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Disentangling the effects of reputation and network position on the evolution of alliance networks

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Abstract
This study uses the panel data social network analysis program SIENA to estimate the effect of actor reputation derived from past performance on alliance formation, while controlling for other constant actor attributes and network position. The authors distinguish between *individual* reputation based on the past performance of the organizations the individual actor has been involved in, and *composite* reputation that takes into account reputation spillover effects from the similarly constituted reputations of past alliance partners. The empirical setting is the project-based film industry, which can be regarded as a constantly changing network of alliances. The study focuses on artistic reputation, based on the reviews of earlier films, and finds that the strength of that reputation and closeness in the network of past alliances are strong predictors of alliance formation. The study finds weak evidence of actors with similar reputations being more likely to form alliances with each other.

Keywords
film, project-based organization, reputation, social networks

Introduction
Alliances can be risky because of the high uncertainty about both the quality of the resources, and the trustworthiness of the potential alliance partner (Gulati, 1995). What actors know or can find out about potential alliance partners therefore becomes an important determinant of whether or not an alliance will be formed. In the literature one can broadly distinguish between two categories of information that actors can use in alliance decisions. First, reputation – also referred to as reputational status (Fombrun and Shanley, 1990) – of which the most important form is reputation that results from past performance (Shapiro, 1983). Second, information about an actor's position in social networks (Benjamin and Podolny, 1999; Burt, 1992; Granovetter, 1973).

In this article we focus on the influence of performance-based reputation on the evolution of alliance networks. The concept of performance-based reputation needs to be qualified in two respects. First, an actor's reputation can be influenced by the reputations of past and current exchange partners (Benjamin and Podolny, 1999; Podolny, 1993, 1994; Pollock and Gulati, 2007). This study focuses explicitly on the impact of such reputation by affiliation or association. Second, collective reputations can be transferred to the individuals that are, or have been, members of that specific collective (Schweizer and Wijnberg, 1999; Tirole, 1996).

Deriving the reputation of individuals from the reputation of collectives, such as organizations they have been involved with, results in a relatively rough indication of individual qualities. However, in many situations it will be difficult and/or costly to distinguish between the individual contributions precisely and to take into account how the internal dynamics of particular associations may have impacted the expression of individual qualities. The value of collective reputations as proxies for individual reputations will increase if observers can compare the performance of the different organizations the focal individual has been associated with. Especially in environments where activities are performed by individuals in series of temporary and changing alliances it is likely that outside observers, who may be potential new alliance partners, will try to infer the qualities of the focal actors from the performance of past alliances in which the focal actor was involved (Jones, 1996).

In this article we use many underlying ideas that have been proposed in connection with the concept of status, but which are just as applicable to the narrower category of performance-based reputation. Actors with low status may try to form alliances with others that have high status, because it brings them higher returns (Stuart et al., 1999). Actors with high status, however, do not have an incentive to affiliate themselves with others with low status, since this would threaten – the value of – their own status (Benjamin and Podolny, 1999; Faulkner, 1983). One would therefore expect that in markets with high uncertainty, alliances are often formed between actors with similar status (Chung et al., 2000; Gulati and Gargiulo, 1999; Podolny, 1994). Alliance formation between actors with similar status can be regarded as a specific form of homophily selection, the phenomenon in which actors who have comparable scores on certain attributes are more likely to form ties (Gibbons and Olk, 2003; Lazarsfeld and Merton, 1954; McPherson et al., 2001). In addition, alliance formation can also be explained by network position, especially by the closeness of alliance partners within the network of past alliances (Chung et al., 2000; Gulati, 1995). This is a specific example of a more general tendency towards transitivity or triadic closure in which friends of friends tend to become friends (Rapoport, 1953).

It is difficult, however, to isolate the influence of reputation as an individual actor attribute and network position on the evolution of alliance networks because these can interact (Gulati and Gargiulo, 1999). First, reputation may spill over between actors that are close to one another in the network. Second, potential alliance partners that are closer to one another in networks also have a higher chance of being similar with respect to individual actor characteristics (Kossinets and Watts, 2009). The core contribution of our article is that we statistically estimate the effect of different types of reputation, based on the performance of organizations the actor has been involved in, on the evolution of alliance networks, while controlling for network position and constant actor attributes of status such as age and sex. Additionally, the article contributes to the literature about the relation between individual and group reputations, and especially the extent to which the former can be derived from signals pertaining to the performance of groups the individual has belonged to.

We do this by applying the social network analysis program SIENA. This is a program suitable for social network panel data and specifically designed for estimating actor-driven network dynamics. SIENA enables researchers to estimate the effects of individual actor attributes – such as reputations – on the evolution of social networks while controlling for structural network effects such as closeness or proximity (Snijders, 2001, 2005; Steglich et al., 2006). The latter is important since there are strong endogenous network effects in the evolution of social networks such as alliance networks (Gulati, 1995). By applying SIENA we respond to calls for more dynamic models of social network analysis (Ahuja et al., 2007; Kilduff et al., 2006; Kossinets and Watts, 2009; Shipilov, 2005).

The article starts with a review of the literature on reputation, networks, status and alliance formation. This leads on to the formulation of a number of hypotheses with regard to the effects of reputation and network endogeneity on alliance formation in the film industry. The film industry provides a suitable case for our study since it is organized on the basis of project-based organizations that dissolve once the project, for which the organization was specifically set up, is completed (DeFillippi and Arthur, 1998; Jones, 1996). The film industry can therefore be regarded as a constantly changing social network of temporary alliances. Moreover, because the film industry is characterized by high uncertainty (Caves, 2000), reputations are expected to play an important role in alliance formations. The focus of this article is on artistic reputation, based on how well earlier films were reviewed by professional film critics. The results of the empirical study are presented and discussed.

