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Shot Durations, Shot Classes, and the Increased Pace of Popular Movies

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We investigated historical trends of mean shot durations in about 9400 English-language and 1550 non-English-language movies released from 1912 to 2013. For the sound-era movies of both sets we found little evidence for anything other than a linear decline plotted on a logarithmic scale, with the English-language set providing stronger results. In a subsample of twenty-four English-language movies from 1940 to 2010 we found that the decline in shot duration is uniform across fifteen shot classes, a result that supports a broad "evolutionary" account of film change. We also explored the proportions of these shot classes across years and genres, and found that 25 percent of the decline in shot duration is due to a shift away from shot classes with longer-than-average shot durations towards those with shorter-than-average durations, and 8 percent of the decline is due to the increased use of shot scales in which characters appear larger.

Movies and Pace

The pace of popular movies has increased and statements about this trend can be found in both the popular media[1] and in scholarly works (see, for example, Bordwell and Thompson 2004; Bordwell, Staiger, and Thompson 1985; Cutting, Brunick, DeLong, Iricinschi, and Candan 2011b; Salt 2006, 2009). Indeed, at times this trend is bemoaned in popular media, as if members of Western (or at least English-speaking) culture were having their attention faculties withered by screen media. Although pacing can refer to motion (Cutting et al 2011b; Cutting, DeLong, and Brunick 2011c) or to the rate of cross-cutting between narrative threads (Bordwell 2013), we will use the term referring to the duration of shots as they have become shorter over time (see also Pearlman, 2009). Indeed, the average shot duration in Hollywood movies has declined from a mean of about 12 seconds in the 1950s to a bit less than 4 seconds in the 2000s (Salt 2006; Cutting et al 2011b).

This decline is part of a trend that Bordwell (2006) has called *intensified continuity*, where the term *continuity* denotes the general style of popular filmmaking. Continuity style creates the perceptually and conceptually smooth transitions of a cinematic narrative as it progresses through diegetic (story) time and space. The *intensification* of continuity can be found in at least three gradual changes to normative movie structure – shorter duration shots, more closeups, and an increasingly roving camera.

The explanation for a more-roving camera seems straightforward. As a result of technological advances, cameras have gotten lighter and smaller. Diminished in size and weight they are easier for cinematographers to move around. Since more than 90 percent of all movie shots have character's faces in them (Cutting 2015) it seems logical that increased camera mobility would generate an increase in closeups. Moreover, it has been suggested that reading the facial change and other bodily responses of characters is the core all of the narrative arts (Zunshine 2012). It turns out that the increasing use of closeups also allows for shorter duration shots (Bordwell 2006: 137; Cutting 2015), perhaps with the explanation that emotions are read faster the larger they are displayed on the screen. Nonetheless, the increase in closeups can account for a small fraction of the decline in mean shot durations from 1940 to 2010 (Cutting 2015). Thus, much more must be going on to explain the increased pace of movies over those seventy years.

It is clear that cuts alter the patterns of viewers' eye movements, and hence of viewers' attention (Mital, Smith, and Henderson 2011). Viewers saccade quickly after a cut from the location of a character in the previous shot to that of a character in the current one, and viewers' eye movements are quite synchronized in time and tightly localized in screen space (Hasson et al. 2008; Smith and Mital 2013). Thus, one can argue, shorter shot durations make for more cuts, which in turn make for more intensified demands on viewers' attention.

The purpose of this article is to focus on historical change and shot durations in popular movies, to wit (1) the statistical corroboration of a linear decline of the mean shot duration of English-language sound-era movies, (2) the demonstration that this linear decline is quite uniform across fifteen different classes of shots, which generally supports our "evolutionary" approach to changes in film style (Cutting and Candan 2013), and (3) the calibrated evidence for two more concrete causes of increased pace – the shifting of the distribution of shots among various classes and increasing use of closeups.

On the Decline of Shot Durations in English-Language Movies

Average shot durations have declined over the era of sound films. But is this decline more-or-less linear (best captured by a straight line), is it articulated in some way (with bends at historically important points among shorter straight lines), or is it curving according to differences in stylistic eras or bottoming out at some minimal value? To test differences among such possibilities one needs the data from a lot of movies.

Barry Salt (2006, 2009) has investigated mean shot durations more than any other researcher. In October 2014, he graciously sent us a file containing his data from almost 11,000 movies, more than 9300 of which are English-language films

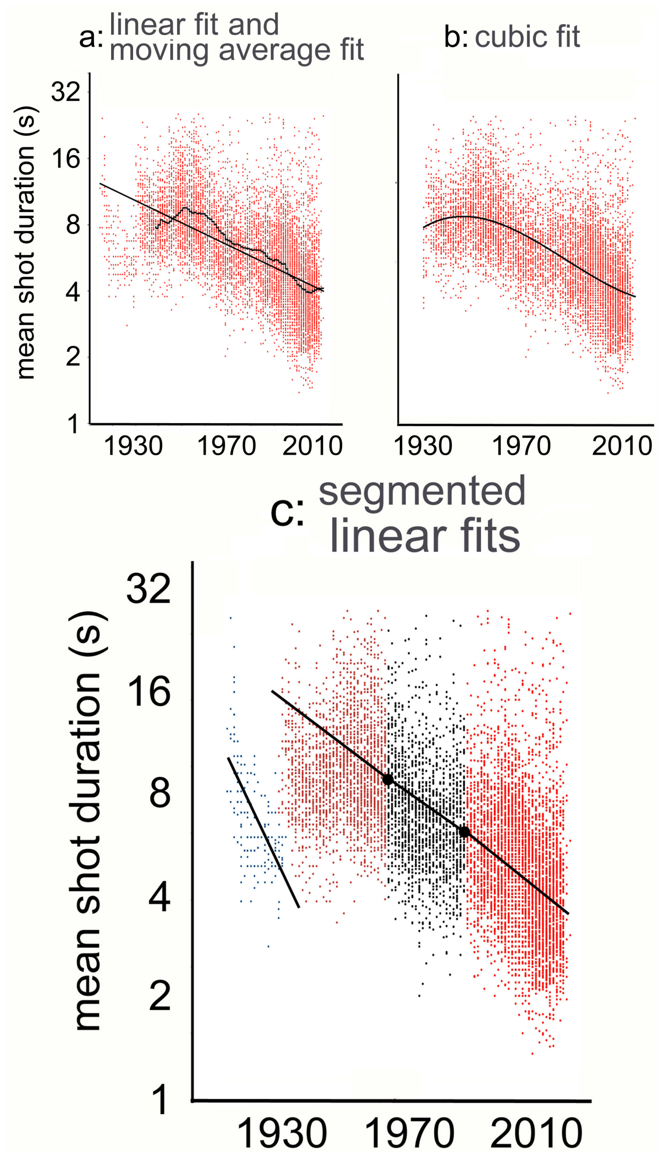

Figure 1. Scatterplots of about 9400 English-language films by release year and mean shot duration (represented on a logarithmic scale). Most of the data were kindly supplied by Barry Salt. Panel *a* shows linear and moving average fits. The jaggedness of the latter is accounted for by averaging an incremental moving window of 600 movies across release years. Panel *b* shows a cubic fit to the sound-era data from 1928 to 2010, which is not statistically superior to the linear fit. Panel *c* shows segmented regression fits among three ranges of release years, 1928-1959 (in red), 1960-1982 (in black), and 1983-2013 (in red), which together are not different than the linear fit; and a separate regression for movies released between 1913 and 1927 (in black).

released between 1913 and 2013. To these we added the 160 released from 1935 to 2010 that we have previously investigated (Cutting et al 2011b). We then removed all duplicates.[2] We then logarithmically scaled[3] the mean shot durations of all movies. The resulting data for sound and silent movies are plotted in Figure 1a with a linear (straight-line) fit to the entire dataset (r = -.573, $t(9411)$ = 68, $p < .0001$, d = 1.4).

