PETAL DIAGRAMS: A NEW TECHNIQUE FOR MAPPING HISTORICAL CHANGE IN THE FILM INDUSTRY

ALWYN DAVIDSON, DEB VERHOEVEN AND COLIN ARROWSMITH

Abstract *As the study of cinema has increasingly turned to the examination of economic ebbs and industrial flows, rather than focussing its attention solely on the critical evaluation of the films themselves, new analytic techniques and tools have been adopted (and adapted) by film scholars. Key amongst these is the use of innovative visualization techniques that can assist in the understanding of the spatial and temporal features of film industry practices. However, like the cinema itself, visualization carries its own spatial and temporal dimension. This article explores some of the benefits and limitations that derive from the use of spatial visualization technologies in the field of cinema studies. In particular, this research presents a new holistic multivariate approach to spatio-temporal visualization for point based historical data. This method has been developed through extending the spatial presence in timeline graphics and through meaningful spatial classification and representation.*

Keywords: cinematic cartography, Geographic Information Systems, geovisualization, media geographies

"*The geographical imagination is far too pervasive and important a fact of intellectual life to be left alone to geographers.*"[1]

From the beginning the cinema was occupied by the geographic. In this originating, abstracting sense, Teresa Castro identifies a "mapping impulse" at the very heart of the movies, which she describes as the way in which films

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themselves engage in an understanding of space.[2] More prosaically, Sébastien Caquard and D. Fraser Taylor[3] note the prevalent appearance of cartography in early cinema in the form of diegetic maps, their use ranging from a simple navigation aid to an integral component in the interaction between characters. These onscreen maps have increased in prevalence and complexity with the recent proliferation of media formats. Caquard has noted the way in which early cinema maps presaged these later developments in digital cartography: "Basically, when professional cartographers created their first animated maps, most of the functions of contemporary digital cartography had already been created and used in cinema."[4]

Geographers were quick to reciprocate, identifying for example, the usefulness of motion pictures for developing new pedagogies in the discipline. In 1920, the opening pages of the inaugural journal for the Society of Visual Education (SVE) endorsed the cinema as the natural successor to the work of visualization previously undertaken by cartography:

> Maps, Charts, Diagrams, Models, Prints – when properly made – need no defense as legitimate and valuable adjuncts to the classroom equipment. The learned world has long since ceased to doubt the value of the Laboratory. It would be ridiculous in our day to argue for the worth of the Microscope or Telescope. The position of the Stereopticon and the Stereoscope in the pedagogic economy is quite secure. Out of all, only the Motion Picture seems to need defending and this late-comer, we fancy, when once the proper hands are at work upon it, will outstrip most of its predecessors in its total contribution to the great work of American education.[5]

What is in fact less evident throughout the mutually dependent history of movies and geography is the use of cartographic techniques for the study of the cinema itself. This is surprising given that the circulation, consumption, distribution and exhibition of films are all spatial in one way or another. As Robert Allen notes "the most notable and enduring characteristics of cinema as a cultural form have been its mobility and geographic reach."[6] This article will examine the uses and limitations of a variety of geo-visualization techniques for improving understanding of film industry practices. In particular it focuses on the development of innovative techniques for investigating the spatial characteristics of film industry performance through time.

THE SPATIALIZATION OF CINEMA STUDIES

The reinvigoration of geography through the incorporation of spatial analysis in a wide variety of disciplines is well documented.[7] This interest has been

dubbed the *spatial turn* and is evident in many humanities disciplines (such as literature),[8] and in the social sciences.[9] The spatial nature of cinema has evoked a variety of approaches under the rubric of cinema studies, particularly as a metaphorical application. For some cinema scholars for example, the concept of "mapping" is intended allegorically, such as referring to a "cartography of relations" to describe the linkages in the film *The 39 Steps* (Alfred Hitchcock, 1935).[10] Or when Giuliana Bruno declares unreservedly that, "film is *modern cartography*."[11] In addition to these figurative understandings of the relationship of geography to cinema, a more technical approach to exploring the spatial nature of cinema has recently emerged.

Cartography and mapping, the visual side of spatial technologies and concepts, have received particular attention in recent cinema studies scholarship. Several authors have attempted to explain the "spatial turn" in cinema through the compound phrase "cinematic cartography" which is characterised loosely by the ways in which cinema and cartography have converged,[12] creating a hybrid form of cartography.[13] Falling under this typology are the practical aspects of creating maps and performing spatial analysis, found in the thematic areas of mapping the geographies of film production and consumption,[14] and in the analysis of geographical patterns of cinema operation and influence.[15]

Previous studies have explored the use of cartographic representations, spatial analysis, and Geographic Information Systems (GIS) to expand the scope of cinema studies to incorporate geographical enquiry and influence. The pioneering work of Jeffrey Klenotic first highlighted the benefits of geographical inquiry in cinema studies by using mapping and GIS to investigate the relationships between cinemas in Springfield, Massachusetts in 1926 and the neighborhoods that surrounded them.[16] From this beginning, scholars have mapped cinema geographies using digitized versions of historical maps, census statistics and boundaries, cinema venue street addresses, location and success of film screenings and festivals, revenue spatial comparison, cinema venue openings and closings, and many more.[17]

The majority of these empirical cinema research projects rely on GIS to organize and explore their spatial data. The applicability of GIS to humanities research has been the subject of substantial debate[18] as the science and precision required by the technology is challenged by many aspects of humanities research (and vice versa). Successful use of GIS typically relies on accurate measurements of geographic location and the disambiguation of entities that run counter to the irregularity, heterogeneity, incompleteness and silence of much cinema data.