Theory

Reputation, status, network position and alliance formation

Having a favourable status or reputation brings many different forms of advantage. Actors that have a high status or favourable reputation are more successful in attracting investors, resources, customers and alliance partners (Benjamin and Podolny, 1999; Fombrun and Shanley, 1990; Milgrom and Roberts, 1986; Podolny, 1993, 1994). They also have more successful careers (Spence, 1973) or tend to survive longer (Rao, 1994). Past research, however, has not always made a clear distinction between the concepts of status and reputation.

Some researchers treat reputation and status as two separate constructs. First, reputation is often derived from the economic notion of perceived quality of current products based on the quality of past products (Shapiro, 1983). Second, status is often used with a reference to the sociological notion of social rank or prominence (Rindova et al., 2005; Washington and Zajac, 2005), which is not based on past performance. Podolny (1993) has defined status as the 'perceived quality of a producer's product in relation to the perceived quality of that producer's competitors' products'. This definition of status comes close to Shapiro's definition of reputation. In a later study, Podolny treats status as a combination of reputation based on 'past demonstrations of quality' and the status of its exchange partners (Podolny, 1994). In the context of alliance formation, Jensen and Roy take a sequential view on status and reputation, where status serves to construct the first set of potential partners, and reputation subsequently leads the focal actors in their choice among the members of this status set (Jensen and Roy, 2008).

This is further complicated since some of these past studies have linked reputation and status to rank and affiliation with past exchange partners (Podolny, 1994; Washington and Zajac, 2005). The implication of these studies may be that status and/or reputation is partly the result of an actor's network position. Network position in terms of centrality, or being a central node in a social network, itself has also been used as an operationalization of status (Bonacich, 1987). Moreover, reputations can be sticky and resemble status since even when an organization has lost its edge over competitors a long time ago, it might still be perceived to be more reputable than warranted based on their *recent* performance (Schultz et al., 2001). In addition, other researchers state that reputation also has (at least partly) an aspect of subjective ranking since it is always relative; it is superior, inferior or equal to that of comparable actors (Deephouse and Carter, 2005; Rindova et al., 2005).

In this article, we clearly distinguish network positions, fixed attributes of status, which are not affected by the actor's behaviour or performance, and reputation. We reserve the term reputation for all information resulting from past performance that can be linked to an actor.

Reputation and alliance formation

Reputations in general, and performance-based reputations in particular, can be constructed on the basis of a wide array of signals, including awards (Anand and Watson, 2004), certification (Rao, 1994) or mere media attention (Rindova et al., 2005, 2007). Some of these signals will be considered to be more credible (Mizerski et al., 1979) than others.

Most importantly for our study, signals that serve to construct the reputation of a particular actor may actually be a reflection of the reputation of groups, teams or organizations the focal actor has been involved in (Tirole, 1996). Moreover, reputation can be transferred back and forth between core employees, such as CEOs, and the organizations they are employed by (Cohen and Dean, 2005; Higgins and Gulati, 2006; Schweizer and Wijnberg, 1999). Because outside observers find it difficult or even impossible to discern the individual contributions to the collective performance, they will tend to ascribe the collective performance to each of the individuals in the group equally, unless there is information available that convinces them otherwise. Even if the composition of the group changes completely, the collective reputation can remain intact (Tadelis, 1999).

Similarly, in an environment where only the products of an organization can be publicly observed, outside observers will ascribe the performance of the organization to all its members equally, unless they have more information on the basis of which they can separate the contribution of individual members. This has important implications, especially in environments where actors regularly form new alliances, while most of the available information from which reputations are constructed concerns the collective performance achieved by the earlier alliances in which the focal actor has been involved (Uzzi and Spiro, 2005). If an individual has always been in the same collective, together with the same other members, it will be difficult to distinguish between the individual and the group reputation. However, if that individual has been a member of a series of different organizations, an individual reputation can be more trustworthily derived from the series of collective performances.

Ideally, alliance partners would be perfectly informed about the quality of different alliance candidates and of the value that can be created using the other's inputs. Yet in an uncertain environment this is not always possible, which in turn will mean that available reputational signals will be likely to play an important role in determining new tie formation. As argued earlier, precisely in environments in which individuals take part in series of collectives with different membership it makes sense to deduce an individual's qualities from the performance of a series of collectives the same individual was involved in. In other words, new alliances will be entered into on the basis of an estimate of the individual reputation that is derived from the series of collective reputations. It can be suggested that a higher reputation will make one a more attractive candidate for a new alliance. We therefore hypothesize that:

Hypothesis 1a Actors with a high individual reputation based on the past performance of the organizations they have been involved in are more likely to be involved in new alliances.

In addition, Podolny and others argue that a producer's status derives not only from this producer's own reputation based on past quality or performance, but also from the status of this producer's exchange partners. Organizations or individuals, in other words, can benefit from status spillover effects (Benjamin and Podolny, 1999; Podolny, 1993, 1994; Pollock and Gulati, 2007). However, since an exchange partner's status, the way Podolny operationalizes it, is also partly based on this exchange partner's reputation, part of the status spillover effect is actually a reputation spillover effect. If an actor's own individual reputation serves to overcome uncertainty about this actor's suitability as an exchange partner, one can argue that similar reputation spillover effects

can result from the reputation of this actor's past alliances partners (Benjamin and Podolny, 1999; Podolny, 1993, 1994; Pollock and Gulati, 2007). This may be due to associative effects in the perception of decision-makers or because of trust in earlier decision-making by high reputation actors. The possible existence of reputation spillover effects suggests the following hypothesis:

Hypothesis 1b Actors with a high composite reputation, based on the past performance of the organizations they have been involved in and the past performance of former alliance partners based on the past performance of the organizations these alliance partners have been involved in, are more likely to be involved in new alliances.

