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Commentary

Events, Movies, and Aging

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What is an event? A mid-20th century Webster's Collegiate Dictionary (1943, p. 425; see also Cutting, 1981) defined it as "that which occupies a restricted portion of four-dimensional space-time." This charming gloss pays perhaps undue homage to modern physics but it is also useful, suggesting that events have spatial and temporal boundaries. Where do these boundaries come from? The practical constraints of the everyday world—the arrangement and movement of the stuff and folks around us—are surely relevant, but so too is the mind of the perceiver. So Zacks and Tversky (2001, p. 17) defined an event as "a segment of time at a given location that is conceived by an observer to have a beginning and an end." Why is this amendment important? Richmond, Gold, and Zacks (2016) convincingly propose that events are a fundament of human cognition, and even a tool that can be used to assess cognitive aging (see also Sargent et al., 2013). We agree.

Perhaps the most endearing example of the power of event boundaries is the *doorway effect*. Embarrassingly, most of us have experienced the situation of arriving in a given location—say the mailroom of our place of work—only to discover that we have no idea why we are there. No, we haven't lost our minds. Radvansky and Copeland (2006; Radvansky, Krawietz, & Tamplin, 2011; see also Brenner & Zacks, 2011) have shown that the mere act of walking through a door can often trigger forgetting. Why? This is a property of event cognition. Events take place in given spaces at given times—the "four-dimensional space-time" alluded to earlier—and those events have boundaries. Doors are prominent and ubiquitous spatial borders. Walking through them opens onto the new and closes off the old. Old stuff can often be forgotten, it may belong to a different event; forgetting clears the mental way so we can better experience the new. That the doorway effect is a good explanation for some everyday forgetting may not ease our embarrassment, but it does show how the mind can parse everyday life.

Events, Scenes, Shots, and Popular Movies

In line with Richmond et al., our research is also concerned with events, but in a quite special venue—popular movies. Popular movies tell stories; they are narratives. In turn these narratives have structure. In particular, they are made up of shots, scenes, and other units (Cutting, 2016), although only the first two concern us here. Shots make up scenes. Scenes, in turn, are defined in theater as taking place in a particular location, with a particular (set of) character(s), in a confined period of time (Polking, 1990), and this framework applies equally well to movies. Moreover, since events as defined by Zacks and Tversky (2001) are also defined with respect to locations, people, and time, it is not surprising that when Cutting, Brunick, and Candan (2012) had viewers segment whole films into events, there was reasonable agreement among them. It seems appropriate to call the units of their segmentation both scenes and events.

In modern movies shots most often have abrupt transitions between them called cuts. The cut is said to have been discovered serendipitously by the early filmmaker George Méliès. Méliès claimed that while filming a street scene in France in the late 1800s, his camera ran out of film. He reloaded, restarted the camera, and spliced the two ends together. The streetcar magically turned into a hearse—and launched his career as film's first illusionist (Packer, 2007). In a narrative sense, before the invention of the cut and its kindred transitions—the fade, the dissolve, and the wipe—film was little more than a display of a real-time happening that may or may not have been captured

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in its entirety. In fact, many of these first films are referred to as *actualités*, or "slices of life" (Parkinson, 1996)—a kiss, a sneeze, a dance, or a brief boxing match. They depicted short spans of everyday activity from a single vantage point. But transitions ignited a revolution by allowing filmmakers to build narratives. By cutting and merging a variety of shots together, they were able to tell more complex stories that relied on the clever construction and ordering of events. They could jump across time, across space, and easily exchange characters as they did so. The family of transitions—cuts and their like—allowed for the cinematic invention of the scene, the scaffold to a full story.

The very fact that the cut and other transitions promoted this revolution speaks to the parsing mechanisms of the human mind. Surprisingly, early filmmakers did not need to instruct audiences on how to watch and understand this new narrative format. Film viewers were well equipped to do so on their own. Indeed, as noted by Richmond et al. (2016), even infants look longer at film pauses that occur before an actor completes an action than those that occur at the completion of action, suggesting that humans are sensitive to event boundaries early in life (Baldwin, Baird, Saylor, & Clark, 2001). The ability to sense event boundaries is nicely captured by Richmond et al. (2016) in their overview of event segmentation theory, which describes the role of violation of expectation (Speer, Zacks, & Reynolds, 2007; Swallow, Zacks, & Abrams, 2009; Zacks, Kurby, Eisenberg, & Haroutunian, 2011). An event often ends and another begins when one's predictions are not realized, and in movies continuity is broken by somewhat unpredictable change in time, place, or characters across scene boundaries.

