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The Role of Film School Collaboration in Film Industry Network Formation: An Empirical Analysis of Data from the Australian Film Television and Radio School (AFTRS)

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Previous research shows that careers in the film industry are largely shaped through networks of interaction among filmmakers. When filmmakers work together on a project, they form collaboration ties that can be repeated on future projects. In this paper, we empirically address the question of whether this process of repeat collaboration bridges two distinct career stages: enrolment in film school and employment in the feature film industry. We utilise two datasets to address this question. The first is a large, curated dataset of Australian feature films released over a fifty year period from 1975 to 2024. This dataset contains information on who worked in ten key production roles across these films. The second dataset is a record of all the student films produced at the Australian Film Television and Radio School (AFTRS) from 1973 to 2014, which also contains information on who performed which production roles on those films. By interoperating these two datasets, we are able to empirically test whether collaborating on an AFTRS student film is associated with collaborating in the Australian feature film industry. We employ multiple regression quadratic assignment procedures (MRQAP) to test our research question. MRQAP is a form of OLS regression that is adapted to deal with network data, where observations are not individual units but rather pairs of units. We find that, controlling for other variables which may contribute to the probability of a collaboration tie, there is a significant positive association between collaboration at AFTRS and in the feature film industry. On this basis we argue that the critical collaborative relationships which shape filmmakers' careers are already present at film school long before the opportunity to work on a feature film arises. This finding has implications for attempts to achieve more equitable collaboration and hiring patterns in the feature film industry, suggesting interventions need to occur much earlier than current policy dictates.

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Introduction

In the film industry, like many other industries, there is a strong sense among those building their careers that "it's not what you know, it's who you know." Film industries are typically organised as project-based labour markets. Groups of filmmakers combine to fill different production roles in creative teams on a per-project basis. This organisational practice creates an employment environment in which relational factors and personal networks are critically important for structuring opportunities for work. As a result, film schools increasingly recognise that not only do aspiring filmmakers require technical training in the craft of producing films, they also require training in the crucial skills of collaboration and networking. Finding collaborators you trust and work well with can make an important difference for navigating a successful career in the film industry. However, collaborative relationships can also act as mechanisms of exclusion. Rigid social networks can result in cohesive in-groups that are resistant to new entrants.

In this paper we explore the dynamics of relationship formation in the film industry. Our primary interest lies in establishing whether film school settings create the pre-conditions for relationship formation in the wider film industry. To do this we use two datasets. The first is the Kinomatics Australian Film Production Dataset (KAFPD), a vast curated dataset compiling information on Australian feature films released between 1975 and 2024 and their production teams (Jones et al.). We also compiled a novel dataset capturing networks of collaboration on student films at the Australian Film Television and Radio School (AFTRS). AFTRS is one of the key talent development pipelines for the Australian screen sector. In order to trace individuals and their relationships as they move from film school into the feature film industry, we matched the people in the AFTRS student film collaboration dataset to the people in the KAFPD. To understand whether working together on a student film at AFTRS is associated with working together in the Australian feature film industry, we draw on the methods and perspectives of social network analysis. We use multiple regression quadratic assignment procedures (MRQAP) to provide insights into the stages at which filmmakers find and form their collaborative relationships. Our analysis reveals that the probability of working together in the Australian feature film industry is increased significantly among people that previously worked together on AFTRS student films. This finding has implications for film industry policy because it suggests that the roots of the industry's collaboration network structure start to take hold well before filmmakers begin work on their first feature film.

Background: Networks and the National Film School

The establishment of a national film and television school in Australia in 1973, later to be known as the Australian Film Television and Radio School (AFTRS), was a

critical component of the government's endeavour to create a globally recognised national media production industry. As a result, the early history of the school was beset with the same divided ambitions as the industry itself, caught between seemingly irreconcilable aspirations for commercial success on the one hand and, on the other, for an innovative national arthouse cinema (Dermody and Jacka). These dual understandings of the vocational value of the school were reflected in its underlying training and education frameworks. The school's programs alternated broadly between auteur-based approaches to creative leadership and more industrially driven conceptions of collaboration. Both models however shared a recognition of the importance of film school enrolment for providing formative professional networks to students.

Graduates of the school have been vocal in their assessment of the value of this training. Recent AFTRS graduate Inez Playford, for example, was enthusiastic in her appreciation of the school's emphasis on industry networking. Despite some initial doubt, after entering the industry she came around to the idea that "these are the people that I'm working with now, you know, so, it is something really amazing about being in this kind of year group that it's like these are my collaborators, these are the people I'm going to be working with forever" ("Master of Arts Screen").

Playford can look to the school's history for plenty of prior examples of her experience. Award-winning director Rolf de Heer, a much earlier graduate, is one of many highly successful Australian filmmakers who established critical working relationships while at film school, such as his ongoing collaboration with composer Graham Tardif. De Heer, answering an interview question about whether he formed his professional relationships at the school, noted the outsize importance of film school connections, emphasising that "the professional relationships that I formed [at AFTRS] were as important as any that I've formed since" (Rolf de Heer, in Quinn and Urban).

It is important to note that work affiliations formed at the school were not always between students. One person who went on to work with a multitude of graduates was the editor Veronika Jenet, who never formally enrolled at AFTRS but hung out on campus creating lifelong working relationships. Another important collaboration in the industry was formed between an AFTRS board member, Tristram Miall, and director Peter Duncan. Although they are not credited on student films together, they both attest to the importance of AFTRS in establishing their working relationship.

Finally, it cannot go unnoticed that other significant but nonprofessional collaborations were made at the school. Many graduates speak about meeting their partner during their studies for example. Many of these relationships supported respective careers even if there is no co-credit in later work. A particularly high profile personal relationship that began at the school is that of directors Jocelyn Moorhouse

and P. J. Hogan. Graduates have also noted that their time at the school gave rise to important friendships:

> The greatest advantage in my going to AFTRS would be the contacts I made, both in my own speciality [and] in others. Not only have we worked together over the years and supported each other, despite being spread over many countries, these people are still amongst my closest friends (IPSOS SRI 187).

