in (A4). As we pointed out earlier, in that equilibrium state there is a perfect correlation between individuals' status and quality ranking. Second, the system universally converges to the equilibrium (i.e., it converges regardless of the initial conditions) if and only if $0 < \omega/s < 1/(n-2)$. In other words, within a certain parameter space, that is, $0 < \omega/s < 1/(n-2)$, the system behaves very predictably. It always converges to the equilibrium in which people's status ranking correlates perfectly with their quality ranking.

But outside that parameter range, that is, when $\omega/s > 1/(n-2)$, the system's behavior is no longer predictable from an analytical perspective, and as such, we use numerical simulation methods to investigate its behavior. It is obvious that as n grows, the parameter space in which we need to employ the numerical simulation method is increasingly large. It is also worth noting that nonequilibrium results are more interesting given our sociological aims because the decoupling between status and quality is theoretically impossible at the equilibrium state. For those reasons, we carried out our investigation primarily through numerical simulations, as shown in the text. The proofs for the above two analytical results are presented in appendix B.

APPENDIX B

PROPOSITION 1.—*The equilibrium as described in (A4) is also an equilibrium for the dynamic system as defined by (A8)–(A11), provided that* $n \geq 3$ *and that the denominator in (A4) is not zero.*

Proof.—An equilibrium state α^* needs to satisfy

$$\alpha^* = A \cdot \alpha^* + \rho. \tag{B1}$$

To prove that (A4) is an equilibrium, we verify that it satisfies (B1). We note that (B1) is a system of equations consisting of $n \times (n-1)$ single equations and will show that each of the equations holds when (A4) is plugged in. Without loss of generality, consider the first equation in (B1):

$$a_{12} = \frac{\omega}{2s}(a_{32} + a_{42} + \cdots + a_{n2}) + \frac{1}{2}a_{21} + \frac{1-\omega}{2s}Q_2. \tag{B2}$$

When we plug (A4) in, the left-hand side of the equation is

$$\frac{(1-\omega)\left\{[s^2-(n-3)s\omega]\cdot Q_1+[2s^2-2(n-3)s\omega-(n-2)\omega^2]\cdot Q_2+s\omega\cdot\sum_{k=3}^{n}Q_k\right\}}{[s-(n-2)\omega][3s^2-(2n-7)s\omega-(n-2)\omega^2]}. \tag{B3}$$

The right-hand side consists of three parts. Letting

$$S=\frac{\omega}{2s}(a_{32}+a_{42}+\cdots+a_{n2}),$$

we can write the right-hand side as

$$S+\frac{1}{2}a_{21}+\frac{1-\omega}{2s}Q_2. \tag{B4}$$

We can further write out S according to (A4), collect terms, and obtain

$$S=\frac{\omega}{2s}\cdot$$

$$\frac{(1-\omega)\left\{s^2\cdot\sum_{k=3}^{n}Q_k+(n-2)[2s^2-2(n-3)s\omega-(n-2)\omega^2]\cdot Q_2+(n-2)s\omega\cdot Q_1\right\}}{[s-(n-2)\omega][3s^2-(2n-7)s\omega-(n-2)\omega^2]}.$$

The a_{21} in the right-hand side can also be expressed according to (A4) as

$$a_{21}=$$

$$\frac{(1-\omega)\left\{[s^2-(n-3)s\omega]\cdot Q_2+[2s^2-2(n-3)s\omega-(n-2)\omega^2]\cdot Q_1+s\omega\cdot\sum_{k=3}^{n}Q_k\right\}}{[s-(n-2)\omega][3s^2-(2n-7)s\omega-(n-2)\omega^2]}.$$

Looking at the right- and left-hand sides, we see that they both are linear combinations of three terms: Q_1, Q_2, and $\sum_{k=3}^{n}Q_k$. We need only to compare the coefficient of each term on both sides to verify that the two sides are equal, a process that is straightforward but somewhat laborious. Thus we do not show the algebraic details but simply report that the two sides are indeed equal.[22]

As the same argument can be applied to any equation in the system (B1), we conclude that (A4) indeed satisfies (B1). QED

[22] The detailed algebra is available on request.

PROPOSITION 2.—For $n \geq 3$, *the dynamic system as defined by (A8)–(A11) universally converges to its equilibrium if and only if* $0 < \omega/s < 1/(n-2)$.

Proof.—We note that the matrix A is real and symmetric. It is thus diagonalizable. That is, we can find a matrix P such that

$$P^{-1}AP = D = \begin{pmatrix} \lambda_1 & 0 & 0 & \cdots & 0 \\ 0 & \lambda_2 & 0 & \cdots & 0 \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ 0 & 0 & \cdots & \lambda_{n(n-1)-1} & 0 \\ 0 & 0 & \cdots & 0 & \lambda_{n(n-1)} \end{pmatrix}, \tag{B5}$$

where the λ's are eigenvalues of A. (Some of the λ's may be equal. That is, there may not be n distinct eigenvalues.) The columns in P are eigenvectors that correspond to the eigenvalues in D.