But is a linear fit to all of the data the most appropriate? Salt (2010, 2014) has preferred a moving average fit, one also plotted in Figure 1a with a window of 600 movies. That is, the mean shot duration is pooled within consecutive, chronologically sampled windows containing 600 movies (1 through 600, then 2 through 601, 3 through 602, … 5281 through 5880, etc.), with the data point plotted at the end of the sequence. This function fluctuates seemingly randomly from linearity. Such a fit is descriptively fine, but it provides no real support for any theoretical understanding. Good theories, and even good descriptions, are typically simple. By inference they are often best described by simple functions with few parameters, but there is nothing parametrically simple about a moving average fit. Moreover, scrutiny reveals that there is something clearly different going on in Figure 1a for the silent era movies (here 1913-1930). Thus, we will confine ourselves first to sound films (1928-2013) and address the silent movies later.

Following psychological tradition we investigated whether some polynomial fit would be superior to a linear one. Polynomial fits contain curves – quadratics with one bend, cubics with two bends of opposite direction, quartics have three, and so forth – but their equations are not as simple as for a straight line. Figure 1b shows a cubic fit to the sound-era data (r = -.612) with a hook at the top and a small tail at the bottom. A quadratic fit to the same data, not shown but with approximately the same shape without the tail, fits about equally well (r = -.608). Indeed, both of these are marginally better than the linear fit to the same range of movies (r = -.595). But despite the very large number of movies considered here neither of these higher-order functions is statistically superior to the linear one ($zs < 1.58$, $ps > .11$). Thus, again following psychological tradition, it seems appropriately conservative to endorse the latter (and simpler), with the implication that we should look for a theoretical account that allows this change to unfold gradually and uniformly over a long period of time. Unfortunately, such accounts are few.

The putative causes for the increased pace of movies can be found in two general sources, popular and academic. The popular concern music videos[4] on the one hand and the notion of a society driven by the demands of television, movie, and computer screens on the other.[5] The more academic concerns the period around decline of the Hollywood-era studio system. However attractive these accounts might be, none bear up under statistical scrutiny.

Consider first the possible influence of music videos on shot durations in the data shown in Figure 1c. The statistical issue is whether or not the first appearance of music videos on television in 1982 created an inflection point in the later, overall downward trend. That is, is there a steeper decline in the movies after the videos began to be broadcast? This can be tested with a segmented regression analysis performed on two domains of data, here those films released from 1960 to 1982 contrasted with those released from 1983 to 2013. An inflection point, or hinge – the point that both regression lines must intersect – is placed at the mean shot duration for films released in 1982 and 1983, the junction point of the two segments. This value is 6.45 seconds. The question becomes: Are these two lines different in their slope? The slope for the latter segment (1983-2010) is -0.0057, and that for the earlier segment (1960-1982) is -0.0052. As should be evident from Figure 1c this difference is barely discernable, and not statistically reliable ($t(6924) = .81$, $p = .42$; Bayes factor = 53.1, strongly favoring the null hypothesis; Rouder et al. 2009). Thus, although no one should deny that music videos have influenced popular movies, there is no evidence that they have had any effect on their mean shot durations.

The second popular account for the shot-duration decline concerns a possible cyclical reciprocity between mass-media screen content and the attention patterns of viewers – sometimes described as a nearly-ADHD (attention deficit hyperactive disorder) affliction. The idea is that quickened screen content (television programs, websites, and movies) alters our general attention patterns, perhaps shortening our attention span, and that the makers of this content must incrementally continue to quicken content to keep up with ever-shortening attentional capacity.

Although this idea promotes an incremental change like that seen in Figure 1, we know of no evidence in its support. There is no inkling that any aspect of attention has declined in the last decades (see, for example, J. Brown 2000), or even in the last century.[6] Moreover, we can propose at least one idea against any link between movies and attention span. Notice that the mean shot durations from films released in the silent era (see Figure 1c) show a vastly different pattern than those released afterwards.[7] Notice further that the mean shot duration in the late silent era was about the same as those of sound films released about 1995. Thus, unless one wants to attribute the same creeping, societally general ADHD to the period of the Roaring Twenties, from which there was a very quick “recovery,” the parallel in shot durations for the two periods (the 1920s and the 1990s) would seem to speak against any direct relationship between an overall decline in attention and mean shot duration.

Finally, a plausible and more academically respectable rationale for the decline stems from the transition between the classical studio era of Hollywood movies and a later era of less top-down filmmaking. Although this transition was not abrupt and no one has claimed that it was, the date is often placed for convenience at 1960 (Bordwell et al. 1985). To test the idea that some kind of filmmaking “freedom” was unleashed from studio control and that this created the current pacing trend, we performed another segmented regression analysis. Here we divided two groups of movies – sound films from 1928 to 1959 and those from 1960 to 1982, hinged at the mean shot duration of those films released in 1959 and 1960 of 8.5 seconds. Again, the slopes of the two regression lines are -0.0057 and -0.0052, with no statistical difference between them ($t(4289) = .68$, $p = .50$, Bayes factor =

46.1, strongly favoring the hull hypothesis). As is apparent in Figure 1c, the transition out of the classical Hollywood studio era had no effect on the linear decline of mean shot duration.

Thus, it appears that none of these putative causes given for the increased pace has empirical support. The decline is not abrupt nor is it demonstrably articulated at any point. Instead, it is uniform and gradual over the course of at least eighty years. We think this effect is best described as an "evolutionary" one (Cutting and Candan 2013). We suggest further that, as part of culturally transmitted practice among filmmakers and perhaps in consort with moviegoers expectations and their increased efficiency at extracting information, filmmakers have sought ever-so-incrementally and perhaps unconsciously to outdo their predecessors, shortening their mean shot durations by the equivalent of about three frames (about 125 milliseconds) per shot per year. Locally, such a change would be very difficult to notice, but as it accumulated over time it would become a striking trend. We recognize that this theoretical description is vague. Thus, we will attempt to put more flesh on the idea later and provide some alternatives.

But first we need first to step back. All of the analyses above refer to English-language movies. Are such results found for non-English language films as well?

On the Decline of Shot Durations in Non-English Language Movies

Salt's data also have almost 1550 films from non-English speaking countries,[8] so we analyzed these for a comparison. Again we log scaled the mean shot durations but this time omitted only six films, those with mean values greater than 30 seconds since the standard deviation was much larger than for English-language films (15.0 vs. 2.5 seconds). Results are shown in Figure 2 divided into two groups.

The silent pictures (here 1912-1930 and from non-English speaking countries) clearly have a rapidly declining slope, as they did in Figure 1c. And again the sound movies (here 1928-2013) have a general decrease and a discontinuity with the silent films. Two regression lines are fit to the sound-era data, linear ($r = .21$, $t(1376) = -8.01$, $p < .0001$, $d = .43$) and quadratic ($r = .23$, $t(1375) = -8.76$, $p < .0001$, $d = .47$). As before the quadratic fit is slightly superior to the linear fit, but not statistically so ($z = .55$, $p = .58$), so conservatively we will again assume that the linear fit is the better description. More importantly, the slope of the linear fit to the non-English language movies is reliably shallower than that to the English language movies (-.0022 vs. -.0053, $t(10784) = 10.27$, $d = .24$).[9] This difference manifests itself most clearly in recent movies. The non-English language movies from the year 2000 to 2013 have a much longer mean shot duration than the comparable English-language films (10.9 vs. 4.7 seconds, $t(2686) = 11.43$, $p < .0001$, $d = .44$).

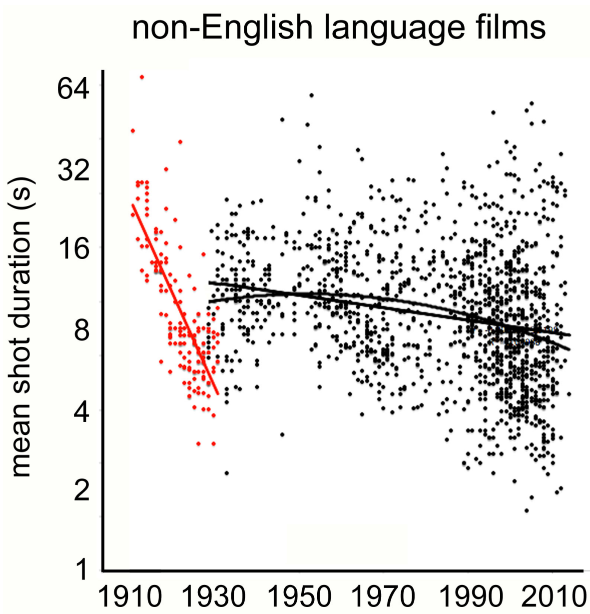

Figure 2. Scatterplot of about 1550 non-English language films from Salt's corpus by release year and mean shot duration. Red dots represent silent era films (here those 1912 to 1930 produced in non-English-speaking countries) and black dots the sound movies (here 1928 to 2013). A linear regression line is fit to the silent films and both linear and quadratic regression lines are fit to the sound movies.