Despite these challenges, GIS offers many conceptual opportunities to researchers. The analytic value of GIS lies in the way it assigns systematic visual cues to different locational values, and its capacity to layer and interlink descriptions of environmental phenomena. These techniques stress the

deliberative qualities GIS brings to representing space in a way that the mercurial manifestations that come from everyday interactions with the GoogleMaps application might not. It is the "constructedness" of thematic mapping in GIS that emphasizes the experiential nature of mapping-as-a-process. And this in turn offers the promise of spatial analysis loosed from physical location *per se*.

In her paper titled "*Limit of Maps? Locality and Cinema-going in Australia*," Kate Bowles[19] discusses the limits associated with using representations of quantitative and spatial data for cinema research. For Bowles, maps are principally a descriptive medium and they fail to provide analytic insight when it is needed most. But, as the following case studies will attest, maps can be productively used to interrogate multiple data sources at once, analyze relationships, distributions and patterns, and present as well as communicate findings in an effective visual way. Visualization and GIS have the ability to enable research that would have otherwise been impossible. This in turn means there is scope not only to facilitate and enhance existing research but to ask new research questions.

In our case studies we have approached GIS as a medium for visual intuition, as a tool that can enable spatial "readings" rather than just depict physical locations. In this sense our research is as much a matter of a "humanist turn" in geo-spatial studies as a "spatial turn" in cinema studies. In fact, whilst GIS is the key technology underlying the spatial analysis of the data in these case studies, it is not always the first choice for the visualization of results. The standard cartographic techniques available in GIS aren't always suitable for the message and data that is being communicated. Often, it is necessary to look beyond GIS to other visualization techniques borrowed from different disciplines or look to customized visual solutions.

THE VISUALIZATION OF CINEMA DATA

The visualization of spatial cinema data is a result of the need to locate people, films and places, to combine information from many sources, to investigate historical aspects of cinema operation and influence, and to discover new insights and geographic and temporal patterns within cinema data.

To date, many of the visualizations that have been applied to cinema venue data have generally not gone beyond conventional mapping techniques available within a GIS. For example, census statistics and their geographic boundaries have been used to support cinema data and are most commonly depicted as Choropleth maps. Choropleth maps take the statistics for each areal boundary and represent them as an aggregated unit typically differentiated by progressions of color. Figure 1 depicts a Choropleth map of the City of Melbourne during a time of Greek migration, where color depicts the percentage of Greek population in each suburb mapped against the presence of cinema venues.[20] Here you can

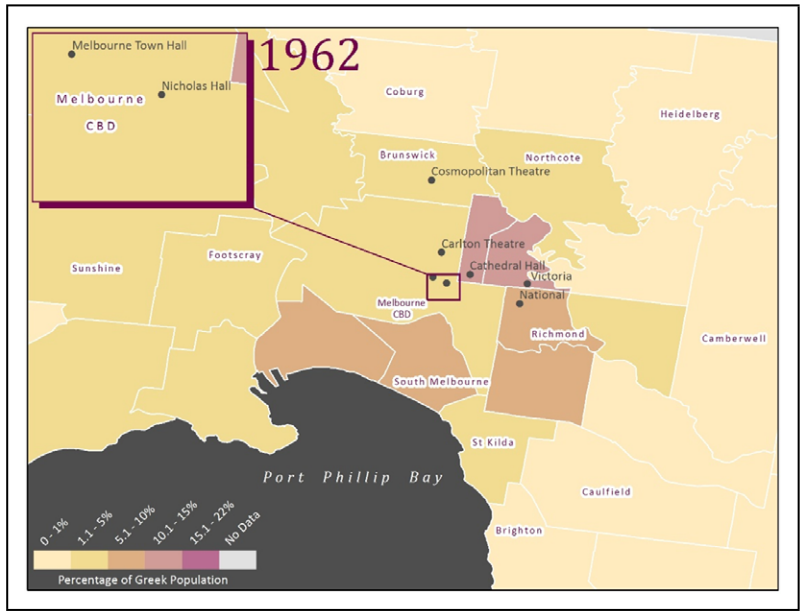

Figure 1. Choropleth map depicting the relationship between percentage of Greek population in metropolitan Melbourne and the presence of Greek cinemas (D Verhoeven et al 2014).

see darker areas that indicate high Greek populations and light grey areas that indicate a low percentage of Greek population and the relationship to cinema locations. There are numerous examples like this in which Choropleth maps have been used successfully to describe the local demographic statistics that underlie venue location.[21]

The location of cinema venues in Figure 2 are depicted using point symbols. Simple point symbols, along with line and area symbols, often represent either differentiated or ordered data. Differentiating and ordering visual variables are used primarily to differentiate between different geographic entities or to show a more gradual difference or order between entities. The term *visual variables* has been adopted from the work of Jacques Bertin[22] to describe the different ways in which graphic elements can be altered through shape, size, orientation, and color (hue, value, and chroma). When the visual variables are applied to point, line, and areal features, it results in cartographic representations for differentiation (differentiating visual variables) and order (ordering visual variables).[23] It is the principles associated with such techniques that form the basis for cartographic products such as the traditional atlas (e.g., different point sizes to represent the relative sizes of small towns, cities, and major cities within a country), road