These personal relationships do not appear in our analysis since there is no common film collaboration tie, but they do underscore the importance of the school as a place in which significant relationships of many kinds were formed.

Literature Review

The importance of networks in the film industry

Scholars have demonstrated that the project-based organisation of work in the film industry means that personal networks are particularly salient in the sector (Faulkner; Faulkner and Anderson; C. Jones; Bertolini and Vallero). Films are made by teams of filmmakers filling different roles (e.g., director, producer, editor), which come together to form temporary project-based organisations that dissolve after the film's production, casting its members out in search of more work. In this way, the temporary nature of project-based organisations means that sustained careers are only possible through informal negotiation and direct competition for employment (C. Jones 65). From the employers' perspective, film production is not only highly collaborative, but it is also high risk. In these conditions, "direct or indirect trust via personal relationships" (Bertolini and Vallero 8) are heavily valued.

The costs of failing to successfully network in the industry are high. Evidence from different film industries suggests that it is very common for people to only work on one or two film projects in their career, making survival in the industry an achievement in itself (Faulkner and Anderson; Jones and Walsh; Lutter; P. Jones et al., "The Networks"; P. Jones et al. "She Must Be Seeing Things!"). Finding people to collaborate with early and building a strong network can be make-or-break factors for fledgling careers in film production. Those working or trying to work in the film industry keenly understand the role networks play in advancing careers. For example, in their report *Emerging Visions: Career Pathways in the Australian Screen Production Industry*, Metro Screen found that "[n]etworks and networking skills were probably the most commonly cited requirement for success in the screen industry" (Metro Screen 32).

The importance of networks, combined with the industry's high dropout rate, has been observed to produce cumulative advantages for those filmmakers who are able

to carve out careers: The more you work, the lower your risk is signalled to others and the higher your value as a potential collaborator is perceived (Bertolini and Vallero 8). For example, in a 1987 study of U.S. feature filmmakers, Faulkner and Anderson found that more experienced and successful filmmakers tend to work more with each other, while less successful filmmakers also have less successful collaborators—a form of what network scholars refer to as assortavitity (Faulkner and Anderson). A similar finding was demonstrated by Wittek and Burgdorf whose 2025 study of historical Hollywood collaboration networks found that filmmakers are more likely to work with people of a similar level of status (as captured by citations from other filmmakers) (Wittek and Burgdorf). These network feedback effects produce a situation where a small number of people that are able to form cohesive bonds in the industry are able to gain outsize access to the relational power at play in the network, while many more people are unable to get a foothold.

The salience of personal networks for film industry careers can also exacerbate exclusionary practices in the sector (Luckman et al.; Verhoeven et al., "Controlling for Openness"; P. Jones et al., "She Must Be Seeing Things!"). When informal relational mechanisms like trust, familiarity, and a sense of "fit" are seen as important, these mechanisms can intersect with personal characteristics such as gender to create a kind of "hiring as cultural matching" (Rivera). This is of particular importance given that film industries around the world have largely failed to establish an inclusive culture where new voices can thrive, and they are usually dominated by cis, able-bodied men (Margolis et al.; Verhoeven et al., "Re-Distributing Gender"). Film production has typically been experienced as a "boys club," with filmmakers feeling that the informal and reputation-based hiring culture often leads to "jobs for the boys" (Grugulis and Stoyanova). Existing work into film production team composition has shown that homophily—the tendency to form relational ties with people who are similar to one's self (Lazarsfeld and Merton; McPherson et al.)—is at play in these industries, though when it comes to gender, homophily is exhibited much more often by men than by women and gender minorities (P. Jones et al., "She Must Be Seeing Things!"; Loist et al.).

Whether the interest is in extending and securing individual careers in the film production sector or in achieving a fairer and less discriminatory work culture, the literature suggests that networks are a critical consideration and help shape these outcomes. Accordingly, a key question for thinking about how policy might intervene in changing the industry's dynamics is: At what point in the career pipeline are collaborative behaviours established? If the relationships that shape people's careers are already emerging in film schools, then perhaps they are sites where we can make headway in redressing the role that collaboration networks play in sustaining inequities and curtailing careers.

Collaboration in film schools

Given that personal networks help structure opportunity in the film industry, several contributions to the film education literature have stressed the skills of collaboration and teamwork in effective film production instruction (Hodge; Sabal; Banks). Dooley and Sexton-Finck argued that although the majority of film education is centred on the technical and procedural elements of filmmaking, "the fostering of students' collaboration skills is of the utmost importance for students hoping to gain employment in screen production" (Dooley and Sexton-Finck 75). In this vein, Sergi, Fitchett and Fisher identified a key learning outcome for film school graduates: understanding professional collaborative production practices, professional working relationships, and on-set etiquette delivered through networking and relationship-building opportunities (Sergi et al.).