Overall, our conclusions about historical trends in non-English-language movies must be weaker. To be sure, shot durations have generally gotten shorter worldwide, and the rate of this decline is essentially linear, but rather than a reduction of about 125 milliseconds it is roughly 50 milliseconds per shot per year, a decline only 40 percent as great. This is an interesting difference but speculation about its cause is well-beyond our present scope. The remainder of this article is focused on the English-language movies.

Fifteen Shot Classes

Given the linear decline for sound-era films shown in Figure 1c, the next logical question is whether or not the decline in mean shot duration is uniform across various shot types. Our rationale is to determine whether the reduction is common to all shots or confined to a few shot types – like shot/reverse shots, inserts, or action shots. A result showing uniform reduction across shot types would provide support for our "evolutionary" approach (Cutting and Candan 2013), a description of a broad and incremental change in film form.

Before making such an assessment, however, we needed an exhaustive set of what we will call *shot classes*. Unfortunately, there are some differences in usages for many shot terms (compare B. Brown 2012; Chandler 2004; Mascelli 1965; Mercado 2011; Salt 2009; and Spottiswoode 1951) and also some large lacunas. Thus, we needed to modify and add shot classes to create a comprehensive system.

We placed all shots into fifteen exclusive classes; that is, every shot was categorized but no shot appeared in more than one class.[10] Most of these are standard to the film literature, others less so. Some of the more standard classes are included within what we call (1) *multiple character shots*. This is not a typical term used in film, but it includes several types of shots that are common to film parlance: two-shots (shots showing two stationary characters, both typically facing one another, and sometimes directly as in Figure 3c in what is called a 50-50 shot, B. Brown 2012: 22), three-shots (showing three stationary characters), four-shots, and more, all seen during a conversation. Cutting (2015) distinguished between two-, three-, four-, and more-character shots in a separate analysis of shot durations, so we will not do so again here. We reserve the various kinds of one-shots (or singles, those with a single character) for other classes.

We then divided other two-party conversational shots into four classes. The first is the most common one-shot, typically referred to in pairs as shot/reverse-shots (also reverse shots or reverse-angle shots). For us each is an (2) *SRS*. In our scheme an SRS shows one stationary character talking to at least one other unseen stationary character, as shown in Figure 3e. Camera position changes and the lens axis typically turns at least 90 degrees between such alternating shots (Salt 2009).

Next in this group are shot/reverse-shots taken (3) over the shoulder (*OTS* shots), where again the conversation is between two stationary people, or two groups, both seen. One is facing generally towards the camera and in focus and the other is facing away in the foreground and often blurred (Chandler 2004). OTS shots are said to bind the two characters in conversation more tightly than SRSs (Mercado 2011). To qualify for this class the listener must be at least slightly turned away from the camera and that some part of her body can be seen. An example of a typical OTS shot is shown in Figure 3d. However. the camera need not be pointed “over” the shoulder. For example, a gunslinger shot might be taken from behind the holster of one cowboy as he faces another cowboy who speaks.

Also included in two-party conversational shots are (4) *reaction shots*, which can be in either SRS or OTS format. Here the stationary person in focus and obliquely facing the camera does not speak (B. Brown 2012; Mascelli 1965; Salt 2009; Spottiswoode 1951). The importance of these shots to the conversation is to show the reaction of the listener to what the talker is saying, and to break up what might otherwise be a long take (long-duration shot) of the talker.

Finally, there are (5) *mediated SRS*s, conversational shots over telephones, intercoms, or analogous devices (for example, holographic teleporters in science fiction movies) where the two stationary conversationalists are not in the same location. These are typically staged in the same way as other shot/reverse-shots, one character facing left and the other right as if to follow the 180-degree rule even though that rule would not seem to apply to characters in different locations.

Figure 3: Stills taken from various shots in *The Social Network* (Fincher 2010) as they appear sequentially in the movie. Panel *a* is from an environmental establishing shot (Category 14 in our system) taken from the credit sequence at the beginning of the film. Panel *b* is from an insert shot (Category 6). Panels *c* through *f* come from four consecutive shots in the "Caribbean night" scene, beginning with Panel *c*, a two-shot (from Category 1, multiple character shots), following in Panel *d* with an over-the-shoulder (OTS) shot (Category 3), a shot/reverse-shot (SRS, Category 2) in Panel e, and a point-of-view shot (POV, Category 9) in Panel *f*.

Among our other standard film-theoretic classes are (6) *inserts*, where the camera focuses on an object or body part, but not the head of a character (Mascelli 1965; Salt 2009). An example of an insert in shown in Figure 3b. Similarly, another common film category is the (7) *cutaway*, a single shot in the narrative sequence that cuts either to a non-talking character not directly involved in the current conversation, to a parallel activity in the narrative, to an object that has been referred to, or to something that represents the ambience of the scene (a black cat in a dark alley). After the insert the sequence then cuts back to the main action (Chandler 2009; Mascelli 1965). Cutaways are occasionally used strategically to cover up staging changes that would otherwise appear awkward, such as the left-right reversal of main characters in the frame.

We also categorized (8) *montage shots*, the individual shots from montage sequences (Chandler 2006; Salt 2009). For us such sequences consist of three or more consecutive shots that are typically not in strict temporal sequence. In older movies these are often separated by dissolves (Cutting, Brunick, and DeLong 2011a). Such sequences are what Metz (1974) called descriptive, bracket, or parallel syntagmas. They diffusely describe an event, a location, or go back and forth between separate events, respectively. Most montage sequences are covered with nondiegetic (background) music even though some conversation may occur.

We are quite strict in defining (9) point-of-view (*POV*) shots, and followed Salt (2009: 418): "A shot taken with the lens pointing along the direction of view of a character shown in the previous or subsequent shot." In contrast, Mascelli (1965) allowed a POV shot to be more or less from the same position of the character looking offscreen. And some accounts merge POV shots with the general category of eye-line matches, where the direction of gaze offscreen of a character in the first shot meets an object or the direction of gaze of a second character, as in SRS pairs (see the differences noted by Branigan 1992; Chandler 2009; Salt 2009). We excluded SRSs from the POV category. A sample POV shot is shown in Figure 3f, a still from a shot that follows directly from the previous shot suggested in Figure 3e. The dialog also set up this POV: "I can't stare at that loop of Niagara Falls which has nothing to do with the Caribbean."

Next is (10) the *action shot*. These are taken from sequences involving guns, fights, chases, explosions, crashes, or some kind of strenuous or extreme physical activity. This categorization supersedes all of the groupings above and below because of the action context. Thus, shots that might otherwise have been deemed reaction shots, inserts, cutaways, or moving character and moving vehicle shots (discussed below) are simply action shots in a longer action sequence. An action sequence typically begins and ends with up-tempo nondiegetic music.

Next is (11) the *solo shot* (also called a single). It is a shot of a single character performing some stationary act or thinking, but not in the process of moving or talking to someone else. These shots are excluded from SRSs and reaction shots, and this class is important because there are some situations that are constructed like shot/reverse-shot sequences but do not contain conversations. For example an isolated character might look offscreen, followed by a POV of what she is looking at, followed by another of her looking around, followed by a different POV. Such shots of the character were coded as solo shots.