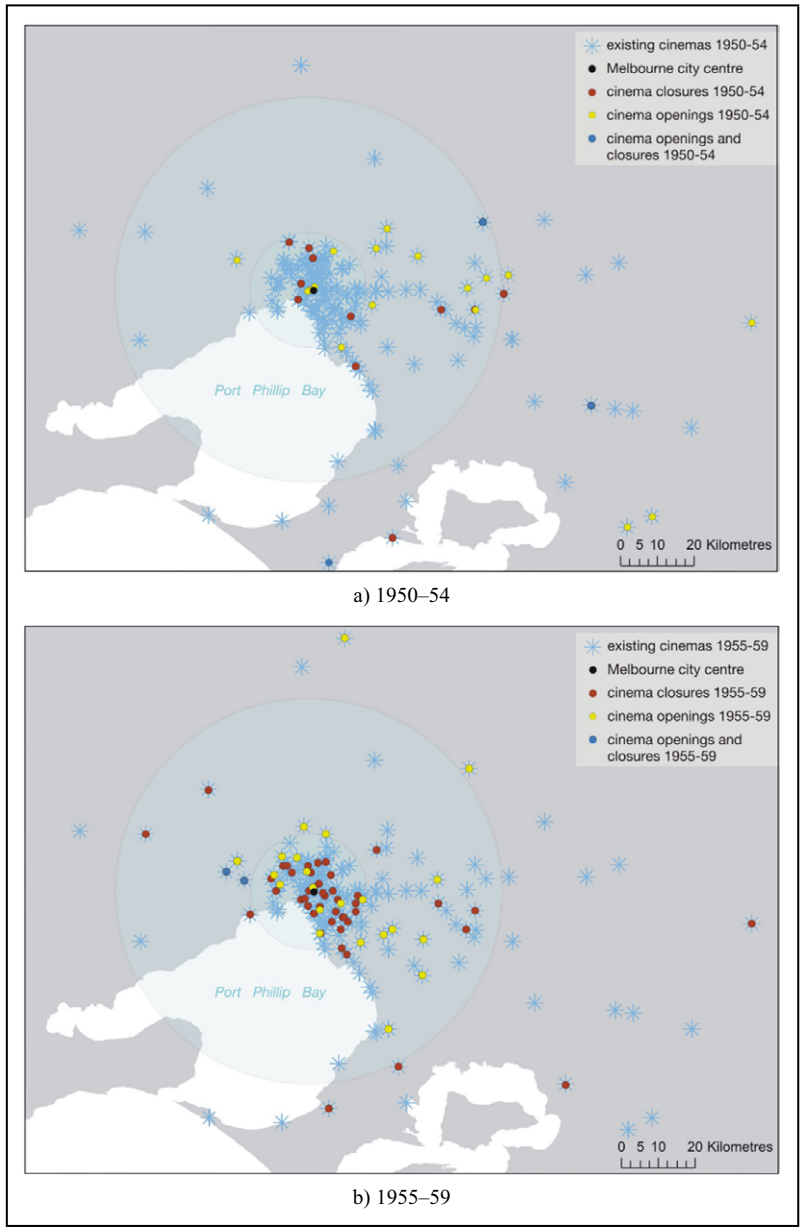

Figure 2. Cinema venue openings and closures between 1950 and 1970 (D Verhoeven 2011).

network maps (e.g., different line styles and widths depicting the road hierarchy), and many interactive web-based mapping products.

For example, ordered visual variables have been used to show the order of distribution of specific films from first release to final release using simple point locations and animated using both Flash and GoogleEarth.[24] Differentiating visual variables for point features is a technique that has been used to represent different attributes of cinema venues. Figure 2 depicts the location of cinema venues during certain time periods, using the visual variable of color to differentiate between those cinemas that opened during the period and those that closed.[25] Differentiated and ordered visual variables are also common in interactive map design, used to simply show the location of cinema venues in websites for historical cinema such as *Cinema Context* of the Netherlands, *Going to the Show* of North Carolina, and *Australian Cinemas Map.*[26] Differentiated point features have been combined with Choropleth mapping for both orienting cinema locations within administrative boundaries, and providing local demographic statistics that underlie venue location.[27]

In addition to these conventional approaches to visualizing cinema data, there are a few examples of mapping, or more generally visualizations, which move beyond traditional techniques. Deb Verhoeven and Colin Arrowsmith[28] adopt the use of Markov chains to calculate the probabilities of distribution practises of certain films, thereby determining the most popular distribution patterns (see Figure 3). In the same study, screenings have also been visualized through the use of Circos diagrams – a technique originally developed for investigating genome sequencing, but applied successfully to cinema data to investigate cinema venue sequencing. Through the use of Markov chains and Circos diagrams, individual film exhibition patterns are able to be explored, and comparisons can be made between different distribution companies or individual films in terms of breadth of release, the dominance of certain venue types, and intricate film circuits. The Cybercartogramme,[29] as part of the Canadian online Atlas of Cinema, adopts an alternative graphic approach to mapping. This method uses ordered visual variables, not for a variable at a location, but through a type of relational graph. Using simple graphs and point symbols it is possible to explore the relationship between revenue for a particular film and demographics of locations, and to therefore examine the influence that location and demographics can have on film revenue. This excellent example of simple graphic design principles highlights the analytic value of the data rather than the geographic location of the cinemas.

Some of the studies discussed above have a temporal aspect either through order of events, through a temporal attribute, or sequence of snapshots. When we focus on change over time it is possible to explore historical data more thoroughly. Change, represented through the transformation in two states, is a technique used to show cinema openings and closures between 1950 and 1970.[30]