In addition to making aspiring filmmakers more prepared for the realities of work in a professional working environment, collaboration in film school can also help them begin the process of building their network and their reputation among their peers. In fact, this can be one of the major benefits of attending film school. It is important to note that film school education has not traditionally been seen as a prerequisite for a filmmaking career, and practical on-the-job experience has generally been valued more highly than formal tuition. However, one of the key perceived advantages to attending film school is the "opportunity to gain early networks that may pay off later" (Metro Screen 25). AFTRS graduates have been explicit about the career advantage they gained from their school collaborations. One graduate enthused:

> The networking/contacts you gain by attending is [sic] just phenomenal. Not only the exposure with leading industry professionals/teachers but the colleagues who you do your years with there are usually the crew you call on when you want to make something or your first choice when making something. It's amazing how often you run into your AFTRS contacts at meetings or pitching events where they support you. (IPSOS SRI 146)

Many of the pedagogical and network-based benefits of collaboration in film schools apply across film industries around the world. However, scholars have recognised the particular role that film school collaborations play in the Australian feature film industry. In an article exploring the link between AFTRS and a handful of very successful women filmmakers in Australia, Aquilia argued that "Tertiary Institutions such as AFTRS … play an important role in establishing and fostering relationships amongst filmmaking peers" (Aquilia 141). Furthermore, Aquilia noted that "the peer support groups established during an intense period of study in undergraduate and graduate

film programmes and the continuous involvement in the production of student films crewed by peers is not only essential to the learning experience, but it is significant to the formation of future film partnerships that are carried into the early career of many graduates." Specifically, Aquilia argued that the collaborative partnerships that emerged at AFTRS were crucial for building the careers of exceptional women directors such as Jane Campion and Jocelyn Moorhouse (144).

However, despite the high profile success of select AFTRS women graduates, and an equitable number of women completing degrees at the school, concern about the gendered distribution of production crew roles has been broadly articulated in a major report into diversity in Australian film schools (Dooley et al., *Diversity On and Off Screen*). Typically, research on film school discrimination has understood the main issue presented by training institutions to be a "pipeline" problem; in which fewer women are qualified in certain skills (Banks; Dooley et al., "Approaches to Gender Diversity"). A secondary goal of our analysis is to test whether observed patterns of gendered collaboration characterise the AFTRS-to-feature-film career progression as not just a pipeline issue but also a network problem.

Research question

The literature we have discussed in this section frames our core research question: To what extent is collaboration in the Australian feature film industry associated with collaboration at AFTRS?

Data

To explore our research question we draw on two datasets. The first is the Kinomatics Australian Film Production Dataset (KAFPD), which is a large, curated dataset compiling information from several public sources that has been extensively checked and cleaned (P. Jones et al., "Kinomatics"). The dataset is open access and available through Zenodo, where further technical documentation describing its composition can also be found. In this paper, we use version 1.1.0 of the dataset, which is the most recent version at the time of our analysis. The KAFPD covers live-action feature films released between 1975 and 2024 and the people that filled ten key roles on those films: cinematographer, composer, costume designer, director, editor, executive producer, producer, production designer, sound designer, and writer. Being limited to these roles means that we are not able to identify collaborations that happen among other production roles and levels. However, there are two reasons why we are able to contribute important evidence despite this limitation. First, existing film network research has largely considered far fewer of these roles (typically only producer,

director and writer, see Dadlani et al.). By broadening the approach to include many more production departments, we capture a much wider view of the web of network connections that connects the film industry. Second, the roles in the KAFPD represent heads of departments and key decision-making roles. The people in these roles generally have hiring power over their own departments and so they play a key part in shaping the overall creative team, including those roles not captured in our data. In total, the KAFPD describes 23,949 roles filled by 9,890 unique people across 1,957 films.

The second dataset is similar in structure but was prepared in partnership with AFTRS and describes AFTRS student film productions and who worked on them. At AFTRS, as at other film schools, students collaboratively produce short films as a component of their degree. These films, although being shorter and having a lower budget than feature films, are intended to resemble feature productions in that they involve a variety of different production roles that must work together to make the film happen. AFTRS provided us with previously collected data containing the names of the people that worked in various roles on student film projects produced at the school each year from 1973 to 2014 (with the exception of 1974 for which there is no data available). This dataset was not derived from or linked in any way to AFTRS's student enrolment records or administrative data sources, and it did not contain other identifying personal characteristics other than names. The AFTRS student film dataset describes 11,529 roles filled by 2,821 unique people across 1,375 films. The roles included in the data are cinematographer, composer, director, editor, location sound, producer, production designer, post sound, and writer.

The set of roles in the AFTRS dataset is similar, but not identical, to those in the KAFPD; it is therefore reasonable to assume that the two datasets represent parts of the same pipeline of role-based skills and specialisations. That the AFTRS dataset only contains information up to 2014 while the KAFPD continues to 2024 could be considered an analytical challenge. However, as our analysis focuses on tracking post-graduation collaborations in the industry and given that the KAFPD contains only department head roles, the time lag is appropriate and allows for the interval between graduating from film school and acquiring sufficient seniority to lead a department and receive a first industry credit at the level of the roles in the KAFPD.

We construct collaboration networks from these two datasets using the same process for each. First, we create a person-by-project affiliation matrix M where the value of the cell m_{ij} is equal to 1 if person i worked on project j and is equal to 0 otherwise. We then multiply M by its transpose M' to obtain the person-by-person adjacency matrix A wherein the value of the cell is a_{ij} equal to the number of times that person i and person j worked on the same film project. This produces a 9,890-by-9,890

adjacency matrix for collaboration ties in the KAFPD, and a 2,823-by-2,823 adjacency matrix for collaboration ties in the AFTRS student film dataset.

An overview of the characteristics of the two datasets and the derived collaboration networks is provided in **Table 1**. We also illustrate the process of defining the collaboration networks diagramatically in **Figure 1** to aid comprehension of the conceptual model. Important for our purposes is that the KAFPD is larger, as is the typical team size on projects in the KAFPD. The KAFPD is also characterised by a higher proportion of people that only ever appear on a single project in the dataset. Thus, opportunities for repeat collaboration are actually more abundant in the AFTRS student film network than in the feature film network.

	AFTRS	KAFPD
Time period	1973–2014	1975–2024
Number of films	1,375	1,957
Number of roles	11,529	23,949
Number (%) of people in the AFTRS data	2,821 (100%)	631 (6.4%)
Number (%) of people in the KAFPD data	631 (22.4%)	9,890 (100%)
Mean number of films worked on per person	3.2	2
Mean number of unique people per film project	6.5	10
Percentage of people only working on one film	41.9%	70.9%

Table 1: The summary compares the characteristics of each dataset employed in our analysis.

