

# Static and dynamic visual narratives, by brain and by eye

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## Introduction

Narrative has been studied for millennia, though recent attention in the cognitive sciences has turned towards visual narratives like those found in comics (Cohn, 2013a) and films (Zacks, 2014). Most agree that the basic principles guiding comprehension involve principles that extend across the verbal and visual domains (Cohn, 2013b; Gernsbacher, 1990; Magliano & Zacks, 2011). However, visual units of narrative—both drawn and moving—demand different affordances to retrieve and integrate information.

Unlike verbal information, the sequential units of visual narratives use an analog spatial representation, from which a comprehender must extract the relevant information, ignore or suppress the irrelevant information, and work to connect such information across a sequence of units. This involves the integration of complex event information and its interaction with narrative structures.

Such a process is further varied in the difference between static, drawn visual narratives (as in comics) and dynamic, moving ones (as in films). The introduction of movement to a sequence provides important cues and an additional layer of constraints on the effective communication of visual sequential information.

This symposium highlights this growing field within the cognitive sciences. First, the presentations focus on visual narratives of both types: static, drawn narratives, and dynamic, moving ones. Second, they split their focus between eye-tracking and cognitive neuroscience. Together, these presentations will highlight the relevance of visual narratives for studying many facets of cognition, including attention, events, narrative, and discourse.

## Do you see what I see? The curious absence of endogenous effects on gaze during cinematic narratives

Our first talk by *Tim J. Smith*, along with John P. Hutson (Kansas State University), Joseph P. Magliano (Northern Illinois University), and Lester C. Loschky (Kansas State University), explores the dynamic nature of film narratives. Cinematic narratives are ubiquitous but unlike textual narratives or static images, how we process edited audiovisual sequences is barely understood. From reading and scene processing we know that exogenous (i.e. stimulus demands) and endogenous factors (i.e. higher-cognitive factors such as individual differences and comprehension) compete over our overt attention, biasing where we fixate and how we process the information. However, eye-tracking studies of film viewing have demonstrated a surprising similarity in where multiple viewers direct their gaze; a phenomenon we call attentional synchrony (Smith & Mital, 2013). Task instruction, individual differences such as expertise and age, and even differences in how the edited scenes are comprehended often fail to show gaze differences. This fragility of endogenous influence is at odds with emerging theories of active vision (Henderson, 2017). In this talk we will review several studies from our labs investigating the causes of attentional synchrony and show how filmmakers have intuited techniques to guide viewer attention in complex dynamic scenes. These findings will be used to extend the Attentional Theory of Cinematic Continuity (Smith, 2012) to include an appreciation of the dynamic interplay between exogenous and endogenous factors during cinematic narratives and the apparent dissociation between gaze and comprehension.

## Eye-tracking sequential context in scenes, comics and movies

The scenes that confront us in our everyday lives are highly structured in time and space. However, most of what we know about how people look at such scenes is based on experiments with isolated images presented in a random

order. This talk by *Tom Foulsham* will describe results from scenes, comics and movies which show how even minimal sequential context changes the way that visual attention is deployed. In natural scene viewing, the way that people look at isolated photographs can be compared to how they view dynamic video or to the gaze behaviour shown when people walk through a real environment. In these cases the differences observed reveal how expectations govern our attention. Building up expectations is also a key part of how visual narratives function in comics and movies. We have begun to examine how eye movement patterns reflect information processing of comic strips (Foulsham, Wybrow, & Cohn, 2016). As expected, participants' viewing patterns change when a coherent narrative is available. The eye-tracking data can also be used to generate new experimental manipulations (e.g., mimicking fixations by zooming into particular content). These manipulations reveal how attention to particular features or moments can affect comprehension of the narrative. This technique is being pursued in both comics and video sequences, providing new insights into top-down control of attention and the exploitation of this in visual media.

### Event Comprehension and Memory in Healthy Aging and Early Alzheimer's Disease

Research on film has also shared methods with the study of visual events. In this presentation, *Jeffrey M. Zacks* explores these relations along with Heather R. Bailey (Kansas State University, and Christopher A. Kurby (Grand Valley State University). Events unfold in time, and viewers track the temporal dynamics of activity as part of event understanding. Adaptively tracking event dynamics is important for guiding action online and for forming durable episodic memories. Event perception and event memory both can be affected by healthy aging and by neurological disorders. Here, we describe a line of research aimed at characterizing how the visual comprehension of events is impacted by healthy aging and by early Alzheimer's disease (AD). One characteristic of aging is that older adults segment ongoing activity into events less well than do younger adults. However, this general pattern is moderated by individual differences, and is amplified by AD. Impaired event segmentation is associated with reduced subsequent memory and impaired action performance. Superior event perception is associated with greater neural synchrony in the right posterior temporal sulcus and left dorsolateral prefrontal cortex. These results suggest that interventions to improve event segmentation or online event memory representations may help visual comprehension and memory in aging and AD.

### Towards a processing model of visual narratives

The past decade has seen a rapid growth of studies on visual narrative in the cognitive and brain sciences, in static form often focusing on the sequential images in comics. *Neil Cohn* will summarize and integrate a growing literature of both behavioral and neurocognitive research into a model of sequential image processing. Complex visual narratives

involve an interaction between two processing streams. An ongoing semantic understanding builds meaning into a growing mental model of a visual discourse. Discontinuity across dimensions of spatial, referential, and event information then incur costs when discontinuous with the growing context. In parallel to these processes, a structural system organizes semantic information into coherent sequences using a narrative grammar that maps semantic information to categorical roles, which are then embedded within a hierarchic constituent structure. This system allows for specific predictions of structural sequencing on the basis of constructional schemas, independent of semantics. Together, these interacting streams engage an iterative process of retrieval of semantic and narrative information, prediction of upcoming information based on those assessments, and subsequent updating based on discontinuity. These core mechanisms are argued to be domain-general, as suggested by similar electrophysiological brain responses generated in response to sequential images, music, and language.

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