Reputation similarity and alliance formation

Apart from the general effect of actors being more attracted to actors with high status or reputation, individuals are more attracted to others that have a *similar* status or reputation (Festinger, 1954). The term homophily selection is used to refer to the process by which actors choose to form ties with others because they are similar in sharing certain personal attributes or characteristics. Studies show that tie formation between similar people occurs at a higher rate than among people that are dissimilar (McPherson et al., 2001). There is, for example, evidence of actors of similar sex, age, education or race forming ties (Ibarra, 1992; Ridgeway, 1991; for a review see Gibbons and Olk, 2003; McPherson et al., 2001). Earlier research on reputation or status has also shown that alliances are often formed between actors that have a similar status (Chung et al., 2000; Gulati and Gargiulo, 1999; Podolny, 1994).

Gould provides an explanation for this phenomenon by stating that high status individuals will not select low status individuals because the latter are unlikely to return or reciprocate on an equal level in the future (Gould, 2002). Moreover, high status individuals have an incentive not to affiliate themselves with low status others since this would threaten – the value of – their own status (Benjamin and Podolny, 1999; Faulkner, 1983). These arguments concerning a more broad based tendency towards status-based homophily selection can be made more specific as a tendency towards reputation-based homophily selection, when actors in their search for alliance partners place a particular emphasis on these potential alliance partners' past performance. In alliance formation dynamics, we expect that low reputation actors will be attracted to high reputation alliance partners in order to benefit from positive reputation spillover effects. High reputation actors, on the other hand, are not likely to be attracted to low reputation alliance candidates because of possible negative reputation spillover effects. One would therefore expect alliances to form between actors with a similar reputation, since this will be the equilibrium outcome of these two opposing forces. We therefore hypothesize that:

Hypothesis 2a Actors with similar individual reputations based on the past performance of the organizations they have been involved in are more likely to form alliances with each other.

Again, similar to our argument leading to hypothesis 1b, taking into account possible reputation spillover effects from past alliance partners (Benjamin and Podolny, 1999; Podolny, 1993, 1994; Pollock and Gulati, 2007), we hypothesize that:

Hypothesis 2b Actors with similar composite reputations based on the past performance of the organizations they have been involved in and the past performance of former alliance partners based on the past performance of the organizations these alliance partners have been involved in, are more likely to form alliances with each other.

Ties, reputation and network position

The relation between reputation on the basis of past performance and status as fixed actor attribute becomes more complicated when taking into account dynamically changing networks. Status has been considered in terms of an actor's structural position within a social network, for instance network centrality (Ahuja et al., 2009; Shipilov, 2005). Network centrality, however, may also be the result of a tendency of actors to form exchange relations with actors that have favourable reputations. Highly reputed actors may be considered more valuable and therefore more popular exchange partners. Centrality, in this case, is the outcome of exchange relations that are originally driven by reputation, based on publicly available quality signals that are exogenous to the social network. Reputation may therefore lead to a central network position providing status which, in turn, may make one a more valuable exchange partner.

There is an additional complication in that reputation spillover through affiliation also implies that actors are close to one another in social networks, and that the effects of spillover may therefore be correlated with network position. It should be noted, however, that closeness refers to relational closeness, not (necessarily) physical proximity. One could argue that closeness within the network of past alliances can cause reputation spillover, even between actors that do not have direct ties. In other words, status or reputation spillover can occur indirectly, since actors that engage in alliances also benefit from spillover from their alliance partners' partners. Moreover, it is not always clear whether tie formation can be explained by homophily selection or by closeness because actors may have first chosen membership of certain groups of actors that are already similar to themselves. Only, in the next stage, once they are a member of a possibly very homogeneous group, do they form ties with group members that are close within their social network (Kossinets and Watts, 2009).

In other words, besides exogenous effects, such as reputation, there are endogenous network effects, such as network position in terms of closeness, that play an important role in tie formation dynamics. This tendency of, for example, friends of friends becoming friends, is referred to as transitivity or triadic closure (Rapoport, 1953). More specifically in the context of alliance formation decisions, it was found that actors that are close to each other within the network of past alliances are more likely to form an alliance among them (Gulati, 1995; Gulati and Gargiulo, 1999). There are two important reasons why this may occur: access to information about new opportunities and coping with the risk of opportunistic behaviour. It should be noted that the degree to which information about both opportunities and opportunism travels through social networks is higher in networks with high density where the actual number of ties is large relative to the total number of possible ties (Wasserman and Faust, 1994).

First, the closer a firm is positioned to another firm in a network of alliances, the more likely it is to identify new *opportunities* for alliance formation. Besides the suggestion that actors engage in limited search and satisficing (Simon, 1987), the structure of the social network in which actors are embedded also influences their chances of hearing about valuable new opportunities (Granovetter, 1973), and therefore their ability to optimize alliance formation decisions. Firms are restricted in optimizing alliance formation in terms of access to the most valuable resources because they are embedded in networks that constrain their opportunity set of firms with which they potentially engage in alliances (Gulati, 1999). Second, forming alliances with others that are close in the network will reduce the risk of *opportunistic behaviour* since these alliance partners may fear of loss of reputation within their local network (Raub and Weesie, 1990).

Because of these reasons we propose the following hypothesis about network position that, thanks to the specific type of network analysis that we employ, can be tested in tandem with the hypotheses about the effects of reputation:

Hypothesis 3 Actors that are positioned close to each other in the network of alliances are more likely to form alliances with each other.