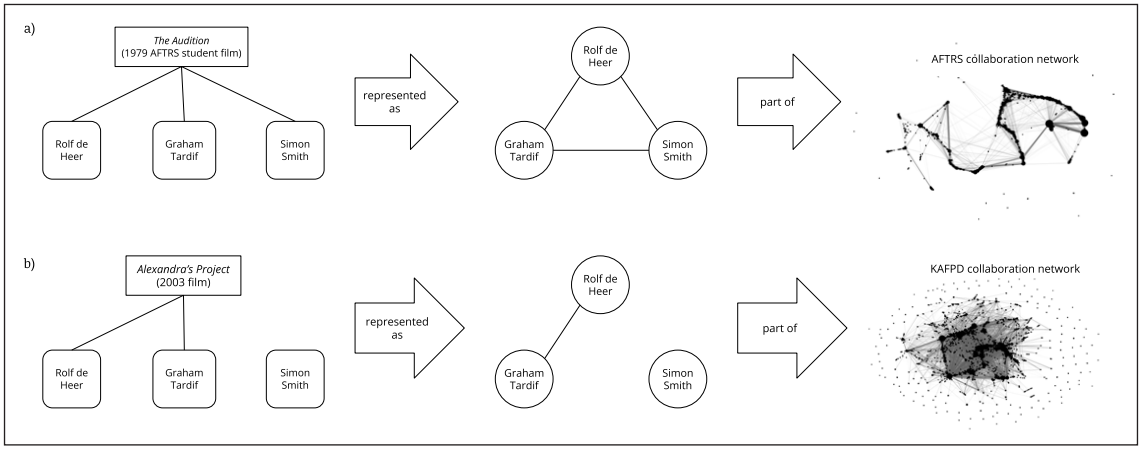

Figure 1: The diagram illustrates how the AFTRS network and the KAFPD network are constructed. In a), Rolf de Heer, Graham Tardif, and Simon Smith all work on the same AFTRS film so they are connected to each other directly in the AFTRS collaboration network. In b), de Heer and Tardif are connected to one another in the KAFPD network as they both work on the same feature film. Smith is also present in the KAFPD, but he does not work on any of the same films that de Heer or Tardif do so he does not have a direct tie to them in the KAFPD.

In essence, our goal is to understand whether the ties in the AFTRS network are associated with collaboration in the KAFPD network. As such, our analytical interest is in the subset of people that are present in both datasets. We identified this subset by manually matching the people in the two datasets based on their credited names.[1] In total, the matching process identified 631 people present in both datasets, representing 22.4% of all the people in the AFTRS data and 6.4% of all the people in the KAFPD. In our analysis we focus on this subset of 631 people present in both datasets. The final step in our data preparation is then to create a smaller version of each adjacency matrix, which is filtered to only contain the 631 rows and 631 columns for people present in both datasets. These matrices are aligned such that the *i*th row and *j*th column in both the AFTRS and KAFPD matrices refer to the same pair of people.

Methods

MRQAP

The methodological approach we used to explore our research question is multiple regression quadratic assignment procedures (MRQAP), an adaptation of ordinary multiple regression specialised for testing hypotheses with network data. The form of a MRQAP model is very similar to a conventional multiple linear regression model, the key difference being that the data are expected to be in two-dimensional matrices instead of one-dimensional vectors. We can define MRQAP as

$$g(Y) = \theta_0 J + \sum_{k=1}^{m} (\theta_k Z_k) + E$$

where $Y \in \mathbb{R}^{n \times n}$, $Z_k \in \mathbb{R}^{n \times n}$, $J = 11^T$, m is the number of independent matrices Z_k, E is the matrix of errors, and g acts elementwise on Y (for dyads i ≠ j).

Practically, estimation of a MRQAP model works exactly the same as for a standard model, as the matrices can be vectorised and then the θ parameters estimated using ordinary least squares (OLS). However, defining the model in terms of adjacency matrices illustrates a key distinction between network regression and standard regression: The observations are dyads, and as such they violate model assumptions about the independence of observations. Once vectorised, all values from the *i*th row or column will be a source of autocorrelation due to the presence of *i* in each. Moreover, with social network data, we cannot assume that a tie x_{ij} is independent of another tie x_{ik}, because the probability of one tie may be conditional on the presence of the other

[1] For more details on this process, see the supplementary materials in the replication data, available on the Harvard Dataverse at https://doi.org/10.7910/DVN/GSNSIG.

tie. This reduces the effective number of independent observations, and thus the true degrees of freedom are smaller than the nominal value assumed by conventional regression. As a result, it is not appropriate to use the standard errors of the regression coefficients to make inferences about the relationships between variables.

Instead, to test hypotheses about the relationships between dyadic variables, we use a different approach that leverages the quadratic assignment procedure (QAP) to randomise the data in a way that preserves the network's structure. In a QAP test, the observed data matrix is permuted by randomly rearranging the rows and columns of the matrix many times. This operation is functionally equivalent to randomly reassigning the vertex labels in the network; thus, the dependencies and structural features of the network are preserved under the permutations. In essence, the test asks, "Given the set of possible networks with these nodes and this structure, how likely is it that we would find the observed relationship between the dependent matrix and the independent matrix if we simply drew randomly from that set?" The permuted matrices provide a reference distribution representing the null hypothesis against which to compare the observed data. This results in a form of linear regression that is able to model the dependency of one network matrix on another network matrix (controlling, if necessary, for further network matrices) and provide appropriate permutation test-based p-values for each coefficient.

