Films become more complex: Shots, plots, crews

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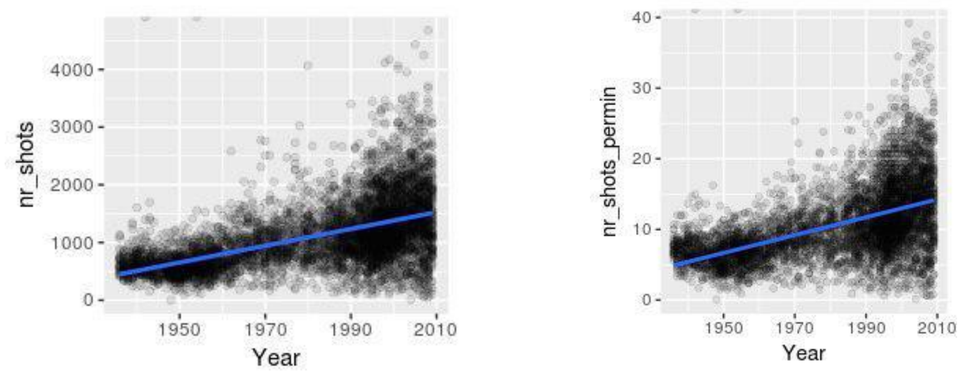
Introduction

Does art become more complex over time? In cultural evolution, complexity has been considered in relation to **cumulative cultural evolution**: through the retention of beneficial traits, culture can become more complex or better fit to its functions (Caldwell et al. 2016). Cumulative culture has been found a hallmark of human culture in areas where progress is easy to notice, for example technologies (Kline & Boyd 2010) or institutions (Turchin et al. 2017). However the relevance of cumulative culture for arts remains to be more closely scrutinized.

We present **three case studies** on the evolution of complexity of films. They indicate that at least for some areas of art, cumulative cultural evolution can be a relevant and a productive research topic. Not only films, but also other arts could grow in complexity, although the exact areas where this "progress" is happening are yet to be discovered in further research.

Study 1: Film shots



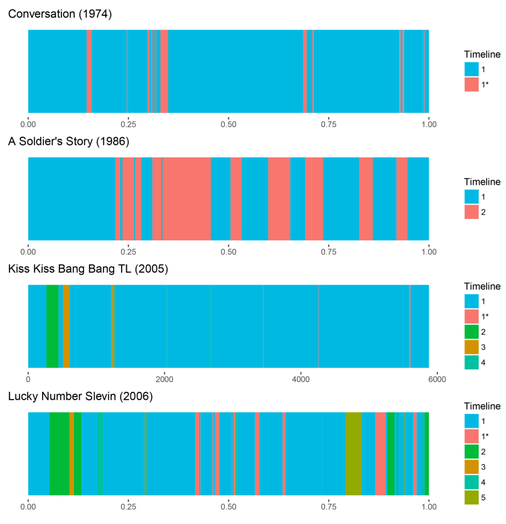
Shots may be considered the most basic units of film narration. Using a database of film shot lengths, collected by Barry Salt (kindly provided to us by James Cutting), we plotted the number of film shots in movies. The number of shots clearly increased during film history – mainly due to the shortening of shot lengths.

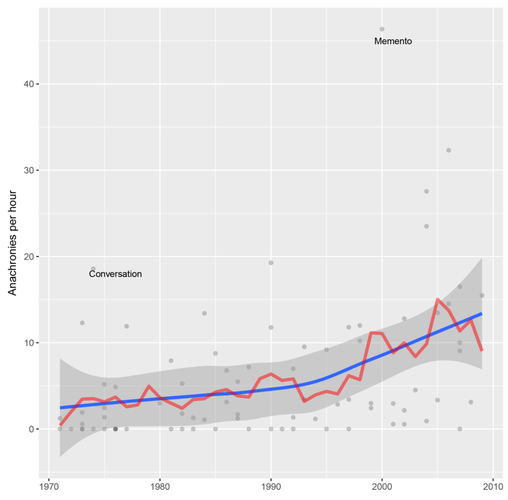
Study 2: Film plots

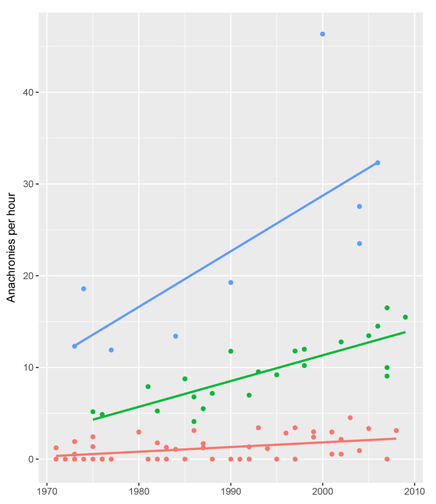
Second, we looked at complexity of film plots. In particular, we looked at the amount of anachronies (i.e., flasbacks and flashforwards) in films.

We assembled a time-distributed **sample** of 80 most popular mystery films from 1970 to 2009 based on the Internet Movie Database (IMDb).