Another category is (12) a *moving-character shot*, sometimes thought to be the essence of film (Arnheim 1957: 181-187; Mascelli 1965: 93-101). Typically, such a shot may show a character moving through the frame while talking (often changing position in an otherwise stationary conversational sequence). However, we also included walk-and-talk shots, where two or more characters walk together in conversation; and shots where one or more characters simply move through an environment toward a destination without talking. Thus, this class supersedes solos and multiple character shots. Also, the camera can be stationary and panning to follow the character(s), or on a track or filmed from a steadicam moving with the character(s). We recognize the diffuseness and ad hoc nature of this category, but its necessity stems from the fact that few of the more standard shot types include moving characters. Again, these shots were so categorized only if they were not part of an action sequence.

In addition there are (13) *moving-vehicle shots*. These feature a moving car, truck, plane, train, boat, or wagon without any prominent appearance of a driver or pilot. However, we also included long-scaled shots with riders on motorcycles, bicycles, or horses. Classification of this type of shot superseded categorization as a cutaway, and although shots of moving vehicles are almost obligatory in chase sequences, those were placed in the class of action shots.

The penultimate type is (14) the *environmental establishing shot*, typically a wide-angle shot of a new exterior or interior space (Barsam and Monahan 2013; Mascelli 1965; Spottiswoode 1951).[11] An example is shown in Figure 3a. These often contain characters but they differ from various multiple character shots in that the visible characters (if any) are much smaller in the image. The intended focus is more on the environment, not the layout of the characters in space. As in Figure 3a, such shots are sometimes parts of an introductory credit sequence.

And finally there is the category of (15) *combination shots*. These shots combine attributes in other kinds of shots. They are found in every film, but are most common in older films. As an example, one such shot might begin with focus on an object with a character's hand on it (as in an insert); it might then zoom out to medium shot of the character sitting at a desk (as in a solo shot), and then zoom out again to a medium-long shot and pan to follow the character as she walks across a room (as in a moving character shot) to another person, and end only after those two characters have engaged in and finished a brief conversation (as in a 50-50 shot). Typically, these shots are quite long in duration and can implicate impressive choreography behind the camera.[12]

Omitted from this classification scheme are several shot types familiar to film scholars. One, as suggested above, is the eye-line match, a shot type that is not sufficiently exclusive for us since it can include point-of-view shots, the various shot/reverse-shots, and cutaways. Similarly we did not include match-on-action situations, where the emphasis is on the cut between shots. This cut is generally placed between the initiation of an action by a character and the fulfillment or continuation of that action. For us, either both of these shots would be moving character shots or, if the cut were placed early enough in the action, it might be a solo shot (or some kind of SRS) followed by a moving character shot. Finally, we have also avoided the categorization of shots as subjective or objective (B. Brown 2012: 35; Mercado 2011), where the former are said to place the viewer "in" the scene and the latter "at the side" (Mascelli 1965: 13-14). We found this distinction to overlap with other shot types in our classification system.

Frequencies and Durations of Shots Across The Fifteen Classes

Using these fifteen classes we categorized every shot in twenty-four movies. We have used these movies for other purposes investigating scene structure and various shot attributes (Cutting 2014; Cutting, Brunick, and Candan 2012; Cutting and Iricinschi 2014). Together, they have about 31,000 shots. These movies were selected from eight release years (1940 to 2010 at ten year intervals) with three movies from each year – one drama, one comedy, and one action movie. They were

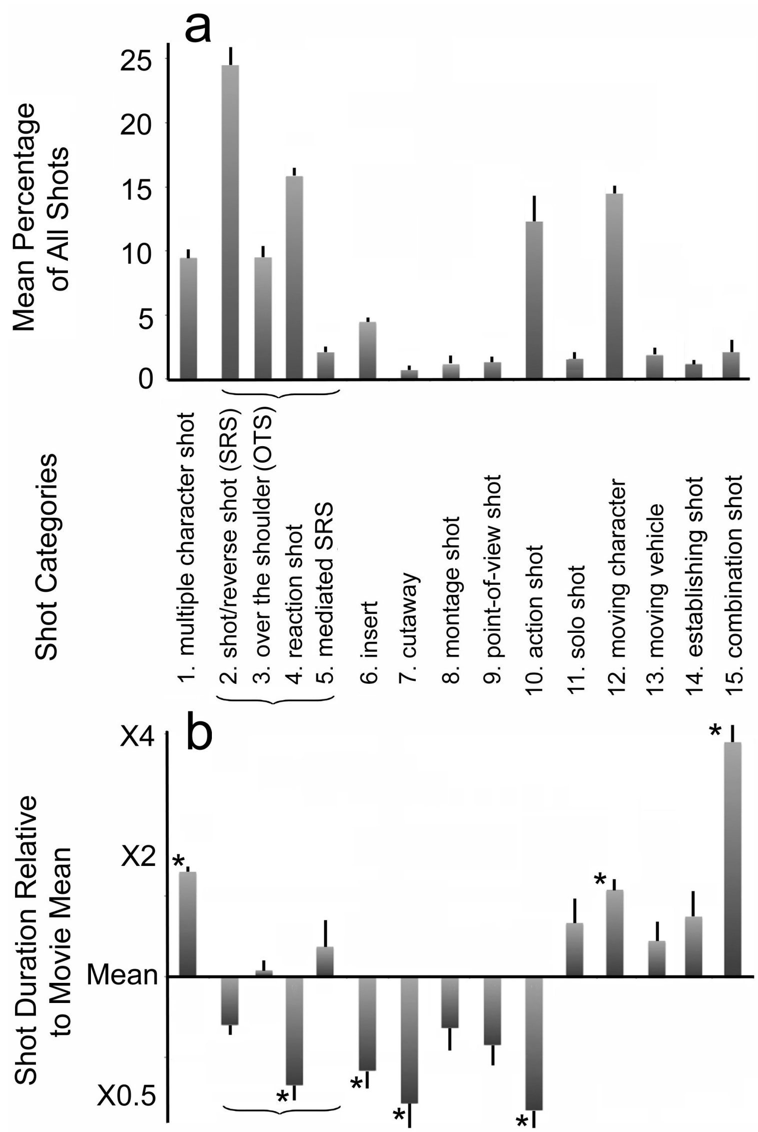

Figure 4. Panel *a* shows the mean relative frequencies of fifteen classes of shots in twenty-four moves released from 1940 to 2010. The dark whisker on each bar indicates one standard error of the mean. Panel *b* shows the mean durations of each of the fifteen classes of shots in each film relative to the mean of all shots in that film. X0.5 = half the mean shot duration, X2 = twice the mean, and X4 = four times the mean. Again, the dark whisker on each bar represents one standard error of each mean. Asterisks indicate those shot classes that are reliably different from the mean duration (α = .0001).

among the highest grossing of their release year or among the most often rated on the Internet Movie Database (http://www.imdb.com). See the Filmography for their listing. As part of a larger project investigating various types of shots and their functions in visual narratives, the first author categorized and tabulated all the shots of these movies. This entailed scrolling through each movie frame-by-frame, frequently back-and-forth, sometimes multiple times.

How frequent are these various classes of shots? Figure 4a shows their relative distributions. The average proportion of each shot class was tabulated first within each movie and then across the twenty-four movies. By far the most frequent are the various forms of shot/reverse-shots (classes 2-5), encompassing fully 50 percent of all shots across the twenty-four movies.[13] The next most frequent are moving character shots (14 percent); followed by action shots (12 percent), which of course are most prevalent in action films (29 percent) and much less so in the other two genres (4 percent). The fourth most common are the multiple character shots (9 percent). The remaining eight classes of shots are rare, accounting for only 15 percent of all shots.

Given the relative frequencies of the shots in these classes, we next need to know their relative durations. Given the considerably different mean shot durations across this set of movies – spread out over an order of magnitude from 2.4 seconds for *Mission: Impossible II* (2000) to 24 seconds for *Harvey* (1950) – we normalized the mean durations of each shot class, dividing them by the mean of all shots in that movie. We then log scaled those ratios and averaged them across the twenty-four movies. Results are shown in Figure 4b. Adopting a very conservative statistical criterion ($\alpha = .0001$), seven of these classes deviate reliably from the mean of all shots from which they are drawn. Those that are reliably longer are (1) multiple character shots, (12) moving character shots, and unsurprisingly (15) the combination shots. Those that are reliably shorter are (4) reaction shots, (6) inserts, (7) cutaways, and again unsurprisingly (10) action shots.