Research setting: the film industry

A particularly suitable setting for studying alliance formation dynamics is the film industry, which can be viewed as a constantly changing network of temporary alliances. Yet because of the heterogeneity in past research concerning the application of constructs that are related to status, we distinguish between: reputation, network position and constant attributes of status. First, reputation is based on past performance, which can be directly derived from the performance of earlier projects of which the focal actor was a member. In addition, one could take into account reputation spillover effects from the performance of the focal actor's alliance partners (Podolny, 1993, 1994) in their respective prior projects with actors other than the focal one. Second, status can be linked to the structural position that an actor occupies in a social network. In this study we focus on network position in terms of closeness in order to estimate the effect of transitivity or triadic closure in alliance formation (Gulati, 1995; Rapoport, 1953). Third, status can be based on constant actor attributes that are given and do not change over time, such as sex or age (Ibarra, 1992; Ridgeway, 1991).

The empirical setting in which we study the effects of reputation, network position and constant attributes of status on alliance formation dynamics is the Dutch film industry. The film industry is very suitable for the purpose of this study since it is organized on the basis of project-based organizations (PBOs) that dissolve once the project for which a PBO was specifically set up is completed (DeFillippi and Arthur, 1998; Ebbers and Wijnberg, 2009; Jones, 1996). The film industry, in other words, can be regarded as a constantly changing social network of temporary alliances between individual – often freelance – film professionals. Moreover, the film industry is characterized by a high degree of uncertainty (Caves, 2000) as a result of which reputations may be expected to play an important role in alliance partner choice. This uncertainty refers to the value of possible alliance partner's resources, their reliability as an exchange partner, but also to the uncertainty with respect to consumer demand (Podolny, 2001). Reputation, affiliation and network position therefore play an important role in the dynamics behind alliance formation in the film industry (DeFillippi and Arthur, 1998; Jones, 1996).

Focusing on the film industry allows us to more or less control for resource complementarity as an alternative explanation for alliance formation. Each film PBO requires a variety of resources from – often freelance – professionals, for example a director, screenwriter, producer, director of photography and editor, whose skills and activities need to be combined and coordinated (Jones, 1996). Since the film industry is characterized by a high degree of role specialization, each film project's alliance formation is driven by resource complementarity between its members.

Film professionals are concerned about the reputations of those with whom they collaborate, since this choice may not only influence the eventual success of the project, but also increase the chances of the project being financed in the first place. Individual reputations, in other words, play an important role in identifying valuable human resources that are selected as members of the PBO (DeFillippi and Arthur, 1998; Jones, 1996). Films have a better chance of getting financed if there is a package of a director, producer, scriptwriter and leading cast that have good reputations (Rosenberg, 2004: 80). One would therefore expect that individuals with a positive reputation have a higher chance of forming alliances. Moreover, this would suggest that film professionals are likely to collaborate in projects with others that have a similar reputation as this will increase the chances of reciprocity (Gould, 2002). This is to a certain extent confirmed in the US film industry,

where producers and directors that collaborate in projects have a similar number of credits (Faulkner and Anderson, 1987).

In this study we focus on the artistic reputations of film makers. Artistic reputation is based on expert ratings in the form of professional critics' reviews (Basuroy et al., 2003; Delmestri et al., 2005) of these same films in national newspapers. The importance of quality assessments by more or less independent experts makes the film industry an especially suitable empirical context (Benjamin and Podolny, 1999; Wijnberg and Gemser, 2000).

Besides reputation and reputation spillover effects from past alliance partners, position in social networks also plays an important role in the film industry, for example in identifying new film project opportunities or finding suitable alliance partners (Cattani and Ferriani, 2008; Jones, 1996). In the film industry, it was found that alliances are more likely between professionals that know one another from earlier projects (Sorenson and Waguespack, 2006; Zuckerman, 2004). For the same reason, one might expect that professionals are more likely to form alliances with other professionals that are close within their network. This dynamic can be explained by the risks that are associated with opportunistic behaviour that can be mitigated by forming alliances with actors that are close within one's network (Chung et al., 2000; Gulati, 1995).

Methodology

We applied the social network analysis program SIENA – a method for stochastic actor-based models for network dynamics. SIENA is designed for statistically estimating models for network evolution by combining a panel data and an actor-driven approach (Steglich et al., 2006; Snijders, 2001, 2005; Snijders et al., 2007, 2010). SIENA fills a gap by allowing researchers to apply a dynamic or evolutionary approach to social network analysis (Ahuja et al., 2007; Kilduff et al., 2006; Kossinets and Watts, 2009) and by focusing on individual actors in organization research (Felin and Foss, 2005). SIENA allows us to disentangle the dynamics of endogenous network effects such as network position, and exogenous actor-specific effects such as reputation, in explaining alliance formation dynamics. In what follows we give a brief and non-technical description of SIENA. For a general first introduction to SIENA, we refer to Snijders et al. (2010). For a more detailed mathematical treatment of SIENA, the reader is referred to Snijders et al. (2007).

The core feature of SIENA is that in estimating the evolution of a social network, it simultaneously distinguishes between *endogenous network* effects, derived from the network structure, and *exogenous actor covariate* effects that are based on the characteristics or attributes of individual actors. An example of an endogenous network effect is the tendency towards transitivity, which is the tendency of friends of friends becoming friends (Rapoport, 1953). Examples of exogenous actor covariate effects are those due to age or sex. Together, these endogenous network effects and exogenous actor covariate effects constitute the so-called *objective function*. This objective function captures all the theoretically relevant information that the actor has at her or his disposal in the evaluation decision to establish a new tie or not (Snijders et al., 2010).