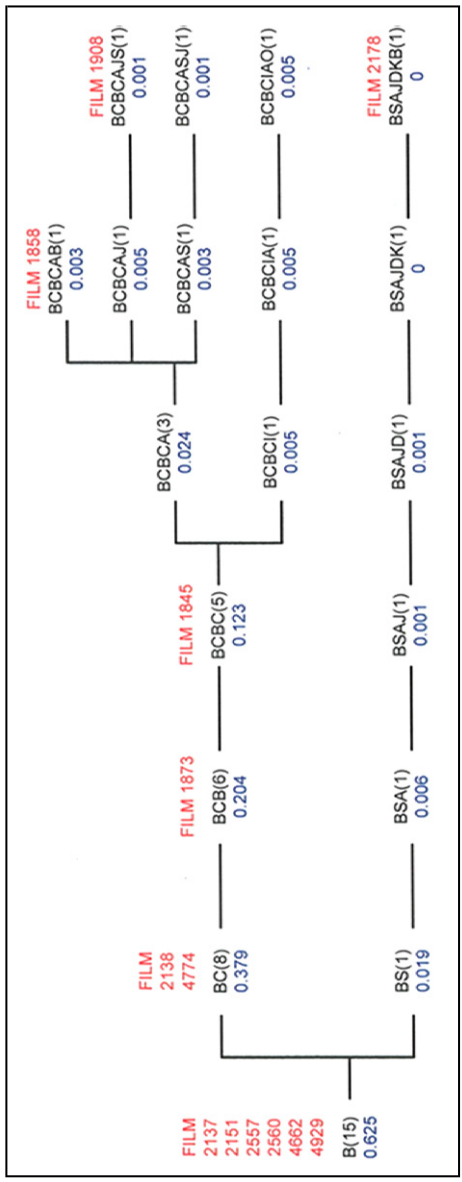

Figure 3. Tree graph of venue probabilities for 12 films using Markov Chain analysis (D Verhoeven and C Arrowsmith 2013).

This is displayed using four snapshots of change in five year intervals (two of which are shown previously in Figure 2). It is possible to explore the changes of cinema venue operation over the study period through looking at the change from one state to another, or one time period to another. For example, Figure 2 captures a period of great change in cinema operation in Melbourne, Australia during the 1950s. The first half of the decade does not experience much activity, but from 1955 to 1959 you can see a large amount of both openings and closures in many areas of the city and surrounding suburbs.

The Choropleth map shown in Figure 1 is a snapshot of an animation depicting the percentage of Greek population in relation to the presence of Greek cinema venues shown as point symbols.[31] When the images are shown in an animation it reveals the influx of Greek population in certain suburbs and arrival and closures of Greek cinema venues serving these communities over the study period. What becomes clear when the images are animated as opposed to just static images is that Greek cinema venues arrived in areas before a big increase in Greek population and left before a significant decline in Greek population. Cartograms are another technique that has been successfully applied to cinema venue data to show the relationship between population and cinema venue closure/opening[32] (see Figure 4). The shape and size of a cartogram is not determined by area, instead it is determined by the value of a variable that can account for the intended distorted geography. For example, a world map of GDP would show a small country such as Switzerland (with a large GDP) as being much larger than normally depicted since the size of the country is now based on GDP instead of area. In fact it would take up a much bigger portion of the map compared to a country such as China as the countries are now no longer based on their relative physical size. In the case of Figure 4, size represents population whilst the color represents changes to cinema numbers within a time period.

The history of the dynamics of cinema venues is highly complex. Cinema venues are spatial, they operate over particular time periods, they have a number of important attributes that cinema historians find relevant, and many of these variables themselves change over time. The techniques described above cannot depict the full range of this complex data in a way that can communicate patterns, explore areas of interest, and reveal insights into the data. Many conventional visualizations stress the geographic aspects of the data whilst the importance of venue variables and change over time is often secondary. The following case study focuses on the development of an innovative technique for visualizing cinema data to improve the understanding of cinema operation during the post-war period in Melbourne, Australia. The aim was to develop a visualization that could consider the three main components of space, time, and venue characteristics in a way that emphasized the relative importance of all without compromising integral aspects needed for historical investigation. This case study demonstrates how an original geovisualization can be created and

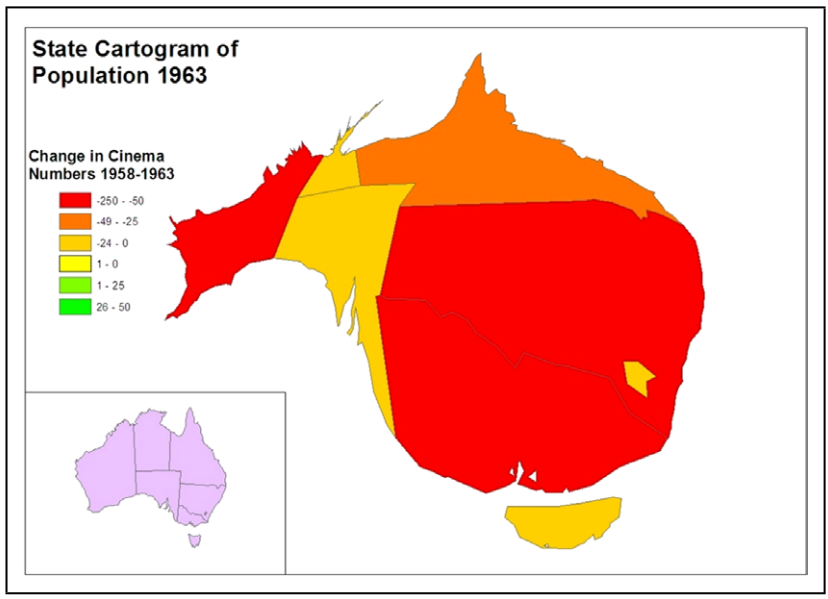

Figure 4. Cartogram showing both population and change in cinema numbers between 1958 and 1963 (C Arrowsmith et al 2010).

designed for a specific investigation, through the consideration of the nature of the data, the objective of the visualization, what is important to represent, and the scale of the data.