Combining frequencies with durations, we find that (12) moving character shots comprise almost one quarter of the run time of the average movie, followed by the SRSs (17 percent). However, this latter category burgeons to 38 percent of run time when all four shot/reverse-shot classes are considered together (adding OTS shots, 9 percent; reaction shots, 9; and mediated SRSs, 2). Multiple character shots occupy 16 percent, and action shots 7 percent, but again differing widely across genres (16 percent for action films and 2 percent for comedies and dramas).

Shots in All Classes Have Become Shorter in Duration

With these shot classes and their mean durations in place we can now ask: Have the durations of these shot classes changed over time? Which types of shots contribute to the pattern seen in Figure 1? Mean values were tallied across each film. The overall patterns from 1940 to 2010 are shown in Figure 5 as regression lines for each of the fifteen different shot classes. Each of these can be taken as an estimate of the linear trend across seventy years of English-language moviemaking. This riot of lines shows one remarkable result: *all* shot classes have decreased in duration from 1940 to 2010. Again, setting a stringent alpha level ($\alpha = .0001$), twelve of these

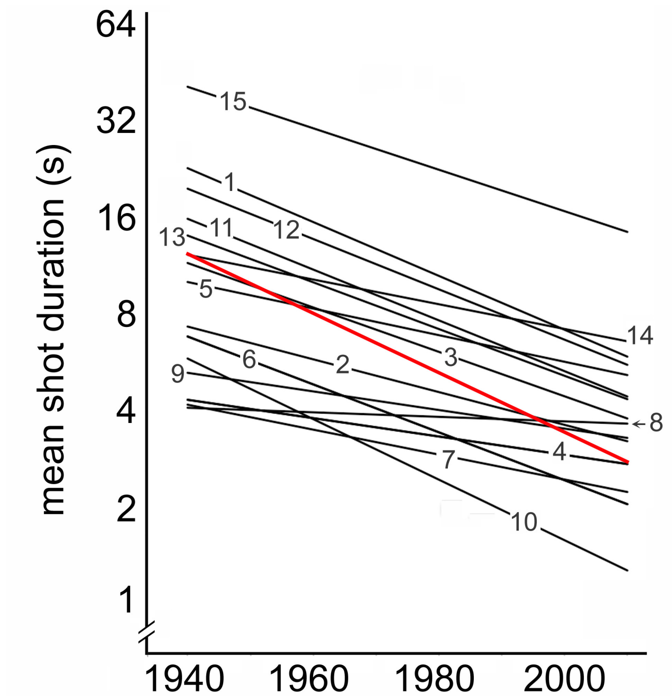

Figure 5. Linear regression lines on a log scale for fifteen types of shots categorized across twenty-four movies released from 1940 to 2010. The numbers associated with each line are the same as those in Figure 4. The red line denotes the regression line for grand mean shot duration of each movie. None of the slopes of these lines differ statistically from one another. The whisker at the upper right shows the mean standard error of the mean durations for each category of shot.

declines are statistically reliable ($Fs(1,>160) > 7.6$), and only (8) montage shots, (9) POVs, and (12) moving-character shots are not. Moreover, among the fifteen classes and their 105 possible pairwise comparisons, *none* of the differences in slopes of regression lines approached statistical reliability.

Thus, it is undeniable and irrefutable that the general trend towards shorter shot durations in movies is distributed more or less equally across every possible shot class. We take this result as providing support for our "evolutionary" approach to the overall reduction in mean shot duration. That is, this decline is an effect universal to all shot classes, not one driven by particular techniques of film style confined to only a few shot classes.

Since action shots are the shortest in duration among these classes it should be unsurprising that action films have shorter shot durations than comedies or dramas. Indeed, the mean shot duration for the eight action films is 4.64 seconds; that for the sixteen comedies and dramas is 8.58 seconds ($t(22) = 3.16$, $p < .005$, $d = 1.35$). One account of this difference is that most of the shots in action films might be like those in the films of other genres, have a much higher proportion of action shots. In other words, since action shots are the briefest of the shot classes (Figure 4b), their plethora in action movies might wholly account for their shorter mean shot duration. Another possibility, however, is that to reflect the increased tension and activity found in action movies all classes of shots would be shortened at least to some degree.

The result, however, is clear. Accounting for differences across release years and correcting for multiple comparisons[14] none of the fifteen comparisons between shot classes in action movies versus comedies and dramas is statistically reliable, not even for the action shots themselves. Thus, with regard to our shot classification scheme action movies are structurally like comedies and dramas except that they do indeed have a lot more action shots.

Historical Changes in Conversational Sequences

The core of almost every narrative, and comprising half of the shots in the average popular film, are the conversations among characters. These are presented mostly in shot/reverse-shot fashion. Given this importance we explored these shot classes further. Figure 6a draws out the trends of three subclasses from Figure 5 – (2) the simple SRSs, (3) the over-the-shoulder shots (OTS), and (4) the reaction shots. Again, there are no reliable differences among the slopes of these lines.

The historical trend, however, is not the most interesting pattern; there are systematic duration differences among these classes. The SRSs have always been reliably longer than reaction shots (4.95 vs. 3.43 seconds, $t(46) = 3.97$, $p < .0002$, $d = 1.17$) and the OTS shots have always been longer than SRSs (7.17 vs. 4.95 seconds, $t(46) = 2.47$, $p < .02$, $d = .73$). Not shown are (5) the mediated SRSs. These are longer still but also rare.

The difference between SRSs and reaction shots makes reasonable sense. The listener in a conversational exchange may need to provide the viewer only some expressive response. These can also be short simply to break up the extended discourse of the talker. The difference between SRSs and OTS shots, on the other hand, seems less intuitively obvious. There must be something in the OTS shots that necessitates them being longer. Is it to allow more fixations, at least one on each person? We don't know. Mercado (2011) suggests that the relative power in the relationship of two characters can be signaled better over the shoulder. OTS shots can also signal the physical proximity of the two characters and thus imply other aspects of their relationship, such as intimacy.[15] In addition, in SRS sequences the viewer might feel she has "lost" the unseen character if the shot of the talker is too long, whereas with an OTS shot both conversationalists are tied together and alternation may be less necessary. This remains something of a puzzle.

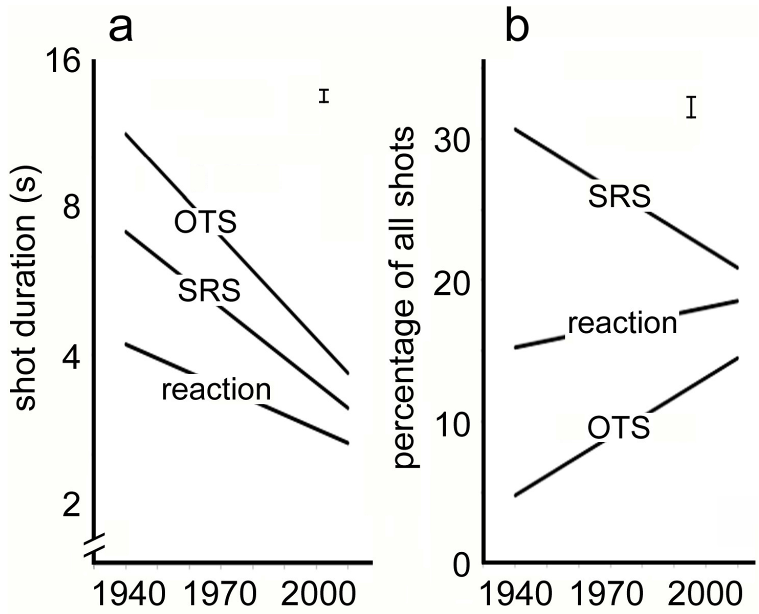

Figure 6: Regression lines for the mean shot durations (Panel *a*) and mean proportions (Panel *b*) of three shot/reverse shot classes by release year. SRS = standard shot/reverse-shot in which a single character is seen talking to an unseen character; OTS = over-the-shoulder shots where the talker faces the camera and the listener faces away and is at least somewhat blurred; and a reaction shot comes from both SRS or OTS sequences in which the character facing the camera is a listener and does not talk during the shot. These three classes of shots comprise 48 percent of all shots in these twenty-four movies. The whiskers at the upper right of each panel show the mean standard error of means for the data that compose each regression line.