In our analysis, we use the implementation of QAP regression provided by the *sna* package (Butts) for the R statistical computing environment (R Core Team) in the form of the *netlm* function. More specifically, we employ the "double semi-partialling" QAP procedure introduced by Dekker et al., as it has been shown to be more robust in multivariate models than alternative approaches. Rather than permute the raw dependent or independent matrices, the double semi-partialling procedure permutes the residuals of each independent matrix after first "partialling out" the effect of the other independent variables on it (Dekker et al.). This process helps test the null hypothesis while also dealing with any multi-collinearity among the independent variables. For each of our models, we ran the QAP tests with 5,000 iterations to generate the null distributions. The p-values thus correspond to the proportion of the 5,000 permutations in which we observe an estimate at least the size of the absolute value of the estimate for the un-permuted (i.e., observed) data.

Model specification

We specified a number of different models to explore our research question. In the models, the observations are dyads (pairs of people) composed of filmmakers who are present in both datasets. As there are 631 such people in our data and all ties are mutual

(if *i* worked with *j*, then *j* worked with *i*), there are $\frac{631 \times 630}{2} = 198{,}765$ "observations" in each model. Here we explain the variables included in our models.

Dependent variable

The dependent variable is the weighted adjacency matrix for the KAFPD data, that is the number of times each pair has worked together in the KAFPD. We know that this matrix is skewed and contains many zeroes, so we also fit models based on transformations of the matrix. The first transformation was to take the logarithm of the matrix (adding one to each cell first to account for the zeroes). The second transformation was to take the Ochiai-normalisation of the affiliation matrix, which is a technique used to obtain similarity-based projections of two-mode networks that are less skewed (Zhou and Leydesdorff). To obtain the Ochiai-normalised matrix, we used the *netmem* R package (Espinosa-Rada). In the models we report in this paper, the dependent variable is the non-transformed matrix, though the models of the transformed matrices are reported in the supplementary materials. The interpretations we present when discussing the results also apply to the models for the transformed data.

Independent variable

The matrix variable corresponding to collaboration in the AFTRS student film dataset captures our key effect of interest. We can either use the weighted AFTRS collaboration matrix (where values indicate the number of AFTRS student films each pair worked on together) or the binary AFTRS collaboration matrix (which simply indicates whether each pair worked on any AFTRS student film together or not). We specified models using both matrices and found that using the AFTRS weight did not change the interpretation of any results. We therefore stick here to the models using the binary AFTRS tie indicator, which is simpler to interpret.

Control variables

One advantage of taking a regression modelling approach is that other dyadic covariates which may be related to collaboration can be included as independent control variables. In addition to the AFTRS ties, we include a number of additional variables which we expect to be related to collaboration in the KAFPD.

Gender-based homophily

As our literature review illustrates, gender homophily can be a structuring factor in film collaboration networks. In particular, we expect to see a disproportionate

tendency for men to work together in the feature film industry, and we would like to control for this tendency when investigating the effect of AFTRS collaboration.

Neither dataset contains information about the gender of the filmmakers so we cannot measure gender effects directly. Instead, we control for a form of homophily based on having a highly gendered name. We use an official dataset of South Australian baby name registrations (see P. Jones) and classify any names as "highly gendered" if they appear more than ten times and are registered to babies assigned male or female at birth at least 95% of the time. Then, we derive a "name gender" variable for the nodes in the dataset, which takes the value "male" if more than 95% of the babies registered with the name are assigned male; "female" if more than 95% of the babies registered with the name are assigned female; or "ambiguous" if neither of these conditions are met or the name is not found in the baby name data. Our goal here is not to attempt to guess the gender of the participants. Instead, it is to explore whether we are able to absorb some of the variance in tie formation that we would expect to be due to gender-based homophily effects. To this end, we derive from the name gender variable a dyadic name gender homophily covariate, which takes the value 1 if *i* and *j* both have male names or both have female names, and 0 otherwise. Any dyads involving ambiguous names or a mix of male and female names take the value of 0 on this variable.

As well as a general gender homophily variable, we also constructed a separate model that differentiates the effect into two separate dyadic covariates, one indicating that both *i* and *j* have male names, and the other indicating that both *i* and *j* have female names. We fit models with both the combined and split name gender covariates to explore whether there is a value in distinguishing between them. We found during the model-building process that several of the models with the separated terms revealed different patterns for male and female names. Therefore we report on the models with gender homophily split into two variables. The models with the combined gender homophily effect can be consulted in the supplementary materials.

Role overlap

Although it is possible for films to have multiple people occupying the same role, it is generally the case that films will only have one person in key positions such as editor, director, and cinematographer. As such, two people who specialise in the same role could be less likely to collaborate with each other on a project as they are both trying to fill the same role. To account for this in our model, we include a role overlap variable which indicates the number of roles that person *i* and *j* have both filled across their AFTRS student film credits. We expect that the more two people's roles overlapped

at AFTRS, the less likely it is that they will both work on the same feature film in the KAFPD.

Time overlap

In addition to directly working together on a student film project, we control for the temporal proximity of each pair of people's AFTRS credits. We wish to capture that two people who attended AFTRS at the same time may be more likely to work together in the feature film industry, regardless of whether they collaborated on a student film project. As we do not know the enrolment dates for each person in the dataset, we instead operationalise this variable based on the year of the credited AFTRS films. Our time overlap variable takes the value of 1 if person *i* and person *j* were credited on any AFTRS film projects within three years of each other, and 0 otherwise. We expect that the variable will be positively associated with collaboration in the KAFPD.

Degree in the KAFPD

As is common in statistical models for network data, we control for node degree in order to account for the fact that some nodes have a higher rate of forming ties with other nodes in general. In network terms, a node's degree is the number of other nodes that it is connected with. For network data where ties have values associated with them (e.g., the number of times *i* and *j* worked together), we can also calculate weighted degree, which sums the values of ties. We capture degree at the dyadic level as the sum of person *i*'s degree and person *j*'s degree in the full KAFPD industry network. This variable thus includes any connections that *i* and *j* have to people in the feature film industry network, even if those people are not in the AFTRS data. We expect that a higher combined degree increases the probability of a collaboration tie because people who work with more people in the feature film industry are more likely to collaborate with each other. This variable should also capture some of the assortativity identified in the literature wherein successful people in the feature film industry tend to work with other successful people. We report here on the models that use the weighted degree scores, though the models using unweighted degree instead are presented in the supplementary materials.

