

Hollywood movies follow a mathematical formula

February 19 2010, by Lin Edwards

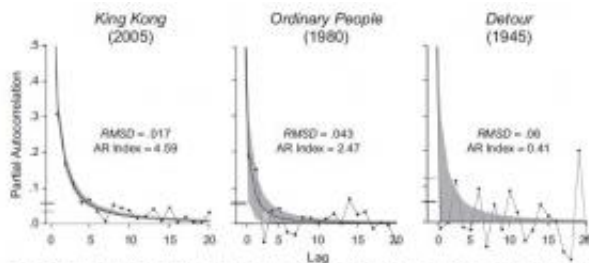


Fig. 1. Raw partial autocorrelations of three films as a function of lag (the ordinal distance between shots whose lengths are being compared). The thick lines represent the fits of a negative exponential function $(1/(lag + 1)^2)$ that for Deterior is thrust up against the ordinate and so cannot be seen. From left to right, the panels show results for films with the best, median, and worst fits across the 150 films. The ordinate is truncated because the Lag 0 value of 1.0 is uninformative. Gray areas indicate 95% confidence intervals around the best fit, determined by bootstrapping. The additional tick marks on the ordinate indicate the upper bound of significant partial correlations; the thick mark is based on the mean number of shots across all films, and the thin one is based on the number of shots in the given film. Our modified autoregressive index (AR index) for each film (see Figs. 2a and 2b) was determined by the intersection of the exponential function and the mean upper bound for all films. RMSE is the root-mean-squared deviation between the fitted function and the raw data.

Image: James E. Cutting, *Psychological Science*, DOI: 10.1177/0956797610361679.

(PhysOrg.com) -- Hollywood movies have found a mathematical formula that lets them match the effects of their shots to the attention spans of their audiences.

Psychologist Professor James Cutting and his team from Cornell University in Ithaca, New York, analyzed 150 high-grossing Hollywood [films](#) released from 1935 to 2005 and discovered the shot lengths in the more recent movies followed the same mathematical [pattern](#) that describes the human attention span. The pattern was derived by scientists at the University of Texas in Austin in the 1990s who studied the attention spans of subjects performing hundreds of trials. The team then converted the measurements of their attention spans into wave forms

using a mathematical technique known as the Fourier transform.

They found that the magnitude of the waves increased as their frequency decreased, a pattern known as pink noise, or $1/f$ fluctuation, which means that attention spans of the same lengths recurred at regular intervals. The same pattern has been found by Benoit Mandelbrot (the chaos theorist) in the annual flood levels of the Nile, and has been seen by others in air turbulence, and also in music.

Cutting made his discovery by measuring the length of every shot in 150 comedy, drama and action films, and then converted the measurements into waves for every movie. He found that the more recent the films were, the more likely they were to obey the $1/f$ fluctuation, and this did not just apply to fast action movies. Cutting said the significant thing is that shots of similar lengths recur in a regular pattern through the film.

Cutting believes obeying the $1/f$ law makes films “resonate with the rhythm of human attention spans,” and this makes them more gripping. Films edited in this way would then tend to be more successful and the style of shooting and editing more likely to be copied. Films of Cutting’s own favorite genre, the Film Noir, do not generally follow the $1/f$ law, with shot lengths tending to be more random. By contrast *The Empire Strikes Back* (1980) and the 2005 blockbuster movie *Star Wars Episode III* (which Cutting considers to be “just dreadful”) both follow $1/f$ rigidly.

The researchers concluded that over the next few decades film makers may take more care to follow the $1/f$ law to try to boost audience engagement.

More information: Attention and the Evolution of Hollywood Film; James E. Cutting, Jordan E. DeLong and Christine E. Nothelfer, *Psychological Science* published online 5 February 2010.

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