We can transform (A11) by multiplying both sides with P^{-1} and using the fact that $PP^{-1} = I$:

$$\begin{aligned} P^{-1}\alpha(t) &= P^{-1}APP^{-1} \cdot \alpha(t-1) + P^{-1}\rho \\ \Rightarrow P^{-1}\alpha(t) &= DP^{-1} \cdot \alpha(t-1) + P^{-1}\rho. \end{aligned} \tag{B6}$$

Letting $P^{-1}\alpha(t) = \alpha'(t)$ and $P^{-1}\rho = \rho'$, we have a transformed system

$$\alpha'(t) = D\alpha'(t-1) + \rho'. \tag{B7}$$

Because of D's simple structure, the new system can be written as

$$\begin{aligned} \alpha'_1(t) &= \lambda_1\alpha'_1(t-1) + \rho'_1, \\ \alpha'_2(t) &= \lambda_2\alpha'_2(t-1) + \rho'_2, \\ &\cdots \\ \alpha'_i(t) &= \lambda_i\alpha'_i(t-1) + \rho'_i, \\ &\cdots \\ \alpha'_{n(n-1)}(t) &= \lambda_{n(n-1)}\alpha'_{n(n-1)}(t-1) + \rho'_{n(n-1)}, \end{aligned} \tag{B8}$$

where $\alpha'_i(t)$ is the ith element of vector $\alpha'(t)$.

It is straightforward to verify that, for any i,

$$\alpha'_i(n) = \lambda_i^n\alpha'_i(0) + \frac{1-\lambda_i^n}{1-\lambda_i}\rho'_i. \tag{B9}$$

Obviously, when $|\lambda_i| < 1$, then as n goes to infinity, $\alpha'_i(n)$ goes to $[1/(1-\lambda_i)]\rho'_i$, regardless of $\alpha_i(0)$. That is to say, the whole system universally converges to the equilibrium point if and only if every $|\lambda_i| < 1$.

Now we will showthat $|\lambda_i| < 1$ for any i when $0 < \omega/s < 1/(n-2)$. To establish that, we need only to demonstrate that the largest $|\lambda_i| < 1$ when $0 < \omega/s < 1/(n-2)$. For that purpose, it suffices to show that the maximal $|\lambda_i|$ is

$$(n-2)\frac{\omega}{2s} + \frac{1}{2}.$$

We note that each row of the matrix A sums to the same constant

$$(n-2)\frac{\omega}{2s} + \frac{1}{2}.$$

A known property of any nonnegative matrix with constant row sums is that its spectral radius, that is, the maximum of the absolute values of the eigenvalues, is equal to its row sum (proposition 15.1.10 in Rao and Rao [1998, p. 471]). That implies, in our case, that the maximal $|\lambda_i|$ of A is

$$(n-2)\frac{\omega}{2s} + \frac{1}{2}.$$

QED

APPENDIX C

TABLE C1
Example of the Simulation Procedure with Dyadic-Level Error

distancePhase	Description
Setup	1. Generate network: $n = 30$, where $i = j = \{1, 2, 3 . . . , 30\}$
	2. Randomly assign exogenous quality: $Q_j \sim N(0, 1)$
	3. Randomly assign dyadic error: $e_{ij,t=0} \sim U(0, x)$, where $x \geq 1$
	4. Generate initial attachments: $a_{ij,t=0} = Q_j + e_{ij,t=0}$
	5. Generate initial choice status: $\sum_{i \neq j} a_{ij,t=0}$
Rounds 1–20	1. Randomly assign dyadic error: $e_{ijt} \sim U(0, x)$, where $x \geq 1$
	2. Generate perceived quality: $q_{ijt} = (1-\omega)(Q_j + e_{ijt}) + \omega \sum_{k \neq i,j} a_{kj,t-1}$
	3. Generate best-response attachments: $a_{ijt} = (q_{ijt} + s a_{jit})/2s$
	4. Generate choice status: $\sum_{i \neq j} a_{ijt}$

APPENDIX D

TABLE D1
EXAMPLE OF SIMULATION PROCEDURE WITH RANDOMIZED INITIAL ATTACHMENTS

Phase	Description
Setup	1. Generate network: $n = 30$, where $i = j = \{1, 2, 3, \ldots, 30\}$
	2. Randomly assign exogenous quality: $Q_j \sim N(0, 1)$
	3. Randomly assign initial attachments (R_{ij}), where $R_{ij} \sim N(0, 1)$ for each i
	4. Generate initial choice status: $\sum_{i \neq j} R_{ij}$
Round 1	1. Generate perceived quality: $q_{ijt} = (1 - \omega)Q_j + \omega \sum_{k \neq i,j} R_{kj}$
	2. Generate best-response attachments: $a_{ijt} = (q_{ijt} + sR_{ji})/2s$
	3. Generate choice status: $\sum_{i \neq j} a_{ijt}$
Rounds 2–20	1. Generate perceived quality: $q_{ijt} = (1 - \omega)Q_j + \omega \sum_{k \neq i,j} a_{kj,t-1}$
	2. Generate best-response attachments: $a_{ijt} = (q_{ijt} + sa_{jit})/2s$
	3. Generate choice status: $\sum_{i \neq j} a_{ijt}$

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