Time-windowed models

The matrices described to this point aggregate collaboration in the full data period. As such, they implicitly assume that the relationships between the independent variables and dependent variable are the same over the whole data period. However,

alumni have suggested that the role of the school in structuring the industry's networks was stronger in the early years when there was a perceived lack of wider networks for aspiring filmmakers to draw upon (Quinn and Urban). In part because the early years of the school coincided with the establishment of a professionalised industry in Australia, it might be expected that graduates would, given the sheer absence of anyone else to work with, lean on the relationships formed at film school as a matter of necessity rather than choice. This would suggest that the association between AFTRS collaboration and industry collaboration may be higher in the early period of the data.

In order to get a better sense of the stability of the relationship between AFTRS collaboration and industry collaboration, we split the AFTRS data up into roughly equal-sized chunks of time (1973 to 1984, 1985 to 1994, 1995 to 2004, and 2005 to 2014) and fitted the models described in this section to each. Practically, we filtered the AFTRS student film dataset to include only films in the desired period. Then we generated an adjacency matrix that captured collaboration among the set of people present in the filtered data. After that, we filtered and aligned the various other matrices, including the KAFPD collaboration matrix serving as the dependent variable, with the time-filtered AFTRS collaboration matrix. Thus, these time-windowed models ask if working together on an AFTRS student film in a particular time period is associated with frequency of collaboration in the full KAFPD.

Findings and Discussion

We start by observing the association between the ties in the two collaboration networks descriptively. Of the 2,141 pairs of people who worked on the same student film at AFTRS and are both present in the KAFPD, 11.1% also worked on the same film in the KAFPD. Of the 196,624 pairs of people who are both present in both datasets but who did *not* work together on an AFTRS film, only 0.9% worked on the same film in the KAFPD. Therefore, in the simplest sense, AFTRS students that collaborated on student films were more likely to collaborate in industry than those who did not work on the same student films. To test the robustness of this observed association, we turn to the regression models defined in the previous section.

The results from our OLS models are presented in **Table 2**. We present three models: the simple bivariate model, containing the AFTRS tie variable as the only independent variable; the baseline covariate model, which contains the control variables but not the AFTRS tie variable; and the combined model, which contains the controls alongside the AFTRS tie variable.

	Simple bivariate model		Baseline covariate model		Combined model	
	Estimate	***p*-value**	**Estimate**	***p*-value**	**Estimate**	***p*-value**
Intercept	0.0108	0.0288	-0.0176	0.0000	-0.0172	0.0000
AFTRS tie	0.1536	0.0000			0.1364	0.0000
Both have men's names			0.0016	0.051	0.0015	0.0774
Both have women's names			0.002	0.1188	0.0017	0.1698
Role overlap			-0.0004	0.4348	-0.0006	0.2332
Time overlap			0.0234	0.0000	0.0171	0.0000
Combined KAFPD degree			0.0003	0.0000	0.0003	0.0000
Pseudo-R^2	0.012		0.032		0.041	

Table 2: OLS regression model results show that in each model, the dependent variable is the number of collaborations in the KAFPD. Reported *p*-values are the proportion of the 5,000 permutations of the network that have a coefficient greater than or equal to the absolute value of the estimate for the observed network data.

The models provide evidence that there is indeed a positive association between collaborating on AFTRS student films and going on to work together in the feature film industry. In both the simple and combined models, the coefficient for the AFTRS collaboration ties is positive and significant, confirming that working together at AFTRS increases the probability of working together in the feature film industry. As expected for a network of this size and density, the overall probability of a tie is low, but it is increased significantly among people that collaborated on a student film at AFTRS. The estimated coefficients for the effect of an AFTRS collaboration on the KAFPD matrix remain well above what we see in the distribution of coefficients estimated across the 5,000 QAP permutations (**Figure 2**). Moreover, the relationship holds even after controlling for other factors we expect to help explain ties in the collaboration network. We can thus reject the null hypothesis. The direction and statistical significance of each effect are the same in the models using a log-transformed dependent variable (see the supplementary materials), with the exception that the negative role overlap effect is significant in the logged baseline ($p = 0.04$) and combined ($p = 0.016$) models.

Interestingly, during the model-building process, we fitted models that included only the AFTRS tie and the name-based gender homophily terms as independent variables. In these models (reported in the supplementary materials), there was a positive and significant effect for pairs of people that both have men's names but a negative and nonsignificant effect for pairs of people that both have women's names. This indicated a pattern consistent with another study of homophily in film