A contemporary movie may have two to three thousand cuts, and *Avengers: The Age of Ultron* (2015) has even a bit more than that. These cuts may seem like they too would be obvious event boundaries, making shots an obvious event unit. But psychologically these are typically neither. Despite their importance in film history, cuts do not automatically define events. More often they provide the support structure for the scene. The average scene in movies of the last fifty years has a median of about seven shots and a mean of about twelve (Cutting et al., 2012). The difference between these numbers indicates that the distribution is highly skewed and that there are some long scenes with very many shots. For example, *The Social Network* (Fincher, 2010) begins with a bar scene of more than a hundred shots of Erica Albright (Rooney Mara) breaking up with Mark Zuckerberg (Jesse Eisenberg), but this is unusual.

Less unusual is the single-shot scene, which can be short but often long in duration. For example, there is also a three-minute tour de force in *Goodfellas* (Scorsese, 1990) where the protagonists walk up to and through the back of the Copa Cabana nightclub. With computer techniques that allow the digital knitting together of different shots, long takes (the name for long-duration shots) have recently become increasingly fashionable. There is a one-shot forest battle scene near the beginning of *Avengers: The Age of Ultron* that is just over one-minute long, full of astonishingly complex (and implausible) action. But this shot/scene is dwarfed by the nearly 17-min continuous "shot" at the beginning of *Gravity* (Cuarón, 2013).

In the oldest movies, scenes were identical with shots—one shot per scene—and they were typically separated by dissolves and fades. As cuts were introduced they were typically placed within scenes, and fades and dissolves were used between them. Since the 1960s, however, transitions between scenes are almost always cuts—just like those within a scene. Moreover, viewers have no difficulty treating scene-boundary cuts differently than within-scene cuts, and these differences can be manifest in various regions of the brain (Magliano & Zacks, 2011). In particular, brain processes appear to "clear out" leftover information from a shot that comes from a previous scene but do less of this after a previous shot within a scene, a metaphor that seems related to the doorway effect.

Cutting et al. (2012) looked at the film parameters in the movies that seemed to promote event segmentation. For films released before 1975, the presence of dissolves, fades, or wipes were by far the strongest source of information, accounting for more than 20% of the variance. But these are now rare, accounting for only about 1% of all transitions, and their efficacy in predicting a scene boundary has almost disappeared. The decline of dissolves, fades, and wipes is likely due to the changing intentions and demands of filmmakers. On the one hand, early filmmakers were proud to display technological feats in storytelling, whereas contemporary filmmakers more often hope to make their technique invisible and bathe their viewers in a visual story, a goal which renders salient transitions damaging to the experience of narrative immersion (Armstrong & Cutting, 2016). In addition, fades and dissolves take time and, as contemporary storytelling has become more complex, time comes at a premium in modern filmmaking.

The most important source of boundary information remaining (and the second most important in older movies) is shot scale, accounting for about 13% of segmentation variance. Shot scale is basically a measure of how large the character is on screen, and ranges from an extreme closeup (where only part of the face is visible) to an extreme long shot (where the entire body of the character is dwarfed by the foreground and background). In general, scenes begin with a longer-scaled shot than the average shot in the scene, and sometimes also end with a longer-scaled shot as well, particularly if there is a change in tone. In other words, spatially it is as if the camera enters the locale of the characters from some distance, moves in to follow a conversation (60% of all shots in movies are of conversations; Cutting & Candan, 2015), and then often backs away before entering a new locale and repeating the cycle. This process seems to mimic spatial navigation and, although many scenes bend and even violate this scheme, it provides a general rule.

Following shot scale in segmentation efficacy is shot duration, accounting for about 9% of the variance. Scenes tend to begin and end with longer-duration shots. It is as if the filmmakers need to give you more time to evaluate information about the setting early on in a scene, then the conversation progresses, often going back and forth between the conversants in what are called shot/reverse-shot sequences. Each scene often ends with a shot of a character delivering some important information or reacting in an important way to what has been said before, and filmmakers let this take time to fully register.