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Commentary

Event Segmentation as a Working Memory Process

Gabriel A. Radvansky*

University of Notre Dame, United States

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In their target article, Richmond, Gold, and Zacks (2017) make an argument for using event cognition principles to assess individual differences, and potentially for improving the experiences of those people for whom this process is hampered. They argue that the ability to parse the flow of action in everyday life—that is, event segmentation—is a basic cognitive process that appears to be compromised in some individuals. They do this by taking what has been learned in the fields of event cognition and aging regarding event segmentation and apply it to the emergence of methods aimed at improving event segmentation ability in underperforming populations. This effort comes out of prior work showing that people who are better at the task event segmentation tend to have better memories for those events (Bailey, Kurby, Giovannetti, & Zacks, 2013; Kurby & Zacks, 2011; Zacks, Speer, Vettel, & Jacoby, 2006). The hope is to derive an event segmentation training regimen that can then transfer to a wide range of other tasks. This is discussed within the context of event segmentation theory (EST) (Zacks, Speer, Swallow, Braver, & Reynolds, 2007; Zacks & Tversky, 2001) and the Event Horizon Model (Radvansky, 2012; Radvansky and Zacks, 2011, 2014).

Several populations of people were identified as being deficient in event segmentation skill, including older adults, Alzheimer's patients, and schizophrenics. The idea is that some of the difficulties that these people are having in some aspects of cognition are with the ability to organize and chunk the information that is flowing through perception and into cognition. Some successes with various approaches to event segmentation are described. The path to such application and development is outlined with the hope that this will emerge as a useful way of improving a basic cognitive process.

Event Segmentation as a Working Memory Ability

There are a number of important ideas about event cognition that come out of and are related to the target paper. One of these is the idea that event processing, particularly event segmentation, is a fundamental cognitive ability that can be measured and improved upon with training. The better a person is able to segment the flow of information into meaningful events, the better organized memory and cognition will be. Thus, event cognition in general, and event segmentation in particular, are not viewed as higher level cognitive processes, but as more basic, foundational ways of processing knowledge (Radvansky, 2017).

Much of the extant literature on working memory processing focuses on the contents of working memory. This includes factors such as how many items can be held in working memory (i.e., working memory capacity), how information is brought into and maintained in working memory (i.e., activation), and how information is deactivated, removed from, or kept out of working memory (i.e., suppression). These are important facets of cognition that we need to understand. However, there must be more to working memory than this.

In addition to how much information can be in working memory, and how easily its contents be directed and controlled, there is also the larger issue of just what work can working memory do? That is, how does it actively work on and manipulate information? Working memory can also be thought of as involving a toolbox of methods or processes that can be used to manipulate and work on information. An important point made by Richmond et al. (2017) is that event segmentation could be one of those basic tools.

Author Note

* Correspondence concerning this article should be addressed to G.A. Radvansky, Department of Psychology, University of Notre Dame, Notre Dame, IN 46556, United States. Contact: gradvans@nd.edu

The need for such a working memory tool is clear. People are constantly being presented with a continuous stream of information. Part of what makes such a stream meaningful to us is the ability to break it up into meaningful packets, namely event models. Event models capture the spatial-temporal context of an activity, including the entities involved, and their properties and inter-relations. According to event cognition theories such as EST, when there is discontinuity or prediction violation along one of these basic event structure dimensions, an event boundary is perceived, the old event model is put aside, and a new one is created (which may or may not use elements from the prior event model).

Given this, it is not surprising that people who have difficulty properly segmenting the flow of information from the world are going to form imperfect event models. As such, their comprehension and memory of the unfolding action in the world will be hurt. The event models that are formed will either have too little or too much information, possibly with conflicting elements. Thus, any steps that can be taken to identify aspects for which event segmentation is compromised, and the ability to target interventions to correct this, can have broad implications for people with such a difficulty.

Other Consequences of Segmentation

The emphasis of the Richmond et al. (2017) paper was on how normative event segmentation is generally associated with better memory. That is, people who segment ongoing events in a manner similar to most other people show better memory for the event information compared to people whose segmentations are non-normative. The idea is that people who segment appropriately are better at capturing the structure and inter-relations among event elements, forming event models as chunks of information, and effectively storing this knowledge in a form that can be readily retrieved later. That said, a boost in overall memory is not the only benefit that appropriate segmentation can lead to. There are other cognitive consequences, including updating during comprehension, the segregation of event information, the benefit to memory from event separation, and the ability to integrate information into common events.