CASE STUDY: VISUALIZING CINEMA DYNAMICS

This case study did not start with a question that needed to be answered or a hypothesis that required testing, as is typical in many projects that make use of geographic data. What we had instead was an interest in a largely overlooked and volatile historical period of the film industry, specifically cinema venue behavior in Melbourne between 1946 and 1986. We also had data. Data came from the Cinema and Audiences in Australia Research Project (CAARP) database for the city of Melbourne, Australia (http://caarp.edu.au). The database consisted of all known venues that screened films (including multi-purpose venues such as halls etc.) and included the spatial location of each venue (address and latitude and longitude) and also each cinema's associated variables (name, opening and closing dates, seating capacity, management and ownership, primary purpose, and screen numbers). The online database is event driven, and therefore considers each change in a cinema venue to be an event and attributes

a time stamp for each change to a cinema variable so the dynamics of cinema venue operation can be captured.[33]

As a result, we ended up with a record of all known cinemas in Melbourne that existed between 1946 and 1986. This data is complex as it encompasses a large spatial extent, has multiple variables associated with each venue, and because it includes a critical temporal aspect. The temporal aspect is important for two main reasons; one, the geographic distribution of cinema venues changes dramatically over time as new ones open and others close; and two, cinema venue variables such as seating capacity and ownership can change many times during a cinema's operation. The challenge therefore is to combine data that is historical, geographic, and thematically changing in an approach to visual representation that could aid in exploring and understanding the relationships between different variables both geographically and over time.[34]

Given the scope and scale of available information about these cinema venues it was not possible to represent every single aspect of the data and still communicate effectively. Instead, to effectively visualize the data, only key characteristics were identified. Following an initial assessment of everything to hand, we determined that the most influential aspects of the data were the presence of geographical space and change over time. The focus of this study therefore was to use the spatial and temporal aspects of the visualization process to better understand the spatial and temporal dimensions of cinema data.

As we have seen, typically when time is introduced to geographic data the resultant visualization is expressed in the form of an animation or a series of temporal snapshots. But these formats are not always the most effective ways to analyze or communicate dynamic data. Instead, the approach in this case study was to aim to produce a geovisualization of historical change using one image only; in other words to see what was possible for representing various changes to cinema operations in both space and time *in a single view*. This resulted in the development of the innovative *Petal* diagrams[35] (see Figure 5). The success of these visualizations rests on a series of *a priori* analytic insights that questioned conventional approaches to representing geographic, temporal, and attribute data.

Geographic Dimensions

In this case study, the visual treatment of space is a core component and is based on the question; how can we organize space more effectively? Visualizing the locations of the cinema venues as points on a map or representing them as aggregated values by suburb would be the most common approach to visualizing the spatial component of the data. However, as we explored the data it became apparent that the street address/geographic coordinates and even suburb of a cinema were not the most important spatial aspects of the data. Instead, it was the

spatial aspect of distance and direction from the city that provided insight into the spatial nature of cinema venues. The relationship of distance and direction from the city are also heavily reflected in the exhibition and distribution patterns of films, the radial nature of much of Melbourne's services such as the road and rail networks, and cultural patterns of Melbourne's population. The cinema industry between 1946 and 1986 behaved in very much the same way as these services. The city acted as the origin of a type of concentric expansion of distribution that not only influenced the spatial distribution of markets, but also the ranking and priority of markets.[36] Using these observations, classes of distance and direction from Melbourne CBD were developed for the spatial component of the data to replace the conventional coordinates, streets addresses and suburbs.

Temporal

A major component of the project was the need to represent historical change and capture the temporal characteristics of cinemas in the period under investigation. In the database, each change to a venue, such as decreases in seating capacity or increases to the number of screens is treated as an event and has a recorded time stamp associated with it. This event either signals a new development in the history of that venue or it signals that a new state has replaced a previous state. When all events are put in order, it is clear to see the "lifetime" of a particular venue; the type of changes, the number and sequence of changes, patterns of events and periods where venues seemingly stand still. Representing the temporal dynamics of cinema venues can bring into relief the nature of their operations. The sequence, position, and type of events on a graph for example can offer insights into those events that act as a catalyst for change. In addition, they can also highlight the temporal and thematic patterns of particular events and can spark new questions, insights, and explanations of such events and the venues that experience them.

Variables

Many typical spatial visualizations have the effect of neglecting the importance of associated variables (attribute data) in order to stress the geographic. Historical spatial data, especially in the humanities, is often "attribute rich" because of the high level of contextual detail required for thorough historical investigation. In this visualization cinema venue variables such as the number of screens and ownership were represented as key characteristics in the operation and lifespan of individual cinemas. The relationship between these multiple variables is an important aspect of cinema performance deserving of representation. This importance is also true for understanding the relationship between cinema variables both geographically and temporally.

The multivariate and changing nature of venues is a key component in the *Petal* visualization technique. Lines have been used to represent the lifespan of a cinema, and the associated visual variables such as line width, style, shape, and color have been used to represent the cinema variables. This has created a multivariate visualization that has the ability to show not only multiple variables at one time, but it can also be used to track changes to these variables.

Interpretation

The *Petal* visualization (Figure 5) is the result of combining conceptualizations of the geographic, temporal, and variable aspects of cinema practice. The visualization is divided up into a framework of cardinal direction and time which radiates from the centre of the image. The beginning of the temporal period rests at the centre of the image and radiates out in regular divisions until reaching the boundaries of the visual representation, or the end of the temporal period. This framework can also be conceptualized as a series of timeline graphs all spanning from the centre but which are extended spatially by being positioned in their correct geographic direction. Figure 6 depicts the basis behind the geographical classification of each of the venues. Here the use of distance and direction from the CBD are used to classify a cinema venue called "Progress Cinema" in an outer Melbourne suburb. Based on classes of distance and direction, the Progress Cinema situated on Colby Drive with spatial coordinates (−37.924144, 145.352709) would be represented as being in the distance class of between 20–50 km (12.4–31 miles) from the CBD and in an east south east direction. Therefore, this cinema venue would be depicted in the visualization within the timeline graph that rests in the ESE quadrant.