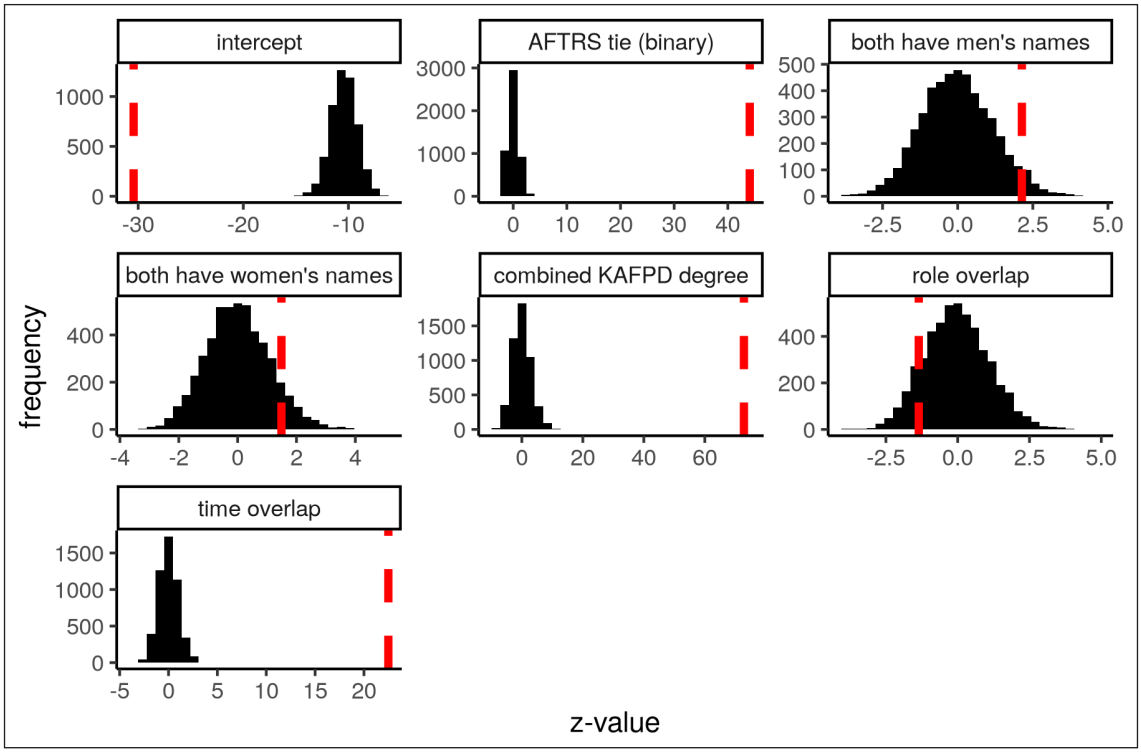

Figure 2: Histograms show the distribution of the combined model coefficient estimates across 5,000 QAP permutations of the dependent variable. Point estimates for the observed data are indicated by the red dashed line. When the red dashed line overlaps the distribution obtained via the permutations, the null hypothesis cannot be confidently rejected. Equivalent histograms for the simple and baseline models are included in the supplementary materials.

collaboration networks which found that men disproportionately work with each other, while women do not (P. Jones et al., "She Must Be Seeing Things!"). However, once we controlled for combined degree in the KAFPD network, neither name-based gender homophily term showed a significant effect on feature film collaboration. This suggests that the assortativity of collaboration among people with many collaboration partners overlaps in some way with the concentration of collaboration among people with men's names.

Our other control variables each show the expected effect on KAFPD collaboration: Filmmakers are slightly less likely to work with people with whom they share a role specialisation; filmmakers who made an AFTRS student film within three years of each other are more likely to work together on a feature film in the KAFPD; and the probability of two people working together in the KAFPD increases as the pair's combined weighted number of collaborators overall in the KAFPD increases. Importantly, none of these effects nullifies the effect of AFTRS collaboration on feature film collaboration in the KAFPD.

The main finding of a positive collaboration effect is particularly interesting in conjunction with the time overlap control variable because it provides evidence that directly working together on a film is associated with future collaboration, over and above simply being at AFTRS at the same time. Our analysis suggests that it is collaboration that breeds further collaboration. Moreover, this mechanism can be distinguished from any industry collaboration arising as a result of mere co-attendance at the school, or from general friendships and bonds made while at AFTRS together.

The models presented in **Table 2** cover the data for the whole time period represented in the AFTRS student film dataset (1973–2014). To explore the temporality of the effects in the data, we present the results of the time-windowed models in **Figure 3**, as well as a summary of each time period's models in **Table 3**.

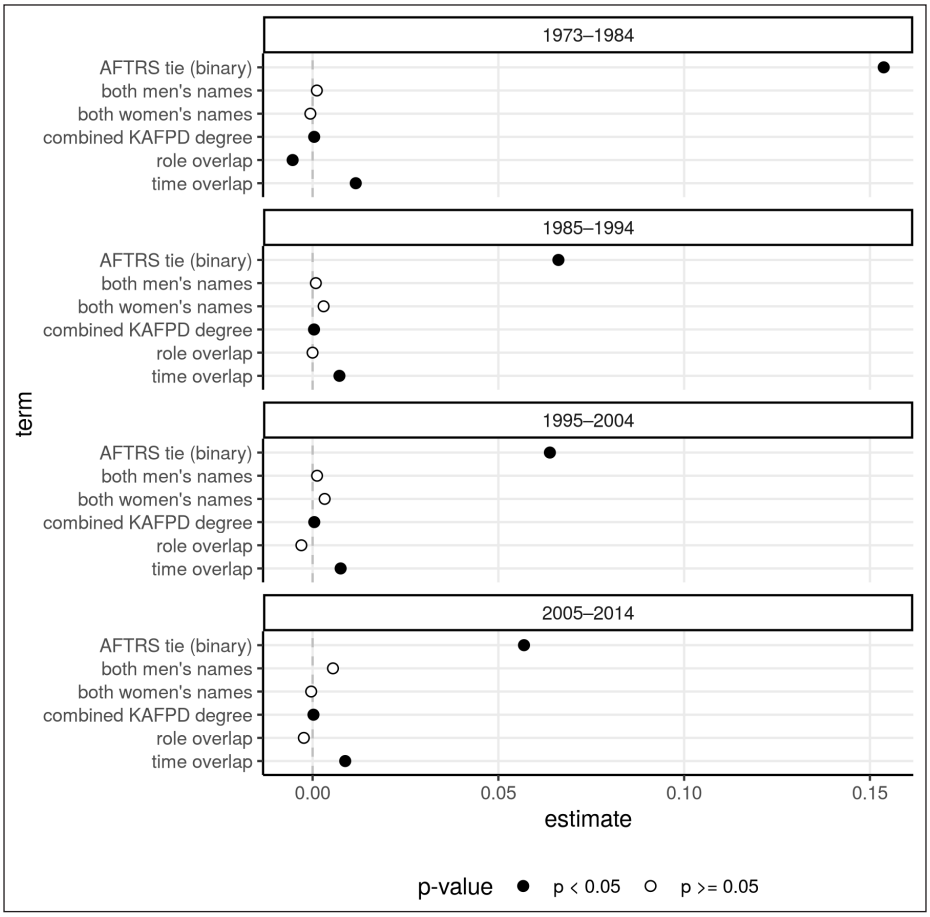

Figure 3: The time-windowed MR-QAP combined models yielded the coefficient estimates shown. Each point is a coefficient estimate, and points are filled black when the absolute value of the estimate is observed or exceeded in fewer than 5% of the 5,000 permutations representing the null hypothesis.