Figure 6b shows the trends for relative frequencies of these shots in films from 1940 to 2010. Notice the decline of SRSs (r = -.34. $t(22)$ = 1.93, p = .09, d = .83) and the rise of OTS shots (r = .48, $t(22)$ = 2.18, p = .04, d = .93). Although both effects are marginal, the difference between the two is a bit more robust ($t(44)$ = 2.66, p < .01, d = .80). Contemporary moviemakers seem increasingly to prefer over-the-shoulder shots to simple SRSs – another puzzle.

Three Contributions to the Historical Decline in Shot Duration

Despite the results discussed above we still have only vaguely addressed the reasons for the shot-duration decline shown in Figure 1. The uniform decline across shot classes in Figure 5 provides some support for our general “evolutionary” approach (Cutting and Candan 2013). But our data here and elsewhere offer evidence for two additional causes. As a backdrop, however, let us restate our evolutionary approach.

Simple Découpage. Incrementally over time editors have cut up into smaller pieces the raw footage they receive from film crews. That is, increasingly perhaps movies have had all the “dull bits cut out” (Truffaut, 1983: 103) no matter how small those bits may be and without regard to the kind of shot in which they may have appeared. Basically, this is a description of the end result of modern editing couched in the economics of informativeness. The problem with such an account is that although it captures the essence of the declining trend in mean shot durations it is currently circular in reasoning. Without some idea of how cinematic information might be measured, it is simply a redescription of the result. Nonetheless, given the failure of all the all other accounts that we have entertained, we need to keep this idea as a background factor, which we will call *simple découpage*, as we search for less generic and more overtly causal factors.

Shot Class Redistribution. Long takes are expensive in both rehearsal time and crew time. Thus, a second factor in shot-duration reduction could be the redistribution of shots among the fifteen shot classes, cutting up longer duration shots and forging them into shorter duration classes. This redistribution could happen in three ways.

The most straightforward is no different than simple découpage, for example taking a combination shot and breaking it into separate components. One hypothetical shot mentioned above started with an insert, backed off to a solo shot, backed off again and panned in a moving character shot, and then finished with a multiple character shot. Each of these four shots would considerably shorter than the original. Such a result generalized across many instances would contribute to the overall mean shot-duration decline. However, combination shots are relatively rare (2 percent) and their fractionation is unlikely to contribute very much to the reduction of overall shot durations.

A second and apparently more promising method would be to break up conversational sequences to include more reaction shots, which are relatively short in duration. Figure 6b clearly shows that this has happened over the last 70 years, but it also shows that the proportional increase (only 4 percent) of reaction shots is small. Thus, this too is unlikely to be a major factor in the fall of shot durations.

A third and more diffuse possibility is that movies have been globally reworked over time so that shots from classes that are relatively longer in normalized duration have been replaced by those in different classes that are relatively shorter, but without any obvious or specific trading among classes. More concretely, this would mean that there are proportionately fewer multiple character shots, fewer moving character shots, and fewer moving vehicle shots – all of which are longer than the average shot in a movie – and more action shots, more reaction shots, and more inserts, which are shorter than the average shot.

Comparing the normalized duration of the shots in these fifteen classes with the amount of change in the proportion of total run-time that those shots have undergone, yields a striking result (r = -.57, $t(13)$ = 2.5, p = .027, d = 1.29). Indeed, shots in longer-duration classes have become considerably less frequent, and those in shorter-duration classes have become more frequent. As shown in Figure 7, the four classes with longest normalized durations (from Figure 4b) have significantly diminished in the proportion of their cumulative run time, and two of the classes with much shorter normalized durations have significantly increased.[16]

From these data we can estimate that 25 percent of the decline in shot durations from 1940 to 2010 is due to the redistribution of shots among the fifteen shot classes. That is, the redistribution of frequencies and consequent run-time totals of the six shot classes shown in Figure 7, coupled with the nine not shown, yields a decline equal to a quarter of the total decline in mean shot duration of this sample of movies.

Shot Scaling. Bordwell (2006: 137) reported that filmmakers have found that longer-scaled (wider-angle) shots must be longer in duration, and that shorter-scaled shots (like closeups) can be shorter in duration. Presumably this is because longer-scaled shots invite the viewer to look around more, requiring more fixations.[17] Cutting (2015) analyzed the over 13,000 shots from 48 movies, the twenty-four that we used here and twenty-four others from release years 1935 to 2005 sampled every ten years. He found this relation – wider-angle shots are longer in duration than closeups – and estimated that shot-scale effects might account for as much as 20 percent of the historical effect of declining mean shot duration, but

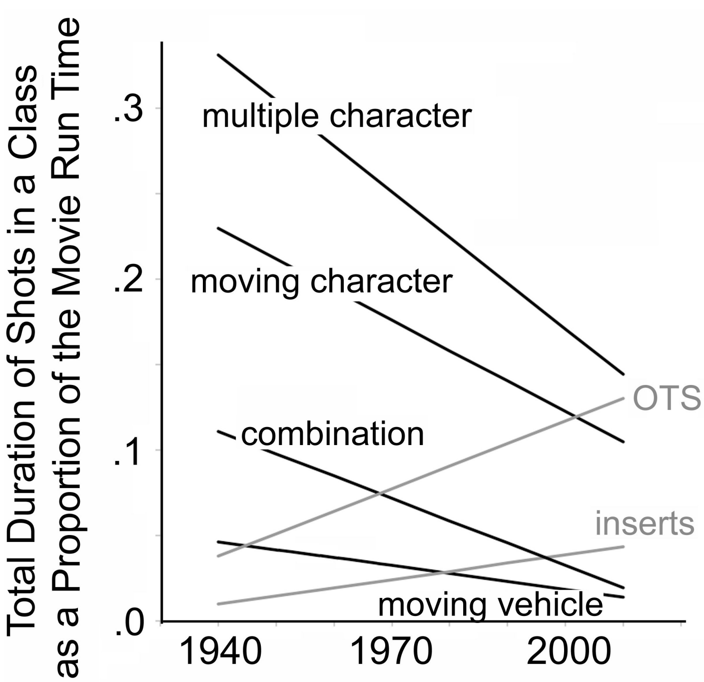

Figure 7: The total proportion of the run time in movies for six classes of shots over seventy years. In general longer-duration classes of shots have become less frequent in movies, and shorter-duration classes of shots have become more frequent. See Figure 4b for the mean durations. OTS = over the shoulder shots.

likely less than that. The data of this study afforded the possibility of a better estimate.

Using the shot categorizations here and their relative frequencies, we matched those to the shot scale data for these same twenty-four movies as analyzed by Cutting, Brunick, and Candan (2012) and Cutting and Iricinschi (2015). We fit linear regressions to the historical trends of each shot category in terms of shot scale and shot frequency, and calculated the change in shot duration dependent on these factors. Indeed, Cutting (2015) overestimated the historical change in shot scale due to movies. We find that this factor can account for 8 percent of the variance in the historical shot-duration data once other variables are factored out.

Conclusions

The average duration of shots in popular movies has been declining in a linear manner for eighty years, most strikingly for English-language films. No one has had a compelling explanation as to why, and there are several explanations given elsewhere for which we find no evidence – the effect of music videos on popular filmmaking, the cumulative effect of screen media on our patterns of attention, and the decline of the studio era in Hollywood.

We have favored an idea concerning the cultural evolution of filmmaking (Cutting and Candan 2013). Descriptively, we propose that filmmakers try to distinguish themselves slightly from their predecessors in many ways. We suggest further that one of these ways, and likely not an overtly conscious one, has been to shorten the shot durations of all classes of shots. Viewers have tolerated this reduction perhaps because they have become more efficient at extracting information from the visual narrative. It turns out that this increase in pace trims about three frames per shot per year. We refer to this as simple découpage, but we recognize that it is a vague and currently an incompletely satisfactory notion.