The *individual parameter* values (β_k) in the objective function can be interpreted as the likelihood of the various different tie changes. In other words, it is an expression of how likely it is for an actor to change her or his network in a particular way. In addition, since the dependent variable represents the change in the network from ties being absent ($0, x_a$) to ties being present ($1x_b$), it follows that when actor i changes one of her or his ties, $f_i(x_b, \beta_k) - f_i(x_a, \beta_k)$ is the log odds ratio for actor i choosing between a tie being present or absent. This makes the probability of a tie being present or absent: $\exp f_i(x_b, \beta) - f_i(x_a, \beta))$ (Snijders et al., 2010).

In order to model tie formation and network evolution, SIENA requires panel data that consists of two types. First, one needs a number of observation moments or 'snapshots' of a network of a – more or less – constant set of actors. In SIENA terminology these snapshots are referred to as network waves. Network waves, for example, can be collected in the setting of a changing network of friendship relations in a class of students. Each network wave is represented as an $n \times n$ adjacency matrix $x = (x_{ij})$ where n is the number of actors and where the ties are binary variables (x_{ij}) that are either present of absent (1, 0). Second, SIENA requires individual actor data to model actor covariate effects.

Using the several waves of network and individual actor data, SIENA provides parameter values (β_k) for both these network effects and individual covariate effects and uses simulation to compare random network dynamics with actual network evolution using probabilities of tie formation. For more technical details about the algorithm, see Snijders (2001). SIENA is a recently developed method that is under continuous construction. At the time of the analysis there is no well-established measure of effect size or R^2 that indicates the overall goodness of fit of the model. This limits the extent to which the results can be compared with those of regression analysis.

Finally, it is important to note that our data consist of non-directed network ties. We do not have information about who took the initiative to form the tie. Directed networks contain much more information related to network structure than non-directed ones. We therefore used the initiative-confirmation model approach, as a specific model option within SIENA, where actors voluntarily and unilaterally form ties. One actor is assumed to take the initiative for establishing or dissolving a tie. When proposing a tie the receiving actor has to confirm, when dissolving a tie this confirmation is not required (Snijders et al., 2008).

Data and operationalization

Network data

At the network level our data consist of a two-mode network linking all directors, producers and scriptwriters of Dutch films produced from 1992 to 2008. In order to control for international minority co-productions, where the non-Dutch part of the film crew is dominant, we only selected film projects where at least two of the three key roles were Dutch. We obtained the network data through the Dutch film database – www.nfdb.nl – and cross-checked it with the Internet Movie Database – www.IMDb.com. Our focus was on the three roles of director, producer and scriptwriter because these can be considered the key roles in film projects (Puttnam, 2004: 18). In addition, the original idea for a film project can be initiated by each of these three roles. Seeing that the topic of our case is the film industry, the reader has to be aware that the term 'actor' should not be confused with actors in the sense of cast members or film stars.

For each role in a film project we only coded a single actor in order to avoid bias towards film projects that featured actors with many roles, or roles with many actors. Individuals that performed more than one role in their career are coded only for their most prominent role in terms of the largest number of credits received while performing that role. This resulted in a total sample of 226 actors ($N = 226$, see also Table 1) derived from 233 film projects with 108 directors, 61 producers and 57 scriptwriters. In addition, because we include only a single director, writer or producer in each film project, relations between actors with similar roles are coded with structural zeros. Coding structural zeros between actors informs SIENA that ties between these actors cannot be formed. This means that we controlled for the fact that, in our dataset, it is impossible for within-role ties, for example producer–producer ties to be formed.

We converted our two-mode network of actors that are indirectly linked through film projects into one-mode networks linking actors directly to other actors. Before converting to a one-mode network we first selected three waves of network data. We constructed three overlapping windows of films with a seven-year interval, 1995–2002, 1998–2005 and 2001–8. The data between 1992 and 1995 are used exclusively for constructing reputation variables for our baseline network 1995–2002. This means that we have three waves of network data. We chose an interval of seven years because on average an actor is involved in a film project once in every seven years. We chose overlapping networks because ties that are formed in the second half of each window would seem to dissolve faster when using non-overlapping networks.

SIENA requires the overall network to consist of a constant set of actors. It can, however, deal with entry and exit of actors by specifically coding their entry and exit. We used the year of the actors' first and last film credits at IMDb.com to code for entry and exit. In addition, we assumed that an actor retired from the industry after having passed the age of 65 unless the actor has a credit at a higher age in IMDb. In that case the year after the last credit is used as the retirement year.

Actor attribute data

We constructed changing individual actor attribute variables for measuring the effect of reputation on alliance formation, and a tendency towards homophily selection among alliance partners. We constructed the *individual reputation* variable based on artistic past performance in film projects. In addition, we used these individual actor reputation variables to construct a *composite reputation* variable that takes into account reputation spillover effects. We also included control variables for age, sex and education. More specifically, with respect to the latter, we included a dummy variable that indicates whether or not an actor has attended the Film Academy – the institution in the Netherlands dedicated to film education.

It is important to note that it is not appropriate to include centrality as an additional individual actor attribute of status because SIENA already takes centrality into account in the rate function. The rate function determines how often particular actors are allowed to change their network ties depending on their network position and individual actor covariates. This means that the change rate – or the opportunity to change ties – is influenced by the network position of an actor, including an actor's centrality (Snijders et al., 2010).

Artistic reputation. The changing actor variable *individual artistic reputation* was based on film critics' reviews in the four major national Dutch newspapers: *Volkskrant*, *NRC Handelsblad*, *Algemeen Dagblad* and *Telegraaf*. For constructing individual artistic reputations we used the average score of the five-star ratings of the last three film projects in which actors had participated. We collected these reviews from the website of *Filmkrant*, a Dutch magazine dedicated to film. Films that were not reviewed were coded using the average review of all others films in the dataset ($n = 7$, or roughly 3 percent of the films). We coded new entrants as having an average artistic reputation for the same reason mentioned earlier.

