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Brief article

Event completion: Event based inferences distort memory in a matter of seconds

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ABSTRACT

We present novel evidence that implicit causal inferences distort memory for events only seconds after viewing. Adults watched videos of someone launching (or throwing) an object. However, the videos omitted the moment of contact (or release). Subjects falsely reported seeing the moment of contact when it was implied by subsequent footage but did not do so when the contact was not implied. Causal implications were disrupted either by replacing the resulting flight of the ball with irrelevant video or by scrambling event segments. Subjects in the different causal implication conditions did not differ on false alarms for other moments of the event, nor did they differ in general recognition accuracy. These results suggest that as people perceive events, they generate rapid conceptual interpretations that can have a powerful effect on how events are remembered.

1. Introduction

We tend to think and talk about our experiences in terms of discrete events even though they occur over a continuous time line. We impose boundaries on streams of activity that reflect conceptual schemes for interpreting and representing event-related information. Imagine, for example, observing someone setting down a coffee mug, releasing it and pulling one's hand back. Even though the time line during which this process unfolds is necessarily continuous, we tend to mentally represent this continuity as three discrete events with clear boundaries. Here, we present novel evidence that causal inferences related to these "event files" can distort perceptual memory in a matter of seconds.

Different factors have been proposed as cues for determining when an event boundary will be created: degree of physical change (Newtson & Engquist, 1976), intentionality cues (Baldwin, Baird, Saylor, & Clark, 2001) and prediction error (Avrahami & Kareev, 1994; Swallow, Zacks, & Abrams, 2009). More recent literature has focused on the downstream effects of segmenting events in these ways. For example, visual attention and memory have been shown to improve at event boundaries (Newtson & Engquist, 1976), and recall for items from on-going events has been shown to be superior to memory from items in previous events, even after controlling for duration between exposure and test (Swallow et al., 2009).

However, much less theoretical attention has been paid to the internal structure of token event representations. Given that the mind is constantly setting up new event representations on the fly, there should also be sophisticated compression routines in place for efficiently packaging previous events as they are being sent to memory. Rapid conceptual inferences may help parse previous events into causally coherent packages in ways that could systematically distort memory. Demonstrations of such an effect could also have implications for false memory effects at much longer time scales (e.g., Loftus & Palmer, 1974).

One example of how disparate information can be made to cohere into a single representation comes from the literature on "causal bridging inferences" (Haviland & Clark, 1974). Readers are faster to verify the sentence "water extinguishes fire" when they read the passage: *Dorothy poured water on the bonfire. The bonfire went out* compared

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to when they read the passage: *Dorothy poured water next to the bonfire. The bonfire went out.* This is because in the "on" case, but not the "next to" case, a reader must infer that the water caused the fire to go out in order to make the text "cohere."

Here, we ask whether similar coherence based inferences might influence an observer's memory of a recently perceived event only seconds after viewing.

2. Experiment 1

Observers watched videos depicting causal launching (e.g., kicking a ball; Michotte, 1946) and throwing events (e.g., throwing a card) that were missing the actual moment of contact (henceforth just "contact"). Participants also saw complete control videos containing the moment of contact.

In a between-subject manipulation, subjects appeared in one of three conditions. In the "with causal implication" condition, subjects saw all the moments of the event (either missing or containing the moment of contact depending on the video) and then saw the resulting flight of the ball. In the "without causal implication" condition, subjects saw something irrelevant from the same scene, like a person walking, instead of seeing the resulting flight of the ball. And in the scrambled condition, subjects saw identical video footage as those in the "with causal implication" condition except that the video segments were scrambled so as to disrupt causal cohesion (see Figs. 2–4 below).

After watching a video, subjects saw a series of still images. One such still image displayed the crucial contact picture like the one shown in Fig. 1.

If bridging inferences influence event memory, then subjects should be more likely to falsely report seeing the moment of contact after watching an incomplete video that implied the moment of contact compared to one that did not. However, false alarm rates on other plausible pictures for which the correct answer is "no" should not differ between conditions. In short, we predicted that people would fill in missing elements in event perception in ways that plug gaps in specific causal conceptual structures, not merely filling in other likely elements suggested by the general context (e.g., Biederman, 1981).

2.1. Methods

2.1.1. Participants

Fifty-eight subjects over the age of 18 from around the New Haven, CT area participated in the experiment. Subjects were randomly assigned to condition. In each condition, one outlier was removed due to response times that were at least two standard deviations away from the mean.

2.1.2. Stimuli

Test videos were created and displayed on a computer monitor using a program written in Psychtoolbox for MATLAB (Pelli, 1997; Brainard, 1997). We employed 6 videos: throwing a ball, kicking a ball, slingshot, throwing a card, putting a golf ball, and badminton. Each video lasted around 30 s.

All videos had time-matched pairs (to within .56 s) consisting of complete and incomplete versions. The complete videos contained the moment of contact while the incomplete videos did not. A series of cuts made it possible to remove the moment of contact in a way that still fit in with the natural flow of the video. Videos were displayed at a frame rate of 30 frames/s. On average, 11.33 frames were removed from the contact part of the incomplete videos.

All videos were made either for the "with causal implication," "without causal implication," or "scrambled" condition. Video durations were time matched across conditions to within a second. The "with causal implication" videos contained footage of the resulting trajectory of the object being launched or thrown. The "without causal implication videos" contained irrelevant footage after the moment of contact (or non-contact) instead of the object's resulting trajectory. The "scrambled" videos were created by segmenting each "with causal implica-

Fig. 1. The critical "contact" picture from the "kicking" video.