We believe the first major contribution of this article is to put some flesh on our evolutionary approach, demonstrating that the increased pace of movies is due to the more or less uniform shortening of all classes of shots. In particular, by categorizing all the shots of twenty-four movies into fifteen exclusive and exhaustive classes and by observing their universal and indistinguishable decline in duration over seventy years, we corroborate the idea of a more general, evolutionary trend that does not focus on particular shot classes.

We believe that the second major contribution of this article is to apportion some of the historical change away from our broad evolutionary account into two other, much more concrete causes. That is, filmmakers have gradually redistributed shots among the fifteen shot classes – away from longer-duration classes and towards shorter-duration classes. This redistribution accounts for one quarter of the diminution in shot duration. Adjustments in shot scaling towards more closeups account for another 8 percent. The remaining two-thirds remains thus far unexplained, but remains roughly consistent with an evolutionary account.

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References

Apple, Wendy. (2005). *The cutting edge: The magic of movie editing.* USA: Warner Home Video.

Arnheim, Rudolf. (1957). *Film as art.* Berkeley, CA: University of California Press.

Barsam, Richard and Dave Monahan. (2013). *Looking at movies* (4th ed.) New York: Norton.

Bordwell, David. (2006). *The way Hollywood tells it.* Berkeley, CA: University of California Press.

Bordwell, David. (2013). The viewer's share: Models of mind in explaining film. In Arthur P. Shimamura (ed.), *Psychocinematics: Exploring cognition at the movies.* Oxford: Oxford University Press.

Bordwell, David, Janet Staiger, and Kristin Thompson. (1985). *The classical Hollywood cinema: Film style and mode of production to 1960.* New York: Columbia University Press.

Bordwell, David and Kristin Thompson. (2004) *Film art: An introduction* (7th ed.) Boston, MA: McGraw Hill.

Branigan, Edward. (1992). *Narrative comprehension and film.* London: Routledge.

Brown, Blaine. (2012). *Cinematography: Theory and Practice* (2th ed.). Amsterdam: Elsevier.

Brown, John Seely. (2000). Growing up digital: How the web changes work, education, and the ways people learn. *Change, 32*(2): 10-20. http://www.jstor.org/stable/40165601

Chandler, Gael. (2004). *Cut by cut: Editing your film or video.* Studio City, CA: Michael Wiese Productions.

Chandler, Gael. (2009). *Film editing.* Studio City, CA: Michael Wiese Productions

Cowan, Nelson, Nathanael M. Fristoe, Emily M. Elliott, Ryan P. Brunner, and J. Scott Saults. (2006). Scope of attention, control of attention, and intelligence in children and adults. *Memory and Cognition, 34*(8): 1754-1768.

Cutting, James E. (2015). The framing of characters in popular movies. *Art & Perception,* in press.

Cutting, James E. (2014). Event segmentation and seven types of narrative discontinuities of popular movies. *Acta Psychologica, 149*: 69-77. dx.doi.org/10.1016/j.actpsy.2014.03.003

Cutting, James E., Kaitlin L. Brunick, and Ayse Candan, A. (2012). Perceiving event dynamics and parsing Hollywood films. *Journal of Experimental Psychology: Human Perception and Performance, 34*(4): 1476-1490. doi: 10.1037/a0027737.

Cutting, James E., Kaitlin L. Brunick, and Jordan E. DeLong. (2011a). The changing poetics of the dissolve in Hollywood film. *Empirical Studies in the Arts, 29*(2): 149-169. doi: 10.2190/EM.29.2.b.

Cutting, James E., Kaitlin L. Brunick, Jordan E. DeLong, Catalina Iricinschi, and Ayse Candan. (2011b). Quicker, faster, darker: Changes in Hollywood film over 75 years. *i-Perception,*

2: 569-576. dx.dor.org/10.1068/i0441aap.
Cutting, James E. and Ayse Candan. (2013). Movies, evolution, and mind: From fragmentation to continuity. *The Evolutionary Review, 4*(3): 25-35.
Cutting, James E., Jordan E. DeLong, and Kaitlin L. Brunick. (2011b). Visual activity in Hollywood film: 1935 to 2005 and beyond. *Psychology of Aesthetics, Creativity and the Arts, 5*: 115-125. dx.doi.org/10.1037/a0020995.
Cutting, James E. and Catalina Iricinschi. (2015). Re-presentations of space in Hollywood movies. *Cognitive Science,* in press. doi: 10.1111/cogs.12151.
Flynn, James R. (2007). *What is intelligence?* New York: Cambridge University Press.
Hasson, Uri, Ohad Landesman, Barbara Knappmeyer, Ignacio Valines, Nava Rubin, and David J. Heeger. (2008). Neurocinematics: The neuroscience of film. *Projections: The Journal for Movies and Mind, 2*(1): 1-26. doi: 10/3167/ptoj.2008.020102.
Mascelli, Joseph V. (1965). *The five C's of cinematography.* Los Angeles, CA: Silman-James Press.
Mercado, Gustavo. (2011). *The filmmaker's eye.* Burlington, MA: Focal Press.
Metz, Christian. (1974). *Film language: A semiotics of the cinema.* (M. Taylor, Trans.) Chicago, IL: University of Chicago Press.
Mital, Parag K., Tim J. Smith, Robin L. Hill, and John M. Henderson. (2011). Clustering of gaze during dynamic scene viewing is predicted by motion. *Cognitive Computation, 3*: 5-24. doi 10.1007/s12559-010-9074-z.
Pearlman, K. (2009). *Cutting rhythms: Shaping the film edit.* Amsterdam: Elsevier
Ratcliff, Roger, & Gail McKoon (2008). The diffusion decision model: Theory and data for two-choice decision tasks. *Neural Computation, 20*(4): 873-922. Doi: 10.1162/neco.2008.12-06-420.
Rouder, Jeffrey N., Paul L. Speckman, Dongchu Sun, Richard D. Morey, R. D., and Geoffrey Iverson. (2009). Bayesian *t*-tests for accepting and rejecting the null hypothesis. *Psychonomic Bulletin & Review, 16,* 225-237. doi: 10/3758/PBR.16.2.225.
Salt, Barry. (2006). *Moving into pictures.* London: Starwood.
Salt, Barry. (2009). *Film style and technology: History and analysis.* London: Starwood.
Salt, Barry. (2010). Comments on *Attention and Hollywood Films.* http://www.cinemetrics.lv/salt_on_cutting.php (downloaded, 15 October 2014).
Salt, Barry. (2013). Salt on Baxter on Cutting. http://www.cinemetrics.lv/dev/CutThoughtC.pdf (downloaded, 15 October 2014).
Smith, Tim J. (2013). Watching you watching movies: Using eye tracking to inform film theory. In Arthur Shimamura (Ed.) *Psychocinematics: Exploring cognition at the movies* (pp. 165-194). Oxford: Oxford University Press.
Smith, Tim J. and Parag K. Mital. (2013). Attentional synchrony and the influence of viewing task on gaze behavior in static and dynamic scenes. *Journal of Vision 13*(8), Article 16, 1-23. doi: 10.1167/13.8.16
Spottiswoode, Roger. (1951). *Film and its techniques.* Berkeley, CA: University of California Press.
Truffaut, François (1983). *Hitchcock* (revised ed.). New York: Simon and Schuster.
Zunshine, Lisa. (2012). *Getting inside your head: What cognitive science can tell us about popular culture.* Baltimore, MD: Johns Hopkins University Press.

Filmography

Altman, Robert. (1970). *MASH.* USA, Twentieth Century Fox Home Entertainment.
Columbus, Chris. (1990). *Home Alone.* USA: Twentieth Century Fox Home Entertainment.