Composite artistic reputation. We also constructed a *composite artistic reputation* variable for each individual actor. The composite reputation variable is the weighted average of a focal actor's individual reputation, and the reputations of past alliance partners based on their past projects *excluding* those in which they collaborated with the focal actor. The individual reputation of the focal actor is weighted as 50 percent, and the individual reputations of its alliance partners combined also as 50 percent. Each of the two other roles is weighted equally.

For example, if a producer has an individual artistic reputation of 2 – the average number of stars in critic reviews of the last three film projects in which she or he participated – the directors the producer collaborated with an average of 3 and the scriptwriters an average of 4, the producer's *composite* reputation is $(0.5 \times 2) + (0.25 \times 3) + (0.25 \times 4) = 2.75$. When the focal actor, for example the same producer, was involved in only one film project, in which also the director and scriptwriter made their debut, there cannot be reputation spillover from the latter two based on the performance of their past projects. The composite reputation, in that case, is the same as the individual reputation and coded as such.

Network closeness. The variable network closeness is operationalized as transitivity or the tendency of friends of friends becoming friends (Rapoport, 1953). In our empirical setting this means the tendency of alliance partners of alliance partners becoming alliance partners.

Control variables. The control variables that we included are the actor attributes age, sex and education. All three are possibly related to status. We collected age and sex information through IMDb, and a myriad of online newspaper articles if not available on IMDb. Education was coded as whether or not an actor had graduated from the Dutch Film Academy. These data were obtained through the Dutch Film Academy, the Dutch Film Database and several Internet sites. Besides the fact that education in itself can be regarded as a status attribute, education can also be a reflection of competence. Moreover, it is also likely that interactions between actors may be driven by their affiliation with the Film Academy (Feld, 1981). These three actor attributes also served as our control variables to test homophily selection effects of constant attributes of status. Finally, we constructed dummies for directors and producers to control for role differences between producers, directors and scriptwriters and their propensity to form alliances.

Results

SIENA needs a certain threshold amount of variation in ties between the network waves to be able to estimate the parameters. The Jaccard index is used to measure the amount of change in the network and its value should be higher than 0.3 (Snijders et al., 2010). Our Jaccard indices over the subsequent network waves are 0.394 and 0.475 and therefore sufficient to estimate the model. Good convergence of the model indicates whether the simulated values deviate from the observed values. All parameter estimates need to be close to 0 and preferably smaller than 0.1 to indicate good convergence. All the variables converged well below 0.1 indicating a good fit.

Table 1 shows descriptive statistics. The correlations for models 2 and 3 can be found in Tables 2 and 3. Table 4 shows the results of the models. In the control model (model 1), under *rate function*, we see the rate scores for each period (1) 3.47 and (2) 3.86, indicating the average number of tie changes per actor between two consecutive waves.

Within the *objective function* one can distinguish between network effects and actor covariate effects. Similar to generalized linear statistical models, there is the assumption that the objective function is a linear combination of a set of components. These components are called effects (for mathematical definitions of these effects, see also Snijders et al., 2010).

With respect to *network effects*, the 'outdegree' parameter (3) is negative and significant (-1.67, $p < .001$). This variable should be included in all models since it measures the tendency of actors to have ties at all. The fact that it is negative means that arbitrary ties are costly, and therefore unlikely that actors will form ties with random others. The parameter 'transitive triads' (4) is

Table 1. Descriptive statistics of network structure and individual attributes

Network structure	
Number of actors	226.00
Average number of joiners:	
Period 1	29.00
Period 2	5.00
Average number of leavers:	
Period 1	1.00
Period 2	3.00
Average number of ties:	
Wave 1	1.82
Wave 2	1.62
Wave 3	1.81
Constant actor attributes	
Age average	50.43
Sex average	1.23
Film Academy average	1.70
Changing actor attributes	
Individual artistic reputation average:	
Period 1	2.29
Period 2	2.32
Composite artistic reputation average:	
Period 1	2.28
Period 2	2.33

positive and significant (1.92, $p < .001$), which means that actors have a tendency towards network closure or transitivity. This confirms hypothesis 3, stating that actors close to each other in the network of alliances are more likely to form alliances with each other. The 'sqrt degree of alter' (5) is a popularity effect. This Matthew type of effect means that small performance differences lead to large popularity distributions (Merton, 1968), or popular actors becoming even more popular. In our model the parameter is negative. In other words, there seems to be a preference for alliance formation with actors that work on a small number of projects.

In model 2 we estimated the effect of individual artistic reputation on alliance formation. We found support for hypothesis 1a. In model 2, 'individual reputation' (14) is positive and significant (0.24, $p < .05$). This can be interpreted as actors that participated in artistically successful films in the past are more likely to take part in new alliances or, in our case, new film projects. In model 3 we tested a similar model but here we used a '*composite* reputation' measure (16) taking into account reputation spillover effects from past alliance partners. In model 3 the 'composite reputation' effect is significant (0.25, $p < .05$) and does confirm hypothesis 1b. The value of 0.25 is slightly higher than the pure 'individual reputation' in model 5.