Each film was manually **annotated** for anachronies, the exact time when an anachrony happens was marked (as shown in the **Figure 1**). Mean film duration in the sample was 115 minutes, adding up to a total of 153 hours of film time that was collectively coded.

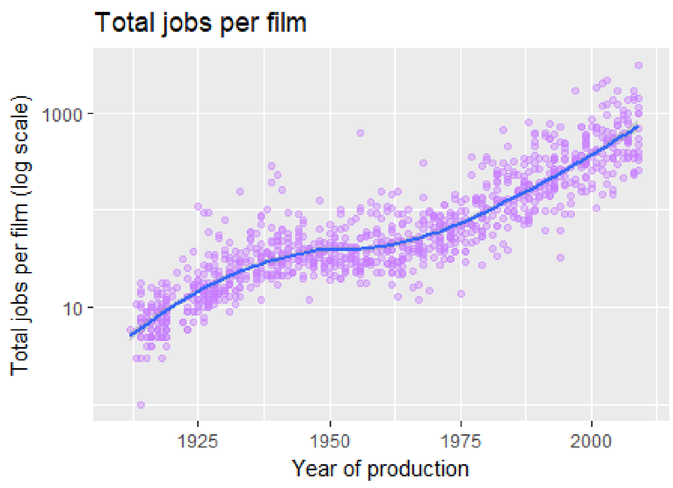


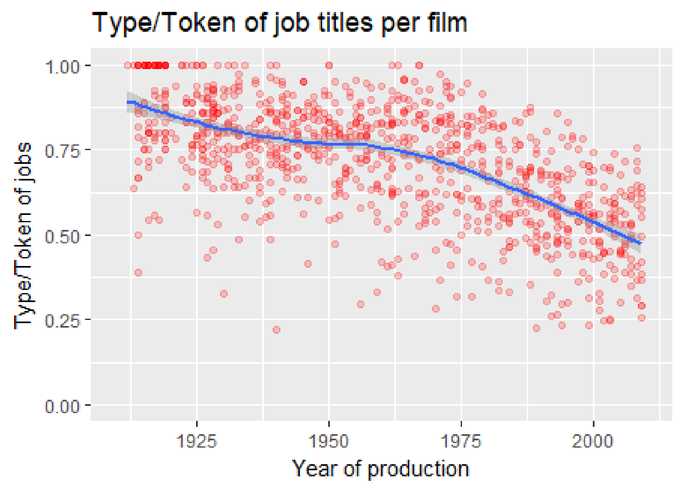


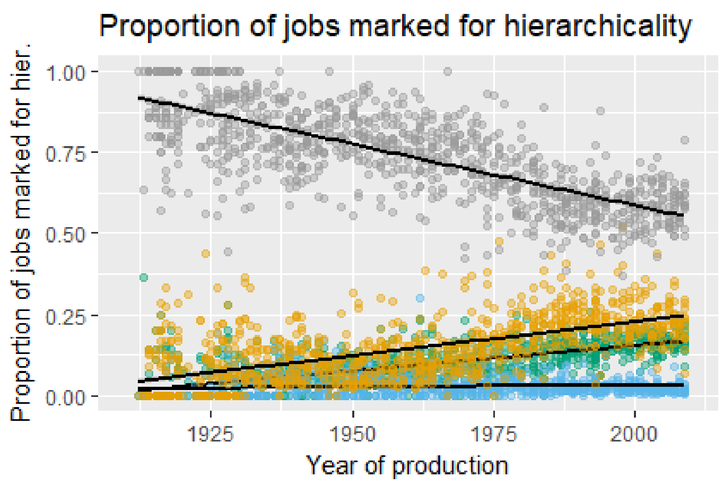


In general, we found out that during the 1970s-2000s film plots were becoming more complex, including more anachronies (**Figure 2**). The rise happened mainly in the last two decades. We used *k*-means clustering algorithm to understand potential subtrends in the data. For this, we clustered the films in each decade into three groups and joined them together based on their relative rank, thus forming groups of films that are **"conservative"**, **"moderate"**, or **"extreme"** in their use of anachronies. Then, we fit a linear regression model to each of the groups. Apparently, **"moderate"** and **"extreme"** films were becoming increasingly more complex in their plot structure, while the **"conservative"** subset kept having very few anachronies (For details, see Kanatova et al. 2017).

Study 3: Film crews







Finally, we studied the sizes of film crews: people involved in film production. Those can be a good proxy for the complexity of films, as producing more complex artefacts often requires larger and more structured production teams. We analyzed films crews of 1,000 most popular films on IMDb (total ~145,000 job entries). Indeed, we found the **exponential growth** in the number of people in film crews, as well as exponential increase in the number of jobs.

Also, not only film crews were becoming much larger, they also were becoming more structured. First, we detected **standardization** of jobs (by measuring Type/Token ratio) of all jobs in each crew. Second, we detected increased hierarchicality of film crews. The amount of **superordinate** jobs (i.e., including such words as "chief", "supervising", etc.) and **subordinate** jobs increased, while the amount of jobs with **no hierarchical marks** decreased.

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