The locations of the cinema venues were collected as point coordinates and stored in a database as coordinate pairs. To transform the data into a format suitable for the visualization, each cinema venue is classified for their position in terms of distance and direction from the CBD. The venue no longer needs to be represented as a point (based on a coordinate pair), instead these points are transformed into lines that rest within the timeline graphs that form the framework of the visualization. There are a number of reasons for this transformation. Because of its continual nature, a line can track the progression of a cinema throughout its lifetime; where length is indicative of longevity. Both points and lines can include visual variables such as size and color to represent different characteristics in the data. However, when used in a more graphic and abstract context, a linear feature can change these aspects along its length, capturing change over time when included in a timeline. A line also has a greater ability for variation through changes in direction and curve, whereas a point cannot vary in this manner. This means greater flexibility in use and also greater capacity for representing and communicating multiple variables.

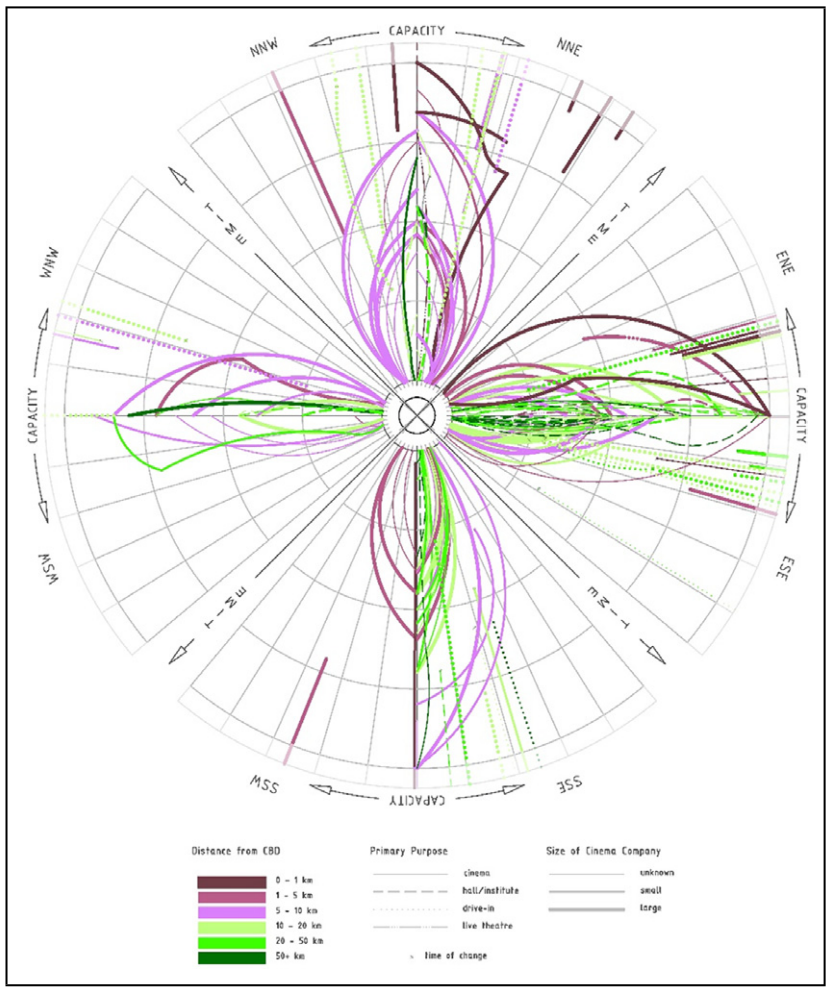

Figure 5. *Petal* Diagram: Visualising the openings and closures of cinemas in Melbourne between 1950 and 1970.

By combining the graphic framework and visual variables, it is possible to represent multiple variables in the one display and depict the time in which each of these variables changed. For example, Figure 7 depicts the history of a cinema venue between 1946 and 1985. The length of the line indicates the lifetime of the cinema, and we can see that it closes in 1985 when the line stops at the central line. The central axis shows capacity, and therefore any change in the direction of the curve indicates a change in capacity (a change

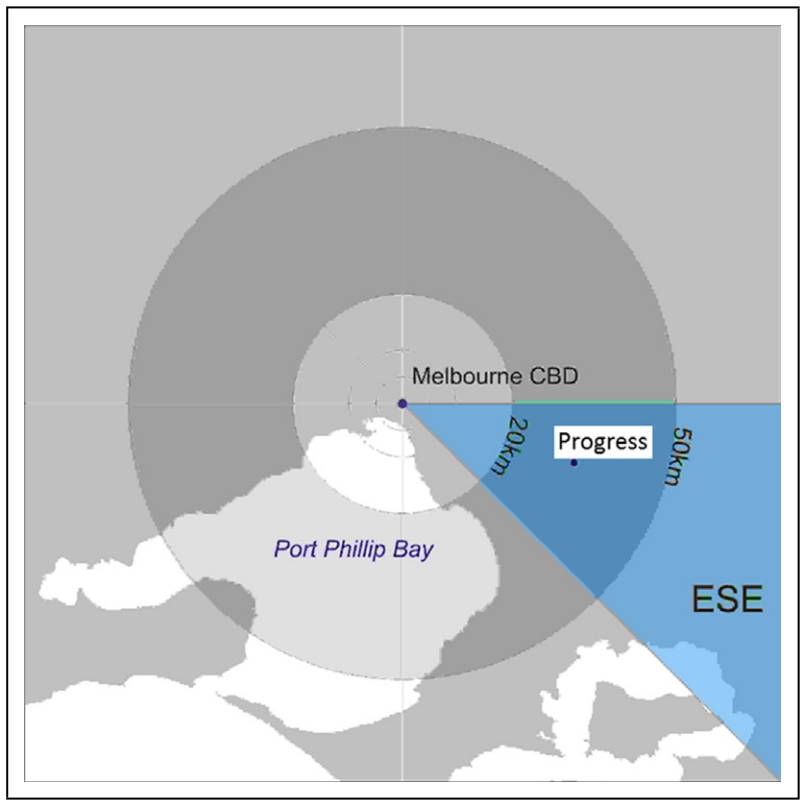

Figure 6. Classifying cinema venues in terms of distance and direction from the CBD.