In model 2 we estimated *homophily* selection effects based on *individual* reputation to test hypothesis 2a, whether actors with a similar reputation are more likely to form alliances. We find weak support for hypothesis 2a since 'individual reputation similarity' (15) in model 2 is nearly significant at the .05 level (0.73, $p = .051$). However, since SIENA is simulation-based, the estimates can vary slightly between simulations. We therefore do not want to discard the possibility of

Table 2. Correlations model 2: Individual artistic reputation

Variable														
Rate period 1														
Rate period 2	.04													
Outdegree	.02	.12												
Transitive triads	–.03	.14	–.08											
Sqrt degree of alter	–.10	–.15	–.65	–.25										
Director dummy	–.03	.20	–.12	.18	.11									
Producer dummy	.29	.27	–.21	.36	–.06	.29								
Age	.03	–.04	.09	.02	–.26	–.14	–.04							
Age similarity	.06	.08	–.22	.08	.06	.01	.27	.02						
Sex	–.08	–.29	–.15	–.14	.07	–.20	–.25	.19	–.19					
Same sex	.00	–.17	–.55	.05	.06	.07	.05	–.02	.01	.34				
Filmacademy	.01	.11	.10	.03	.02	.34	.01	–.22	–.03	–.05	.04			
Same filmacademy	.04	.06	–.45	.08	.06	.12	.16	.02	.10	–.09	.01	–.30		
Individual reputation	.01	–.02	.02	.00	–.17	.16	.16	.09	–.02	–.10	.02	.05	.08	
Individual reputation similarity	–.04	.19	.07	–.10	–.15	.07	–.04	.17	–.15	-.20	-.03	–.06	.17	.01

Table 3. Correlations model 3: Composite artistic reputation

Variable														
Rate period 1														
Rate period 2	.01													
Outdegree	.07	.12												
Transitive triads	–.04	.12	–.04											
Sqrt degree of alter	–.02	–.16	–.64	–.34										
Director dummy	–.08	–.04	.07	–.10	.13									
Producer dummy	.26	.03	–.02	.28	–.16	–.14								
Age	.06	.07	.21	.06	–.30	.04	–.04							
Age similarity	–.08	.08	–.04	–.01	–.09	–.24	.01	.06						
Sex	–.08	.02	–.22	.17	–.03	.00	.03	.17	–.14					
Same sex	–.06	.01	–.60	.12	.09	.01	–.02	–.06	–.02	.43				
Filmacademy	.04	.23	.19	.00	–.04	.22	.01	–.09	.18	–.05	.05			
Same filmacademy	–.09	–.17	–.46	.01	.14	–.06	.03	–.11	–.14	.00	.04	–.52		
Individual reputation	–.02	.03	.12	.00	–.22	.05	.01	.08	–.05	.02	.01	.15	–.08	
Individual reputation similarity	–.14	–.08	–.01	–.08	.07	.06	–.42	–.03	–.07	–.10	.02	–.10	–.12	–.13

Table 4. Parameter estimates of film collaboration network evolution: Artistic reputation

		Control			Individual			Composite		
		Model 1			Model 2			Model 3		
		Estim.	SE	*p*-value	Estim.	SE	*p*-value	Estim.	SE	*p*-value
Rate function										
1	Rate period 1	3.47	0.44	< .001***	3.46	0.42	< .001***	3.47	0.45	< .001***
2	Rate period 2	3.86	0.50	< .001***	3.89	0.52	< .001***	3.91	0.48	< .001***
Objective function										
Network effects										
3	Outdegree	–1.67	0.15	< .001***	–1.65	0.15	< .001***	–1.65	0.15	< .001***
4	Transitive triads	1.92	0.12	< .001***	1.94	0.11	< .001***	1.95	0.11	< .001***
5	Sqrt degree of alter	–0.21	0.05	< .001***	–0.23	0.05	< .001***	–0.23	0.04	< .001***
Actor covariate effects										
6	Director dummy	–0.09	0.20	.641	–0.07	0.23	.770	–0.06	0.18	.722
7	Producer dummy	0.90	0.27	< .001***	0.94	0.27	< .001***	0.94	0.21	< .001***
8	Age	–0.02	0.01	< .001***	–0.02	0.01	< .001***	–0.02	0.01	< .001***
9	Age similarity	0.92	0.34	.008**	0.91	0.33	.006**	0.93	0.36	.010*
10	Sex	–0.03	0.17	.882	–0.02	0.15	.905	–0.02	0.15	.895
11	Same sex	0.23	0.12	.044*	0.23	0.10	.026*	0.23	0.10	.030*
12	Filmacademy	–0.23	0.17	.160	–0.24	0.16	.129	–0.24	0.16	.144
13	Same filmacademy	0.11	0.09	.208	0.11	0.10	.227	0.12	0.10	.219
14	Individual reputation				.024	0.11	.028*			
15	Individual reputation similarity				0.73	0.37	.051^{+}			
16	Composite reputation							0.25	0.12	.042*
17	Composite reputation similarity							0.49	0.39	.211

$^{+}p < .1$, $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

a significant effect at the .05 level. In addition, in model 3 we estimated *homophily* selection effects based on *composite* reputation to test hypothesis 2b, whether actors with a similar reputation derived from both their own reputation and that of past alliance partners are more likely to form alliances. The parameter 'composite reputation similarity' (17) in model 3 is not significant. We therefore do not find support for hypothesis 2b.

In the control model (model 1) we included two role dummies to distinguish between producers, directors and scriptwriters. The positive parameter for 'producer role' (7) can be interpreted as producers being more likely to be involved in new alliances than directors or scriptwriters (our baseline group). We also included the variables age, sex and education (more precisely the Film Academy) in order to measure the effect of constant actor attributes of status. We see that 'age' (8) has a negative and significant effect on tie formation (−0.02, $p < .001$). Older film professionals are less likely to be part of new alliances. Concerning *homophily* selection, 'age similarity' (9) is positive and significant (0.92, $p < .01$). Actors, in other words, prefer to form alliances with others that are of a similar age. Additionally, 'same sex' (11) is also positive and significant (0.23, $p < .05$). In other words, males prefer to collaborate with males, and females with females. There is no significant homophily selection effect for film academy.