Time period	Number of people	Simple model pseudo-R^2	Baseline model pseudo-R^2	Combined model pseudo-R^2
1973–1984	179	0.031	0.033	0.062
1985–1994	150	0.011	0.05	0.057
1995–2004	196	0.008	0.06	0.067
2005–2014	184	0.007	0.013	0.019

Table 3: This overview shows the simple, baseline, and combined models for each of four networks delimited by the time period of the AFTRS student films.

The time-filtered models suggest that the positive relationship between AFTRS collaboration and KAFPD collaboration persists through each time period but that the magnitude of the effect may not be constant across time. In the earliest time period, the effect of AFTRS collaboration seems to be more strongly linked with KAFPD collaboration in the sense that in each subsequent period the coefficient estimate is notably smaller. In addition, the pseudo-R^2 increases the most between the baseline model and the combined model in this period. However, it should be noted that it is difficult to compare effect sizes across models, so we cannot draw firm conclusions about the relative strength of the effect between time periods from these models alone.

Conclusions and Suggestions for Further Research

This paper has examined if collaborating on student films at one of Australia's foremost film schools increases the chances of collaborating on Australian feature films at the professional level. Using QAP-based OLS regression models, we find robust support for a general positive association between AFTRS collaboration and industry collaboration.

Given that the Australian film industry is relatively small, and AFTRS is the country's premier film school, perhaps the finding that relationships formed at the school are important for screen sector careers is not surprising. However, the finding has a range of implications for the way in which film schools understand the impact of their teaching programs. The evidence that student collaborations on film school projects often continue into the feature film industry strongly suggests that attention should be paid to the formation of these collaborations, in particular to questions around equity. If inequitable patterns are present in the project teams students form, then instructors may want to consider whether these patterns are exclusionary and, if so, intervene. Equity policymakers can also look to earlier interventions at film school focusing on incentivising nascent behaviours rather than redressing already established industry habits.

Our findings also suggest deeper questions that arise from the significance of formative collaborations at film school. As Verhoeven et al. note, "The screen industries create complex symbolic products in which representations of personality, visual presentation and social relations are inextricably intertwined" (Verhoeven et al., "Through a Glass Darkly"). The persistence of student collaborations into later industrial relationships might also reveal repetitive aesthetic and narrative patterns that in turn prompt us to ask whether specific voices and visions are reiterated and amplified at the expense of others, thereby contributing to in-built inequities in the industry both on and off screen. It is one thing to note the way in which film schools reproduce the social inequalities found in broader social settings, including through the formation of defensive collaboration networks (Banks). It is another to understand how these foundational networks serve to ramify inequities by ensuring that opportunities for new collaborators, and therefore new combinations of ideas, voices, and visions, are circumscribed by the existence of prior relationships. This study proposes these questions be considered in further research.

Other questions arise that would benefit from additional research. First, it is possible that filmmakers graduating from AFTRS are more likely to work with other AFTRS alumni, regardless of if they collaborated directly on a student film with them or even attended AFTRS at the same time. Direct collaboration (working together on an AFTRS student film), shared cohort membership (both attending AFTRS at the same time), and co-affiliation (both attending AFTRS at any time) are all network ties that may arise from attending AFTRS, and each has different dynamics and implications. Our study has focused on direct collaboration and has controlled for shared cohort membership via overlapping co-attendance, but it cannot account for the effect of co-affiliation because all of our observations are by definition co-affiliated with AFTRS (i.e., there are no cases that are not affiliated with AFTRS). Future work may build on our analysis by adopting an analytical framework that can explore the separate but important question of whether Australian filmmakers that share a film school affiliation are more likely to work together than filmmakers who do not share a film school affiliation, regardless of if they co-attended or collaborated at the school.

Second, the lack of personal information that we have for the nodes in the network prevents us from including additional control variables in the model, such as similarity in age or ethnicity, which may also play a role in relationship formation. For gender, we addressed this indirectly by using highly gendered names to account for gender-related variance, but we acknowledge the imprecision of this approach. Additional data variables describing the social character of collaborations would benefit further research.

Third, by including the full data period in one model, we are implicitly assuming that the relationships between the independent variables and the dependent variable are stable across the data period. However, our time-windowed models suggest that the importance of film school collaboration for feature industry collaboration may have changed over the course of AFTRS's history. Our choice of methods makes comparison across models difficult, so we are not able to make any firm conclusions about the relative association of AFTRS collaboration and feature film collaboration between time periods. Future research on this topic could adopt a methodological approach that is able to accommodate the temporal aspect of the phenomenon more directly.

Finally, the feature film industry is only one destination for film school students, many of whom go on to careers in television, documentary film, advertising, video games, radio, and other creative industries, each of which has its own distinct way of organising work and opportunities. Researchers particularly interested in the broader link between film school networks and career success may wish to look beyond the feature film industry to build a fuller picture of the role networks play in launching and sustaining media careers after graduating.

Data Availability

The supplementary materials for this article, along with the data and code for reproducing the study are available in the Cultural Analytics Dataverse repository at https://doi.org/10.7910/DVN/GSNSIG.

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Competing Interests

The authors have no competing interests to declare.

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