occurred in 1962, showing a large decrease in capacity and then again in 1981, showing an increase to approximately 1500 seats). The color, line style and line width indicate additional variables; distance from the CBD, primary purpose of the venue (in this case a hall), and number of screens respectively. When all venues under study are combined within the one view, we get a picture of the history of cinema operation; a dynamic and holistic view that is removed from a strict geographical space in order to emphasise aspects of greater importance.

Analysis

The *Petal* visualization is a flexible structure where the temporal period, number of cinema venues, and associated variables can be selected by the

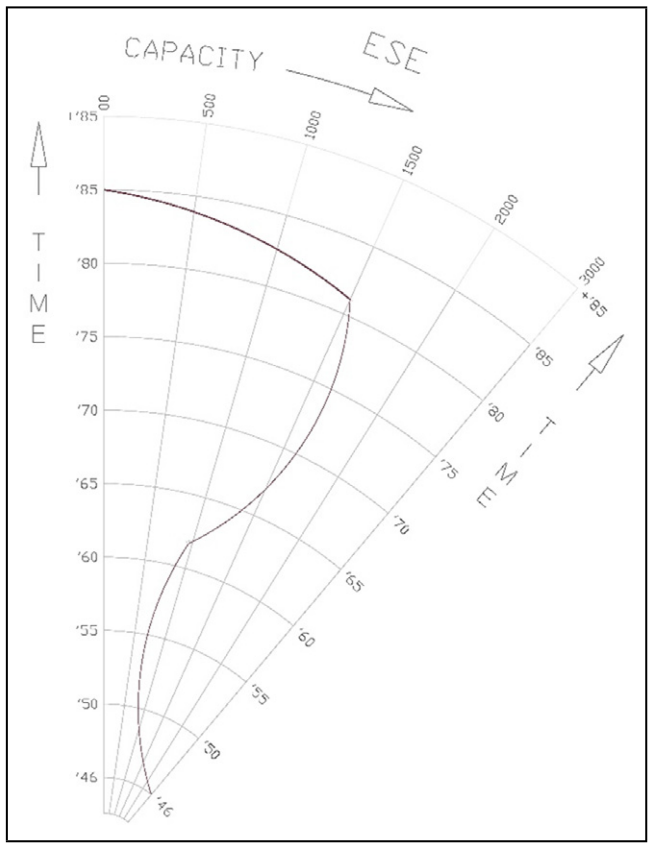

Figure 7. The analysis of one cinema venue from 1946 until its closure in 1985.

user and displayed using their choice of visual variables. The flexibility of the visualization is important as it can then be used as a tool for exploration of the data. Without a particular question in mind, this visualization allows the data to be investigated from a number of angles. For example, Figure 5 depicts all cinema venues that either opened or closed during the 20 year period from 1950 to 1970. Therefore only certain cinemas are investigated and a temporal period is selected. The figure also depicts seating capacity (central axis), the primary purpose (for example hall, or theatre – line style), and the size of the cinema company (line width). By representing all of these aspects together, along with the spatial dimension of distance (represented by line color) and direction, it is possible to explore the relationships between the different aspects and discover areas of interest or extract patterns that inspire further investigation.