Cukor, George. (1940). *The Philadelphia Story.* USA: Warner Home Video.
Curtiz, Michael. (1940). *Santa Fe Trail.* USA: MGM/UA Home Entertainment.
Fincher, David. (2010). *The Social Network.* USA: Columbia TriStar Home Entertainment.
Ford, John. (1940). *The Grapes of Wrath.* USA: Twentieth Century Fox Home Entertainment.
Higgins, Colin. (1980). *Nine to Five.* USA: Twentieth Century Fox Home Entertainment.
Harlin, Renny. (1990). *Die Hard 2*. USA: Twentieth Century Fox Home Entertainment.
Koster, Henry. (1950). *Harvey.* USA: Universal Studios Home Video.
Marshall, Garry. (2010). *Valentine's Day.* USA: Warner Home Video.
Kramer, Sidney. (1960). *Inherit the Wind.* USA: MGM Home Entertainment.
Kershner, Irvin. (1980). *Star Wars: Episode V - The Empire Strikes Back.* USA: Twentieth Century Fox Home Entertainment.
Kubrick, Stanley. (1960). *Spartacus.* USA: Universal Home Video.
Mankiewicz, Joseph L. (1950). *All About Eve.* USA: Twentieth Century Fox Home Entertainment.
Meyers, Nancy. (2000). *What Women Want.* USA: Paramount Home Video.
Milestone, Lewis. (1960). *Ocean's Eleven.* USA: Warner Home Video.
Nolan, Christopher. (2010). *Inception.* USA/UK: Warner Home Video.
Post, Ted. (1970). *Beneath the Planet of the Apes.* USA: Twentieth Century Fox Home Entertainment.
Rafelson, Bob. (1970). *Five Easy Pieces*. USA: Columbia TriStar Home Entertainment.
Redford, Robert. (1980). *Ordinary People.* USA: Paramount Home Video.
Scorsese, Martin. (1990). *Goodfellas.* USA: Warner Home Video.
Soderbergh, Steven. (2000). *Erin Brockovich.* USA: Universal Studios Home Video.
Tourneur, Jacques. (1950). *The Flame and the Arrow.* USA Warner Home Video.
Woo, John. (2000). *Mission: Impossible II*. USA/Germany: Paramount Home Entertainment.

Footnotes

[1] A Google search of "quicker pacing in movies" (24 Oct 2014) brings up dozens of websites discussing the matter.

[2] As a check on Salt's data we compared his data to ours on the same movies. There was very little difference. In the sample there are over 6200 movies produced in the US, over 1500 from Britain, over 100 from Australia, almost 100 from Canada, and a bit less than 50 each from Ireland and New Zealand, with 1300 unclassified but with English-language titles. We also screened out films (57) with average shot durations more than five standard deviations above the mean of the sample (25 seconds).

[3] One might wonder why log scaling (converting raw durations by a logarithmic transformation) is necessary. There is a long history in psychology and elsewhere of treating time in this manner, and a log transform of an exponential function creates a straight line. Exponential functions are quite common in science and straight lines are easier to deal with both visually and statistically. More theoretically, Ratcliff and McKoon (2008) assume that information accumulates through a biased random-walk process and that the time this drifting accumulation takes to reach a criterion creates a log-normal distribution. More concretely, if one has a number of processes that have a mean of 1.0 and vary randomly, say between 0.5 and 1.5, and if one multiplies them together over many trails, their products will generate a log-normal distribution. Finally, all parametric statistics, such as those used it this article, are based on normal distributions. Thus, log-scaling a distribution that is log-normal will generate a normal distribution. DeLong (2013) has documented the almost perfectly log-normal distribution of shot durations across nearly 150 movies (see also Salt 2006)

[4] See, for example, Wikipedia for the entry on "post-classical editing" (assessed 14 October 2014): "The quick cuts which are characteristic of post-classical editing are something that younger

generations have become accustomed to. The influence of MTV on the fast-paced, quick-cuts that can be seen in movies today is not something all filmmakers agree upon. Director Lawrence Kasdan [Apple 2004] states … that the generation of people who grew up on MTV and 30 second commercials can process information faster, and therefore demand it. Editors were pushed in the direction of the quick cut style of editing in order to stay in tune with what their audiences wanted and demanded."

[5] See Klass, P. (9 May 2011) Fixated by screen, but seemingly nothing else. *The New York Times.* http://www.nytimes.com/2011/05/10/health/views/10klass.html?_r=0, and Alderman, L. and Hwang, K. O. (assessed 31 Aug 2010) "Does technology cause ADHD, EverydayHEALTH. The latter suggests: "It's probably wise to limit your child's time with screen media. While these media may not *cause* ADHD, they could very likely exacerbate a problem that's already there — or simply lead to poorer attention overall." http://www.everydayhealth.com/adhd-awareness/does-technology-cause-adhd.aspx

[6] If anything, attention span may have increased over the last century, but surprisingly there seem to be no direct data on this. Indirectly, however, we know that attention span is positively correlated with intelligence (e.g. Cowan et al, 2006) and that measured IQ has increased over the last century (e.g. Flynn, 2007).

[7] These films were classified as English-language movies in the sense that they were produced in English-language speaking countries. It is well-known that intertitles could be substituted in any language and the films distributed worldwide. Notice also that there is no segmented regression possible between the stages of 1913-1927 and 1928-1959. The reason is that a hinge between these two periods fails to leave the two regression lines statistically reliable. And why it took sound filmmakers until about 1995 to achieve a pacing state that silent filmmakers had a bit more than 70 years before is an interesting, but unanswered question.

[8] These include about 360 from France, about 160 from both India and Germany, 120 from Italy, 90 from Japan, 60 from Sweden, 50 from Russia, 40 from Spain, 30 each from Hong Kong and from China, and about 20 each from Argentina, Czechoslovakia, Denmark, Iran, Korea, and Mexico; with a handful from over forty other countries.

[9] For those countries with more than twenty-five films in the sample and with a release-period ranging over a period of at least sixty years (to avoid truncated-range effects) there are statistically reliable ($p < .05$) declines for the films from France, Germany, Hong Kong, India, Italy, Japan, and Spain, with a similar trend for films from Sweden. Only Russia (Soviet Union) had a slight, but not statistically reliable, increase in mean shot duration.

[10] We know of only one other attempt to classify and enumerate all shots in films. Salt (2009) focused on three types of shots – reverse angle shots (SRSs), point-of-view shouts (POVs), and inserts. Our results are not wholly compatible with his, probably because with more classes we developed stricter, and perhaps more idiosyncratic, definitions. Many of our combination shots, for example, start with an insert and then back up to show a character, often in a medium shot.

[11] Cutting and Iricinschi (2015) defined establishing and re-establishing shots as those that begin a scene in a new location or time and those that return to that location or time, respectively. This is not a standard definition for the latter. In particular, re-establishing shots are often master shots (or multiple character shots) inserted within a conversational SRS sequence either to track the dynamics of the conversation or to remind the viewer of the arrangement of the talkers, or both.

[12] Only one of our films, *Santa Fe Trail* (1940), had intertitles so we included these shots in the combination shot class. In other films with a few overlaid words, for example *Goodfellas* (1990), we simply ignored those words and classified the shot by its content.

[13] Salt (2009: 280 & 368) reported 40 percent of shots as reverse angle (SRSs) in 20 films from 1959 and 1999, a value not far different from the 48 percent here when excluding the mediated SRSs examples. However, he also reported frequencies of as much as 10 percent each for POVs and inserts, considerably more than the 2 percent and 5 percent that we have found. It is likely, however, that many of our moving vehicle shots (2 percent) could also be called inserts, and that some of the multiple character shots (9 percent) could be considered POVs.

[14] We used the Šidák correction, $[1-(1-\alpha)^\wedge(1/k)]$, where k is the number of comparisons and $\alpha = .05$.

[15] Cutting (2015) noted that longer duration shots are associated with shots of greater scale (farther from being closeups). However, there is no reliable difference in shot scale for SRSs and OTS shots.

[16] This calculation takes the mean shot duration of each shot class and multiplies it by the number of shots in that class (which is the run-time of that shot class), and then divides that value by the duration of the movie. If shot duration for a given class declined but the proportion of such shots increased, it might maintain or increase its proportion of movie run-time. This is the case for inserts and OTS shots. If the shot durations declined and their proportion also declined, then their proportion of run-time will also decrease. This is the case for multiple character shots, moving character shots, moving vehicle shots, and combination shots. In addition action shots are excluded from Figure 7, although their contribution is the same direction as the other short-duration classes (increasing in slope) but their run-time change is small and not significant because of sharp differences across genres.

[17] Smith (2013) has shown a linear decrease in the variance of fixation position on screen from long shots through medium closeups. However, for close-ups and extreme close-ups the variance again increases