Discussion and conclusion

In this article we studied the influence of reputation on the evolution of the Dutch film industry's alliance network. The film industry is characterized by high uncertainty (Caves, 2000), as a result of which one can expect any trustworthy signals of the quality of film professionals to play an important role in alliance formation. Moreover, the film industry in the Netherlands is almost exclusively project-based, which makes the alliance network of freelancers highly dynamic (Ebbers and Wijnberg, 2009). This also makes it more likely that signals derived from past performance of a series of organizations in which the focal individual was involved provide a useful signal to potential alliance partners.

In addition to reputations, network structure and position are known to have an influence on alliance formation dynamics (Burt, 1992; Granovetter, 1973) especially closeness (Gulati, 1995). When estimating the effects of actor-specific reputation attributes on the formation of alliances we therefore controlled for endogenous network effects in terms of closeness in the network of past alliances in order to isolate effects of exogenous actor-specific reputation attributes. We were able to do that by employing the social network analysis program SIENA that dynamically models actor-driven network evolution while controlling for overall network structure and positions (Snijders, 2001; Snijders et al., 2010). If actor attributes result in tie formation this does not happen in a vacuum, but in a network environment that is a result of earlier tie formation and can affect the likelihood of further tie formation. Precisely this ability of analysing simultaneously the effects of actor characteristics and network structure is a feature of SIENA that cannot be replicated using standard regression techniques or other techniques of network analysis and that allowed us to test the hypotheses of this article in one model and interpret the results as a coherent whole.

Artistic reputation was derived from professional film critics' reviews. We estimated the effect of an individual's own artistic reputation on alliance formation and, in addition, the effect of an individual's composite reputation that also takes into account the reputation of past alliance partners. This allowed us to test reputation spillover effects (Benjamin and Podolny, 1999; Podolny, 1993, 1994; Pollock and Gulati, 2007). Finally, we estimated homophily selection effects, both on the basis of constant status attributes age, sex and education, and on the basis of reputation.

First, we found that actors with a strong *individual* artistic reputation are more likely to form alliances. Second, we found that the effect of a *composite* measure of artistic reputation, which takes into account reputation spillover effects from past alliance partners, was comparable to the effect of individual reputation. We therefore conclude that there is no evidence of reputation spillover since the propensity to engage in alliances – in our case new film projects – can be explained better or at least equally well by individual reputation.

Third, we found some evidence of individuals with *similar* individual reputations tending to form alliances. We found a weak effect for homophily selection between individuals that have a similar individual artistic reputation. We found no evidence for homophily selection based on *composite* reputations taking into account reputation spillover. This is a surprising result that does not support earlier research (Chung et al., 2000; Gulati and Gargiulo, 1999; Podolny, 1994).

Fourth, we found a significant effect of network position, in terms of closeness, on tie formation. In other words, film professionals are more likely to form alliances with other film professionals that are close within their network of past alliances. This is in line with similar findings of past studies at the interorganizational level (Chung, et al., 2000; Gulati, 1995).

Our study has a number of limitations that also point the way towards further research. First, although the Dutch film industry is very suitable for our study because of the fact that

all production takes place in project-based organizations, the total number of projects is lower compared to, for example, the US film industry. Future research, which allows the analysis of a larger population of actors and a larger number of projects, would allow several interesting ways to build on our arguments and results.

Second, we only modelled the effects of artistic reputations, measured by reviews. We did conduct a supplementary analysis of the effects of commercial reputations, based on a return on investment measure using box-office and budget data, but found no significant effects. The reason for this could well have to do with the particular institutional setting in the Dutch film industry, in which most productions receive significant support from (semi-)public authorities that seek to promote artistic quality. In turn, this will lead to the professionals themselves also giving a much greater weight to the artistic reputation of colleagues when forming ties. However, future studies could include other dimensions of reputation or other relevant reputation signals such as past awards (Anand and Watson, 2004) or media attention (Rindova et al., 2007).

Third, reputation spillover effects might be modelled even better by weighing the reputation based on past performance of the focal actor, her or his past alliance partners and past alliance partners' alliance partner, in a similar fashion to Bonacich's eigen-vector-based measure of network centrality (Bonacich, 1987; Mizruchi et al., 1986).

Fourth, our network data were non-directed, meaning that we only have information on the presence or absence of ties. We do not, however, have information about who took the initiative to form these ties. Directed networks would allow for measuring additional reputation and status effects such as reciprocity. This also means that we could not distinguish between tie-initiation dynamics for each specific dyadic relation. This might have shown that each role – director, producer and scriptwriter – has different objectives in alliance formation. A low reputation partner might, for example, want to gain legitimacy through positive reputation spillover (Podolny and Phillips, 1996) for which the high reputation partner may want monetary compensation. This limitation in particular points the way towards further research with directed network data about alliance formation since SIENA lends itself well to include the direction of tie formation in the analysis.

Finally, the arguments proposed in this article suggest that the more actors think they can detect individual quality directly, the less strong will be the effect of reputation derived from the performance of the collective ventures the focal actors were involved in. At the same time, the extent to which individual reputations can be derived from organizational performance will depend on the size of the organization and the length of time individuals spend in them. The project-based organizations in the film industry are relatively small compared to business organizations in most other industries. They also last for periods that are short compared to the length of the individuals' careers. In industries characterized by small organizations with limited life-spans it may therefore be easier to derive individual reputations from organizational performance. It would be very interesting to find out the extent to which actors in a network are (or consider themselves to be) able to directly evaluate individual qualities of actors. If actors in a network consider themselves to be able to also directly evaluate individual qualities of actors it would be very interesting to find out which factors, apart from industry characteristics, determine the relation between the effect sizes of this directly observed individual reputation and the reputation that is derived from organizational performance.

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