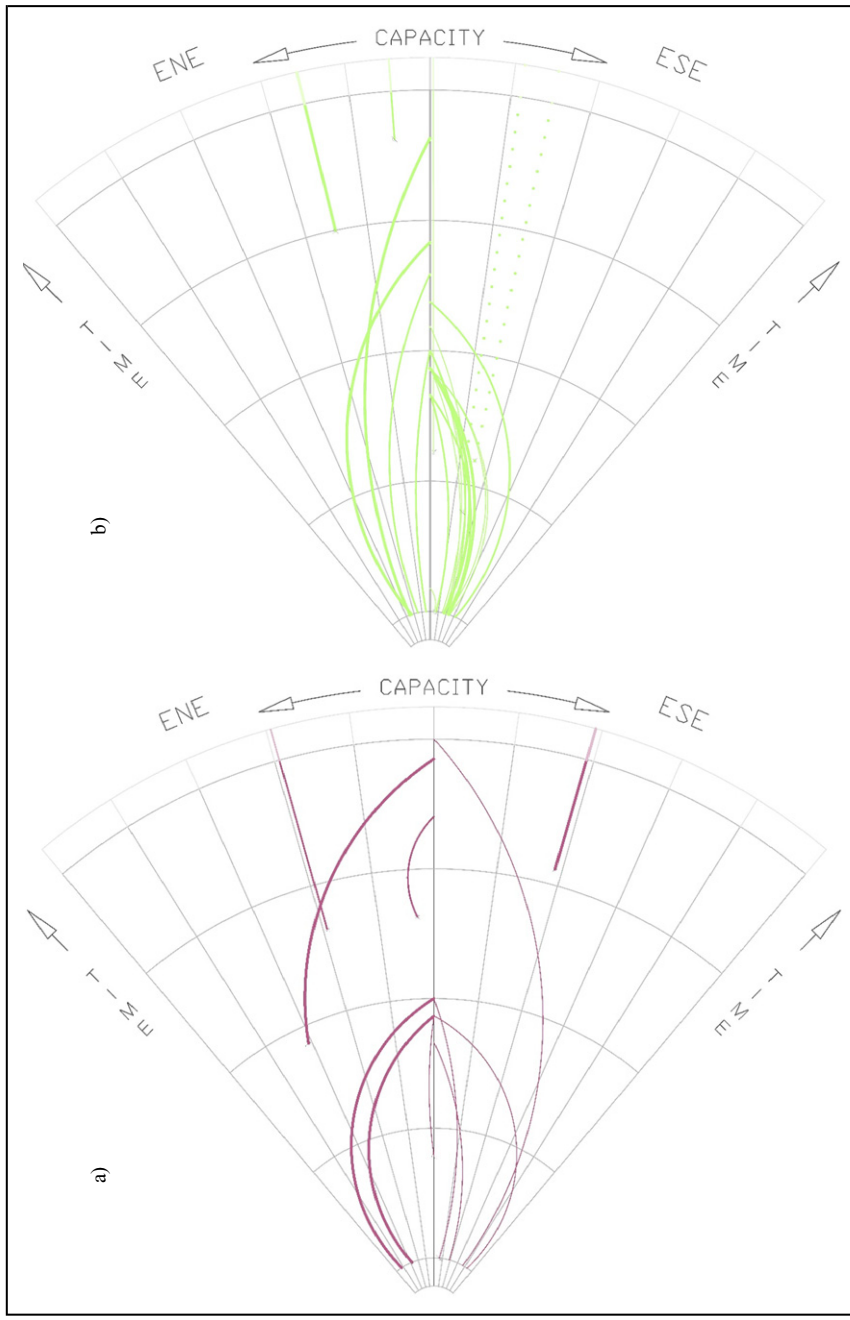

Figure 8. a) Venues within 1–5km of CBD. b) Venues within 20–50km of CBD.

What can we gather from this visualization? Most significantly, the visualization shows a large number of closures over the 20 year period, but is dominated by closures between 1958 and 1962; with large numbers of outer suburban theatres closing in the east and south east, and inner suburban theatres in the north and west. This is depicted in the visualization by many lines coming to an end between the years 1958–1960. Those cinemas that closed between 1950 and 1970 experienced very little to no change, which is indicated by a lack of change in all of the visual variables such as line style and line shape. For the majority of those that did change, they survived the peak period of closure. The visualization shows that closures occurred amongst the privately owned cinemas as well as those owned by large cinema companies (as indicated by line thickness). The east shows a large number of halls that screened movies closing in the outer suburbs, a pattern which is not obvious in other areas of Melbourne. The number of cinema closures far outweighs the number of cinema openings. There is a temporal pattern throughout the extent of Melbourne that shows a stream of openings between 1963 and the late 1960s. Many of the theatres that start to operate in the 1960s have capacities of below 1000 seats. This is in contrast to many of those that closed, where capacities for many were between 1000 and 1500 seats. This contrast is particularly evident in the east. A notable exception to this are large cinemas opening up in the CBD shown in the visualization north of the city, all of which are owned by large cinema companies. Prior to this, cinema venue openings are largely limited to drive-in theatres, the first of which appears in 1954 in the outer east. All of these drive-ins occupy outer suburban areas because of the need for space and are largely operated by large cinema companies. It should be noted that the original visualization was designed to be viewed at a size of A3 or greater in order to investigate the intricacies of the individual venues.[37]

Comparisons between certain attributes can be made more effectively with the use of the selection/querying capabilities within the visualization technique. This can be useful simply in eliminating unwanted information. For example, comparing results from two particular classes of distance is possible by placing two snapshots side by side or by only including the relevant information in the one visualization. Figure 8 is an example where this would be useful. It depicts two visualizations comparing two distance classes, 1–5 km (0.6–3.1 miles) and 20–50 km (12.4–31 miles), of cinema venues from the CBD. By eliminating all other venues, this approach ensures that the focus can be given to the relevant data and comparisons can be made more readily.

By visualizing the data, it is possible to investigate aspects of cinema venue performance that are not accessible from data that is primarily formatted in the written word as lists or tables. These visualizations can also be used to support claims or challenge theories. What they do not necessarily tell us is why we are seeing such patterns. Why were cinema closures located primarily in particular

parts of the city? Why did the closures occur when they did?[38] Visualization acts as a tool to aid in understanding and investigating areas of interest and to prompt further investigation.

CONCLUSION

The decision to adopt a particular mapping technique is based on a number of factors. Whilst all of the studies mentioned above have been used to map cinema data, this data itself comes in many forms, scales, and types. In addition, the role of the visualization or map also varies significantly. Will it be used for displaying results, to simply show the location of entities, to aid in analysis or investigation, or in the support of an argument? Additionally, it is important to consider what specifically to represent; is it the location of features, change over time, the characteristics or variables associated with geographic features, the relationship between features, or a combination of these or others? Factors such as the scale of the study, the geographic extent of the study, the complexity or generalisation of the data, and the type of data available, are all significant when it comes to choosing or developing the right visualization or map. This choice can therefore not be taken lightly, as all of these factors can determine whether a visualization is successful or not.

This case study has enabled data that is usually reserved for written communication to be visually analyzed, interpreted, and displayed in a way not previously explored. By creating visual access to multivariate and temporal spatial information it is possible to produce new insights into the geographic and temporal patterns and relationships present in cultural data. Not all of the visualizations used for cinema research are used to analyze change across multiple variables. But the development of innovative techniques that are able to handle these characteristics have the ability to extend the use and possible outcomes of visualizations in cinema studies and the humanities.

END NOTES

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