During comprehension, the perception of event boundaries is important for the updating of one's understanding of the current circumstances. For example, during narrative comprehension, when an event boundary is encountered, people abandon the previous event model and create a new one to represent the current set of circumstances. As a result, any information that is part of the current event, even if it carried over from the prior event, is more available in working memory. However, information that is part of the prior event model becomes less available (e.g., Thompson & Radvansky, 2016; Zwaan, 1996). This is important because a failure to identify event boundaries properly could lead to a person inappropriately retaining information that is no longer appropriate, or failing to include new, appropriate information for the new event. As such, understanding, memory, and other cognitive processes would be compromised. This would even extend to more interactive, real-world situations, such the finding that walking through doorways causes forgetting (e.g., Radvansky & Copeland, 2006). This phenomenon reflects the real-world consequences of needing to update one's understanding as events unfold in the world. A person who has difficulty identifying that an old event has ended and a new one has begun is going to be at a disadvantage comprehending what is going on and what they should do to act appropriately.

Another aspect of event segmentation is that it regulates the activation of knowledge. Specifically, when later remembering, typically when one part of an event is activated, other parts are activated, or primed as well (Horner, Bisby, Wang, Bogus, & Burgess, 2016). This activation of information is limited to that one event and does not extend to other events (Ezzyat & Davachi, 2011). Thus, when event segmentation is done appropriately, people are better able to focus their thinking on what is appropriate at the time and to leave out what is not. However, if event segmentation is compromised, then the flow of thought is going to be compromised by not allowing a person to limit their thinking to what is appropriate.

While Richmond et al. (2017) noted that proper event segmentation leads to better memory, what they did not mention is that event segmentation can improve memory by segregating different elements of knowledge into different memory structures. For example, people who learn sets of information in different events, such as different rooms, remember more information that if that information is learned in a single event (e.g., Pettijohn, Thompson, Tamplin, Krawietz, & Radvansky, 2016). This happens because the event structure itself provides a means of chunking and organizing knowledge. As such, people who segment poorly would be less able to structure information. Any improvement as to how well a person segments the flow of information will improve this aspect of cognition.

Finally, problems with event segmentation may not only reflect a compromised ability to identify when one event ends and another begins, but also compromised ability to know when information might be better combined as part of a common event. This is important because when information is stored across multiple related but different event representations, this can produce interference during later memory retrieval, thereby impairing the ability to remember. But, if this information can be appropriately integrated into a common event memory, then such interference may be avoided, leading to better retrieval (e.g., Radvansky, 1999).

Overall, while event segmentation is an important working memory process that aids overall memory, a more in-depth analysis reveals that such appropriate event segmentation can have an influence on a wide range of comprehension and memory processes. If Richmond et al. (2017) are successful in their quest to identify when this process is impaired, and find ways to address this, then this improvement can have wide-ranging cognitive benefits.

Contributors to Segmentation Ability

To support event segmentation as a basic cognitive ability, we can make use of other aspects of memory and cognition that are used in this process. For starters, clearly the ability to segment events depends on how novel or familiar the event may be. If

the event is familiar, then a person would be expected to have relevant scripts and schemas that can be brought to bear on the unfolding information (Alba & Hasher, 1983). These semantic memory representations provide a means of pre-identifying where event segments should be, allowing a person to target them during processing. So, providing people with the fundamental semantic knowledge to at least have a passing familiarity with the basic event type can aid in segmentation.

Another important aspect of event segmentation to keep in mind is that events are recursively structured. That is, events can often be broken down into smaller sub-events. This has been shown in research exploring how continuous streams of information can be reliably segmented at coarse and fine grained levels. Conceptually, segmentation at a fine-grained level should involve sub-events of the larger events of coarse-grained segmentation. So, events can often be decomposed into smaller events, and they can also be integrated into larger event structures that unify several events. This recursive nature of events is clearly seen in the research on autobiographical memory. Conway (1996) has made the argument that autobiographical memories can be organized into three levels. These are the event-specific, general event, and lifetime period levels. The event-specific level corresponds to the event models discussed by Richmond et al. (2017). These event-specific memories can be organized into larger general memories. There are two types of general memories. Some of these are an extended series of event-specific memories, such as the events that transpire over a period of an hour. Others are collections of similar events that are separated in time, such as memory for taking a class during a semester at school. Thus, event segmentation might be aided by emphasizing the recursive nature of the unfolding events.

Discussion

Richmond et al. (2017) make a compelling argument that event segmentation is a basic cognitive ability that might be improved upon for individuals with certain cognitive deficits. This suggestion is in line with research and theory development in the field of event cognition. Given that we can readily identify people who are either good or bad at event segmentation and describe what these differences are, we are in a good position to correct any problems that they may be having. This perspective takes the view that I have made more explicit here that event cognition is a fundamental process of working memory. It is a working memory ability that can potentially be improved upon, which can then improve a range of everyday cognitive processes. This applies to processing events in the moment as they are unfolding, remembering events that did happen in the past, and thinking about events that might happen in the future. I have also tried to highlight the wider range of cognitive process that can be affected by imperfect event segmentation. Event segmentation is foundational to effective cognition. Any effort to improve it to normative levels is likely to benefit people with cognitive deficits that compromise event segmentation ability and all of the cognitive processes that use the outcome of such efforts.

Conflict of Interest Statement

The author declares no conflict of interest.

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